Digital Solutions for Youth Agripreneurs

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This Brief is part of the Solutions for Youth Employment (S4YE) Knowledge Brief series focusing on the design and implementation of youth employment programs.

Digital technologies, services, and tools can offer opportunities to young entrepreneurs in agriculture (agripreneurs) to make more informed decisions, increase productivity and incomes. COVID-19 pandemic has also accelerated interest in understanding the potential of digital technologies. This knowledge brief focuses on how digital solutions can address four key constraints for young agripreneurs : 1) *access to finance*- by increasing access to mobile banking, alternate credit scoring and leveraging crowdfunding platforms 2) *access to inputs*- by increasing access to mechanization services, streamlining input supply chains 3) *access to markets*- by providing access to real-time price information, integration of low cost technologies to reach vulnerable populations, especially women, 4) *capacity development* – by improving agricultural extension systems, using new technologies like precision agriculture, drones to provide early warnings to control pest, disease in livestock. While digital technologies offer significant opportunities to improve food system outcomes, they should not be viewed as a panacea and associated risks include lack of data privacy, cybersecurity breaches etc. need to be addressed.

Young farmers may be more open to adopting digital solutions in agriculture. More segmentation and customization of digital services can further increase adoption of digital services. Digital platforms which bundle services can bring multiple solutions into one relationship with young farmers and create efficiencies through aggregation and cross-subsidization.

I.   Why is youth agri-preneurship important?

Agriculture continues to be a major employer in poor countries. Analyses in 2016 found that 65 percent of poor working adults made a living through agriculture. Given high population growth in poor countries, as in much of Sub-Saharan Africa, the agricultural workforce is projected to continue growing in the foreseeable future[1]. As countries develop, agriculture's role as an employer declines, and the average farmer becomes older and more wage oriented. In parallel, the broader agri-food system expands, and the scope for agriculture-related job creation shifts beyond the farm. This process of *structural transformation* shifts more people from agriculture to non-agriculture jobs.

It is mostly through youth that structural transformation occurs. Young people, on average, are more agile, educated, and adaptive to changing labor market conditions. There is a perception that youth, especially in Africa, may no longer be interested in agriculture[2]. Exit from agriculture is a normal part of structural transformation. Rural youth typically have less access to land than their parents did, because many parents are not ready to transfer the farm or the farm is too small to set all children up with viable farms, and land (rental) markets are underdeveloped. But we observe that there is no sudden accelerated exit of youth for the sector[3]. In fact, many youths remain in agriculture. and are most likely to lead on

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[1] (Christiaensen, et al., 2020)
[2] (IFAD, 2019)
[3] (Christiaensen, et al., 2020)

modernizing the sector, increasing its productivity and the range of products – which is also a key part of the structural transformation process. And others might move into jobs in agribusiness services, which form an increasingly important part of the agri-food chain as economies develop. Recent studies[4] have found that post-farm agri-preneurship (Box 1) can create positive spillovers by developing economic linkages, infrastructure, and local market integration. An increase in youth agri-preneurship can lead to the expansion of towns, the introduction of new firms, and other economic and social organizations. Youth appear to access opportunities within the extended food system more easily than in non-food systems especially wage work in urban and peri-urban zones[5].

Box 1: Who is an Agripreneur?

An agripreneur, is an entrepreneur who considers 'agribusiness' opportunities within the extended food system, which includes: Production, Processing, Packaging, Transportation and Storage, Distribution, Services, and Recycling Waste.[6]An agripreneur is "an entrepreneur whose main business is agriculture or agriculture-related." Agripreneurs identify opportunities within a market to directly produce foodstuffs, such as vegetables, fruit, dairy, meat, fish, and grains utilizing innovative and sustainable production methods. An agripreneur works within a food system located in but not necessarily limited to a rural location.

Food systems extend beyond farm production to include activities along value chains, such as food processing, transportation, retailing, restaurants, and other services[7]. In many countries, the off-farm aspect of the food system accounts for a larger share of the economy's manufacturing and service sectors. While the employment share in farming tends to decline as per capita incomes rise, the food manufacturing and services share tends to increase (*structural transformation*).[8]

Increasingly, national and global organizations are recognizing the role young entrepreneurs can play in agriculture. Various international frameworks have defined commitment to the cause[9]. These frameworks and action plans recognize that agriculture and the agribusiness sector can provide promising entrepreneurship opportunities to young men and women. Continued investment in quality rural education, which continues to underperform in developing countries, is needed[10]. There is also recognition that besides transport, storage, and access to affordable, reliable, sustainable, and modern energy, as well as water, access to internet infrastructure in rural areas and increasing rural connectivity through digital technologies can help bridge the rural-urban digital divide and offer better rural job opportunities in agriculture, the food system, and the broader rural economy.

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[4] (Christiaensen, et al., 2020)
[5] (Christiaensen, et al., 2020)
[6] Adapted from Eat in Sustania 2015
[7] (Townsend, et al., 2017)
[8] (Townsend, et al., 2017)
[9] Such as 2030 Agenda for Sustainable Development Goals, Agenda 2063: https://au.int/en/agenda2063/overview; G20 Germany 2017 https://www.consilium.europa.eu/media/23551/2017-g20-rural-youth-employment-en.pdf
[10] (World Bank , 2018)

II.   How can digital solutions address constraints faced by young agripreneurs?

Digital solutions can make jobs in the agriculture sector more lucrative for youth by increasing yields and profitability. By reducing information asymmetry, transaction costs, digital technologies can bring agricultural advisory, credit, insurance, and other services within reach of smallholders while improving access to markets and value chain development. A study in 81 countries revealed significant positive effects of an increase in digital adoption and agricultural productivity[11]. In Kenya, findings from a study show that farmers who participated in a digital tech-based market information systems project had a higher use (or value) of seed and fertilizer per acre and increased labor and land productivity[12]. Many digital solutions also make farming work more convenient and less grueling and open opportunities for youth across the value chain, further increasing its appeal.

Digital solutions can also create more jobs and improve the quality of jobs (better jobs) in agriculture as digital technologies create new opportunities in farming (farmer surveillance, data analysis) and farming-adjacent sectors (e.g., farm agents, food processing jobs, transport, logistics, waste management).

Depending on digital connectivity (Figure 1), the use of digital technologies is most advanced in the provisions of advisory services (e.g. e-extension), followed by digital financial services (e.g. e-wallet) and market linkages, and supply chain management, with Kenya, South Africa and Nigeria leading in the adoption of digital solutions for agriculture[13].

Figure 1: Opportunities for digital agricultural disruption increases with digital connectivity
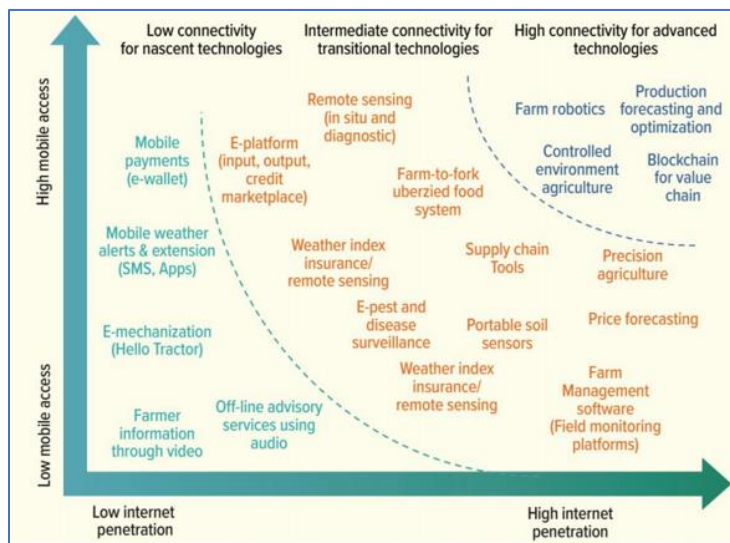
Source: Scaling Up Disruptive Agricultural Technologies in Africa. International Development in Focus, World Bank

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[11] (Lio & Liu, 2006)
[12] (Ogutu, et al., 2014)
[13] (Kim, et al., 2020)

Recognizing its potential, donors and incubators are working on digital solutions to bring more youth into agriculture. For example, USAID, Syngenta, IREN, and the Toyota Kenya Academy created a forum for youth to present their products to possible investors called the Young Innovators Agribusiness Competition. The COVID19 pandemic has accelerated donor interest in understanding the potential of digital technologies to create more better jobs in the food systems and make food systems environmentally sustainable and healthier for people.

While digital technologies have significant potential, much more needs to be done to understand their complex impact on jobs. These technologies may also pose some risks. (Box 2)

Box 2: Digital Solutions for agriculture: Risks and assumptions

- **Several risks associated with digital technologies include overconcentration of service provider market power, lack of data privacy; exclusion of vulnerable and poor, potential job losses; and cybersecurity breaches etc.**[14]. Addressing these will require policymakers to keep service provider entry barriers low, ensure good data governance, foster inclusion through targeted support to smallholder farmers, especially youth, women, and other vulnerable groups, and support skills development.
- **Evidence of digital technologies and their impact on job outcomes remains scarce.** While emerging evidence suggests a largely positive impact of digital technology solutions on agriculture productivity, the relative novelty of digital technologies and the methodological challenge of singling out the impacts of digital technologies, makes rigorous evaluations very challenging. **While digital technologies offer significant opportunities to improve food system outcomes, they should not be viewed as a panacea.** Other investments are needed to address the multiple constraints farmers face, such as roads, energy, post-harvest storage, and logistics that can better link farmers to markets[15]. Countries can also make policy improvements to increase incentives for farmers and agribusinesses to invest in farms and agricultural value chains. These investments and policies may, in turn, increase demand for digital technologies.

Digital Solutions have the potential to bring vitality to agriculture by drawing in youth. In Africa, about 70% of the population is under 30[16], with the youth population growing faster than any other region. This further exacerbates the concern about the increasing youth unemployment rate. High youth unemployment results in several challenges increased crime rates, and social conflict. Digital innovations can help mitigate this by creating new, higher-quality jobs in the agri-food sector like farmer surveillance and data analysis[17]. Some of these digital solutions which address the challenges for youth agripreneurs particularly, *Access to Finance, Access to Inputs and Equipment, Access to Markets, and Capacity Development,* are detailed below[18]. Table 1 below lists examples of such digital solutions and contrasts them with traditional solutions.

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[14] (Townsend, et al., 2017)
[15] (Townsend, et al., 2017)
[16] (Kim, et al., 2020)
[17] (Kim, et al., 2020)
[18] This knowledge brief in not exhaustive and is intended to illustrate examples of how digital solutions are being used to support youth agri-preneurship.

Table 1: Youth Agri-preneurship: Digital Solutions to Key Constraints[19]

Challenge	Traditional Solutions	Examples of Digital Solutions
1. Access to finance (Insufficient/unfair access to credit and financial products)	• Moneylenders, family & friends	• Smallholder farmer payment solutions (e.g., agribiz to farmer, government to farmer, farmer to input supplier) • Digital Agri-wallets and commitment savings systems • Smallholder credit (e.g., digital credit assessment/delivery/ collection platforms and products) • Smallholder insurance (e.g., digitally enabled index weather, precipitation, pest insurance) • Crowdfunding platforms for smallholder farming • Business-to-business fintech data analytics intermediaries (e.g., digital credit profiles)
2. Access to inputs and equipment	• Manual, animal aided, mechanized	• Digitally enabled equipment-sharing schemes • Digital solutions and devices for animal management
3. Access to markets	• Farmer cooperatives, intermediaries	• Market information systems and services • Digital platforms for finding buyers and linking buyers and sellers • Digital solutions & blockchain for traceability and transparency of products • Tech-enabled logistics & warehouses/cold chains • Ecommerce solutions for supply chain linkages
4. Capacity Development (insufficient advisory, climate-smart services, inadequate access to data)	• Producer organizations, extension agents • "Observe & respond' solutions • Intuition based decision making	• Advisory services delivered through videos and platforms linking experts • Real-time alerts for weather/pests etc. • Precision farming technologies • Digital farmer extension services • Digital soil testing services • Farm management software • Water and energy optimization technologies

1. Access to Finance

Youth are not able to access the finance they need to grow, as compared to adults. Incomplete or non - existent credit scores restrict abilities to get loans. Youth often have more limited collateral, like assets, title deeds, etc., to secure a loan. They often receive uncompetitive loan terms (e.g., higher interest rates and shorter repayment periods). Most young farmers lack access to formal financial institutions and miss out on basic banking services, loans, and pensions. They often rely on traditional borrowing from friends and family. In the short term, access to finance affects farmers' operational decisions, such as investing

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[19] Developed using The Digitalization of African Agriculture Report, & Scaling Up Disruptive Agricultural Technologies in Africa,

in seeds and other inputs, crop choice, timing of harvest, and sales. It also determines their longer-term decisions on the management and implementation of production methods[20].

Improving access to digital payments for banking, saving and transfer functions

While access to formal finance remains low, new technologies can offer easier access to simple banking, saving and transfer functions. Digital payments address the inefficiencies of cash by reducing the time and cost of having to travel to transact, increasing the speed at which payments arrive to their intended recipient, cutting the risk of theft and fraud associated with carrying cash on long journeys, increasing the ease and transparency of accounting, and providing a point of entry to broader financial services for previously underserved farmers, many of whom are young[21] (Box 3). Studies[22] have shown that access to a mobile money account increases aggregate household savings. Higher savings enhance behaviors such as fertilizer use among young farmers,[23] which increase productivity.

Box 3: Agri Wallet-Using Blockchain for digital financial inclusion for smallholder farmers

Agri Wallet is a fintech solution in Kenya, offered by a Dutch social enterprise Dodore. Agri-wallet is a blockchain-enabled mobile purse that smallholder farmers use to manage their business finances and can borrow money to spend on agricultural inputs such as fertilizer and seed.
Key features:
1)Farmers: Farmers can open an Agri-wallet account for free. When farmers earn revenue through sales, they can choose to be paid in money through M-Pesa (a Kenyan mobile payment system) or (partly) in tokens for their wallet. Tokens are earmarked for purchasing input supplies from merchants vetted by Agri Wallet, comparable to a voucher system.
2) Lenders: Because credit takes the form of tokens rather than currency, lenders are more willing to provide farmers with loans.
3)Improving efficiency: Agri-Wallet, allows farmers to borrow money to spend on their agricultural inputs and pay back their loans digitally. Thus, saving travel costs for extension offices and banks and improving time management and reduced need to carry cash. More importantly, digitizing agricultural payments via mobile phones can improve security, efficiency, and transparency[24].

Lowering risk of lending to youth by using alternative credit scoring

Alternative credit scoring for youth agripreneurs can help increase access to finance. Digital solutions can help lower the risks associated with agricultural lending and establish trust between farmers and other value chain actors, including farmer organizations and financial institutions. By recording farm performance data and financial transactions, including productivity, expenses, and revenues, young farmers can build comprehensive credit profiles without the need for collateral which they often don't have. Lending institutions can combine this data with more sophisticated technology, such as machine learning and blockchain, to derive *reliable lending decisions*. For example, FarmDrive in Kenya (Box 4) collects and aggregates data from multiple sources to build credit scores for farmers. Thus, financiers can

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[20] (Mercy Corps, 2019)
[21] (Partnership for Financial Inclusion, 2018)
[22] (Glatzel, et al., 2019)
[23] (Glatzel, et al., 2019)
[24] (Emeana, et al., 2020)

benefit from a broader spectrum of fundable clients, leverage online data collection, reduce errors, and increase efficiency.

Box 4: Supporting Youth Agripreneurs by providing alternate credit scoring

- [FarmDrive](#), an ag-tech company in Kenya, uses mobile phones, alternative data, and machine learning to close the critical data gap that prevents financial institutions from lending to creditworthy smallholder farmers.
  Key features: Based on a farm's data (productivity levels and accounting), as well as satellite, agronomic, and local economic data, FarmDrive prepares reports to analyze the creditworthiness and solvency of the beneficiary farmers. FarmDrive's alternative credit-risk assessment model creates a detailed credit profile tool, provides financial institutions with an agriculturally relevant and data-driven model to assess risk and develop loans that fit the needs of smallholder farmers. Once approved, the loans can be received via mobile money, making transfers even easier. FarmDrive additionally bundles loans with hybrid index insurance and supports financial institutions to create loan products that are more likely to be repaid on time and protected in the event of unforeseen climatic shocks.
  Impact: Between the launch of FarmDrive in 2014 and October 2018, the company had distributed over US$300,000 in loans to Kenyan farmers, 37 percent of whom were young farmers[25].

- In 2019, Myanmar agritech company [Impact Terra](#) signed an agreement with the country's second-largest MFI, Sathapana Bank, to develop a smallholder finance pilot scheme in Shan State. Through its Golden Paddy app, Impact Terra collected digital data on maize farmers, a subset of the 50,000 farmers registered on the app. Farmer data was either self-reported by farmers, captured during farmer registration on the app, or originated in weather and agronomic advice sent to maize farmers during the growing season. With farmers' consent, Impact Terra analyzed the data and then used the analysis to populate detailed profiles and segment farmer credit risk for Sathapana's crop loan (see figure below). Detailed profiles fed into a customized farmer credit-scoring model that allowed farmers to apply for credit. During the pilot, 50 per cent of the maize farmers repaid their loans early, while the remaining 50 per cent repaid the loans at the agreed time[26].

THE BUSINESS MAN	is a role model to other farmers. The farmer has been in the business for a while and has optimised their farming practices and is eager to invest their time in increasing performance.
THE ENTREPRENEUR	is a skilled farmer who has learned how to manage their farm properly and is actively growing and expanding their business, always on the lookout for the latest tech.
THE LEARNER	has been successfully farming for longer and is eager to learn new and improved methods to grow their business.
THE NEWCOMER	has just started growing crops meant for the market on a relatively more experienced farmers small piece of land.
THE SUBSISTENCE FARMER	grows crops for personal use; yields are used for survival and household needs with little to no surplus trade.

Source: Digital credits coring for farmers: Opportunities for agritech companies in Myanmar, GMSA

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[25] (Glatzel, et al., 2019)
[26] (Loukos, 2020)

Using digital crowdfunding platforms

New crowdfunding platforms leverage private capital within and outside farming communities by connecting farmers with potential investors. The funding can be a donation or be made in exchange for a good loan or equity in the venture. Crowdfunding platforms such as Farmcrowdy (Box 5) and Porkvest in Nigeria enable farmers to access credit directly from a sponsor, who would earn a share of the profit after harvest in return. These funding systems are a modern and extended version of the more traditional form of borrowing from family and friends.

Box 5: FarmCrowdy- Mobile app-based crowdfunding for agripreneurs[27]

FarmCrowdy (now called Crowdyvest) is an agriculture investment platform in Nigeria founded in November 2016. It offers a mobile app for farmers to receive sponsorship from investors interested in their crop or animal farming through crowdfunding.

Key features: FarmCrowdy offers two integration processes for both the farmers and the investors.
1) For farmers, a) Farmcrowdy selects crops to be cultivated according to seasons and the land selection. b) then reaches out to farmers through the farm association in a community to choose based on recommendations. It does not deal with individual farmers; it picks based on recommendations from farmers association in a local government or community. c) They also provide expert advice to farmers, farm inputs for selected farmers, and source out buyers for farm produce
2) For investors, a) they register on the platform, select the farm they are willing to sponsor, release the funds b) and then track the progress of the farm by viewing sent text, pictures, and videos of the farm and reduce risk.
Impact: Raised USD 15M for 25,000 farmers used to cultivate over 17,000 acres of farmland.
Outcome: Lower production costs, reduced lending risk, better yields, efficient marketing, increased incomes, and better food security.

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2. Access to Inputs and Equipment

Access to adequate tools, machinery, and inputs is often a limiting factor for young farmers, affecting production and the efficiency of the entire food value chain. The uptake of agricultural inputs such as improved seeds and fertilizers, irrigation, and small-scale mechanization, including better technologies, are fundamental for improving yields and implementing sustainable farming practices. Existing and new digital technologies can help increase the sustainable application of inputs by bridging the information gap, easing access to finance to purchase inputs or hire machinery, and addressing supplier inefficiencies and market barriers.

Improving access to mechanization services

Digital Solutions can facilitate agripreneurs access to mechanization services, such as tractors. For example, by connecting tractor owners to farmers through IoT (Internet of things)[28], digital solutions can

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[27] Summarized from Farmcrowdy: Empowering Farmers with Technology
[28] IoT in agriculture uses robots, drones, remote sensors, and computer imaging combined with machine learning and analytical tools for monitoring crops, surveying and mapping the fields and provide data to farmers for rational farm management plans to save both time and money. Source: cropin.com

make agricultural mechanization services more accessible and affordable for tractor owners(e.g., Trotro Tractor(Ghana), Hello Tractor). The "uberization" of the agriculture sector is an innovative approach that lowers the cost of access to tools and machines (Box 6). It provides viable alternatives to costly subsidy programs and government-run procurement and distribution schemes. There are several platforms offering tractor hiring services and other services ranging from plowing, harrowing, planting, spraying, harvesting, and baling to hedge trimming.

These technologies are often created and managed by tech-savvy youth. Young farmers are also generally early adopters or serve in formal or informal roles to support less tech-savvy farmers in using these technologies. For example, Hello Tractor's platform connects tractor owners to farmers via a digital application, increasing on-farm efficiency through machinery and mechanization. The service employs a team of booking agents — young, tech-savvy men and women living in or near rural villages — to help facilitate access to their platform, even for those who may not have access to or comfort using a mobile phone or the booking platform[29]. Not only does this model create employment for youth, but it also leverages their skill sets to create impact in the broader community.

Box 6: Hello Tractor- "Uberization" of agriculture inputs[30]

Hello Tractor, is an ag-tech company in Nigeria that connects tractor owners and smallholder farmers in Sub-Saharan Africa through a farm equipment sharing app.

Technology Solution: Hello Tractor has developed technology to increase and optimize tractor activity in Africa by connecting tractor owners to farmers through an IoT digital solution. Hello Tractor's technology is an off-the-shelf monitoring device that allows equipment owners to better manage their machines on the farm using an app when fitted onto a tractor. Each monitoring device is equipped with an international SIM card, providing GPRS (General Packet Radio Services) and SMS capabilities for data transmission and built to withstand agricultural wear and tear. The monitoring device tracks the tractor, providing 24-hour visibility of tractor assets in the field. If the monitoring device is tampered with or removed from the tractor, the owner is notified immediately. The technology fits onto any brand of tractor to help owners manage machine fleets in the field, minimize fraud and maximize machine value.

Impact: Since 2015, serviced more than 500,000 farmers. A 2020 impact study [31] found that 73% of farmers report that Hello Tractor has *increased crop revenue* and 83% of farmers report that Hello Tractor has *increased their crop production*. Hello Tractor creates value for commercial tractor owners. By aggregating and accessing disjointed smallholder farmer customers, the Hello Tractor app provides the means to hire out and monitor fleets of ag machinery that may otherwise sit idle and result in lost income.

Route Optimization: Hello tractor is working to integrate blockchain and artificial intelligence to optimize deployment of their tractor supply according to location, seasonal considerations and shorten the distance and time to get equipment to farmers. This could add more predictability to the supply chain, reduce risk, and help build confidence among investors and financing banks.

<u>**Streamlining complex input supply chains**</u>

Agricultural input supply chains are large, complex, and frequently fragmented, involving distributors, retailers, aggregators, and farmers—each with their requirements and agreements. For last-mile farmers,

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[29] (Foote, 2018)
[30] Summarized from Hello Tractor: Break Ground, Drive Change
[31] I (60_decibels, 2020)

access to inputs can thus seem mired in logistical challenges, opaque and unclear pricing systems, and high costs driven by inefficient operations. Digital technologies can help to synthesize supplier networks, streamline operations, improve efficiency and transparency, expand market coverage, and tailor offers for local needs (Box 7).

Box 7: iProcure-Digital Solutions for Input Supply Chains

iProcure is an input supply chain platform in Kenya, linking farmers and farmer cooperatives to manufacturers of agricultural inputs. Farmers effectively place a "request for procurement" on the platform, outlining what they require. Multiple suppliers then offer matching quotations, allowing the farmers to select the one best meeting their needs. This replaces the traditional system of buying supplies and reduces the search costs for farmers. Farmers can also create their own trusted supplier networks to manage and evaluate and use to create automated recurring orders and invite their own trusted suppliers to join the system. While suppliers can directly market to buyers who are actively seeking to procure goods or services that they offer. IProcure offers farmers discounts of 10 to 20 percent through accrued efficiencies every time they purchase farming products. iProcure also provides business intelligence and data-driven stock management across the supply chains so that suppliers can analyze their market share and real-time critical sales data, growing sales, and product performance.
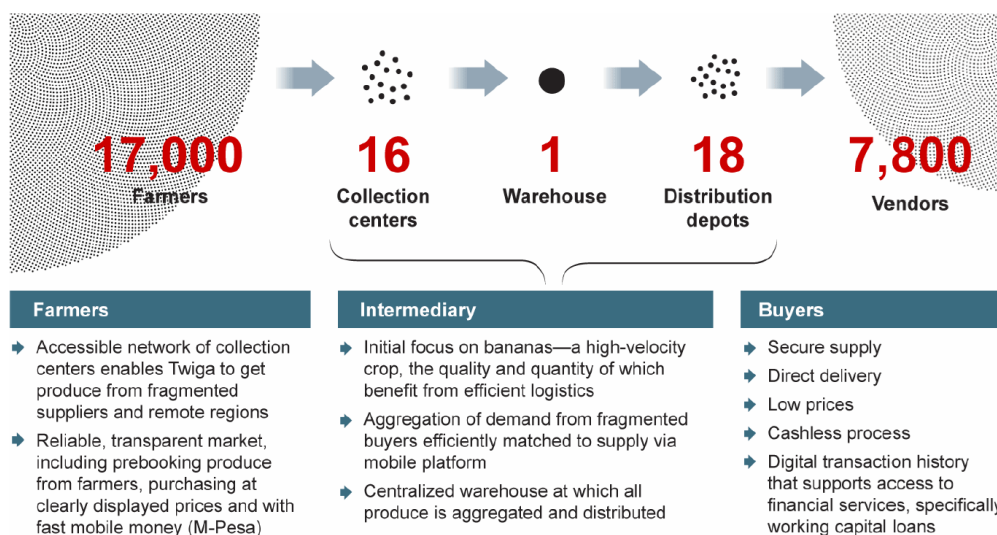
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3. Access to markets

Providing access to real time price information

Most young farmers have limited access to real-time information on market prices that would enable them to make sound decisions on when, where to sell their crops, and the prices. Access to price information through digital technologies can increase farmers' negotiating power and limit the risk of selling produce under value. The lack of reliable access to markets is a major barrier to viable opportunities in agriculture and a potential deterrent for future agripreneurs. Twiga Foods uses a digital mobile phone platform to provide guaranteed market access to small-scale farmers by connecting them to local vendors. The digital marketplace ensures that transactions are cashless, pricing is transparent, and unsold produce is minimized (Box 8).

Box 8: Twiga Foods- Guaranteed Access to Markets

Twiga Foods, an IFC client, is a company in Kenya created in 2014 to connect small fruit and vegetable farmers in rural Kenya to small and medium-sized vendors in urban cities. The Twiga model (Figure below) uses blockchain technology to track the transactions carried out by its clients and M-Pesa to streamline their payment processes.

Twiga has created a technologically advanced end-to-end logistics system valuable to farmers and vendors

17,000 Farmers → **16** Collection centers → **1** Warehouse → **18** Distribution depots → **7,800** Vendors

Farmers	Intermediary	Buyers
➡ Accessible network of collection centers enables Twiga to get produce from fragmented suppliers and remote regions ➡ Reliable, transparent market, including prebooking produce from farmers, purchasing at clearly displayed prices and with fast mobile money (M-Pesa)	➡ Initial focus on bananas—a high-velocity crop, the quality and quantity of which benefit from efficient logistics ➡ Aggregation of demand from fragmented buyers efficiently matched to supply via mobile platform ➡ Centralized warehouse at which all produce is aggregated and distributed	➡ Secure supply ➡ Direct delivery ➡ Low prices ➡ Cashless process ➡ Digital transaction history that supports access to financial services, specifically working capital loans

Source: Dodla Dairy, Twiga Foods, and Babban Gona: Three Model Farmer-Allied Intermediaries, Bain and Company, 2020

Impact: Through a mobile-based cashless platform, Twiga can offer higher prices and a guaranteed market to farmers, reducing post-harvest losses—lower prices and a reliable supply to vendors. For farmers, the platform enables access to a fair priced, transparent, mobile marketplace. Consumers also benefit from prices that are up to 10 to 15 % below the traditional wholesale market for their fresh produce[32]. Using its data, the clients can also assess their ability to access loans and other financial products. Twiga's system has reduced post-harvest losses to 5 percent, compared to 30 percent in informal markets where farmers typically sell produce[33]. As of September 2020, over 17,000 farmers and 7,800 vendors in Kenya work with Twiga—which pays 20 to 40 percent more than brokers and farmer groups and delivers payment in full within 24 hours through mobile money transactions[34]. This helps farmers anticipate income and aids in financial planning. Twiga's platform aggregates market participants, facilitating a more efficient matching of buyers and sellers in Africa's large but fragmented fruit and vegetable market.

Integration of simple, low-cost technologies (like SMS, radio stations) can increase the scale of digital platforms targeting price information dissemination (Box 9). In the rural areas of Niger, farmers using SMS-based real-time information decreased the search cost on agricultural price information by half[35]. Across several districts in Uganda, information on prices for some main crops was disseminated through local radio stations, enabling farmers to negotiate higher farm-gate prices on their surplus production.[36]

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[32] (Tam & Mitchell, 2020)

[33] (Cook & O'Neill, 2020)

[34] (Tam & Mitchell, 2020)

[35] (Glatzel, et al., 2019)

[36] (Glatzel, et al., 2019)

Box 9: Assar- Using Voicemail, SMS to connect to farmers in low bandwidth areas

The "Asaar" information platform of World Bank's project <u>Morocco Strengthening Agri-Food Value Chains</u> disseminates information related to national agricultural markets (e.g., price, location of sales outlets, etc.). This platform has been recently enhanced by integrating new digital tools (mobile applications, SMS, etc.) to reach a larger number of producers and agri-food firms (covering 200,000 users). A new mobile application: "PubliAsaar" (downloadable from the website of the Ministry of Agriculture), has been developed. It will soon be also published on the Play Store and App Store platforms. The use of voicemail and SMS offers new opportunities to make up for the sometimes-low internet connection at home in rural areas and increases the impact and inclusiveness of the market information system.

Benefits for young women agripreneurs

Digital solutions can be beneficial for women agripreneurs and reduce their dependence on unregulated markets, unreliable market information and trading malpractices that make them vulnerable to price volatility and higher transaction costs (Box 10).

Box 10: Jeevika- Increasing access to markets for women agripreneurs

World Bank-supported <u>Bihar Rural Livelihoods Project 'Jeevika'</u> supported women-owned/led, farmer producer companies (FPC) that leveraged tech-enabled platforms and digital solutions: i) mobile-based crop/price advisory (Kiosk Mobile via smartphones with biometric capturing device and printer); ii) electronic platform for commodity trading/risk hedging (Kiosk Laptop); iii) mobile/online banking (Kiosk-Micro ATM - device functions as a bank-in-a box and provides several financial and nonfinancial services to community members); iv) networked warehouses; and v) digital weighing machines, moisture meters, and driers. These solutions improved post-harvest practices, reduced transaction costs/time, and reduced farmers' vulnerability to fluctuating market prices. Financial turnover has risen 10-fold (US$ 2Million), price realization up 15-20% and FPC membership is being scaled up from 1000 to 10,000 within Bihar and to 50,000 across India. The FPC demonstrates an inclusive business model that uses tech platforms to empower and connect women farmers with formal agri-markets.

Using e-commerce, digitally enabled marketplaces

Digitally enabled marketplaces for agricultural products can shorten agricultural value chains, provide access to new markets, reduce transaction costs, and offer new business opportunities. The power of e-platforms lies in the significantly reduced search cost of matching producers with consumer and lenders with borrowers and their capacity to transfer and distribute risk. This process has the potential to reduce past market failures and profoundly reshape value chains sharply. Indirectly linking producers to consumers, e-platforms have the potential to shorten value chains for some products. Lower search costs help farmers bypass intermediaries and improve agricultural market performance. Lack of knowledge and skills and low trust in online transactions are the main reasons for low adoption. Storage and transportation of fresh produce present another challenge to growing remote e-commerce sales. If these aspects are addressed, there is potential or significant growth.

4. Capacity Development

Young agripreneurs in rural areas often lack access to appropriate agricultural training or extension services. Agricultural practices and farming techniques that could boost yields, preserve the quality of soils, or make the most efficient and prudent use of agricultural inputs are often not being harnessed. Due to poor infrastructure in some of the most remote areas, reaching smallholder farmers with information on best practices can be difficult, costly, and time-consuming. As a result, extension services are often not available on time.

E-extension services for agriculture

Digital tools can improve the agricultural extension system by providing services at scale , at the right time and facilitating the adoption of new agronomic practices, resulting in yield improvements and higher income for farming households. In 2014, a study from Kenya revealed that small sugarcane farmers who received farming advice via SMS right around the time they needed to complete tasks, such as watering their crops, saw an increase in yields by 11.5 percent[37]. Digital Green, which works in South Asia, Latin America, and Sub-Saharan Africa, has produced and disseminated over 5,000 locally relevant videos in more than 50 languages, enabling farmers to share knowledge on agricultural production practices with one another that provides a relatively cost-effective way of helping increase adoption of improved production practices. These videos are primarily screened offline in communities that have limited electricity and Internet connectivity (Box 11).

Box 11: Digital Green in Ethiopia- Creating offline communities of practice for farmers

Digital Green is an agricultural information dissemination project working with smallholder farmers across the world. Established in India in 2006, Digital Green has been working in Ethiopia since 2011 with partners to promote improved agricultural technologies, practices, and nutrition practices through its video-based extension approach. In partnerships with the Ministry of Agriculture and Natural Resources and the Ministry of Agriculture and Livestock's Agriculture Extension Directorate, Digital Green has implemented four programs that leverage peer-to-peer learning via video, radio, and interactive voice response. Because the content is developed using a participatory process and local extension agents are trained in dissemination, there is greater uptake of the recommendations.

An independent midterm evaluation of its pilot project "Connect Online— Connect Offline" (COCO) platform concluded that 42 percent of participating farmers had adopted quality protein maize for household consumption, 45 percent had adopted improved health practices including antenatal care, improving childbirth, reducing maternal mortality and morbidity, and improving postnatal care, and 25 percent had adopted a line planting method for teff, wheat, and maize.

Digital solutions can also help in sharing traditional knowledge with younger farmers. Rural communities apply their food production, processing and storage practices based on indigenous knowledge, passed on through generations. Farmers often also have specific knowledge on the nutritional value and other characteristics of indigenous crops, such as a crop's tolerance to drought or heat. Digital technologies can play an important role in facilitating the storage, access, retrieval and sharing of such knowledge to benefit from value chain development and food systems transformation.

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[37] (Glatzel, et al., 2019)

Mobile technology advancements are creating opportunities to continue agri extension remotely during COVID-19. Digital extension can be low cost (with as low as 3 USD per farmer as an annual cost[38]) and highly scalable tool. It also enables the continuation of learning where farmers can go back to the significant and relevant points in digital modules. This can be particularly important in areas where education levels are low, as mobile technologies can offer new ways of accessing important information through videos, pictures, or voice messages. For example, Syngenta Foundation in partnership with Kuza, a Kenyan-based digital micro-learning and community platform, the Syngenta Foundation is working on 'Digital Go to Market Kits' under their Agripreneur initiative in India. This structured, micro-module learning can be accessed by users in their own time and at their own pace and offers modules dealing with practical, sector-specific skills, interpersonal skills, and business management training. For successful results, e-extension services need to provide timely, localized, and customized information that addresses specific farming concerns in a comprehensible format and appropriate language (Box 12).

Box 12: Arifu- Using mobile technology for agri-extension

Arifu is a Kenyan digital content and interactive learning platform. They work with stakeholders (like foundations, non-profits, private sector) to create content for farmers across Africa to learn about good agricultural practices, agriculture inputs offered by Arifu's partners, access to finance, and other relevant information.
Omnichannel accessibility: Arifu's platform is accessible through smartphones and feature phones and uses channels like SMS and smartphone applications like WhatsApp, Facebook Messenger, and Telegram. The onboarding process on SMS can be done through an invitation message or by typing in a code word such as "Arifu"; this prompts the Arifu chatbot to share the content menu with the learner. The learner is then able to engage with Arifu's different content modules. This beneficial to partners/projects seeking to target people from underserved communities, especially in rural areas.
Content design: Arifu uses design thinking principles to generate and disseminate information. The content is contextualized using text and media (more videos, graphics), which is first tested through a series of in-person testing. It is also available in different languages such as English, Pidgin, and Yoruba (in Nigeria), making the learning process easier.
Impact: In an impact study done in 2020 with 5,000 farmers undergoing training using Arifu's platforms found that 57% farmers improved income (187 $ more income per acre), 47% farmers reported improvement in production & 35% farmers perceived improved quality of life as a result of using the platform. Top self-reported changes on-farm: effective fertilizer and pesticide use, trying new farming techniques, better livestock management, and better farm yield. Top changes in quality of life: improved abilities to pay for food, cover education costs and invest in livestock.

At the same time, digital technologies that complement field advisory visits are found to be more effective. Used in combination with other more traditional forms of extension may make e-extension services even more useful to farmers. An evaluation in 2015 found that extension officers using the Farmbook technology, a digital agricultural extension tool developed by Catholic Relief Services, reached significantly higher numbers of farmer groups compared to extension agents who relied on more traditional approaches. Combining high, medium, and low-tech options can empower youth to learn effectively (Box 13).

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[38] (60_decibels, 2020)

Box 13: Don't lose the plot- Using different types of digital tools can empower youth[39]

Don't Lose the Plot (DLTP), is a reality show that showcases four young farmers from Kenya and Tanzania, farming and living side-by-side throughout the growing season competing to win a prize worth US$10,000. In addition to the TV show, a budgeting tool (Budget Mkononi) was also developed to build a personalized budget for those starting an agribusiness and built an online agricultural support platform that includes a web portal with digital tools and information agriculture.

DLTP combines high, medium, and low-tech options to connect with a wider youth audience base:
- DLTP led to improved knowledge on farming and agribusiness among high-intensity viewers in Kenya and Tanzania
- DLTP led to increased use of irrigation and fertilizers – in Kenya, 30% of high-intensity viewers used irrigation in the period following the DLTP pilot season, compared with 15% of non-viewers
- Over 29,000 people have accessed the website since its launch, 60% of them being youth.
- Budget Mkononi is a live budget tool available on the show's website with crop-specific costs pre-factored in. So far, ~6,000 budgets have been created across 11 crops.
- DLTP's social media allows participants to interact with content and with each other and provides daily tips on crops, animal husbandry, and financial planning. Over 1,232 people follow DLTP's Facebook page and 692 people follow its Twitter page.
- iShamba access allows participants real-time access to expert advice, including agricultural tips, weather forecasts, and market prices. The tool is SMS-based and has been used 900 times.
- Information-by-post allows viewers to request by SMS free crop-specific brochures after a show is posted to their address. So far, over 3,200 SMSs have been sent for booklet requests.

KEY INSIGHTS:
Multiple digital tools attract young people: Youth made up 60% of website users, 66% of Facebook users, and 80% of Twitter users. Youth liked the opt-in nature of the platform, which let them pick their own unique engagement style.
Mobile internet devices are a key part of success: 62% of users came from mobile devices, whereas 35% came from a desktop computer.
Language: Whereas more TV viewers preferred the Swahili broadcast, 98% of website users chose the English site.
Social media increases awareness: Trending on social media helps attract more youth to the platform.

Making farming sustainable, productive and reducing outbreaks and diseases

New digital technologies can help make farming more sustainable and productive while creating new employment opportunities across the value chain. For example, digital technologies can support precision agriculture (Box 14), aimed at sustainably maximizing agricultural productivity through the targeted use of inputs, such as seed, fertilizer, and water. The development of digital hardware for agriculture in the form of sensors, drones, smart irrigation powered by the IoT, and even robotics is disrupting the way that decisions are made, and inputs are applied. For example, in World Bank's Integrated Modern Agricultural Development Project in China, digital applications were deployed to improve water use efficiency in irrigation systems, fertigation, pesticides application, and monitoring pollutants. Drones were routinely used for observation. "Micro meteorological stations" were established that provided real-time information via text messages on meteorological conditions and agricultural advice relevant to farmers coupled with demonstrating new, high-yield, climate-resilient crop varieties,

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[39] Summarized using AFA Case Study: Digital Pathways for Youth in Agriculture

and infrastructure improvements. Sensors placed around the farm or on farm equipment enable farmers to monitor their crops' progress closely. For example, the sensors can connect to an automated drip irrigation system, making the irrigation process more efficient and freeing farmers' time for other tasks. In general, real-time data and information allow farmers to promptly identify and manage potential problems, even at individual crop levels.

Box 14: Precision Agriculture[40]

Digital technologies, including AI, are being leveraged for precision farming, in which intelligence from both farmers and public data sources is assessed by algorithms to use inputs to production— water, land, pesticides, fertilizer, and nutrition—more effectively and increase the farmer's return on investment

- Intelinair an American agtech business, gathers high-resolution aerial images, temperature readings, humidity measurements, rainfall, soil samples, terrain type, equipment utilized, planting rates, applications, and other data points, and applies hyperspectral analysis, computer vision, and deep learning to identify patterns and build a complete and precise situational representation of every monitored field for the entire growing season. As the machine learning system trains on new data, it becomes stronger, smarter, and more effective. The system can, for instance, identify abnormal crop conditions before the human eye can detect them. The intelligence generated by the system is delivered to farmers via smart alerts that allow them to make proactive, real-time decisions in their fields. Minimizing the cost of inputs should improve the sustainability and resilience of farms.

There is growth of precision agriculture tools/companies in developing countries as well

- Agrosmart is a Brazilian company offering its technology platform to farmers in Latin America, the United States, and Israel. Agrosmart consolidates millions of data points from field sensors and satellites and applies machine learning and other AI technologies to improve farming performance, reduce environmental impact, and deliver intelligence across the agriculture value chain. The company offers several packages of services to producers of various sizes for an annual subscription fee. Each package delivers different information to the client, such as weather forecast, irrigation advice, and soil conditions. The system also eliminates the need for Internet or cellular coverage in the field to send the data to the Internet. With the insights provided, producers can become more efficient, reducing labor time and water and energy consumption while increasing yield. Users also benefit from a connected and monitorable supply chain.

Precision farming is now being extended, from applications that provide insights and information to farmers to on-farm robotics equipment that acts autonomously

- India-based robotics company TartanSense is building a semiautonomous rover to traverse cotton farms with a downward-facing camera capturing images of plants and weeds. When AI algorithms running on the system detect weeds, the rover automatically sprays them with agrichemicals through precision nozzles. This can increase farm income by reducing labor required to pull weeds. It can also minimize chemical residue levels from broadcast spraying in the soil and reduce health risks to operators— traditionally women—from residue from traditional spraying methods. AI-enabled applications like TartanSense's spraying system are increasingly being trialed and rolled out in conjunction with pest and disease, detection, pruning, harvesting, and crop grading.

Digital technologies such as drones and satellites using aerial imagery and sensors can help farmers by providing timely warnings on pests and plant diseases. While these technologies might not be available for all smallholder farmers, the captured data could also be shared via platforms, apps, and early warning

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[40] Summarized using Artificial Intelligence in Agribusiness is Growing in Emerging Markets,

systems (e.g., CropIn in India). These warning systems are critical for the prevention of outbreaks and the monitoring of existing pests and diseases by mapping the spread of disease or insects, such as the fall armyworm. For example, Cameroon-based start-up Agrix Tech has developed an application that helps farmers with low levels of literacy manage these issues. Farmers can upload photos of infected crops on their phones. Machine learning and translation technology is then applied to the images to provide pest and disease management advice in the local dialect. Importantly, the app can be used offline, as the AI technology does not require Internet connectivity, which is limited in parts of rural Cameroon.

Digital technologies can also be applied to livestock for early warning systems, facilitating access to vaccinations and responding more quickly to outbreaks of pests and disease. For example, DigiCow offers dairy farmers AI services, vet services, and recording keeping through a simplified App to nearly 1000 dairy farmers so far. The farmers are receiving online assistance in case of emergencies. These services are enabling farmers to increase their profits through data-driven decision-making.

III. Emerging design trends in digital solutions for agripreneurs

Digital platforms that bundle services can support youth for impact at scale. In a more conventional approach, youth need to engage with a digital solution on their own through multiple relationships and intermediaries. This approach can be costly and inefficient. Digital platforms (Note: *Digital Platforms bundle services and facilitate direct interactions between multiple providers like input suppliers, extension service providers, banks, etc., and farmers. Platforms (different from traditional digital solutions, which utilize a more linear process)* like DigiFarm (Box 15), DeHaat, Farm to Market Alliance, Tur Trade Africa can bring multiple solutions into one relationship with the young farmer, creating efficiencies and reducing costs through aggregation and cross-subsidization.

Youth who participate in platforms receive a variety of support, which increases their likelihood of success at farming. Increased success at farming reduces the risk of default, which de-risks the investors supporting youth opportunities in agriculture. Also, digital platforms generate more real-time data on youth activities, decisions, and finances. This data helps partners better understand agripreneurs and drive the development of more comprehensive youth profiles. Platforms can also reduce the costs that users and partners alike must pay to participate and increases the potential return, per dollar, on investment– whether that return is developmental or financial.

Box 15: Bundling services through digital platforms DigiFarm

DigiFarm is an integrated mobile platform in Kenya that offers farmers one-stop access to various services that decrease the cost and increase the quality of farm inputs while enabling farmers to transact, learn and grow easily. It supports three levels of interventions. 1)Education: DigiFarm and its partner Arifu provide farmers on the platform with skill development to better equip them with the knowledge they need to increase their yields. 2.) Access to inputs: DigiFarm connects farmers with higher quality and cheaper inputs through its partnership with iProcure. Farmers use the digital app to order inputs at 15-20% less than the price of normal inputs and collect them at local aggregators and/or co-ops. 3) Access to loans: As part of its second-phase roll-out, DigiFarm and its partner FarmDrive provides farmers with loans directly linked to input sales, to help them gain better access to inputs. This also helps generate credit history for the farmer, which will further benefit the farmers
DigiFarm is a USSD-enabled platform that can be used on most feature phones(2G). Results from a recent evaluation of DigiFarm indicate that:

- Young farmers are more adoptive to DigiFarm, with 5 out of 6 being under 40 years old
- Many DigiFarm users already make use of their mobile devices for social media and now want to use them as business tools, including photography for crops
- Most customers and loan borrowers are young, literate, tech-savvy men who live close to farm depots
- Young farmers are excited about keeping records of their activities on their phones so that they can update their information in real-time, from anywhere

Arifu partnered with AFA to provide free personalized educational content via 2-way SMS. ~60% of the participants were youth, and 13% were farmers. The program's youth success included:

- The majority learned how to increase their money and grow business, including how to budget, save and manage debt
- Farmers had a better grasp of business management principles like planning, costing, and marketing compared to non-farmer.

IV.   Adoption of digital solutions by young agripreneurs.

This paper focused on three types of digital solutions commonly used for bringing agri-preneurship services to youth (Table 2). The use of these different solutions is dependent on 1) the service/ application being created 2) accessibility (cost of operations, infrastructure requirement, etc.) as discussed in Sec II above.

Table 2: Commonly used digital solutions used to bring services to youth in agriculture[41]

Type	Services	Accessibility
Broadcast Media (TV, radio)	- Targeted information like crop farming, budgeting - Stories that extend advocacy, education and build trust with local leaders. - Q&A with experts	- Generally low cost, available everywhere, minimal literacy requirements - Requires broadcast bandwidth, TV, radio station
Feature Phones (2G and USSD- enabled phones to rely on SMS and avoid internet)	2- way communication - Access to information and education - Digital finance (e.g., mobile money, digital loans, and input purchases)	- Requires 2G cellular - Generally low cost, available in most locations, with lower literacy requirements - Mediated use through extension officers, agents, brand ambassadors, etc.
Internet-Enabled Devices	- Business tools (e.g., budgeting) - Social media - Sales and systems management - Interactive education	- Requires 3G+ cellular signal - Generally higher cost, available in urban/per-urban locations, with higher literacy requirements - Mediated use through extension officers, agents, brand ambassadors, etc.

The adoption of digital technologies by youth in agriculture is impacted by capacities and aspirations across sub-segments of young farmers. A case study by Mercy Corps and Mastercard foundation in 2018 defined 4 youth personas that vary along with key demographic, behavioral, and attitudinal criteria and lead to unique pathways/ adoption of digital solutions by youth in agriculture. These are

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[41]Summarized from AFA Case Study: Digital Pathways for Youth in Agriculture, and reflections in this paper

summarized below (Table 3). Youth market for digital solutions in agriculture is dynamic and growing, and not homogenous. Through segmentation and customization of digital services adoption of digital services and success rates for young farmers can be improved.

Table 3: Youth personas in adopting digital solutions for agri-preneurship

Youth Persona	Key characteristics	Examples of using digital solutions for success in agriculture
Static Planner	Static Planners put their home and families first, seeing agriculture as a means of achieving stability for their dependents (are usually women). They do seek financial independence, which will offer greater freedom to determine their path within agriculture.	• Could benefit from learning about new technologies, product approaches, and market strategies around value chains with high female engagement, such as groundnuts, sorghum, and millet. • Building financial identities through digital savings and planning services • in-person support within the platform can build trust and further advise on incrementally setting new and bigger milestones.
Determined Builder	Determined Builders have achieved success by progressively and intentionally growing their agricultural business activities. They accumulate assets, diversify agricultural activities, and experiment with new ideas and technologies.	• Include digital channels that can help find and lease inputs like suitable land to expand agribusiness or obtain larger loans to support new investments and working capital. • Tapping into social networking, using tech platforms to connect with other successful farmers and larger agribusinesses for learning and inspiration (e.g., employing new agricultural techniques or alternative modes of earning income on the land).
Opportunistic Mover	Opportunistic Movers take risks and have a belief in their ability. They find success through opportunistic wins, but their experiments occasionally fail, promoting a pessimistic outlook. Their social safety net and technology usage help them try new things but don't guarantee results.	• Online platforms with bundled services around investment opportunities, financial and insurance products • Digital solutions to connect with other successful farmers and access group-oriented savings, financial support, and credit products
Rootless Climber	Rootless Climbers are ambitious for success in agribusiness and other businesses but struggle to make their aspirations real. They see limited employment prospects so often dabble in other value chain businesses, relying on their knowledge and work ethic to help them persevere.	• Methods to structured savings (e.g., automated deductions or mandatory savings schemes) • Targeted financial literacy and education, training for new value chains and best agricultural practices • Engagement in informal financial groups to access small loans.

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