

Can digital innovation help end hunger?

With the right focus, digital technology can help transform food security and lift millions of smallholder farmers out of poverty.



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Building a better
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Supporting smallholder farmers can help address the challenge of feeding an ever-growing global population sustainably, while also lifting hundreds of millions of people out of poverty.

Rob Dongoski

EY Global Agribusiness Leader

Welcome

EY and the Syngenta Foundation for Sustainable Agriculture (SFSA) are united in the belief that the success of smallholder farmers is vital to achieving the United Nations Sustainable Development Goals (SDGs). Supporting them can help address the challenge of feeding an ever-growing global population sustainably, while also lifting hundreds of millions of people out of poverty.

Digital technology shows vast potential to help improve smallholder farmers' resilience,

productivity and incomes; however, the sheer size and complexity of the agricultural value chain can make it hard for innovations to achieve true scale and significance. With this report, we aim to showcase some of the best examples of where traction is being achieved and to illustrate how these projects and enterprises – and others like them – might plot a path to even greater scale.

While we don't claim to have all the answers, we believe what we share here can help digital innovators

to better navigate the complexity of the agricultural value chain; to understand the need for a systems-led approach to product, service and business model development; and to recognize the networks and partnerships they will need to build to realize their enterprises' full potential.



By 2050, the global population is expected to increase by almost 40% to 9.6 billion people. To feed this drastically increasing population, the UN Food and Agriculture Organization (FAO) predicts that the agriculture industry will need to produce 70% more food while only being able to use 5% more land. This means approximately 1 billion tons more wheat, rice and other cereals, and 200 million more tons of livestock per year, on almost the same agricultural surface area.

Coupled with growing environmental pressures, this presents a daunting challenge. Since most land suitable for agriculture is already farmed, this growth must come from higher yields – particularly among smallholder farmers who produce the majority of the world's food. This is why EY is proud to work with SFSA, and to support its continuing mission to help smallholders become more professional and profitable growers, to add value to rural communities, and to sustainably improve food security.

Awareness of improved farming practices, availability and affordability of quality inputs, aggregation of outputs, and access to credit and markets are all essential to improving smallholders' yields and incomes. And as illustrated by the examples in this report, all can be meaningfully improved by digital technology.

In sharing these examples, and some simple frameworks for helping innovators drive integration across a vast and complex value chain, we aim to play our part in scaling a digital agriculture revolution – one that meets the challenge of improving food security, while also lifting millions of people out of poverty.

Rob Dongoski
EY Global Agribusiness Leader



Agriculture is a fundamental instrument for development and poverty reduction in developing countries. It will continue to be so in the decades ahead. The key group requiring attention here are the hundreds of millions of smallholders who are not yet running successful farming enterprises. Many are working in increasingly challenging circumstances. Sustainably improving smallholders' prospects is the task of SFSA and our many partners. It is also my personal commitment.

SFSA focuses on helping small-scale farmers access and use the services, agricultural technologies and links to markets with which they can improve their production and livelihoods. Our overarching goals are food security for all, resilience of families and communities, and agricultural transformation that helps create enduring improvements in the incomes of rural populations.

Achieving these goals is only possible through partnerships, which use complementary assets and expertise to maximum advantage. SFSA builds and brokers novel partnerships between public and private organizations, testing and demonstrating the positive impact of resulting innovations on vulnerable smallholders and the organizations that engage with them.

Digital technologies have a critical role to play here. They can enable useful innovations to be made more affordable and accessible to smallholders, at greater scale, more quickly than ever before. This paper provides concrete examples and helpful further insights. SFSA is most grateful to EY for their good work in making this possible. It is our hope that thousands of other organizations seeking to engage with smallholder agriculture will apply these insights and also share their own. We can then all move from interesting case examples, such as those in this report, to truly sustainable and inclusive transformation of agriculture and food systems, at scale.

Dr. Simon Winter
Executive Director, Syngenta
Foundation for Sustainable
Agriculture



Agriculture is a fundamental instrument for development and poverty reduction in developing countries.

Dr. Simon Winter

Executive Director, Syngenta Foundation
for Sustainable Agriculture

Executive summary

Hunger is on the rise.

The FAO reports that the number of people facing chronic food deprivation has been steadily increasing since 2014 to an estimated 821 million. This world, in which one in nine people still go to bed hungry every night, is the same world in which more than 30% of food production goes to waste, and in which US\$1 trillion of value is lost across the agricultural value chain each year.

Despite this, EY and SFSA see grounds for optimism at the intersection of smallholder farming and digital innovation.

Doubling the productivity of small-scale food producers features prominently in the SDGs with good reason. Two billion people, often living in the poorest parts of the world, rely on agriculture for their livelihoods. Improving their productivity and incomes can help address the growing challenge of feeding an ever-growing global population, while also lifting hundreds of millions out of poverty.

Long marginalized within the broader agricultural value chain, digital innovation offers the means for smallholder farmers to take their rightful place at the forefront of a sustainable agriculture revolution, empowering them with the tools and knowledge to increase their efficiency, yields and incomes to previously unattainable levels.

With demand for food increasing and the challenges affecting the world's poorest farmers rising with the threat of climate change, spreading the benefits of digital agriculture is not just an urgent need, but good sense. As this report highlights, digital innovation is already playing a major role across all parts of the agribusiness value chain, however, there remains a great deal more to be done to realize its full potential.

Above all, this rests on:

- ▶ Recognizing digital's potential – and its limitations – as a facilitator of greater transparency and connectivity. Success still depends on “real world” infrastructure and people, particularly the field agents who often form a critical part of the smallholder agriculture value chain.
- ▶ Thinking systemically and developing digital services that are interoperable by design. The greatest advances in food production and smallholder livelihoods will come when innovations are designed from the ground up to work in concert with others, helping improve the efficiency and effectiveness of the whole value chain and facilitating creation of shared value.

- ▶ Maintaining a clear focus on commercial viability, including metrics such as breakeven point and average cost to serve. Impact metrics are, of course, important, but without an equally rigorous focus on cost and scalability, digitally enabled services and business models will find it difficult to become truly self-sustaining.
- ▶ Maintaining a similarly clear focus on priorities for further development and diffusion of digital innovations. When innovators can clearly articulate their purpose, and when they can isolate the components of the agricultural value chain most critical to achieving it, they can focus more of their time and resources to development of digital services that will make a lasting and meaningful impact in these areas.

With respect to these last two points, the simple frameworks and tools at the end of this report can help agritech entrepreneurs, and the impact investors who support them, plot a clearer path to scale.



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01



Introduction

80%

In Africa and Asia, 80% of the land farmed and food produced is by smallholder farmers.

Given that agriculture and food production is their livelihood, it's a paradox that smallholder farmers and their families make up about three-quarters of the world's hungry and undernourished. Because they are often unable to grow enough food to feed themselves adequately throughout the year, or to achieve equitable prices for their crops, they must buy more food than they sell.

This can be a consequence of multiple factors, including lack of access to knowledge on effective practices, lack of access to credit to purchase the right inputs at the right time and the plethora of intermediaries from "farm to fork" that can see them receiving as little as 10% of the value of their output. It's also often exacerbated by aversion to investing time and money in untried tools and practices that could potentially put their livelihoods and their families at risk.

Despite these barriers and more, smallholder farmers nevertheless are responsible for more than half of the food calories produced globally.¹ They are the "engine room" of agriculture and have a vital role to play in global efforts to end hunger, improve food security and promote sustainable agriculture (SDG 2), especially in low-income countries that depend most heavily on them for the food they consume.

The actual and potential contribution of smallholder farmers has arguably been grossly undervalued. However, this is changing as recognition grows of:

- ▶ The challenges involved in producing more food, on less land, using fewer resources

- ▶ The fact that in Africa and Asia, where the major increases in population are expected to happen, 80% of the land farmed and food produced is by smallholder farmers
- ▶ The ripple effect on sustainable development when smallholders – the majority of whom are women – are able to establish a life beyond subsistence and channel their incomes toward the health of their families and communities

Compared with other sectors, the World Bank has posited that growth in agriculture is up to four times more effective in reducing poverty² and it's not hard to see why. From "Zero poverty" (SDG 1) to "Gender equality" (SDG 5) to "Responsible consumption and production" (SDG 12) – to name but three additional SDGs – it's clear that reaching multiple sustainable development targets will be difficult, if not impossible, without empowering smallholder farmers to thrive.

EY and SFSA share the view that digital technology can be a hugely positive force in providing just such empowerment, reducing the costs of engaging with smallholder farmers and supporting better integration of the complex web of stakeholders across the agricultural value chain. From the "Internet of Things" (IoT) driving precision agriculture, to sensors facilitating 24/7 farming and data analytics enabling cultivation of the most efficient seeds, digital innovation is already making a difference and we believe it can achieve a great deal more.

¹Samberg, L., Gerber, J., Ramankutty, N., Herrero, M. and West, P., 2016. Subnational distribution of average farm size and smallholder contributions to global food production. *Environmental Research Letters*, 11(12), p.124010.

²Townsend, R., 2015. *Ending poverty and hunger by 2030: an agenda for the global food system*. Washington DC: World Bank Group.

02



Understanding the smallholder agriculture value chain



Photo credit: SFSA

It's important to understand the vastness and complexity of the value chain.

To fully appreciate the potential for digital innovation to make a difference to the lives and livelihoods of smallholder farmers, it's first important to understand the vastness and complexity of the value chain they are part of.

With no established means for depicting this, EY created the visualization below (see Figure 1) and used this as the basis for analyzing the models of a number of leading agritech initiatives and enterprises. As we'll describe later, their examples illustrate the potential of digital technology to better integrate multiple parts of the value chain. But before we get to that, it's important to set some context.

Figure 1: The smallholder agriculture value chain

Core components	Planning	Land registration	Planning guidance	Land preparation	Farm management	Initial assessment	
	Inputs	Digital profiles	Product awareness	Input quality	Access to finance	Demand prediction	
	Production	Digital diagnostics	Behavior change	Digital production support	Yield monitoring and management	Production efficiency	
	Logistics	Inbound logistics	Short-term storage	Outbound logistics	Output quality	Feedback loops	Supply chain transparency
	Markets	Relationship management	Marketing information	Access to customers			
Supporting components	Value addition	Automated equipment	Supply chain management				
	External ecosystem	Customer data systems	Savings and money security	Insurance	Broader access to finance		

Definitions		
Planning	Land registration	Helping smallholders gain title to the land they farm, providing protection and legitimacy for formal financing arrangements
	Planning guidance	Providing data to help smallholders make better decisions about what to plant and when
	Land preparation	Providing smallholders with affordable access to tractor and other land preparation services
	Farm management	Providing data to inform better business and farming decisions, improving smallholders' cash flow and profitability
	Initial assessment	Curating appropriate plans for smallholders based on accurate surveys of their land and local environment
Inputs	Digital profiles	Creating digital profiles for smallholders that facilitate access to digital services
	Product awareness	Providing branded materials to field agents and lead farmers to build awareness of support available to smallholders via a product or service
	Input quality	Providing mediation and monitoring of agricultural inputs to reduce cost and risk of counterfeiting, and improve outputs
	Access to finance	Providing secure and flexible ways for smallholders to purchase inputs on credit (e.g., with loans repayable in line with harvest cycles)
	Demand prediction	Using access to buyers and market information to give smallholders advance knowledge of demand for their produce
Production	Digital diagnosis	Using imaging technology to diagnose issues with crops (e.g., disease or pest infestation) and applications to provide timely guidance on treatment
	Behavior change	Using digital media and in-person networks (e.g., field agents) to encourage adoption of leading practices
	Digital production support	Increasing use of precision farming techniques (e.g., remote sensors, GPS-based soil sampling)
	Yield monitoring and management	Driving greater visibility of production yields and providing smallholders with timely reminders and alerts on influencing factors (e.g., weather patterns or correct dosages of chemicals)
	Production efficiency	Providing smallholders with affordable access to innovative tools for boosting productivity, such as irrigation systems and mechanized planting
Logistics	Inbound logistics	Delivering inputs and products to smallholders in a timely and effective manner
	Short-term storage	Providing affordable options for aggregating and storing smallholder produce to reduce post-harvest losses
	Outbound logistics	Providing for greater choice in, and reducing costs of, transportation of smallholder produce to buyers
	Output quality	Providing greater transparency for smallholders (and facilitating contract farming) by grading production quality at point of collection or aggregation
	Feedback loops	Gathering and providing real-time feedback for smallholders at point of distribution to aid future productivity improvements
	Supply chain transparency	Improving traceability of produce throughout the supply chain
Markets	Relationship management	Strengthening connectivity and relationships between smallholders and buyers
	Marketing information	Providing access to market prices and other market information to better inform smallholders of the value of their produce and enhance their negotiating power
	Access to consumers	Strengthening demand for smallholder produce and improving smallholder incomes through direct access to consumers
Value addition	Automated equipment	Using automated machinery, predictive maintenance and real-time performance data to improve smallholder productivity
	Supply chain management	Maintaining and strengthening relationships between smallholders and key stakeholders throughout the supply chain, including input suppliers, buyers and processors
Value chain enablers	Digital infrastructure	Providing the foundational services (e.g., internet connectivity) required for digital applications and services to function effectively
	Customer data systems	Developing better customer and market data to further improve forecasting of demand, access to consumers and recording of transactions
	Savings and money security	Using mobile money to improve smallholder access to savings products and other banking services
	Insurance	Improving availability of indexed-based insurance, and the collection, verification and analysis of data on which and affordable pricing of these products depend
	Broader access to finance	Helping smallholders build a credit history and gain affordable access to other life-enhancing goods and services (e.g., educational loans)

Framing the agricultural value chain as a complex system reminds innovators not to design solutions in isolation.

Recognizing different levels of maturity

While technologies addressing the inputs, production and market components of the value chain have been traditional focus areas for sustainable agriculture – and are therefore relatively mature – those addressing planning and logistics are still in development and look likely to become the next major focus for disruption.

In the planning space, the full potential of technologies – such as the use of artificial intelligence (AI) to better guide planting and harvesting activities, and IoT platforms to enable more effective farm management – has yet to be realized. And while logistics have already been disrupted to an extent (e.g., driving more effective crop collection and storage), there are still gaps in the provision of broader transportation services, as well technologies that drive greater transparency across the supply chain. The latter, especially, will be a key requisite to further integrating smallholder farmers into global supply chains.

Areas of the value chain least serviced at present are value addition and external ecosystem components. The former is central to driving further efficiencies, but it will be dependent on the pace of innovation and normalization of costs (for example, of automated equipment). The latter will be vital to helping smallholders become more self-sufficient and financially independent through access to services such as savings and financial products that are not simply linked to input credit or insurance (e.g., loans based on production).

The importance of systems thinking

The case studies that follow showcase examples of innovations that are helping to integrate multiple parts of the agricultural value chain and this is very deliberate.

In the end, innovation that only helps optimize one particular component of the value chain is destined to be limited in its impact. The greatest advances in food production and smallholder livelihoods will come when innovations are designed from the ground up to work in concert with others, helping improve the efficiency and effectiveness of the value chain as a whole, and facilitating creation of shared value.

As well as considering how their products and services interact with others, digital innovators should also reflect on the “non-digital” dependencies and ramifications of their solutions. While digital is great at “facilitation,” the practical challenges of making something happen out in the “real world” can be fraught with complexity. By way of an analogy, designing a ride-hailing app is one thing; having the cars, drivers and roads to actually get people where they want to go is quite another. So, too, are the legal and regulatory issues that such an innovation can raise (for example, in this instance, questions surrounding drivers’ employment status).

For both these reasons, it pays to treat the agricultural value chain as a complex system, not merely a complicated one. With a multitude of independent actors and no central control points, the component parts of a complex system can’t be relied upon to react to each other, and to changing conditions, in reliably predictable ways.

Framing the agricultural value chain as a complex system reminds innovators not to design solutions in isolation. It reminds them of the critical need to develop a deep understanding of market conditions, of the motivations of different actors – including brokers, field agents and aggregators – and how technology can serve and unite those interests. It also supports and encourages investment of “patient capital” on the understanding that success will take more than a smart plan and disciplined execution. It will likely involve a process of evolution and course correction, taking time to listen and observe carefully how the system reacts at each stage of development, and adapting and iterating accordingly.

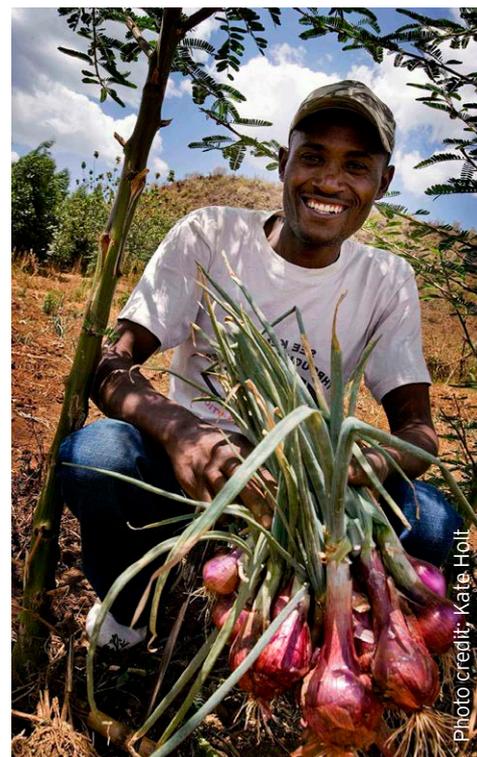


Photo credit: Kate Holt

03



How can digital
innovation make
a difference?

Digital technologies can have a transformative effect toward improving the livelihoods of smallholder farmers.



The following case studies help illustrate the current and potential impact of digital across all parts of the agriculture value chain.

They may be only a small sample of initiatives and enterprises geared toward improving the livelihoods of smallholder farmers; nevertheless, they illustrate how digital technologies can have a transformative effect, especially in relation to the so-called “five A’s” core to improving smallholder livelihoods:

- ▶ “Aggregation” to achieve economies of scale
- ▶ “Awareness” of improved farming practices
- ▶ “Availability” and “Affordability” of quality inputs
- ▶ “Access” to credit and markets

Agri-Entrepreneurs (AE) Enterprise Platform

75k

Some 600 AEs support more than 75,000 smallholder farmers.

Syngenta Foundation India's (SFI) AE program aims to create employment for rural youth and improve smallholder livelihoods by training young people as advisors to their surrounding communities. Taught in matters such as their region's micro-climate, soil health, seed and water management, and pest and disease control, successful agents become AEs running their own businesses. Each working with roughly 100 to 200 farmers, these AEs provide a one-stop-shop for accessing better quality inputs, crop advisory services, buyers and credit, in turn driving more effective agriculture practices.

success stories, the platform aims to foster a mutually supportive network of buyers, sellers and advisors.

This platform has been instrumental in increasing the scale and impact of the AE network. Now comprising some 600 AEs, supporting more than 75,000 smallholder farmers, those farmers have reported revenue increases of between 50% and 100% as a result of the services and support they have received.

The AE Enterprise Platform is designed to improve the efficiency and effectiveness of the entire AE model, from initial selection of AEs right through to helping them manage their day-to-day business and interactions with farmers, including farmer profiling, demand generation, transaction management, and monitoring and evaluation. Also offering farmers access to information in their local language, interactive video tutorials and

Figure 2: Value chain components addressed by the AE Enterprise Platform



Member farmers have seen their crop yields increase to more than twice the national average and net incomes rise to up to three times that of their peers.

Babban Gona

Babban Gona (which means “great farm” in Hausa) is on a mission to increase the incomes of one million smallholder farmers across Nigeria by 2025. Franchising thousands of mini maize and rice cooperatives, known as “Trust Groups,” it provides an integrated credit package of training, financial services, agricultural inputs and marketing services to smallholder farmers, via its Farm University platform and a network of some 200 field agents.

Based on analysis of each member’s farm, Babban Gona designs a specific loan of inputs comprising high quality seeds, fertilizer and herbicides, which is repayable at the end of the growing season. This is coupled with pre-season training and development, and monthly in-season meetings, that equip smallholders with knowledge of leading practices for land preparation, planting, fertilizer application and harvesting. And at the end of the season, because Babban Gona controls the entire production value chain from seed production through to harvesting and storage, it’s able to market members’ grain to premium off-takers.

As a result, member farmers have seen their crop yields increase to more than twice the national average and net incomes rise to up to three times that of their peers. These gains have seen Babban Gona mushroom from a base of just 106 farmers in 16 Trust Groups in 2012 to a network of more than 16,000 farmers and 4,200 Trust Groups in 2018, with ambitions to further triple the number of member farmers by the end of 2019.

This whole model is supported by seed-to-harvest mentoring and advice from Babban Gona field agents, each of whom is equipped with a series of apps to improve the efficiency and scalability of the operation. These include an app to support screening and recruitment of member farmers and another to support farm analysis – both replacing labor-intensive manual processes and helping to increase the number of farmers reached. There’s also an app to simplify recording of key data throughout the season to aid yield monitoring and detection of any issues during the production cycle.

Figure 3: Value chain components addressed by Babban Gona

Core components	Planning	Land registration	Planning guidance	Land preparation	Farm management	Initial assessment	
	Inputs	Digital profiles	Product awareness	Input quality	Access to finance	Demand prediction	
	Production	Digital diagnostics	Behavior change	Digital production support	Yield monitoring and management	Production efficiency	
	Logistics	Inbound logistics	Short-term storage	Outbound logistics	Output quality	Feedback loops	Supply chain transparency
	Markets	Relationship management	Marketing information	Access to customers			
Supporting components	Value addition	Automated equipment	Supply chain management				
	External ecosystem	Customer data systems	Savings and money security	Insurance	Broader access to finance		

35%

The e-Hub model has helped more than 22,000 smallholders have increased their incomes by an average of almost 35%.

Farmers' Hub (e-Hub)

Owned by rural entrepreneurs, agribusiness suppliers or farmers' cooperatives, farmers' hubs provide a range of free and fee-based services to smallholder farmers to help them increase their yields and incomes. Located close to farming communities and transport infrastructure, each hub serves roughly 500 to 1,000 farmers and links them to 10 to 20 buyers. Smallholders benefit from more affordable access to quality inputs, machinery and equipment, marketing information and agronomic advice, while buyers benefit from product aggregation and more reliable supply.

Previously reliant on cumbersome and error-prone manual systems, e-Hub provides farmers' hub owners with on-demand transaction management, market information and analytics via a simple mobile app and reporting dashboard. They can use it to enter transactional data, generate invoices, receive credit alerts, view cash flow reports and compare prices across hubs, as well as push market information and crop management advice to farmers via SMS.

e-Hub has been critical to establishing more than 45 farmer hubs across Bangladesh, Kenya and Senegal. Much of this success is attributed to market research, with SFSA and e-Hub developers spending considerable time following the everyday work of farmers' hub entrepreneurs and observing their business processes.

Using insights to tailor the e-Hub model to local market conditions and ways of working has helped increase adoption, impacting more than 22,000 smallholders and increasing their incomes by an average of almost 35%. SFSA is now seeking to expand use of the e-Hub model across its other principal markets in Asia and Africa.

Figure 4: Value chain components addressed by e-Hub



Farmforce is a software-as-a-service model that simplifies the management of smallholder farmers, outgrower schemes and contract farming programs.

Farmforce

Organizing large numbers of smallholders so they reliably grow high quality crops for formal markets is a difficult challenge. So, too, is making sure that production is transparent, traceable and up to quality standards.

Farmforce is a software-as-a-service model that simplifies the management of smallholder farmers, outgrower schemes and contract farming programs, ³using mobile technology to track growing activities, harvests, financing of loans and audits, all in real time. Its mobile platform can be used to meet the needs of a wide variety of stakeholders in the agricultural supply chain, be they nongovernmental organizations seeking to professionalize smallholder farming, outgrower programs requiring smarter management and greater transparency, buyers and aggregators in need of real-time yield estimates, or exporters seeking traceability of produce.

Traceability and compliance with food safety standards are the really critical points, as these are requirements for access to formal markets that have traditionally been very difficult and time consuming to fulfill. Farmforce is helping change the game by using mobile technology to make servicing these needs an integral part of smallholder production, with an estimated one million smallholders benefitting from the system and Farmforce's relationships with 26 major agribusiness clients across Africa.

³Outgrower programs are systems that link networks of smallholder farmers with domestic and international buyers. Also known as contract farming, these programs enable buyers to improve their control over crop supply, often at pre-agreed prices, as well as crop quality standards. In return, smallholders can access more secure markets, often receiving technical and financial support as a benefit of cultivating within a group.

Figure 5: Value chain components addressed by Farmforce



Smallholders use an interactive mobile service to register when seeds have been planted, aiding tracking of harvesting activities and monitoring of weather patterns.

Kilimo Salama

Subsequently spun off into commercial operation, Agriculture and Climate Risk Enterprise (ACRE), SFSA’s Kilimo Salama (safe agriculture) program helped pioneer index-based insurance for low-income farmers. Because of the high cost of verifying losses on large numbers of small landholdings, traditional loss-based insurance is unviable for rural smallholders. Recognizing this, index-based insurance takes a scientific approach.

Underpinned by installation of a network of automated weather stations and remote sensor technology, insurance payouts can be pegged to easily measured indices, such as rainfall, that are closely related to agricultural losses. When an index exceeds a certain threshold, farmers receive a quick, efficient payout – without the need to provide additional evidence – giving them greater confidence to invest in their farms.

The whole model is likewise underpinned by mobile technology. Smallholders use an interactive mobile service to register when

seeds have been planted, aiding tracking of harvesting activities and monitoring of weather patterns. They use the same service to report any losses. And, at the end of the season, any insurance payout is transferred to their mobile phone “wallet.”

Despite the many challenges – from low levels of financial literacy among its customer base to the time-consuming process of collecting, verifying and analyzing the data upon which affordable and accurate index insurance depends – commercial spin-off, ACRE, reports that uptake of this product has helped more than 1.7m farmers across Kenya, Rwanda and Tanzania to insure over US\$181 million against a variety of weather risks.

Figure 6: Value chain components addressed by Kilimo Salama

Core components	Planning	Land registration	Planning guidance	Land preparation	Farm management	Initial assessment	
	Inputs	Digital profiles	Product awareness	Input quality	Access to finance	Demand prediction	
	Production	Digital diagnostics	Behavior change	Digital production support	Yield monitoring and management	Production efficiency	
	Logistics	Inbound logistics	Short-term storage	Outbound logistics	Output quality	Feedback loops	Supply chain transparency
	Markets	Relationship management	Marketing information	Access to customers			
Supporting components	Value addition	Automated equipment	Supply chain management				
	External ecosystem	Customer data systems	Savings and money security	Insurance	Broader access to finance		

15k

Already impacting the lives of 15,000 farmers, the business projects reaching 150,000 by 2023.

Tulaa

Its name derived from the Sanskrit word for balance, Kenyan agritech startup, Tulaa, aims to level the playing field for smallholder farmers. It uses mobile technology and AI to smartly connect farmers, input suppliers and buyers in a digital marketplace, providing a combination of credit, advisory and brokerage services. Already impacting the lives of 15,000 farmers, the business projects reaching 150,000 by 2023.

Farmers can use Tulaa’s app to purchase quality inputs, such as fertilizer and seeds, on credit. Tulaa buys those inputs from the nearest participating retailer and the farmer pays Tulaa back over several months using its mobile payment platform – all supported by AI-driven credit scoring, repayment monitoring and notifications. Based on their location, crop and the inputs they’ve purchased, Tulaa also uses satellite data and AI to send farmers tailored agronomic advice to help improve their yields, and to forecast production volumes and broker the sale of produce with buyers.

This bundling of services recognizes the vicious cycle of expensive credit, low productivity and lack of market connectivity that so often traps smallholder farmers in subsistence. While the opportunity to pay for quality inputs on affordable credit is obviously hugely important, it is of limited value without advice on how to get the most out of those inputs and the ability to secure a fair price for what you produce. Ultimately, AI-supported credit scoring and reliable crop estimations significantly lower the cost and risk for buyers of dealing with smallholders.

Figure 7: Value chain components addressed by Tulaa

Core components	Planning	Land registration	Planning guidance	Land preparation	Farm management	Initial assessment	
	Inputs	Digital profiles	Product awareness	Input quality	Access to finance	Demand prediction	
	Production	Digital diagnostics	Behavior change	Digital production support	Yield monitoring and management	Production efficiency	
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	Markets	Relationship management	Marketing information	Access to customers			
Supporting components	Value addition	Automated equipment	Supply chain management				
	External ecosystem	Customer data systems	Savings and money security	Insurance	Broader access to finance		



S
C

dig



EY and SFSA
see grounds for
optimism at the
intersection
of smallholder
farming and
digital innovation.

04



Photo credit: SFSA

Helping innovators plot a path to scale

The business sustainability review scorecard provides digital innovators with a practical set of questions to help them evaluate the effectiveness of their service offering.



The examples above are illustrative of digital services that take a holistic approach to addressing the multiple challenges facing smallholder farmers, or at least bundling several components within the same delivery model.

The same framework and tools created by EY to understand these models and assess their impact can be used by other impact enterprises to reflect on the reach and impact of their own digital services, or by impact investors to similarly review their portfolios.

Business sustainability review scorecard

The business sustainability review scorecard provides digital innovators with a practical set of questions to help them evaluate the effectiveness of their service offering. Its purpose is to assess current and potential impact of the offering by reviewing through three lenses:

- ▶ The impact of a particular service or initiative on smallholder farmers, particularly on their incomes, as well as wider benefits to society
- ▶ The costs associated with establishing, supporting and expanding the service

- ▶ The potential for the service to scale and impact a greater number of smallholders

Table 1 below illustrates an example scorecard of a digital tractor service for smallholder farmers, showing questions, answer options and the weighted score given to each. ⁴Answers generate a review result indicative of the overall effectiveness of the service:

- ▶ 80%-100% (green) – The service is impactful, cost effective and has significant reach. There will only be a couple of specific areas (highlighted orange or red) in need of attention in order to maintain and grow meaningful impact.
- ▶ 60%-80% (amber) – On the whole, the service is reasonably efficient and effective, however, there will be multiple areas requiring focus or a greater number of issues in need of more urgent attention.
- ▶ Less than 60% (red) – There are multiple significant challenges that must be addressed in order to achieve significant scale and impact. The value chain gap analysis framework (see below) may help with a more in-depth reappraisal of the service's fitness for purpose.

⁴Scoring options are not rigid. They may be adapted according to different market conditions, for example adjusting for realistically attainable populations of smallholder farmers in given geographies.

Table 1: Impact assessment scorecard

Question		Purpose	Scoring options	Weighted score	Example attributed score
	To what extent does your service offering increase the incomes of smallholder farmers?	Understanding average revenue increase for smallholder farmers served	Increases revenue by >40%	9	9
			Increases revenue by >30%	6	
			Increases revenue by >20%	3	
	How many smallholder farmers are empowered by your service offering?	Understanding the total number of smallholder farmers served	50,000+	6	6
			10,000-50,000	4	
			0-10,000	2	
	How many components of the smallholder agriculture value chain (see Figure 1 above) does your service offering address?	Understanding the extent to which a service offering supports integration of multiple parts of the value chain	>4	3	3
			2-3	2	
			1	1	
	What proportion of the components addressed are considered critical to the success of smallholder agriculture in the region where you operate?	Understanding the extent to which a service offering has been tailored to specific customer needs and market conditions	75%-100%	3	2
			50%-75%	2	
			0%-50%	1	
	Beyond improving smallholder livelihoods, how many additional outcomes does your service offering support?	Understanding wider social benefits, e.g., food security, gender equality, reduced migration	>4	3	3
			2-3	2	
			1	1	
Which market types are made more accessible to smallholders by your service offering?	Understanding level of accessibility provided to different markets	Local, regional and potential for export	3	3	
		Local and regional	2		
		Local only	1		
Impact subtotal					25
Cost	Roughly what would be the operational cost, per smallholder farmer, of establishing your service offering in a new geography?	Understanding investment required to expand into new markets	<US\$10 per farmer	6	2
			US\$10-US\$50 per farmer	4	
			>US\$50 per farmer	2	
	What is your average cost to serve?	Understanding cost of maintaining ongoing support to smallholders once a service offering has been established	<US\$5 per farmer	6	2
			US\$5-US\$10 per farmer	4	
			>US\$10 per farmer	2	
	What are the fixed costs to your business, per unit/region of expansion?	Understanding the operational costs of expanding into new markets	<US\$2,000	3	2
			<US\$2,000-US\$5,000	2	
			>US\$5,000	1	
	How many smallholders do you need to serve to break even?	Understanding how quickly a service offering can become self-sustaining, allowing capital to be assigned to new initiatives.	0-10,000	3	2
			10,000-30,000	2	
			30,000+	1	
Cost subtotal					7
Scale	How much capital is required to scale your service offering to more than 50,000 smallholders?	Understanding total cost to achieve scale	<US\$25,000	6	4
			US\$25,000-\$100,000	4	
			>US\$100,000	2	
	How long would it take to scale your service offering to more than 50,000 smallholders?	Understanding the time commitment required to achieve scale	<6 months	3	1
			6-18 months	2	
			>18 months	1	
Scale subtotal					13
Total review score					38/54
Review result					70%

Value chain gap analysis

Using a simple two-step process, the agriculture value chain gap analysis framework can help innovators, and the impact investors who support them, to further evaluate priority areas for development. This framework essentially asks two questions in relation to each element of the agriculture value chain:

1. To what extent is improving the efficiency and effectiveness of this value chain component critical to achieving your enterprise's purpose or social mission?

2. How mature is your digital service for realizing that improvement?

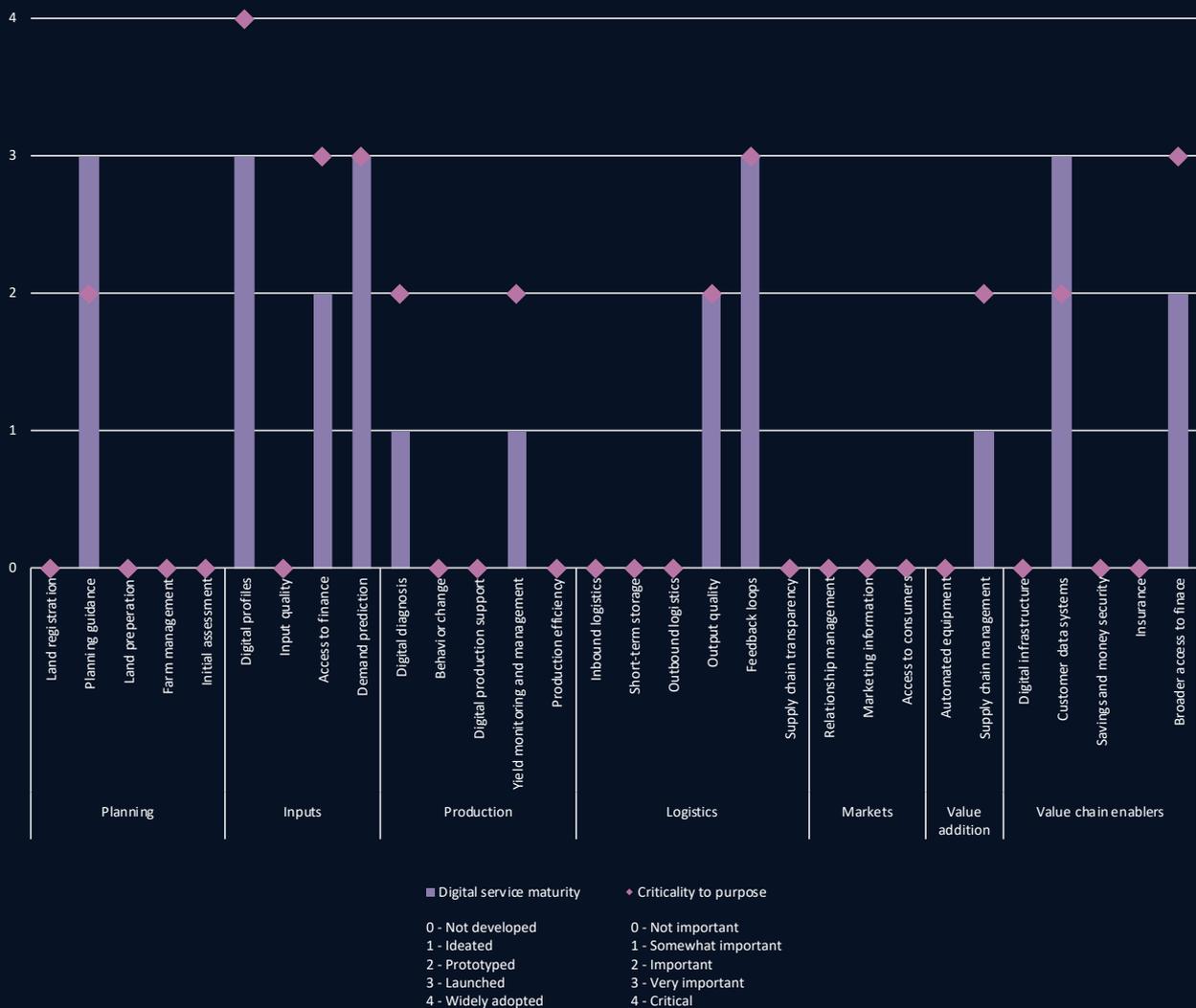
With answers to both ranked on a five-point scale, as illustrated by Figure 8 below, this supports identification of mismatches between criticality and maturity that warrant special attention.

For example, the illustrative outputs from this process below would indicate that priority one should be to work toward greater diffusion of innovations to help smallholder farmers create digital profiles, since this is ranked as the single most

critical component to achieving purpose, but not yet widely adopted in the market.

As the next most critical components, priority two would be to advance services supporting input quality and broader access to finance from prototype to launch. Priority three would be to advance services supporting digital diagnosis, yield monitoring and management, and supply chain management to the prototype stage.

Digital service maturity vs. criticality to purpose



A yellow forklift operator is shown in a warehouse setting, moving a large stack of white sacks on a pallet. The operator is wearing a hard hat and safety gear. The sacks are secured with red and blue straps. The background shows the industrial structure of the warehouse with orange beams and high ceilings. The number '05' is overlaid in large white font on the left side of the image.

05

Conclusions



Digital innovation offers the opportunity for smallholder farmers to take their rightful place at the forefront of a sustainable agriculture revolution.



With two billion people around the world relying on agriculture for their lives and livelihoods, achieving multiple SDGs will be difficult, if not impossible, without helping smallholder farmers to thrive.

Making sure that smallholder farming pays and offers a life beyond subsistence is essential, not only to future food security, but also to lifting millions of people out of poverty and giving them the agency to change their lives.

Digital innovation offers the opportunity for smallholder farmers to take their rightful place at the forefront of a sustainable agriculture revolution, empowering them with the tools and knowledge to increase their efficiency, yields and incomes to previously unattainable levels. However, fulfilling that potential requires a mindful approach and systemic thinking to break through the vicious cycle of expensive credit, low productivity and lack of market connectivity that so often traps smallholders in subsistence.

A hallmark of the successful examples of digital innovation featured in this report is that they treat the vast and complex agricultural value chain as a complex adaptive system. They recognize both the potential and the limitations of technology as an enabler of transparency and connectivity, understanding not only the value and importance of integrating multiple parts of the value chain, but also the dependencies on “real world” people and infrastructure to establish and embed different ways of working.

In the end, innovation that only helps optimize one particular component of the value chain is destined to be limited in its impact. The greatest advances in food production and smallholder livelihoods will come when services and business models are designed from the ground up to improve the efficiency and effectiveness of the value chain as a whole, and when due regard is paid to how these models can be scaled. Applying the simple diagnostic tools outlined in this report can help current and aspiring agritech innovators – and the impact investors who support them – to address both these critical concerns.

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The Syngenta Foundation (SFSA) is an independent nonprofit organization based in Switzerland. Its core funding comes from the agribusiness company Syngenta. SFSA's mission is to create value for smallholders in developing countries, through innovation in sustainable agriculture and the activation of value chains. SFSA's main streams of work are Agriservices, Access to Seeds, and Risk Management & Financial Inclusion. Digital solutions play important roles in all three.

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