Public Disclosure Authorized
Public Disclosure Authorized
Public Disclosure Authorized
Public Disclosure Authorized

WORLD BANK GROUP

Private Sector Solutions to Helping Smallholders Succeed

Social Enterprise Business Models in the Agriculture Sector

Editors Elaine Tinsley and Natalia Agapitova

Private Sector Solutions to Helping Smallholders Succeed

Social Enterprise Business Models in the Agriculture Sector

Editors Elaine Tinsley and Natalia Agapitova

WORLD BANK GROUP

© Copyright March 2018
The World Bank
1818 H Street, NW
Washington, D.C. 20433
All rights reserved

Photos: cover (Chhor Sokunthea/World Bank); p. 2, 39, 82 (Arne Hoel/World Bank); p. 67 (Chhor Sokunthea/World Bank); p. 93 (Peter Kapuscinski/World Bank); p. 125 (Dominic Chavez/World Bank); p. 150 (Trevor Samson/World Bank); p. 159 (A'Melody Lee/World Bank); p. 183 (Salahaldeen Nadir/World Bank); p. 210 (Stephan Gladieu/World Bank); p. 221 (Thomas Sennett/World Bank); p. 247, 275 (Scott Wallace/World Bank).

Contents

Acknowledgments

This book was prepared by Elaine Tinsley and Natalia Agapitova as part of the World Bank's Social Enterprise Innovations program to explore the experiences of social enterprise in addressing key development challenges in agriculture. The content and business models were reviewed and summarized by Ishira Mehta and Punjeet Jhajharia. The agriculture models were researched and written by a team from Intellecap, including Usha Ganesh, Lakshmi Poti, Anuja Kaushal, and Rishabh Parakh, and from Endeva UG, Christina Tewes-Gradl and Marius Ehrlinspiel. Sharon Beth Fisher provided editing support and James Quigley provided design.

Our gratitude also goes to the many social enterprises featured who offered insights into their operations, their challenges and their successes, and to whose work we hope will be scaled globally.

Introduction

Smallholder farmers in developing countries face tough challenges to their productivity, growth, and sustainability—including lack of access to affordable financial products, limited knowledge of high-quality inputs, low usage of technology and market data, and poor market links across the value chain.

To close these gaps and help smallholder farmers thrive, social enterprises are implementing innovative solutions in the agriculture sector to serve them. Social enterprises are defined as private for-profit, nonprofit, or hybrid organizations that use business methods to advance their social mission. In the case of agriculture, social enterprises often address a particular pain point in the value chain, with the intention that the cost of their services or products will be recuperated by the benefits and income gains that smallholders will achieve.

To serve such a "last mile" market, social enterprises will often develop a business model that is innovative, cost-effective, and provides strong value for money in providing quality services and products.The purpose of this book is to showcase the market-based solutions that have proven effective at supporting smallholders and to synthesize the experiences of social enterprises around the world. This book catalogues more than 100 social enterprises, categorized into 9 business models, that cut across the agriculture value chain. The book is divided into four sections:

1) ***Accessing Finance:*** Traditional financing often has not adequately addressed smallholder farmers' need for financial services, primarily due to perceived high credit risk and incompatible financial products. Social enterprises are devising more efficient, cost-effective, and customized financial solutions to unlock credit and manage risk. Models in this section focus on alternative finance providers, specialized financial intermediaries, and index-based agricultural microinsurance.

2) ***Improving Productivity:*** Limited access to technology, lack of productivity enhancement inputs, low awareness about farming best practices, and weak links across the agricultural value chain constrain smallholder farmers. In response, social enterprises have introduced user-friendly information and communications technology (ICT) applications, non-ICT extensions (i.e., advisory and consulting services), and capacity building services to use yield-enhancing solutions more effectively.

3) ***Increasing Post-Harvest Value:*** The short shelf life of some agricultural produce, risk of spoilage, pest attacks, and quality deterioration lead to distress sales and lower prices for smallholder farmers. This section describes two models that address these issues: post-harvest services that offer processing and packaging solutions to increase shelf life, and general or sector-specific storage solutions that target different types of agricultural produce.

4) ***Creating Value Chain and Market Linkages:*** Poor connections to markets impacts farmers' incomes directly and keeps them in a cycle of low investment and productivity. This section focuses on direct-to-market models that remove middlemen from the distribution chain and multi-stakeholder platforms that facilitate information flows and business transactions between suppliers and buyers.

To promote replication and adaptation of these models into new countries, an overview of each section compares the models' ease of implementation, effectiveness, financial viability, scalability, and need for government support. Additionally, technological services, whether through mobile banking or e-commerce and mobile-based platforms, are critical components that help social enterprises lower their costs and reach a vast number of clients across the agricultural value chain. By providing insights into context, we hope other entrepreneurs and enablers can learn from the existing models and encourage similar business solutions in their countries.

The audience for this book is those interested in solutions that serve the interests of smallholder farmers and in having a dialogue around the social enterprise agenda—entrepreneurs, development practitioners, social entrepreneur enablers, and policy makers. Agriculture-focused organizations can find relevant models that inform their development operations, particularly for those wishing to continue beyond a project cycle to create a sustainable business model.

The demonstrated results and future opportunities of these models show immense potential for improving financial services, best practices, and long-term success for smallholder farmers. Scaling will depend on the support of government and other partners, who can strengthen social enterprise activities and thus generate better economic, social, and environmental results for these farmers and their families and communities.

Abbreviations and Acronyms

AfDB	African Development Bank
APMC	Agriculture Produce Market Committee
ESCO	Energy Saving Company
EU	European Union
FAO	Food and Agriculture Organization
FPG	Farmer Producer Group
FPOs	Farmer Producer Organizations
ICT	Information and Communications Technology
IRDC	International Research Development Centre
IVR	Interactive Voice Response
MFI	Microfinance Institutions
MNO	Mobile Network Operator
NGO	Non-Governmental Organization
ROI	Return on Investment
SDC	Swiss Agency for Development and Cooperation
SE	Social Enterprise
SHG	Self-Help Group
SMS	Short Message Service
USAID	United States Agency for International Development
USSD	Unstructured Supplementary Service Data
WFP	World Food Program

ACCESSING FINANCE

ACCESSING FINANCE

Sector Challenges

Millions of smallholders in developing countries lack irrigation systems and are unable to access or afford high-quality inputs, such as seeds and fertilizer and are also left particularly vulnerable to weather-related risk. Smallholder farmers face a number of challenges in accessing appropriate and adequate financial services. Supply side challenges, such as lack of flexible credit products and lack of last-mile access, and demand side challenges, such as low capacity to service debt hinder credit supply and uptake. Inadequate access to finance and insurance causes smallholder farmers to confine themselves to low-risk/low-yield crops and sub-optimal inputs, which results in lower yield. This makes their produce less competitive in the market and also increases the risk for other upstream value chain players due to low quality and uncertain supply. Lower incomes force cash-strapped farmers into a debt cycle, where they seek credit to repay previous loans.

Traditional financing methodologies have not been able to adequately address the need for appropriate financial services to smallholder farmers in developing countries. The gap in agricultural finance is primarily due to perceived high credit risk in agricultural lending and incompatible financial products.

Models that Address These Challenges: Description and Analysis

I. Non-Bank Finance Providers

Several enterprises have adopted simple yet powerful innovations to make the delivery of financial services efficient, cost-effective and customized to the needs of smallholder farmers. Access-to-finance solutions include several innovative components such as alternative techniques to assess credit worthiness, new products to address variable cash flows and ICT-based products to ensure last-mile reach. Most finance providers are structured as banks and MFIs. Some finance providers are also structured as non-profit organizations (such as One Acre Fund) or social investment funds (such as Root Capital)

- *Innovative credit risk mitigation and collateralization:* The absence of property, land and other tangible assets renders smallholder farmers ineligible to receive traditional commercial loans. Hence, many enterprises have developed financing instruments which use agri-based assets and inventory to substitute for property collateral and mitigate credit risk. Examples include input financing in which inputs provided on credit are considered as collateral, and joint-liability group lending, in which group

members are responsible for collecting payments on time and co-guaranteeing each other.

- *Tailored financial product design to address mismatch in cash flows:* The 'one size fits all' approach does not work in lending to smallholder farmers. Given the diverse income streams, crops, harvest cycles, and value chain interactions, a flexible repayment structure is essential for successful farm financing. Enterprises have developed solutions that analyze and match payment terms to the irregular cash flows of different activities. Many enterprises use cash-flow based evaluation methods that allow them to effectively assess the harvest cycle and determine the best product fit for the farmers.
- *Non-financial services bundled with financial assistance:* Smallholder farmers generally lack the financial literacy required to understand different financial products and face the risk of over-indebtedness or under-investment. Due to their financial circumstances, they often deploy capital into unproductive uses. Therefore, many enterprises offer bundled services such as financial education, agri-inputs, capacity building and market linkages, along with financial services such as credit, savings and microinsurance.

II. Financial Intermediaries

Many social enterprises act as intermediaries to finance providers in order to reduce friction in the flow of finance to smallholders and minimize the credit risk traditionally associated with agricultural finance. Financial intermediaries often specialize in particular areas in smallholder financing such as risk mitigation tools, ICT-enabled delivery and value chai financing:

- *Risk mitigation:* Some social enterprises are devising innovative ways to perform credit scoring and maintain a track record for smallholder farmers. SCOPEInsight, an organization based in the Netherlands, has developed assessment tools and actionable insights that help finance providers assess risk and design financial products.
- *ICT-enabled delivery:* Some social enterprises are leveraging technology for digital data collection, payment and crowd funding. Mobile wallets and web-based platforms are the means used for channeling the funds. For instance, SmartMoney, a mobile network operator in Uganda, offers mobile money services to enable banks to serve smallholder farmers and achieve last-mile access in a cost-efficient way.
- *Value chain financing:* Value chain players themselves act as intermediaries to directly fund farmers they are associated with. Common examples include warehouse receipt financing, input supplier financing, asset financing and out-grower schemes.

III. Index-based Microinsurance

Index-based agricultural microinsurance is a type of microinsurance in which pay-outs are based on publicly observable indexes rather than actual incurred losses. Compared with traditional agricultural microinsurance, the index mechanism substantially reduces transactions costs and spares low-income farmers the trouble of having to go through the onerous process of filing claims.

Farmers purchase coverage for risks related to their crops or livestock, paying their premiums in cash or via mobile banking. The most common risks are drought, excessive rainfall, storms, and pest infestation.

Payouts are made automatically when objective criteria—such as rainfall, based on data from weather stations—exceed a certain value. Not having to assess losses on a case-by-case basis substantially reduces administrative costs, allowing insurers to charge lower premiums. Automatic payouts also eliminate the complicated and time-consuming claims process, which in the past caused farmers in developing countries to distrust insurance.

Analysis of the Models

Analyzing the three models across different parameters brings up interesting findings and implications for implementation and scale up.

Comparative Analysis of Agricultural Finance Model

Model	*Ease of Implementation*	*Effectiveness*	*Financial Viability*	*Scalability*	*Need for Government Support*
Non-Bank Finance Providers	Medium-High	High	High	Medium-High	Medium-High
Financial Intermediaries	Medium-High	Medium-High	Low	Medium	Medium-High
Index-Based Microinsurance	High	Medium-High	Low	Medium-High	High

Ease of Implementation

Non-Bank Finance Providers

Most capital suppliers cite farmers' lack of understanding of financial products as the major hindrance in smallholder lending. On the other hand, smallholder farmers usually undermine the need for financial products such as savings and insurance even as they continue to struggle with heavy debt burdens. This information asymmetry limits customer acquisition and the scattered reach of the financiers make delivery of services costly. Therefore, most finance providers generally run financial literacy programs in parallel with their credit delivery, either by themselves or by tying up with external trainer partners. Enterprises usually do not charge the farmers separately for the financial education and the cost is factored in the interest calculation or subsidized by the government or by donors.

ADOPEM, a bank in the Dominican Republic focused on financing smallholder farmers, conducts weekly training sessions on the importance of savings, the material for which is designed by CODESPA Foundation. Opportunity International has developed material such as DVDs, TV and radio segments, comic books, games and role-playing activities as self-learning guides for farmers to improve their financial acumen. Juhudi Kilimo also maximizes

the benefit of its asset finance offering by imparting knowledge about potential risks of storing cash and the importance of maintaining financial documents.

Enterprises that provide a wide range of financial products tailor-made according to the crop type, harvest cycle, tenure, and cash flows find better acceptance among the farming community. For example, AMK, an MFI in Cambodia, offers bullet and amortization loan structures, individual and group lending, infield and branch repayment options, and USD and local currency options. Development organizations, such as BRAC in Bangladesh, have an agri-specific loan called Borga Chasi, which is cross-sold to farmers along with their dairy and inputs.

Financial Intermediaries

Financial intermediaries generally work with field agents (their own or those of their partner financial institutions) to build the initial critical mass and then tap into networks of existing customer base of farmers to reach other farmers. In-person, on-the-ground relationships are very important in local communities and field force networks led by groups from financial institutions or NGOs can harness the power of these relationships. FarmDrive identifies and works with Youth Farmer Leaders, typically young farmers, to spread awareness and organize trainings. Presently, FarmDrive has on-boarded 15 farm leaders, each responsible for his/her own locality.

With the development and expansion of mobile solutions, the process of coordinating and communicating with these networks is becoming more efficient. For example, myAgro has field agents who hold weekly meetings with farmer cooperatives to onboard farmers. It relies on the farmers' local networks and partners with savings groups to increase awareness of the benefits of using mobile layaway as a financing option.

Financial intermediaries improve the accessibility of their products by adopting an omni-channel strategy to serve a wide variety of farmers. For example, FarmDrive's services are available over SMS, USSD, and Android. This ensures that even farmers with the most basic phones are able to access the FarmDrive platform.

Index-Based Microinsurance

Index-based insurance products can be difficult to explain to farmers, especially in environments where insurance culture is weak or farmers have had bad experiences in the past. Implementing organizations therefore usually disseminate information via their networks of local NGOs or member-based organizations, such as agricultural cooperatives or farmers associations. Government extension services can also be used to promote products. Potential clients usually trust these organizations, making them invaluable in creating awareness. In addition to traditional training sessions in which the product is explained, many schemes have used brochures and TV or radio advertisements. Mobile banking helps make the product available in even the most remote regions.

Effectiveness

Non-Bank Finance Providers

Well-structured financing can help farmers find a pathway out of the cycle where low investment leads to low returns. Some smallholder lenders, such as Green Bank of Caraga

in Philippines, have implemented commitment savings – these are savings accounts which farmers can only access after they reach a certain committed savings goal. Opportunity International Bank in Malawi also offers tobacco farmers a product where they can set aside their profits from harvest to fund the inputs for the next season. This creates a win-win situation for both, the smallholders and the lender; the savings can form a substantial capital base for the lending activities of the financial institution, while encouraging farmers to minimize expenditures and thus reduce the risk from cash-flow volatility.

Root Capital has enabled several agricultural businesses to grow in an environmentally sustainable way, facilitating increased and stable incomes for 35,000 farmers and improved livelihoods for the 200,000 family members they feed and clothe. It has provided nearly USD 980 million in loans to 623 businesses that collectively source from 1.2 million smallholder farmers. In 2015 alone, Root Capital's loans helped its clients generate USD 1.2 billion in combined revenue, 81 percent of which was paid directly to the smallholder farmers from whom they source. Additionally, its Women in Agriculture Initiative reached 200,000 women in 2015 by investing in businesses that promote gender-inclusive practices.

Financial Intermediaries

The key outcome that all financial intermediaries work towards is a smoother and assured flow of financial services from formal financial institutions towards smallholder farmers. Although it is too early to attribute accurate impact figures and draw correlation of the financial empowerment of smallholder farmers and the role of financial intermediaries in causing these outcomes, there is an increased acceptance among farmers to approach such intermediaries and willingness among banks to push agri-based financial products through these specialized enterprises. Agricultural finance in Kenya increased from USD 335 million in 2007 to USD 620 million in 2011, and is attributed mostly to the introduction of mobile banking and other technology solutions . In India, the State Bank of India has been able to add 100,000 villages to its service network through a combination of mobile phone technology and cash points (within shops) in the village. This has brought millions of smallholder farmers into the banking network.

Mobile wallets can bring about a rapid transformation in the livelihoods of smallholder farmers, especially if adopted by the Government for national subsidy schemes. The efforts of the Federal Government of Nigeria (FGN) provides a good case study on how the cost of administering such subsidies, a key component of financing the value chain, can be reduced through digital financial services .

In Nigeria, only 11 percent of poor smallholder farmers received Government subsidized inputs because the Government input procurement and distribution system was very inefficient and costly, suffered from corruption, and displaced private commercial sales of fertilizers. Majority of the inputs were re-sold in the open market at high profit margins. Despite the huge sums spent on fertilizer subsidies, fertilizer use was still less than 10 kg/ha, compared to the global average of over 100 kg/ha . Cellulant, a digital e-wallet services provider, helped streamline the disbursement of fertilizer subsidies under the Nigerian Government's Growth Enhancement Support (GES) scheme.

In the first 20 months of implementation of the e-wallet, six million farmers (which include more than 450,000 women) participated in GES and received subsidized fertilizer and improved seeds. In less than 160 days, though the e-wallet, 150,000MT of fertilizer and

about 10,000MT of seeds were supplied to agro-dealers, and distributed to 1.2 million farmers. Today, FGN and relevant Nigerian state governments each contribute 25 percent of the fertilizer cost resulting in a 50 percent subsidy provided directly to smallholder farmers. In the period 2011–2013, the number of smallholders benefitting increased from 800,000 to 4.3 million, while the cost per smallholder receiving the fertilizer fell from USD 225–300 to USD 22 .

Index-Based Microinsurance

Index-based agricultural microinsurance can increase farmers' income and productivity by increasing their willingness to invest and engage in riskier practices (Cole and others 2012). Insured farmers are more likely to plant higher-yield/higher-risk crops, invest more in fertilizers, and adopt other production-enhancing methods. Uptake is more common in areas that experienced several years of below-average rainfall or crop yields. It is also higher when the insurance is presented by a trusted third party, such as an NGO.

In the absence of insurance, many small farmers engage in costly mitigation strategies to prevent loss, using savings or selling off assets in the event of loss. Microinsurance can prevent these losses. Indexed insurance reduces administrative costs by eliminating the need for claim inspection and verification.

Index-based agricultural microinsurance costs significantly less than traditional insurance, because insurers do not need to verify individual claims. To ensure affordability by the target group, governments frequently subsidize microinsurance schemes. Even so, low willingness to pay and high price sensitivity substantially hinder uptake (Biener and Eling 2012). Affordability remains a challenge. The degree to which index-based microinsurance reaches the poorest farmers varies greatly. Findings from the Index-Based Livestock Insurance Project (IBLIP) in Mongolia suggest that better-off farmers tend to purchase coverage. In contrast, the R4-Rural Resilience Initiative in East Africa has found it difficult to attract better-off farmers.

Financial Viability

Non-Bank Finance Providers

Most smallholder financiers rely on grants or concessionary loans from governments or philanthropic organizations to reduce their cost of on-lending. They also leverage technology to minimize operational expenditure. The operational efficiency has allowed these enterprises to enhance their margin and pass on the benefit by reducing the interest rate by as much as 2 to 3 percent. Opportunity International provides its field staff with mobile tablets to register new farmer borrowers, open new savings accounts, measure the size of the farm using GPS and geo-tag the farm. A negligible rate of default (1 percent) and a healthy ratio of donor-to-farmer contribution of 1:4 enables One Acre Fund to achieve financial sustainability.

Smallholder farmers also benefit from agricultural value chain finance i.e., financing that takes place within the value chain as well as outside it. Agrofinanzas in Mexico has an innovative business model in value chain financing. It specializes in lending to small farmers that do not have prior formal borrowing experience. It builds relationships with large firms and provides credit services to their suppliers who are smaller firms. Agrofinanzas leverages

borrower information obtained from large firms (about their small suppliers), thus reducing the probability of default. Root Capital uses factoring agreements, or signed purchase contracts between micro agribusinesses and their buyers, for both short-term and long-term loans. The purchase agreement serves as a substitute for traditional collateral as it represents a discrete, future revenue stream that can be pledged to repay the loan.

Financial Intermediaries

The major costs incurred by financial intermediaries are the costs from training, platform development and human resources. Generally, financial intermediaries draw their revenues from a combination of one or more of these three sources - the financial institution they partner with, the farmers they serve and any agribusiness or other value chain players who avail of their services. The business model leverages on enterprises' ability to liaise with multiple stakeholders in the agriculture value chain and become their long-term, trusted partners. The intermediaries are able to achieve early breakeven because they generally have a very low initial expenditure (generally less than 20 percent of the total annual costs). However, these enterprises earn thin margins (typically around 3–10 percent) and depend on a large customer base, the business of its partners, and volume of transactions.

Index-Based Microinsurance

The design of robust indexes that reflect smallholders' as well as insurers' risk is vital to both the impact and the financial viability of the business model. The design of such indexes often entails high initial investment costs in research and development. Basing an index on rainfall, for example, requires a dense network of weather stations, which many developing countries lack. Private insurers often find developing the tools that model agricultural risk (such as catastrophe risk simulation techniques) too complex and expensive (World Bank 2010). These costs are therefore often borne by governments or international donors.

Insurers often reinsure their products. Reinsurance is particularly crucial in the agricultural sector to manage covariant risk, especially in developing countries, where insurers often operate in small areas with limited product portfolios.

No model has yet shown evidence of financial viability; most schemes receive significant financial support from governments or donors. Some models (CADENA, NAIS, mNAIS) subsidize premiums directly, covering 75–90 percent of the premium cost. Others (ACRE) charge actuarial premiums and use support for research and development.

Scalability

Non-Bank Finance Providers

Most non-bank smallholder financiers are deeply engaged with their farmer borrowers, and offer bundled extension services or inputs along with the credit. This limits their ability to scale. However, primary research suggests that group lending models have proved to be very scalable due to lower operating cost per individual borrower.

One Acre Fund is able to scale rapidly by using a standardized operating model. It has a 'district operating unit' that can be replicated easily and cost-effectively. Each unit includes a field director, 6–10 field managers, 30–50 field officers, and a bookkeeper. At scale, a district can serve about 10,000 farmers.

Financial Intermediaries

The business model of financial intermediaries allows them to scale exponentially across geographies and reach a substantial number of farmers. Zoona, a third-party provider of mobile payments, partners with value chain players that contract with smallholder farmers. Such value chain players make one payment to Zoona, which then makes e-voucher or mobile payments to each of the contracted farmers. E-voucher recipients can redeem the vouchers at input retailers or at cash-in/out agents. On a monthly basis, the Zoona platform currently supports 50,000 transactions valued at USD 3.5 million and reaches over 60,000 people. Zoona began in Zambia and has expanded into Zimbabwe, Mozambique and Malawi. Most financial intermediaries face challenges in achieving the critical mass that allows them to be sustainable. They also face infrastructural issues such as low internet connectivity, lack of internet-enabled phones and on-ground field agents to enable last-mile reach.

Index-Based Microinsurance

ACRE covers more than 185,000 farmers in Kenya, Rwanda, and Tanzania. Guy Carpenter covered 43,000 cotton farmers in its first year of operation, paying out about $230,000 to beneficiaries after the drought that year.

Few schemes have achieved scale, however. Weak demand, poorly designed indexes, and smallholders' liquidity constraints mean that most smallholders in developing countries remain without insurance coverage. Models that have achieved scale share several features (IFAD and World Food Programme 2010):

- Integrated approaches: Insurance complements other risk-management strategies. It should be used only to offload that portion of risk that cannot be addressed by other means.
- Participatory methods: Drawing on farmers' knowledge in the design of products has led to improvements in indexes, especially where data are limited. Collaboration with the target group also helps create acceptance and awareness. Engaging potential clients in role-playing games in the pilot phase substantially increased demand in the R4 Initiative.
- Supply chain approach: ACRE's close links to the M-PESA mobile banking system reduce transaction costs and increase availability.

Government Policy to Enable These Types of Enterprises/Models

Non-Bank Finance Providers

In order to support agri-finance providers, governments should introduce appropriate risk-based regulatory framework and smart subsidies that spur innovation and avoid market distortion. In Ghana, the e-switch money transfer system serves small scale financial institutions allowing farmers in rural areas to use biometric cards for payment operations. Bancamía, an MFI in Colombia engaged in smallholder financing, uses Colombian governmental guarantee funds to protect itself from the risks of lending to the agricultural sector.

Some government interventions involve direct credit or refinancing. In India, the Small Farmers' Agribusiness Consortium (SFAC), promoted by the Government of India, provides interest-free soft loans of up to USD 12,000 to projects in agriculture or allied sectors. It also operates an Equity Grant Fund which enables Farmer Producer Companies (FPCs) to receive a grant equivalent to equity contribution of the members. In Nigeria, the government established the Agricultural Credit Support Scheme (ACSS) in 2006 to finance large agricultural projects such as establishment or management of plantations, cultivation or production of crops, livestock, and fisheries and farm machinery and hire services. The purpose of ACSS is to facilitate the development of the agricultural sector by advancing credit to farmers at low interest rates.

In Kenya, the government has innovated with a wide range of financial products adapted for the agricultural sector. The Kenyan government has partnered with the Alliance for a Green Revolution in Africa (AGRA) to initiate the Programme for Rural Outreach of Financial Innovations and Technologies (PROFIT) in order to scale access to agricultural financing in Kenya . The PROFIT program is expected to scale up an existing risk sharing facility of USD 5 million provided by AGRA, IFAD and the Government of Kenya to Equity Bank. The existing scheme has helped disburse a total of USD 50 million and has so far benefitted over 49,000 smallholder farmers in the form of direct lending for farm inputs. A credit facility of USD 7 million will also be provided under the PROFIT Program, targeting deposit-taking MFIs that seek access to funds for expansion for their rural and agricultural portfolios. The PROFIT Program has allocated USD 5 million in the form of technical support and capacity building for banks as well as for beneficiaries with limited business experience. It will also strengthen the management and governance of selected rural Savings and Credit Cooperatives Organizations (SACCO) to enhance their efficiency.

Financial Intermediaries

In most developing countries, Government sponsored risk mitigation tools can be more efficient than direct lending programs. For example, Government guarantee programs in Mexico have significantly helped financial institutions manage the risk of lending to small and medium producers. These guarantees require less government involvement and fewer funds, thus avoiding bureaucratic delays. On the other hand, in Peru and Honduras, the Government policy has traditionally been to finance farmers directly through programs run by state-run banks. However, the result is that banks focus more on commercial farmers, not subsistence farmers. Also, as most banks mandate collateral, guarantee programs give the banks more flexibility to increase their risk appetite to include smallholder farmers in their portfolio.

In Nigeria, the Government-promoted Nigeria Risk Incentive System for Agriculture Lending, or NIRSAL, enables key agricultural sector participants, including farmers, to access finance at single-digit interest rates, using innovative forms of security for their borrowing. For example, agro-dealers can borrow funds using stock as collateral and previous trade history as a reference. For their part, farmers can borrow as groups using mechanisms such as cross-guarantees. This approach has worked so far – since March 2012, Nigeria has injected more than 20 billion naira (about USD 122 million) in loans to key agricultural sector participants.

Governments are also working with private analytics providers to increase the impact of their loans and reduce risk. In Zimbabwe, the Zimbabwe Agricultural Development Trust established the Credit for Agricultural Trade and Expansion (CREATE) fund, a revolving fund accessed by value chain actors through financial institutions. The fund provides working capital to input suppliers and off-takers whose activities ultimately benefit smallholder farmers. Genesis, a Zimbabwean analytics company, helps ZADT to develop and pilot financial products suitable for direct access by smallholder farmers. Genesis identified the 'mung' bean and sesame value chains for product development and testing.

One of the constraints restricting the growth of ICT-based financial intermediaries is the lack of clear policies around the use of mobile money. Since there are multiple stakeholders in the mobile payment ecosystem (MNOs, agents, finance providers etc.), there is often an overlap of different regulatory jurisdictions, leading to complexity. Distinct and specific Government policies and guidelines could catalyze innovation in this sector and enhance the scalability of enterprises catalyzing the flow of financial services to smallholders. For example, in Africa, especially in Kenya, Tanzania and Uganda, the Governments have taken positive steps to encourage interoperability so that mobile money is more liquid and more users are encouraged to use it. This will encourage more value chain players to adopt mobile money and help financial institutions cater to smallholder farmers through digital payments, lowering their costs.

Index-Based Microinsurance

Public-private partnerships can operate on a larger scale than commercial insurers, thanks to their affiliation with national social security programs and access to data (Herbold 2010). These partnerships reach millions of low-income households. Examples include NAIS and mNAIS in India and Componente Atención a Desatres Naturales (CADENA) in Mexico. Both governments subsidize up to 90 percent of the premiums.

Index-based insurance depends heavily on accurate and up-to-date meteorological and agronomic data, which governments collect. Government involvement is also crucial in providing a sound regulatory and legal framework, which determines the scope of activity of insurance companies and ensures their financial integrity. A solid legal framework fosters confidence among all actors. Regulatory frameworks may need to be revised and adjusted to reflect the specifics of index-based agricultural insurance.

Conclusion

Availability of credit is critical in the pre-harvest stage to enable farmers to purchase inputs such as seeds, nutrients, fertilizers, pesticides, irrigation systems, equipment and extension advice. Farmers also need funds to invest in yield enhancement technologies and improve market linkages. Enterprises have adopted different innovative models to unlock credit to smallholder farmers. Many enterprises have automated paperwork and data capture to a large extent, resulting in faster turnaround and disbursement of loans. Some enterprises bundle a microinsurance product with credit and earn revenue from the premium. Enterprises also provide asset financing for farming equipment to farmers who pay in monthly installments.

Many enterprises have also adopted the model of "solidarity groups," also referred to as joint liability groups, to address challenges related to absence of collateral.

Financial intermediaries address several financing gaps faced by smallholder farmers by decreasing transaction costs among value chain actors, promoting transparency in the flow of commodities, powering the aggregation and analytics of data (behavioral, agronomic, and market), and enhancing credit-worthiness. Social enterprises are developing innovative financing models whereby the flow of funds to farmers can be made less risky and lending decisions can be data-driven. Their solutions broadly aim to improve risk management for financial services providers, leverage technology for digital data collection, payments and crowdfunding, and facilitate value chain finance. These enterprises have partnered with financial institutions to provide innovative applications such as warehouse receipt financing, farmer data digitization, input loans through closed-loop business models and mobile-based payments.

Farmers in developing countries are highly vulnerable to risks, but most cannot afford commercial insurance. Schemes in which pay-outs are based on objective criteria, such as rainfall, are less expensive than traditional insurance, because individual claims are not assessed. Making these products available to smallholders can increase their productivity, by allowing them to engage in higher-risk/higher-return strategies. Mobile banking can make indexed insurance more affordable, increase availability, and speed pay-outs.

Non-Bank Finance Providers for Smallholders

Providing innovative financial solutions to address credit challenges facing smallholders

HIGHLIGHTS

- Enterprises have innovated in mitigating credit risk in agricultural finance through input financing, group lending, and using contractual agreements as collateral.
- They reduce market risks for farmers through flexible repayment structures and bundling non-financial services in the value chain with credit.
- Enterprises conduct farmer training to improve financial literacy among smallholder farmers. They design products, such as committed savings programs, to reduce farmers' debt burden.

Summary

The availability of credit is critical in the pre-harvest stage to enable farmers to purchase inputs, such as seeds, nutrients, fertilizers, pesticides, irrigation systems, equipment, and extension advice. Farmers also need funds to invest in yield enhancement technologies and improve market links. However, the needs of smallholder farmers are seldom met by mainstream financial institutions offering traditional financial products. Even where financial products are available, they are accessible only to a small subset of farmers, for instance, those belonging to farmer producer organizations (FPOs), growing horticultural or other cash crops, or those having strong relationships with value chain actors (e.g., contract farming schemes with agro-processors).

Enterprises have adopted innovative models to unlock credit to smallholder farmers. Many enterprises have automated paperwork and data capture to a large extent, resulting in faster turnaround and disbursement of loans. Some enterprises bundle a micro-insurance

product with credit and earn revenue from the premium. Enterprises also provide asset financing for farming equipment to farmers who pay in monthly installments. Many enterprises have also adopted the model of solidarity groups, also referred to as joint liability groups, to address challenges related to the absence of collateral.

Development Challenge

Globally, 500 million households (approximately 2.5 billion people) rely on small-scale agriculture for their livelihoods (CGAP 2013). These smallholder farmer households live on less than USD 2 per day, and typically cultivate less than five acres of land. Limited access to financial services, especially credit, is a major challenge to such smallholder farmers in low-income geographies such as Latin America, Sub-Saharan Africa, and South and South-east Asia. The aggregate demand for credit from these regions is estimated to be more than USD 200 billion, of which only around USD 50 billion is presently met by formal and informal financial institutions and value chain actors (Dalberg 2015).

Smallholder farmers face a number of challenges in accessing appropriate and adequate financial services. Supply side challenges such as lack of flexible credit products and lack of last-mile access, and demand side challenges such as low capacity to service debt hinder credit supply and uptake.

The other barriers that constrain capital availability are:

- Lack of organized farming and structured value chains
- Low financial literacy and financial management skills of smallholder farmers
- Absence of land titles and tangible assets for collateralization
- High degree of seasonality resulting in cash flow fluctuations
- Variability in harvest performance due to external risks such as rainfall, weather, pests, price fluctuations, and storage facilities

Inadequate access to finance causes smallholder farmers to confine themselves to sub-optimal inputs, which results in lower yield. This makes their produce less competitive in the market and also increases the risk for other upstream value chain players due to low quality and uncertain supply. Lower incomes force cash-strapped farmers into a debt cycle, where they seek credit to repay previous loans. Incomes of smallholder farmers are synced with the harvest cycle, and lack of steady or uniform flow of funds causes volatility in their consumption pattern, which can only be smoothed by savings. They borrow from unregulated money-lenders at exorbitant interest rates or selling the harvest early at a heavy discount to market rate.

Business Model

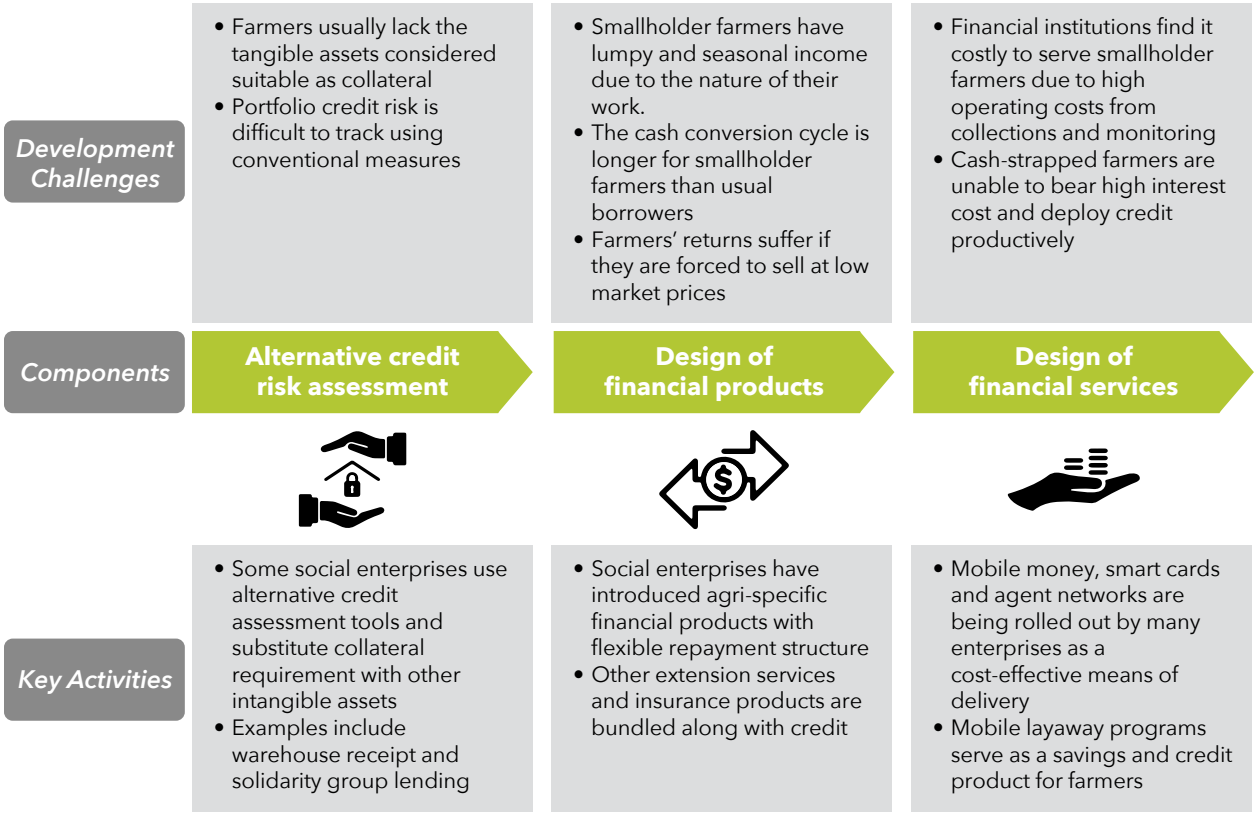
Several enterprises have adopted simple yet powerful innovations to make the delivery of financial services efficient, cost-effective and customized to the needs of smallholder farmers. They have developed novel tools and funding structures to minimize risks, costs and information gaps in agricultural finance, and offer scalable, sustainable and market-driven financing solutions to farmers. These enterprises aim to help smallholder farmers

reduce their financial vulnerability, manage agricultural risks optimally and increase their bargaining power in the market.

Components of the Model

Access-to-finance solutions include alternative techniques to assess credit worthiness, new products to address variable cash flows and ICT-based products to ensure last-mile reach. Most finance providers are structured as banks and MFIs. Some finance providers are also structured as non-profit organizations (such as One Acre Fund) or social investment funds (such as Root Capital)

Figure 1. Components of the model



Finance providers have adopted the following innovative strategies:

Innovative credit risk mitigation and collateralization

The absence of property, land and other tangible assets renders smallholder farmers ineligible to receive traditional commercial loans. Enterprises also find it difficult to underwrite loans to farmers in the absence of credit scores from national credit bureaus. This makes agricultural financing risky for lenders and costly for farmer borrowers. Hence, many enterprises have developed financing instruments which use agri-based assets and inventory to substitute for property collateral and mitigate credit risk. Examples include input financing in which

inputs provided on credit are considered as collateral, and joint-liability group lending, in which group members are responsible for collecting payments on time and co-guaranteeing each other. Loans are also given against contracts from big buyers.

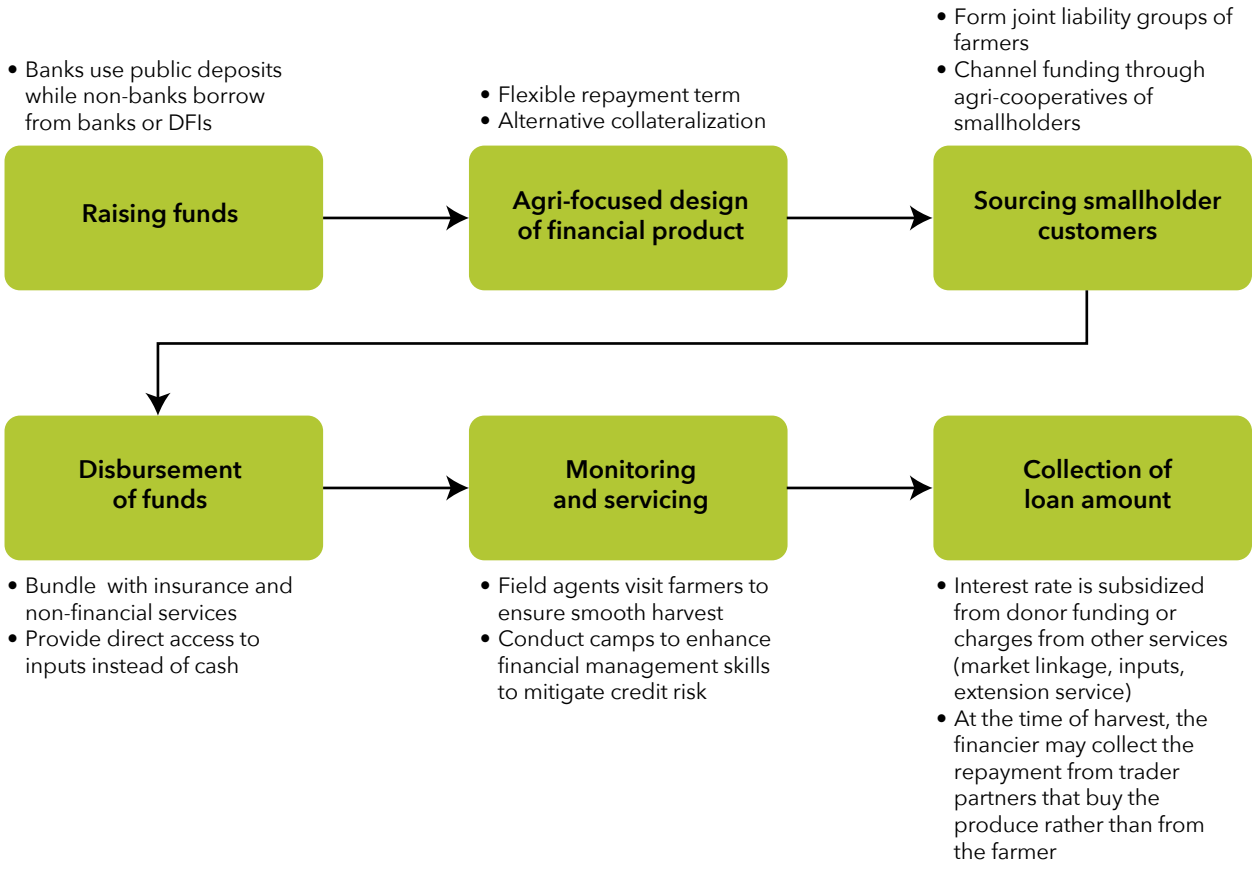
Tailored financial product design to address mismatch in cash flows

The 'one size fits all' approach does not work in lending to smallholder farmers. Given the diverse income streams, crops, harvest cycles, and value chain interactions, a flexible repayment structure is essential for successful farm financing. Enterprises have developed solutions that analyze and match payment terms to the irregular cash flows of different activities. Many enterprises use cash-flow based evaluation methods that allow them to effectively assess the harvest cycle and determine the best product fit for the farmers.

Non-financial services bundled with financial assistance

Smallholder farmers generally lack the financial literacy required to understand different financial products and face the risk of over-indebtedness or under-investment. Due to their financial circumstances, they often deploy capital into unproductive uses. Therefore, many enterprises offer bundled services such as financial education, agri-inputs, capacity building and market linkages, along with financial services such as credit, savings and micro-

Figure 2. Process of the model



insurance. Direct-to-farmer finance providers often provide agronomic support services to smallholder farmers to mitigate production and price risks. These services most often include training to promote agricultural best practices and improve yields. In some cases, these services also encompass market access support to connect smallholders to buyers and improve price realization.

Cost Factors

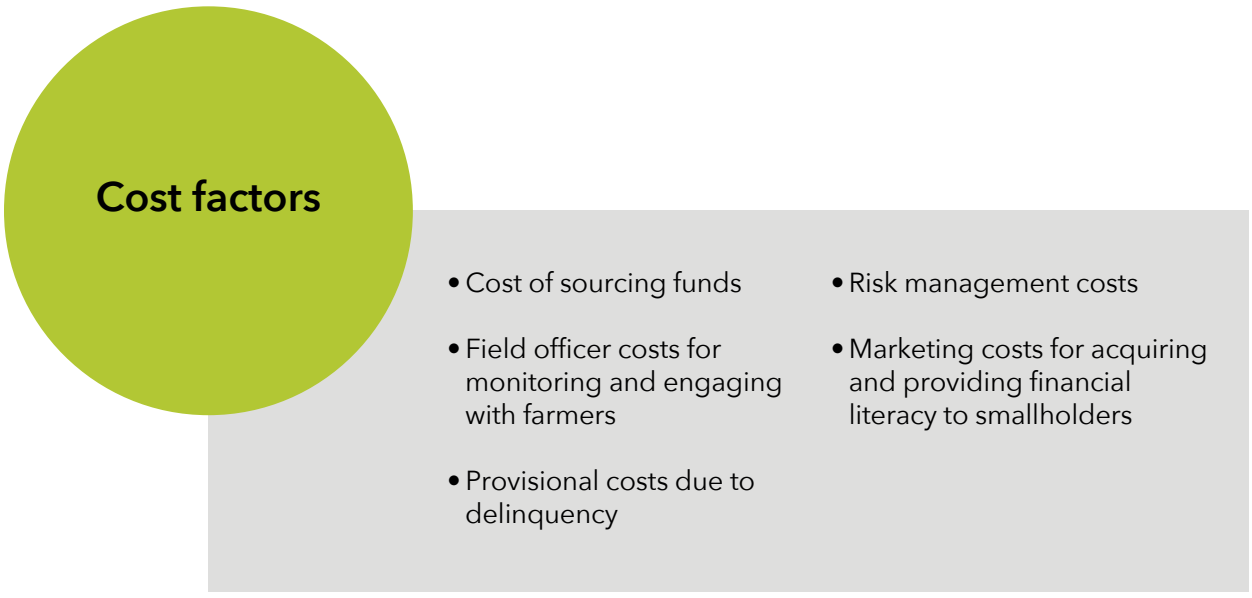
The major components of costs incurred by finance providers are for customer acquisition and risk management.

Providing micro loans is more expensive than lending large amounts, as the costs of loan appraisal, monitoring and follow-up are fixed regardless of the ticket size of loans. The cost of funds for finance providers ranges from 6 percent to 12 percent depending on the geography and source of finance.* Finance providers typically raise funds as grants or from DFIs and other social lenders who can lend with low return expectations. Farmers are often widely dispersed across rural areas that are not well-connected, and credit officers have to travel long distances to reach them. This implies high costs from transport, sales outlets and branches. Significant administrative costs are incurred on training new agents and developing management information systems. Many providers hire credit officers with a background in agriculture to ensure that they have the technical understanding to collect and analyze agricultural information. This often entails a higher human resource cost, but the credit risk is observed to be lower.

Reveue Streams

The main revenue streams for finance providers to smallholder farmers are the interest payments and fees from registration, processing or subscription. The revenue is derived

Figure 3. Cost factors for the model



* Primary interviews.

from the differential margin between the interest rate and cost of funds. Enterprises such as One Acre Fund customize the principal repayment to the preferences and capacity of the individual farmer. They manage cash flows by leveraging grants, and set disbursal dates according to harvest period for each value chain. Enterprises such as Vasham also allow for a single balloon repayment of principal and interest when the loan is due. Some enterprises like Babban Gona have also helped the farmers sell their produce to traders and processors and earn a margin on the total profit.

Some enterprises bundle micro-insurance with the credit product and earn revenue from the premium. These enterprises upsell insurance products along with credit or require smallholder farmers to contribute savings before drawing credit. These mandatory savings accounts typically range from 10 percent to 25 percent of the loan value and serve as a form of partial collateral for providers in case of smallholder default.

In the absence of collateral, many enterprises have also adopted the model of 'solidarity groups,' also referred to as joint liability groups. These groups consist of 10-15 farmers each, usually engaged in similar activities, who organize themselves to receive credit and technical assistance. Solidarity group lending reduces the cost from operations and default risk for lenders. For example, Juhudi Kilimo, a Kenyan agri-financing social enterprise, runs a program wherein farmer clients co-sign each other's loans and receive unsecured micro-credit and micro-insurance. Many finance providers offer credit for the purchase of farming equipment and receive monthly repayment installments from the farmers. This also offsets the collateral requirement as the agri-equipment is considered as the security.

Some enterprises, like Vasham in Indonesia, not only offer credit, but also help farmers gain optimum prices for their output in the market. Vasham runs the KONCO contract farming program through which it provides working capital loans to farmers and then connects them with aggregator companies that buy the produce at competitive prices. These prices are locked-in so that farmers receive downside protection if prices drop at the time of harvest. Vasham receives 10 percent of the profits from farmers as revenue (Vasham, n.d.).

Root Capital, a social lender, funds microenterprises, associations or cooperatives that aggregate produce from hundreds of farmers, rather than directly funding smallholders. Root Capital provides loans ranging from USD 50,000 to USD 2 million. The loans are tailored to the needs of the businesses, and include trade credit loans (to purchase products from producers and meet operating expenses), capital expenditure loans (to purchase or maintain fixed assets such as equipment or land), long-term working capital loans (to meet general business capital needs); pre-harvest credit loans (to support individual producers' production capacity through the purchase of inputs such as seeds and fertilizer); and buyer finance loans (to finance purchases from community-based suppliers and provide working capital to borrowers).

Finance providers have different approaches in delivering value-added support services along with credit. Some providers offer services directly through dedicated field staff or loan officers, and typically charge farmers a fixed fee or attach an additional service fee on interest payments. Other enterprises refer the farmers to partners that provide capacity building and support, and charge them a fixed commission. The partner is responsible for covering the costs associated with these support services, through fees charged to smallholders, philanthropic capital, and/or other revenue sources.

Financial Viability

Most smallholder financiers rely on grants or concessionary loans from governments or philanthropic organizations to reduce their cost of on-lending. They also leverage technology to minimize operational expenditure. The operational efficiency has allowed these enterprises to enhance their margin and pass on the benefit by reducing the interest rate by as much as 2 percent to 3 percent.† Opportunity International provides its field staff with mobile tablets to register new farmer borrowers, open new savings accounts, measure the size of the farm using GPS and geo-tag the farm. A negligible rate of default (1 percent) and a healthy ratio of donor-to-farmer contribution[6] of 1:4 enable One Acre Fund to achieve financial sustainability. (This implies that One Acre Fund covers 75 percent of its costs through service fees from farmers and 25 percent of its costs from donor funding.)

Smallholder farmers also benefit from agricultural value chain finance i.e., financing that takes place within the value chain as well as outside it. An example of internal value chain financing is input supplier credit where agro-input retailers offer deferred payment sales to smallholder farmers. External value chain financing is that which is made possible by value chain relationships and mechanisms: for example, a bank issues loans to farmers based on contracts with trusted buyers or warehouse receipts from recognized storage facilities. A typical case of external value chain finance is where small fruit and vegetable growers are able to access bank finance for agro-chemicals based on their export contracts. The exporter pays the farmers through the bank, which deducts the scheduled loan payments before releasing the net proceeds to the farmer group. Agrofinanzas in Mexico has an innovative business model in value chain financing. It specializes in lending to small farmers that do not have prior formal borrowing experience. It builds relationships with large firms and provides credit services to their suppliers who are smaller firms. Agrofinanzas leverages borrower information obtained from large firms (about their small suppliers), thus reducing the probability of default.

Some enterprises such as Root Capital use factoring agreements, or signed purchase contracts between micro agribusinesses and their buyers, for both short-term and long-term loans. The purchase agreement serves as a substitute for traditional collateral as it represents a discrete, future revenue stream that can be pledged to repay the loan. When the product is shipped, the buyer directly pays Root Capital for interest and principal payments due on the loan, thus decreasing the risk of default. This lending methodology, using fixed-price forward contracts as loan collateral spreads the risk among the value chain players, a paradigm shift from traditional lending, in which risk is borne solely by the most vulnerable producers.

Partnerships

Finance providers forge strategic partnerships in areas such as business development, product design, credit disbursal and collections. Some enterprises employ a unique partnership model to improve the supply chain efficiency along with providing finance. DrumNet, a Kenyan NGO, partners with banks, input suppliers and agri-buyers and facilitates direct financial transactions among them instead of burdening the farmer. Input suppliers sell their products to farmers on credit and receive payments directly from the bank through DrumNet, which

† Primary interviews with One Acre Fund, Root Capital, and Juhudi Kilimo.

collects the principal and interest from the forward-linkage traders instead of farmers. Similarly, the Indonesian bank BTPN provides credit to farmers in the pre-harvest stage in cash or in kind and simultaneously partners with agri-buyers who commit to buying the produce from these farmers. The loan is repaid when the farmers sell their crops post-harvest to these agri-buyers. These buyers deduct repayment from the farmer's sales and remit it back to the bank.

Many lenders also partner with agricultural universities to provide training to their credit officers. MFIs such as Financiera Confianza partner with inputs providers to source farmers as clients and advertise in each other's branches. Another interesting partnership model is the one between CARD Bank in the Philippines and Ideas42, a group of experts in behavioral economics. Ideas42 helped CARD Bank to redesign its savings product and incorporate behavioral levers such as goal-setting and text message reminders. Similarly, Musoni Kenya partnered with Grameen Foundation to design a product that allows for staggered loan disbursement, reducing the default risk. Enterprises also prefer to collaborate with trusted intermediaries to perform its non-core activities such as financing and training.

Implementation: Delivering Value to the Poor

Awareness

Most capital suppliers cite farmers' lack of understanding of financial products as the major hindrance in smallholder lending. On the other hand, smallholder farmers usually undermine the need for financial products such as savings and insurance even as they continue to struggle with heavy debt burdens. This information asymmetry limits customer acquisition and the scattered reach of the financiers make delivery of services costly. Therefore, most finance providers generally run financial literacy programs in parallel with their credit delivery, either by themselves or by tying up with external trainer partners. Enterprises usually do not charge the farmers separately for the financial education and the cost is factored in the interest calculation or subsidized by the government or by donors. For example, ADOPEM, a bank in the Dominican Republic focused on financing smallholder farmers, conducts weekly training sessions on the importance of savings, the material for which is designed by CODESPA Foundation.

Finance providers have adopted many different ways to create awareness. Opportunity International has developed material such as DVDs, TV and radio segments, comic books, games and role-playing activities as self-learning guides for farmers to improve their financial acumen. Juhudi Kilimo also maximizes the benefit of its asset finance offering by imparting knowledge about potential risks of storing cash and the importance of maintaining financial documents.

Acceptance

Enterprises that provide a wide range of financial products tailor-made according to the crop type, harvest cycle, tenure, and cash flows find better acceptance among the farming community. For example, AMK, an MFI in Cambodia, offers bullet and amortization loan

structures, individual and group lending, in-field and branch repayment options, and USD and local currency options. Development organizations such as BRAC in Bangladesh have an agri-specific loan called Borga Chasi, which is cross-sold to farmers along with their dairy and inputs.

Loan disbursements need to be in sync with the crop cycle. Proximity Finance, an enterprise in Myanmar, provides farmers with ongoing access to credit (working capital) in ticket sizes ranging from USD 150 to USD 230. Since 2007, it has financed 90,976 inputs, which, in turn, increases annual farmer incomes by an average of USD 250. The repayment period generally extends through the harvest season with installments structured to Myanmar's Dry Zone and Delta crop cycles. Proximity Finance also provides a plain-vanilla five-month credit product for farmers to purchase seeds, fertilizers, irrigation equipment and other inputs.

Accessibility

To make financial products accessible to smallholder farmers, some enterprises have made smart design modifications to plain-vanilla credit instruments. For example, the Rural Resilience Initiative (R4) in Ethiopia links labor-based safety nets that provide cash or food in exchange for work on community projects. R4 is an innovative approach to helping communities better manage risk, one that involves a set of integrated tools: insurance, credit, savings, and disaster risk reduction. R4 provides credit to farmers and farmers work on natural resource conservation to reduce the risk of disasters in order to protect assets and improve productivity. This innovative model has made insurance highly accessible and desirable to poor farmers in Ethiopia. Compensation for weather-related losses enables farmers to avoid selling productive assets and facilitates faster recovery.

Enterprises have also developed agent networks to expand their outreach in rural areas. For example, Financiera Confianza has established customer service points in small shops in rural areas where farmers can withdraw and repay. Juhudi Kilimo uses referrals, conducts road shows and advertises on radio for market activation. It also has on-the-ground credit officers who follow up on current farmers' projects as well as identify new opportunities.

Enterprises adopt innovative means to reach clients and provide last-mile access. Bancamía offers services through 'Lineamía,' which is a form of telephone banking available to all clients. This service enables the enterprise to accept loan applications over the phone, hear requests and complaints, and sell certain types of financial services. Financiera Confianza uses mobile announcement vehicles, daily newspapers, referral incentives, and radio as its marketing channels. Bancamía also uses radio and TV spots to target farmers. It advertises through booths at local fairs and provides referral bonus.

Affordability

Small farmers are sensitive to transaction costs incurred to access credit, for instance, cost of travelling to bank branches, especially during peak harvest season when they are very busy. Many finance providers, therefore, leverage mobile banking platforms to reduce farmers' time and cost for availing finance. ICT-enabled service delivery reduces the outreach cost for the farmers too, making the financial services affordable.

Opportunity International uses a hub-and-spoke delivery model whereby hub branches are opened in market centres, and mobiles and POS machines are used as access points in the

surrounding rural communities. This enables affordable banking services to farmers living in sparsely populated regions as well. Many enterprises adopt a cross-subsidization model wherein they offset the low cost of finance to smallholder farmers with higher priced value-chain finance for traders and processors. For example, Grafco Sacco has variable pricing for agriculture loans.

Juhudi Kilimo has collaborated with Ford Foundation to develop a mobile platform for providing extension services free of cost to the farmers (this includes training on market research, disseminating weather and market information through mobile tech platform etc.) so that the risk is mitigated to a certain extent and the risk premium is reduced, making the loans affordable.

Results and Cost Effectiveness

Scale and Reach

Most non-bank smallholder financiers are deeply engaged with their farmer borrowers, and offer bundled extension services or inputs along with the credit. This limits their ability to scale. However, primary research suggests that group lending models have proved to be very scalable due to lower operating cost per individual borrower.

Doreo Partners, an impact investing firm in Nigeria, has implemented an innovative franchise model called Babban Gona, whereby subsistence farmers are grouped into a franchisee and provided with end-to-end services including credit, training, inputs, and transportation. The harvest is then sold to large processor corporates at negotiated prices and farmers receive quarterly dividends. This model provides Doreo Partners with economies of scale and commission from other value chain players. One Acre Fund is able to scale rapidly by using a standardized operating model. It has a 'district operating unit' that can be replicated easily and cost-effectively. Each unit includes a field director, 6–10 field managers, 30–50 field officers, and a bookkeeper. At scale, a district can serve about 10,000 farmers. Each district within a country operation uses standard procedures for monitoring and repayment collections. As a country operation grows larger, it realizes economies of scale, and lowers the cost of serving an individual client.

Improving Outcomes

Farmers' decisions to invest and produce crops are closely influenced by access to financial instruments. Improving access to finance can increase farmers' investment choices and provide them with more effective tools to manage risks. In turn, appropriate technologies to measure credit-worthiness can direct more private sector lenders and capital into the farming community. For example, in Malawi, the use of fingerprints to identify farmers allowed lenders to pinpoint sub-prime borrowers. Therefore, farmers were hesitant to default, and lenders were incentivized to engage in more transactions.

Adapta Sertão is a network of organizations that aims to assist small scale farmers in adapting to climate change in the semi-arid community of Pintadas, Bahia, Brazil. In addition to supporting farmer households in accessing water infrastructure, farming technologies, technical assistance, processing plants and markets for agricultural products,

Table 1. Examples of companies and their scale and reach

Company	*No. of years of operations*	*Countries of operation*	*Scale and reach*
Juhudi Kilimo	7 years	Kenya	31,000 farmers
One Acre Fund	10 years	Kenya	420,000
Dorea Partners (Babban Gona)	3 years	Nigeria	2,000+

Adapta Sertão established a local micro-credit bank with loan services tailored for small-scale family farmers. Through Adapta Sertão, small farmers could buy productive irrigation equipment, making them more resilient in the face of a fast-changing climate. The incomes of local farmers increased from less than USD 250 per month to over USD 500 per month, and crop losses decreased from 70 percent to 20 percent.

Cost Effectiveness

Well-structured financing can help farmers find a pathway out of the cycle where low investment leads to low returns. Some smallholder lenders, such as Green Bank of Caraga in Philippines, have implemented commitment savings—these are savings accounts which farmers can only access after they reach a certain committed savings goal. Opportunity International Bank in Malawi also offers tobacco farmers a product where they can set aside their profits from harvest to fund the inputs for the next season. This creates a win-win situation for both, the smallholders and the lender; the savings can form a substantial capital base for the lending activities of the financial institution, while encouraging farmers to minimize expenditures and thus reduce the risk from cash-flow volatility.

Root Capital has enabled several agricultural businesses to grow in an environmentally sustainable way, facilitating increased and stable incomes for 35,000 farmers and improved livelihoods for the 200,000 family members they feed and clothe. It has provided nearly USD 980 million in loans to 623 businesses that collectively source from 1.2 million smallholder farmers (MasterCard Foundation 2016). In 2015 alone, Root Capital's loans helped its clients generate USD 1.2 billion in combined revenue, 81 percent of which was paid directly to the smallholder farmers from whom they source. Additionally, its Women in Agriculture Initiative reached 200,000 women in 2015 by investing in businesses that promote gender-inclusive practices.

Scaling Up

Challenges

The regulatory environment is uncertain in some countries such as Kenya, posing additional risks for banks to provide funds for agricultural financing. Banks are often unwilling to lend to enterprises that on-lend to smallholder farmers due to small ticket size of loans, high credit risk, and high costs of due diligence and collections. Additionally, finance providers

incur high transaction costs due to the lack of last-mile reach and the poor rural networks. The vast majority of smallholder farmers do not participate in producer organizations, and providing finance to them individually is not very profitable. Finance providers are also unable to assess credit-worthiness due to insufficient documentation and lack of readily available financial data with smallholder farmers.

Long-term lending is exposed to volatility, and agriculture commodity markets are extremely volatile. A smallholder who is financed today may find it difficult to repay if commodity prices collapse. Moreover, hedging and insurance products to mitigate risks tend to be very expensive. As a result, few long-term finance models for smallholders and producer organizations exist, though some social lenders such as Root Capital are beginning to experiment with them. The table below gives an indication of the scale at which finance providers operate:

Role of Government and Policy

In order to support agri-finance providers, governments should introduce appropriate risk-based regulatory framework and smart subsidies that spur innovation and avoid market distortion. A good credit guarantee program also helps reduce the risk of loans to farmers, and can incentivize finance providers to fund more farmers and release more funds. For example, Bancamía, an MFI in Colombia engaged in smallholder financing, uses Colombian governmental guarantee funds to protect itself from the risks of lending to the agricultural sector. In Ghana, the e-switch money transfer system serves small scale financial institutions allowing farmers in rural areas to use biometric cards for payment operations. However, other government policies can inhibit the growth of non bank finance providers—in India only a registered Bank or non-bank financial company can disburse loans, limiting the range of entities able to provide this service.

Some government interventions involve direct credit or refinancing. In India, the Small Farmers' Agribusiness Consortium (SFAC), promoted by the Government of India, provides interest-free soft loans of up to USD 12,000 to projects in agriculture or allied sectors. It also operates an Equity Grant Fund that enables Farmer Producer Companies (FPCs) to receive a grant equivalent to equity contribution of the members. In Nigeria, the government established the Agricultural Credit Support Scheme (ACSS) in 2006 to finance large agricultural projects such as establishment or management of plantations, cultivation or production of crops, livestock, and fisheries and farm machinery and hire services. The purpose of ACSS is to facilitate the development of the agricultural sector by advancing credit to farmers at low interest rates (Eze et al. 2010).

In Kenya, the government has innovated with a wide range of financial products adapted for the agricultural sector. The Kenyan government has partnered with the Alliance for a Green Revolution in Africa (AGRA) to initiate the Program for Rural Outreach of Financial Innovations and Technologies (PROFIT) in order to scale access to agricultural financing in Kenya (Gates Foundation n.d.). The PROFIT program is expected to scale up an existing risk sharing facility of USD 5 million provided by AGRA, IFAD and the Government of Kenya to Equity Bank. The existing scheme has helped disburse a total of USD 50 million and has so far benefitted over 49,000 smallholder farmers in the form of direct lending for farm inputs. A credit facility of USD 7 million will also be provided under the PROFIT

Program, targeting deposit-taking MFIs that seek access to funds for expansion for their rural and agricultural portfolios.

Conclusion

Access to financial services is critical for smallholder farmers to make investments in productivity, improve post-harvest practices, smooth household cash flow, establish market linkages and promote better risk management. Technology and innovations in last mile reach enable finance providers to reach rural markets and serve not only large farmers, but also smallholder farmers.

Many of these enterprises use technology to cost-effectively identify potential client farmers, assess their credit worthiness and provide them with information and financial services. However, there is little evidence of enterprises having achieved financial sustainability without lower cost funding or donor support. Social enterprises (SEs) attempt to improve the financial viability of their lending operations by adopting mobile applications and unique risk mitigation techniques. The provision of non-financial services along with finance also helps these SEs gain the trust of the farmers and mitigate other factors that may increase repayment risks. With government support, these finance providers are able to scale much faster and reduce interest rates, thus benefitting the farmers.

Table 2. Social enterprises: Non-bank finance providers for smallholders

Company	*Country*	*Solution description*
Agrofinanzas	Mexico	Agrofinanzas is a non-bank financial institution specialized in lending to Agri-SMEs.
AMK	Cambodia	AMK is a rural-focused MFI in Cambodia.
Banco Adopem	Dominican Republic	Banco Adopem is one of the largest MFIs in the Dominican Republic. It has one highly flexible agricultural loan product, agrocrédito, which allows for customized payment schedules based on each smallholder's preferences and payment capacity.
Bancamia	Colombia	Bancamía's agricultural lending is done primarily through two credit products: Agromía and Credimía.Both are designed according to the cash flow from the farmers' activities.
Doreo Partners (Babban Gona)	Nigeria	Babban Gona franchises Farmer Groups and provides tailored and cost effective end-to-end professional training, input, credit and marketing services to these groups. Members get access to Babban Gona market services that assure good warehousing practices, access to good markets and increased profits.

Table 2. Social enterprises: Non-bank finance providers for smallholders (continued)

Company	*Country*	*Solution description*
DrumNet	Kenya	DrumNet, a Kenyan NGO, partners with banks, input suppliers and agri-buyers and facilitates direct financial transactions among them instead of burdening the farmer.
Financiera Confianza	Peru	Financiera Confianza is a leading institution in the Peruvian microfinance sector, whose mission is to build opportunities for low income families
Grafco Sacco	Kenya	Grafco Sacco is a savings and credit co-operative society. It has an agriculture loan program to provide long-term and short-term loans to dairy farmers, poultry farmers and greenhouse farmers
Juhudi Kilimo	Kenya	Juhudi Kilimo provides microloans that allow Kenyan smallholder farmers to access high-quality agricultural assets that enhance the productivity of their farms.
One Acre Fund	Kenya, Rwanda, Burundi and Tanzania	One Acre Fund offers smallholder farmers an asset-based loan that includes: 1) distribution of seeds and fertilizer; 2) financing for farm inputs; 3) training on agriculture techniques; and 4) market facilitation to maximize profits.
PRODEM	Bolivia	PRODEM is a large non-profit micro-lending entity
Proximity Design	Myanmar	Proximity has two lending operations for smallholder farmers in Myanmar—Yetagon Credit for asset financing and Proximity Finance for working capital needs of farmers during the harvest season
Rural Resilience Initiative (R4)	Ethiopia	R4 provides credit to farmers and farmers work on natural resource conservation to reduce the risk of disasters in order to protect assets and improve productivity
Vasham	Indonesia	Vasham leverages a closed loop business model to provide Indonesian smallholder farmers with financing, expertise, and income security they need to achieve significantly better standards of living. Vasham provides two kinds of loans; farming input loans and operational capital loans.

References

Bill and Melinda Gates Foundation. nd. "Alliance for a Green Revolution in Afria (AGRA)." http://www.gatesfoundation.org/How-We-Work/Resources/Grantee-Profiles/Grantee-Profile-Alliance-for-a-Green-Revolution-in-Africa-AGRA

Consultative Group to Assist the Poorest (CGAP). 2013. "Focus Note No. 85: Segmentation of Smallholder Households: Meeting the Range of Financial Needs in Agricultural Families." April. http://www.cgap.org/sites/default/files/Focus-Note-Segmentation-of-Smallholder-Households-April-2013.pdf

Dalberg, Citi Foundation, Skoll Foundation; Catalyzing Smallholder Agricultural Finance http://dalberg.com/documents/Catalyzing_Smallholder_Ag_Finance.pdf

Eze, Christopher, et al. 2010. "Agricultural Financing Policies and Rural Development in Nigeria."Presented at the 84th Annual Conference of the Agricultural Economics Society Edinburgh 29–31 March. http://ageconsearch.umn.edu/bitstream/91677/2/7eze_lemich_ugochukwuetal.pdf

MasterCard Foundation. 2016. "Root Capital and The MasterCard Foundation to Increase Incomes for 300,000 Farmers in West Africa." http://www.mastercardfdn.org/root-capital-and-the-mastercard-foundation-to-increase-incomes-for-300000-farmers-in-west-africa/

Vasham. nd. www.vasham.co.id

CASE STUDY

Juhudi Kilimo

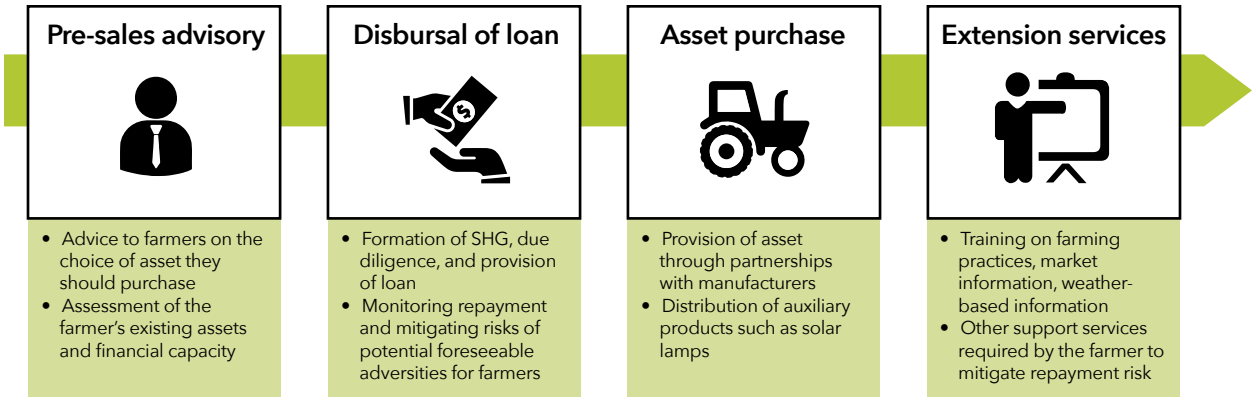
Founding year: 2009
HQ: Nairobi, Kenya
Countries of operation: Kenya
Orientation: For-profit
Employees: 172
Turnover: USD 3.2 million (in 2015)

The per capita food productivity in Kenya is 30 percent lower than that of the rest of Sub-Saharan Africa, resulting in 21 percent of total food consumption being imported or received as food aid. Many of these rural poor smallholder farming assets are unable to access financial services required to acquire more productive farming assets to increase yields on the farms because of lack of collateral or business assets required for financing by MFIs.

Juhudi Kilimo addresses this problem by providing innovative micro-asset financing to the rural smallholder farms. The assets produce a cash flow (such as selling milk or eggs) and there is a reduced risk since the asset financed can also act as collateral in the event of default. It also undertakes capacity building for farmers in collaboration with the Ministry of Agriculture in Kenya. Installments are typically covered by the extra revenue from the asset purchased. Multiple layers protect the farmer from bad indebtedness–the group guarantees the loans, the asset bought acts as collateral, and the animals purchases are insured.

Operating Model

Juhudi Kilimo is a for-profit spin-off of K-Rep Development Agency, a Kenyan microfinance incubator. It offers loans for assets that can generate income and act as collateral. The key products offered by Juhudi Kilimo include: animal financing for high-yielding dairy cows and poultry; farm equipment financing for irrigation equipment, water tanks, milking sheds, pumps, and grain mills; and green energy financing for products such as clean cook stoves and solar lighting systems. It lends to groups of 15–20 farmers where members co-guarantee their loans, reducing default rates to only 3 percent. Juhudi requires a prior commitment (Loan Guarantee Fund) of 15 percent of the intended loan amount. Each new group receives



2 months of training from Juhudi before members are eligible to take loans. Group members who are new to formal lending receive training on basic bookkeeping, loan management and the risks and benefits of finance.

Farmers can get a first loan of up to Ksh 100,000 shillings (USD 1,040 for a dairy cow). Juhudi Kilimo qualifies clients to receive progressively higher loans as farmers repay their loans, reassessing a farmer's debt capacity at each level. Starting with loans of ~USD 1,000, farmers can apply for up to double the earlier amount at each successful full repayment, with a cap at ~USD 10,000. Every loan goes through a new credit appraisal, and approval is not automatic. It also offers top-up loans for energy devices (such as solar lanterns and improved cook stoves), education and emergency to its most loyal clients. This allows them to keep the churn rate at just 5 percent.

Loan officers cater to rural clients through a network of 21 field offices across Kenya. Each loan officer serves up to 350 clients within a 45km radius. To establish credit-worthiness, loan officers conduct loan appraisals on farms, and recommend the most appropriate and affordable financing product. These loans finance income generating assets that are sourced from local suppliers. The loan officers capture and store real-time client data on their tablet through a cloud-based loan tracking system. This allows them to process loan applications more efficiently, which has greatly improved client satisfaction. This technology also helps to track loan officers' performance and client repayment rates.

Juhudi Kilimo partners with NGOs and extension service providers (both, Government and private) to offer training and information on best farming practices to its clients in rural Kenya. To help farmers in accessing market information, Juhudi Kilimo works with other players in the value chain such as rural milk cooling plants and poultry marketers. It has collaborated with iCow through support from GALVmed and Ford Foundation to develop a mobile communication platform and video training kit to provide agricultural advice to its borrowers.

Financial Sustainability

Juhudi has raised over USD14 million in debt financing from organizations such as Kiva.org, Ford Foundation, Rockefeller Foundation, Grameen Credit Agricole, Fefisol, Alterfin, Deutsche Bank, Triple Jump, responsAbility, Global Partnerships and Regmifa. Juhudi's current shareholders include social investors, namely, Acumen Fund, Soros Economic

Development Fund, and Grameen Foundation. Field support and training are delivered through partnerships with Kenya's Ministry of Agriculture Livestock & Fisheries, SwissContact and TechnoServe.

Over 80 percent of the revenues come from interest on loans, while the rest is split between loan application fees, membership fees and passbook fees. Juhudi Kilimo tries to balance self-sufficiency and impact to farmers. It limits costs of serving dispersed rural populations and outreach by leveraging SHGs to do initial screening, collect repayments and recruit new members. Since it does not take deposits, its cost of funds is as high as 16–18 percent unlike those of banks or deposit-taking microfinance institutions. Currently, Juhudi lends to farmers at a flat rate of 20 percent per annum, making a margin of about 6 percent—compared to interest rates of 20–25 percent charged by the rest of their peers. Juhudi also receives grants, typically in the range of USD 20,000, for technical assistance projects (such as outreach and marketing, hiring experts to train staff and farmers clients and acquiring technology solutions to improve on business efficiencies and service delivery to customers).

Juhudi has more than 31,000 active borrowers and a 1 billion Kenyan shillings (USD10 mn) loan book with PAR >30 days at <3 percent. It broke even in August 2015, having brought in new management in April 2015. The company has since invested in internal controls and reorganized the business to improve operational efficiencies, staff productivity and capacity development. This resulted in an operational self-sufficiency (OSS) of 123 percent. Juhudi has adopted innovative cost saving technologies such as Safaricom's MPESA mobile money transfer system and Electronic Funds Transfer (EFT) in disbursing loans to client. To manage risk, it designed a loan product for livestock farmers (dairy animals) that includes insurance and vaccination against major diseases. The financed livestock (approximately 15 percent of the outstanding portfolio) are insured against death and disease at a cost of 3 percent of the value of the cow.

Impact

Most of the assets provided by Juhudi's financing not only produce income, but also provide supplemental protein-rich food for families, fertilizers and employment. The additional income earned is also used by farmers to pay their children's school fees. Half of Juhudi's customers are women who are empowered to make key household decisions and are less likely to suffer from gender related conflict and violence. Juhudi Kilimo has partnered with F3 Life which combines credit scoring with training on environmental best practices such as soil conservation and water management. Farmers are required to practice environmental friendly farming as a requisite to receive loans. Juhudi also provides credit to buy energy efficient products (e.g., solar lamps and improved cook stoves) through partnerships with SEs such as Ecozoom, Biolite, Orb Energy and Greenlight Planet.

Challenges and Lessons

Many agri-financiers shy away from the sector due to numerous risks or provide funding to Juhudi at a high cost. Most of the available financing instruments in the country are not designed to match with agricultural cycles which often result in seasonal income to farmers. Juhudi's financiers expect them to pay back quarterly or monthly and thus to ensure cash

flow, the farmers have to pay back monthly. High operation costs in rural areas due to poor infrastructure and low levels of literacy also pose a challenge for Juhudi. Juhudi Kilimo requires capital that is synchronized to planting seasons.

Juhudi also faces several risks associated with market fluctuations and weather changes. In order to address this, they provide insurance covers to farmers so as to cushion them in case of disease outbreak, loss of livestock etc. It is also currently exploring additional insurance products such as weather index crop insurance, health insurance and political violence insurance. It uses peer pressure from guarantors to encourage defaulting farmers to pay, and in some cases, they also use auctioneers.

Road Ahead

Juhudi Kilimo is piloting loans to individuals with its best clients who ask for larger loans than what the rest of the group is willing or able to guarantee. It has also piloted loans for new types of products such as biogas digesters, water tanks and solar water pumps. In addition, it is planning to allow small top-up loans for good clients (as is already done for solar lanterns and improved cook stoves). It plans to introduce mobile loan disbursements and repayments. It is also experimenting with training videos and training presentations on the tablets and portable projectors on specific technical advice on agriculture practices. It has established Juhudi Labs with the mandate to research, innovate and incubate, pilot and test new products before they can be rolled out to the farmers to ensure that they meet the specific needs.

CASE STUDY

One Acre Fund

Founding year: 2006
HQ: Bungoma, Kenya
Countries of operation: Kenya, Tanzania, Rwanda, Burundi, Uganda, and Malawi

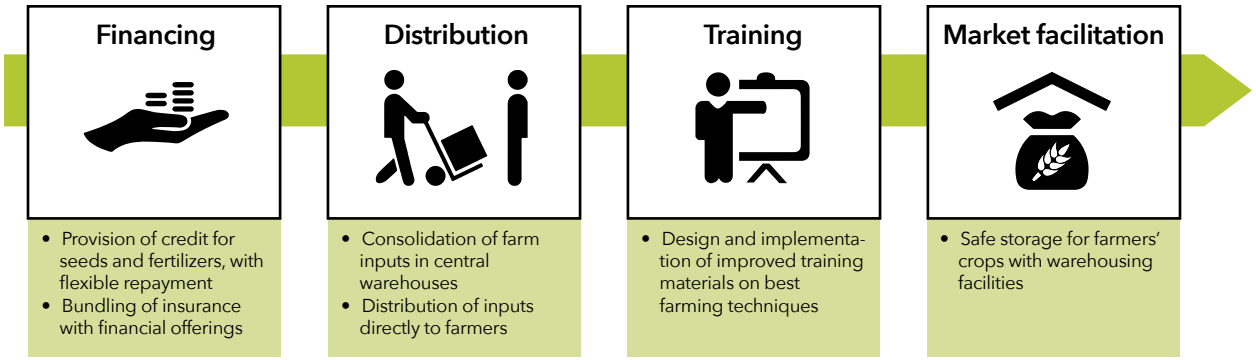
Orientation: Non-profit
Employees: 4,300
Turnover: USD 29 million

One Acre Fund is a nonprofit organization that supplies smallholder farms in East Africa with asset-based financing and agriculture training services to reduce hunger and poverty. It offers a comprehensive service bundle that includes inputs on credit, training to maximize productivity, crop and life insurance, as well as market access, all delivered at the farmers' village. Moreover, inputs are delivered at the time of planting and farmers are offered flexible repayment terms.

One Acre Fund has laid the foundation for a virtuous cycle whereby farmers increase their productivity and incomes and thus remain loyal to the organization. In 2015, it served 305,000 farm families throughout East Africa. In 2016, that number is projected to grow to 420,000 families. The multi-faceted approach of One Acre Fund towards helping local farmers maximize agricultural profit and sustainability is the differentiating factor in its business model.

Operating Model

One Acre Fund sells inputs packages on credit to farmers to cultivate maize, millet and sorghum. The inputs are purchased from One Acre Fund's partner manufacturers and consolidated in a central warehouse. The enterprise hires 10-ton trucks to deliver the inputs to the fields. The base package, which includes maize seeds and fertilizers corresponding to the size of the land, is delivered before the planting season. In addition to these basic packages, farmers can purchase "top up" packages for additional inputs, storage bags and energy products. These inputs are also available to them on credit. One Acre's teams include units of field managers and officers. One field director oversees



each field team unit of 10 field managers and 50 field officers, who are individually responsible for delivering the program to around 200 farmers. A central head office in each country supports the field teams in finance, accounting, human resources, logistics, marketing and administration.

Every two weeks, One Acre Fund delivers specific in-field training in targeted areas throughout the season, and also provides an educational handout on fertilizer impact and proper use. One Acre Fund has purchased a weather-index insurance from Syngenta Foundation, and passes on the benefit to farmers by forgiving some part of loans in case of crop failure, thus helping them mitigate risk. It also sells other products such as tree seeds, solar lights, reusable sanitary pads, hermetically sealed crop storage bags, and energy-efficient cook stoves on credit to farmers to improve their quality of life.

To control the average indebtedness of its clients, One Acre Fund caps its loans at USD 200, while the average ticket size is as low as USD 70. Also, to mitigate credit risk, it applies the concept of social collateral, whereby lending is made available to a cohesive joint-liability group of 4–10 farmers. A security deposit of USD 11 is taken upfront from farmers before extending the loan to ensure willingness and ability to repay. Field officers meet regularly with the farmer groups to coordinate delivery of farm inputs, administer training and collect repayments.

The annual service fee is around 17 percent for 3–10 month tenure loans. The loan repayment schedule is flexible. Full loan repayment is only required after the harvest is done, but farmers are encouraged to pay small amounts, whenever they can over the course of the season. The groups have a 2-week grace period to ensure repayment by all members. Around 80 percent of the farmers choose to re-enroll in the program season after season because they value the package that One Acre Fund offers, even though the package is at a premium of around 25 percent.

In 2013, the Rwandan government invited One Acre Fund into an official partnership to operate an agricultural training program through its nationwide extension network. It has successfully operated this training program since 2013 in partnership with MINAGRI (the Rwanda Ministry of Agriculture) by training government agronomists at multiple levels, and aims to train a nationwide network of 'farmer promoters,' who can ultimately train farmers in villages across Rwanda.

Financial Sustainability

In Kenya, One Acre Fund has an average gross margin of 32 percent on the inputs it sells. This margin includes an average 13 percent mark up on bulk products, a 17 percent flat service fee on input costs, crop insurance of ~5 percent of input costs, a fixed program fee of USD 7.6, and a delivery fee (which also helps pay for storage and warehousing costs).

One Acre Fund incurs maximum cost on field staff, input storage, transport and distribution, and insurance. Besides field operating costs, there are costs arising from R&D, pilot projects, government relations, monitoring, and fund raising. One Acre Fund also has access to a grant pool that enables it to leverage working capital from both farm input suppliers and banks. Costs related to new country scouting and government partnerships, innovations and M&E, and global support programs are paid for by donors.

Around 99 percent of the farmers repay their loans, which covers 79 percent of One Acre's field expenses. Grants are needed to fill the remaining gap of roughly USD 33 per farmer (including overhead). To improve sustainability, One Acre Fund focuses on levers such as transaction size per farmer and farmer loan repayment rate, as well as staffing ratios like clients per field officer. Currently, it is piloting new marketing and sales methods to improve enrollment for field officers and farmer mobile repayment (via MPESA) to reduce the need for collecting and recording repayments manually.

Impact

In 2015, the core program of One Acre Fund resulted in the increase of annual farmer incomes from USD 250 to USD 387 (55 percent). The farmer ROI (extra profit a One Acre Fund farmer makes for every extra dollar of investment) was 300 percent. In 2015, there was a 40 percent improvement in the harvest maize farms supported by One Acre Fund compared to that from non-One Acre Fund land. Farmers see their agro-productivity increase by 60 percent-300 percent (depending on crops, soil and climate) in comparison to neighboring farmers. The adoption of One Acre Fund's practices has had positive spillover effect on non-clients as well, increasing maize production by 200 pounds per field.

Challenges and Lessons

One Acre Fund faces competition from some banks or informal money lenders for loans. These loans, however, offer only cash credit, and not seeds and fertilizers on credit. They also do not deliver inputs or provide training. The other challenge is that the present model of One Acre Fund requires considerable manpower, which limits scalability. One Acre Fund is working on strengthening the infrastructure required to coordinate among the field team and the support staff.

Road Ahead

In 2015, One Acre Fund launched "Tubura University," a set of in-house development courses to provide its staff with training in English, computing, leadership and management skills. It has also put together a scale innovations team to explore ways to increase client density in areas of operations. These teams run research projects to build organizational knowledge by analyzing quantitative data, survey senior field staff, and incorporate human-

centered design tenets into field operations. They propose changes to the repayment model, new approaches to marketing, or even advocate for the adoption of new technology. One Acre Fund is looking to grow at 37 percent to reach 420,000 farmers by the end of 2016 and 1 million farmers by 2020. To achieve these targets, it is focused on "growing in" (increasing the density of farmers served in regions of current operations), as well as "growing out" (expanding to serve farmers in regions outside of current operations).

Financial Intermediaries for Smallholders

Providing innovative and cost-effective means to assess smallholder credit-worthiness and lower transaction costs

HIGHLIGHTS

- Financial intermediaries improve access to finance for farmers by devising innovative credit scoring and risk mitigation tools and promoting financial literacy.
- They develop ICT-based tools and services to decrease transaction costs, track payments, build farmers' credit history.
- Enterprises facilitate agricultural value chain finance, which can be a cost-effective solution to reach a large number of smallholders and an entry point for farmers to access long-term credit.

Summary

Very few financial products are designed to address the challenges faced by farmers, such as seasonality in payment (only after the harvest), and a lengthy investment period without cash flow for long-gestation products. Specialized loan officers who understand these challenges are also in short supply. As a result, most banks have traditionally regarded agriculture as fundamentally unprofitable or risky at best.

Financial intermediaries address several financing gaps faced by smallholder farmers by decreasing transaction costs among value chain actors, promoting transparency in the flow of commodities, powering the aggregation and analytics of data (behavioral, agronomic, and market), and enhancing credit-worthiness. Social enterprises (SEs) are developing innovative financing models whereby the flow of funds to farmers can be made less risky and lending decisions can be data-driven. Their solutions broadly aim to improve risk management for financial services providers, leverage technology for digital data collection, payments and

crowdfunding, and facilitate value chain finance. SEs have partnered with financial institutions to provide innovative applications, such as warehouse receipt financing, farmer data digitization, input loans through closed-loop business models, and mobile-based payments.

Development Challenge

Traditional financing methodologies have not been able to adequately address the need for appropriate financial services to smallholder farmers in developing countries. While the global demand for finance from smallholder farmers is USD 450 billion, supply falls short at USD 20–30 billion. The gap in agricultural finance is primarily due to perceived high credit risk in agricultural lending and incompatible financial products (Initiative for Smallholder Finance n.d.). Remoteness of rural markets from urban financial centers, isolated and dispersed populations, and poor road and energy infrastructure are other factors that make it difficult and expensive for financial institutions to serve and monitor farmer borrowers.

Farmers face high performance risk (crop failure) and market risk (no clients, low prices), which can be mitigated through a combination of access to credit and savings products. Financial intermediation is essential to optimize the agricultural and financial cycles (e.g., purchase inputs when these are cheap and sell produce when it is expensive). Without such support, farmers remain in the suboptimal loop of low-investment/low-productivity agricultural operations.

The information gap between the financial institutions and smallholder farmers renders the ecosystem inefficient. Also, banks find it difficult to assess the credit-worthiness of smallholder farmers due to low levels of farmer education and financial literacy (no record keeping, business plans, or bank accounts). Credit scoring techniques, which could reduce the cost of loan appraisal, are difficult to apply due to the lack of standardized and objective data.

Business Model

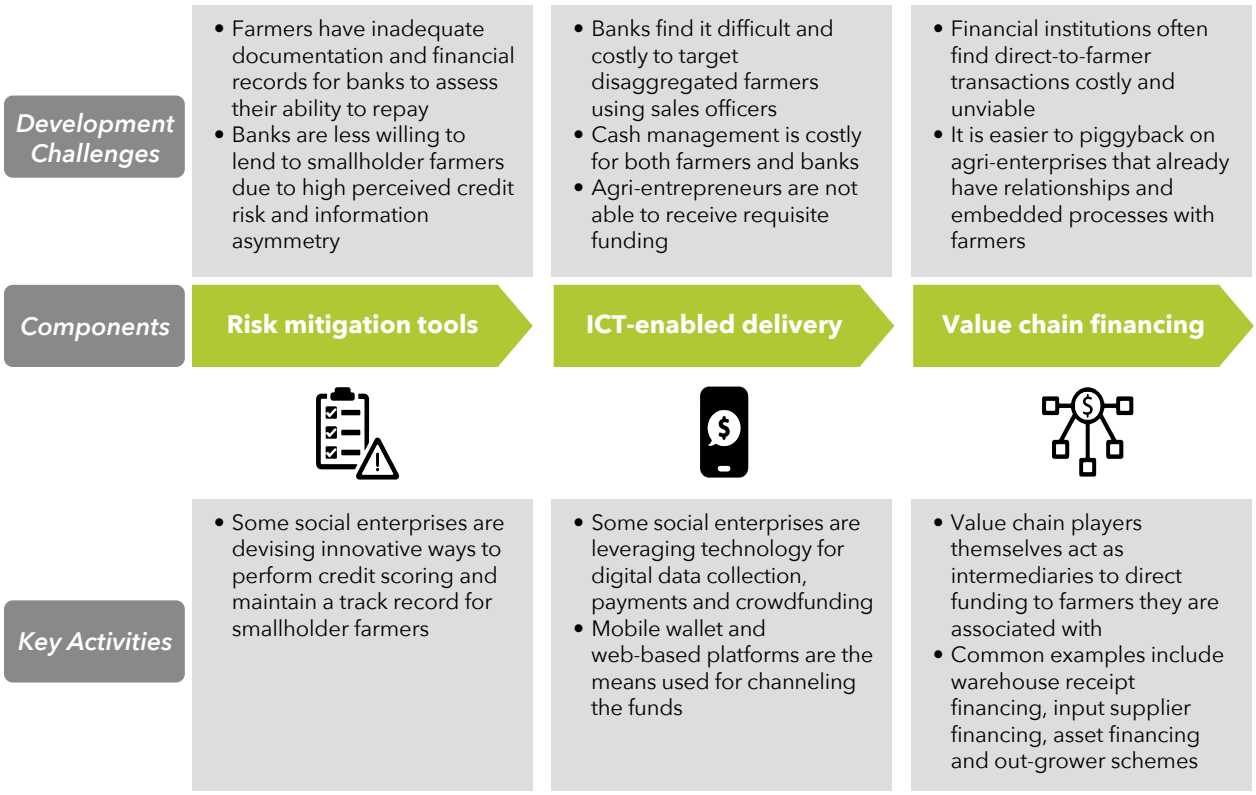
Many SEs act as intermediaries to finance providers in order to reduce friction in the flow of finance to smallholders and minimize the credit risk traditionally associated with agricultural finance. Financial intermediaries often specialize in particular areas in smallholder financing such as credit risk analytics, e-money platforms, or agro-dealer financing. These enterprises catalyze financial services to smallholder farmer communities in a variety of ways. For instance, SmartMoney, a mobile network operator in Uganda, offers mobile money services to enable banks to serve smallholder farmers and achieve last-mile access in a cost-efficient way. SCOPEInsight, an organization based in the Netherlands, has developed assessment tools and actionable insights that help finance providers assess risk and design financial products.

Smallholder households benefit significantly from access to savings accounts and mobile transactions, in addition to credit services. Formal savings accounts offer the added advantage of security; they can also serve as collateral. Mobile money accounts facilitate seamless money transfers from buyers or government programs to input providers, farmers

and farm laborers. Such accounts provide smallholders with a secure place to store money, and make it easier for them to receive remittances from family members. Remittances are a critical source of supplemental income for poor rural households, particularly during the lean season, before harvest. Examples of financial intermediaries providing this service are Umati Capital and TigoCash.

Components of the Model

Figure 4. Components of the model



Risk mitigation tools

Commercial banks and microfinance institutions (MFIs) have traditionally held small agricultural finance portfolios as they find it difficult to assess the credit-worthiness of individual farmer borrowers. Some enterprises address this issue by devising innovative solutions for credit scoring and maintaining a track record for smallholder farmers. This increases the willingness of financial institutions to lend at reasonable rates to farmers. For example, FarmDrive, a Kenyan social enterprise, attempts to bridge financing gaps by enabling smallholder farmers to maintain records using a digital bookkeeping platform. It provides access to aggregated agricultural data and smallholder farmers' data, which is used by financial institutions to inform lending decisions and design suitable credit products. The enterprise enables farmers to track their productivity, expenses and revenues, which are then analyzed to reveal performance patterns. Users of FarmDrive record their activities using SMS or a mobile app if they have a smartphone. The enterprise is currently developing a

workbook that farmers can fill in and hand to a FarmDrive agent, who will then store the data digitally.

Finance providers cite challenges in assessing credit risk when lending to farmers. In response, some intermediaries have developed tools that increase the efficiency of the credit process to smallholder farmers. For example, Grameen Foundation has created the Sustainable Agriculture Food Environment (SAFE) platform to pilot a tool called Agricultural Risk Evaluation Tool (ARET) with Cooperativa de los Andes (COOPERAN), a large coffee cooperative in Antioquia, Colombia. ARET draws on data from more than 1,500 smallholder farmers in Colombia who have received loans. More than 150 variables were evaluated —ranging from fertilizer use and water access to the number of temporary workers the farmers hire at harvest and certifications they achieved. From this data, 10 key correlated variables were identified to segment farmers into eight groups representing increasing risk of loan defaults ranging from 0–17.1 percent.

Financial services providers also build risk mitigation solutions by working with value chain intermediaries. For example, the Agriculture and Climate Risk Enterprise (ACRE Africa, formerly Kilimo Salama by Syngenta Foundation) has developed different insurance products that are underwritten by insurers, but distributed and pre-financed by MFIs or value chain partners. For instance, dairy livestock insurance is offered in partnership with a dairy cooperative or a lending institution. These partners pay the premium upfront, then either deduct it from payments to farmers for milk deliveries, or combine it with loan payments. These arrangements significantly lower the insurers' costs to serve farmers as the partners carry the risk of premium repayment. The partners also benefit from the fact that their customers or suppliers (farmers) are protected. By the end of 2015, ACRE Africa's insurance products had already been adopted by nearly 400,000 farmers, and the company expects to scale rapidly.

ICT-enabled delivery

In order to ensure reach, financial intermediaries leverage technology for digital data collection, payments and crowdfunding. They do this through tech platforms, mobile money and mobile apps. Some enterprises build platforms that enable MFIs and agri-suppliers to easily manage their agri-loans. Platforms such as Farm Capital in Kenya and Farmable in Ghana also act as crowdfunding platforms and enable individual investors to fund small-scale agricultural entrepreneurs. As a delivery channel, mobile phones are a powerful tool to reach vast numbers of clients with a range of information and simple financial services at low costs.

Some enterprises carry out the disbursal and repayment of loans using mobile money so that real-time monitoring is possible and manual cash handling is avoided. For example, Musoni offers a comprehensive range of portfolio and financial reports and an accounting module. Its solution integrates with both, M-PESA and Airtel Money, enabling all transactions to be carried out using mobile money. The Musoni App enables field officers to register clients, apply for loans, or view key reports while travelling in rural areas.

Value-chain financing

Value chain players such as input providers, dealers, traders, and processors collaborate with financial institutions such as banks, MFIs and non-banking finance corporations (NBFCs) to jointly develop lending mechanisms for smallholder farmers. Common examples include

warehouse receipt financing, input supplier financing, asset financing and out-grower schemes (contract farming).

Each of these lending mechanisms provides solutions to get around smallholder farmers' lack of assets for collateral. In warehouse receipt financing, smallholder farmers pledge their agricultural produce as collateral to obtain credit from agri-NBFCs or banks against the receipt issued by the partner warehouses. The farmers are, thus, able to monetize their agricultural produce without actually selling the commodities. Often, this hypothecation system is also accompanied by grading of commodities according to their quality. This enables agri-NBFCs to adopt risk-based pricing of loans. For example, Rent-to-Own (RTO) is a social enterprise that supports micro entrepreneurs in rural Zambia by providing finance via micro-leasing and access to productive assets at affordable prices. It employs local agents who leverage their social networks to determine client credit- worthiness and incentivizes repayment by enabling the farmers to own the asset eventually.

Financial intermediaries have also developed solutions to ease the liquidity crunch that farmers face through the crop life cycle. Sarura Commodities, a Rwandan social enterprise, has developed a modified warehousing receipt financing system that it calls 'warrantage' to ease farmers' liquidity crunch. Under the warrantage model, farmers receive an initial payment equivalent to 60 percent of the harvest value (paid from the inventory-credit financing) when crops are deposited in the Sarura warehouse, and a second payment equivalent to 40 percent of the post-harvest sale value when the stored crops are sold to the premium off-takers. The staggered proceeds smooth out the otherwise long payment lags and provide cash flow for other types of business investments. An average smallholder staple-crop farmer benefits from a 50 percent increase in profits from traditional market channels.

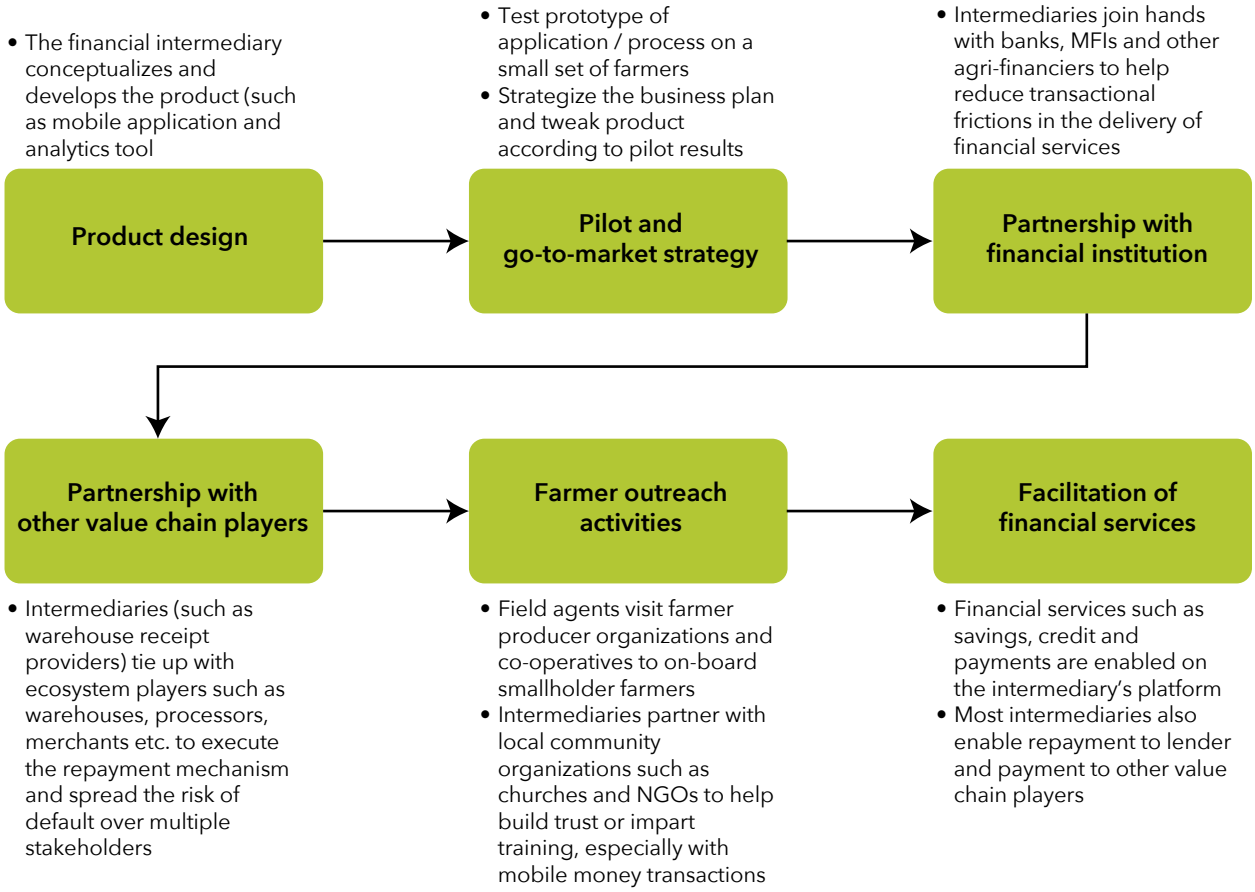
Some value chain financing intermediaries also adopt ICT delivery channels such as SMS, mobile applications and web platforms. These ICT channels are used to provide last-mile financial access where physical presence may be costly and difficult. For the customers who struggle without access to finance, these services are a means to move from survival to sustainability. For example, Umati Capital (UCAP), a non-bank financial intermediary in Kenya, focuses on the provision of supply chain finance across several value chains. It has set up mobile applications at each stage of the value chain to capture data to inform their disbursal of smallholder farmer loans via the mobile wallet channel. It also enables financing from angel investors to agricultural SMEs that supply to larger entities. Umati's integrated technology platform automates the invoice management process with web-based software to enter and manage invoices of agri-businesses (suppliers to large processors).

Similarly, Kifiya, a financial technology company in Ethiopia, enables financial service providers such as microfinance institutions and banks to reliably deliver full financial services securely and cost-effectively to remote areas through its branchless banking and mobile money services. It aims to build a digital payments ecosystem by supporting agricultural actors along the value chain to switch from expensive cash handling processes to digital payments. This is supported by financial literacy training for smallholders.

Cost Factors

The major costs incurred by financial intermediaries are the costs from training, platform development and human resources.

Figure 5. Process of the model



The cost components in this business model vary across enterprises. The fixed capital cost is very low as most intermediaries operate as an asset-light model. They are, therefore, generally able to recover costs and achieve economies of scale easily.

- *Risk mitigation tools:* Most of the costs incurred are on business development and reaching out to farmers. For example, FarmDrive's operating expenses include cost of training farmers on the use of the mobile application, and costs of profiling farmers. Similarly, for F3 Life, a company in Kenya that does credit scoring of farmers for financial institutions, major costs are incurred in demonstration land and training to financial institutions for use of F3 Life's tools.
- *ICT-enabled delivery:* For enterprises adopting this approach, the IT infrastructure and training staff comprise the major costs. For example, SmartMoney, a digital payments company, cites hiring and retaining the rural staff, training machinery (trainers and vehicles) and MIS maintenance as the major cost components.
- *Value-chain financing:* This sub-model consists of enterprises with more on-ground presence than the above two sub-models. For example, FoodTrade ESA, an enterprise that provides credit on the basis of warehouse receipts, incurs major expenses on maintaining a warehouse and a developing digital recording system. Similarly, myAgro incurs costs on inputs bought from large manufacturers, logistics in delivery of inputs to rural areas and personnel.

Table 3. Types of enterprises

Type	*Enterprises*	*Main cost components*
Risk mitigation tools	FarmDrive, SCOPEInsight, Compuscan, F3 Life	Human resources, product development, business development
ICT-enabled delivery	Musoni, UCAP, Farm Capital, Kifiya, Farmable, SmartMoney	IT system development and maintenance, training farmers
Value-chain financing	Rent-to-Own, Joseph Initiative, myAgro, FoodTrade ESA	Personnel costs (local offices and field agents), logistics costs, warehousing costs, inputs

Revenue Streams

Generally, financial intermediaries draw their revenues from a combination of one or more of these three sources - the financial institution they partner with, the farmers they serve and any agribusiness or other value chain players who avail of their services. The revenue may be a fixed fee or a percentage of the loan amount that the enterprise facilitates for farmers. For example, FarmDrive earns revenues from financiers for their use of the credit profiles (fixed fee) and from farmers who receive credit (percentage of loan amount as transaction fee). On the other hand, for F3 Life, the revenue is sourced only from commissions paid by financial institutions as a percentage of the loan amount.

Some enterprises also collect fees from value chain intermediaries to subsidize services to farmers. For example, SmartMoney has two revenue streams—payments and deposits. It only charges the off-takers (agribusinesses), and not the farmers. It collects a 5 percent fee from the agribusiness based on transaction volume (a commission is charged every time they transfer money); about 1 percent of this is distributed to cash agents (as commission) and 4 percent accrues to SmartMoney. Off-takers benefit because they are able to avoid incurring huge costs associated with transacting in cash. SmartMoney provides a wallet account to farmers for cash-in and cash-out. There is no withdrawal fee for farmers. On deposit side, it works with banks to help them reach the last-mile access to rural areas.

Some enterprises such as SCOPEInsight and Compuscan earn revenues by partnering with financial institutions and providing credit information gathered about farmers and farmer cooperatives in the form of assessment reports. Similarly, XDS Credit Bureau in Zimbabwe tailor-makes credit profiling and assessment solutions that assist the private sector and development agencies to commit financial resources to smallholder and communal farmers under commercially viable terms and conditions.

Financial Viability

The business model leverages on enterprises' ability to liaise with multiple stakeholders in the agriculture value chain and become their long-term, trusted partners. The intermediaries are able to achieve early breakeven because they generally have a very low initial expenditure (generally less than 20 percent of the total annual costs). However, these enterprises earn thin margins (typically around 3–10 percent) and depend on a large customer base, the business of its partners, and volume of transactions.

Financial intermediaries offer a host of services to remain profitable. FoodTrade ESA's warehouse program combines enablers in digital technology, warehouse receipts, in-kind inputs and payments to support farmers in obtaining credit by using their stored crops as collateral for loans. Once farmers have deposited their crops in the warehouse, the inventory is captured in a central system that can be accessed in real-time to confirm that crops meet standards and are, in fact, stored at the warehouse. Banks use this information to lend to farmers directly. Alternatively, farmers can purchase inputs in-kind from agro-dealers, who can also access the system and get repaid by banks.

Some enterprises employ cross-subsidization strategy to ensure its own commercial viability and affordability for farmers. SmartMoney does not charge the farmers anything but charges the value chain players and financial institutions that it partners with. Similarly, Tigo, a mobile network operator (MNO), which has rolled out its mobile wallet TigoCash, charges commodity buyers a fee for the transaction (percentage of transferred amount), rather than charging the farmers.

More recently, financial intermediaries have launched digital crowdfunding platforms that work on an equity or commission sharing basis. Farm Capital Africa (FCA), a financial intermediary in Kenya, pools funds from urban-middle class individuals, African diaspora and institutional investors via the internet. FCA channels the capital through mobile money into microbusinesses of small-scale agripreneurs (mostly youth and women) for a term-based profit share derived from the produce. FCA forms a joint venture with the micro-entrepreneurs and manages the allocation and use of funds that are spent on the farm. Besides capital, FCA also sources and provides distribution services to transport the produce to buyers, and imparts agronomic training and business management services to ensure business continuity and the project's success.

Similarly, Farmable has developed an innovative on-line funding model (crowdFarming), where social investors (cowBackers) can purchase a 'share' in a real cow in Ghana (a cowShare) in return for exclusive rewards. This provides a continuous (and expanding) source of funding for Farmable initiatives designed to improve smallholder farmer capacity and cattle production processes.

Partnerships

Financial intermediaries generally work alongside a wide variety of partners such as financial institutions, agribusinesses, and value chain players. Joseph Initiative (JI), a grain management and trading company in Uganda, has partnered with Opportunity International to serve as a platform for delivery of financial services by pre-financing inputs at the beginning of the season while ensuring repayment at the collection centers after harvest. Farmers are organized into lending groups that further co-guarantee repayment and the JI's technology platform tracks data on farmer yields. JI provides training and agricultural extension services via Joseph Centers, as well as some processing capacity/support. Value chain operations are coordinated via the JI tech platform, which promotes transparency, efficiency, and capture of impact data, advances research, and quickly integrates feedback.

SCOPEInsight partners with capacity builders such as NGOs, extension service providers or consultants, who seek to professionalize farmer organizations with support or training. It also works with value chain players such as traders, processors or input suppliers who need a secure and sustainable supply chain with professional farmers. Lastly, it partners

with financial institutions that look for low cost and low risk investment opportunities in agriculture. SCOPEInsight has launched an initiative called Agribusiness Market Ecosytem Alliance (AMEA) in partnership with IFC and development organizations ICCO, VECO, NCBA, CLUSA, ACDI VOCA and Agridus. AMEA aims to address fragmentation in current capacity building programs by offering SCOPEInsight-based global and standardized metrics for assessing farmer performance and a training system to ensure farmer development according to their needs.

Many value chain intermediaries are developing financial products not only for farmers but also for other value chain players. In Honduras, major input suppliers, such as Caldega and Del Campo, are developing creative financing products for smallholders, as well as small input suppliers, who in turn advance inputs on credit to small producers. FUNDER, an NGO in Honduras has an arrangement with Antorcha (supermarket) and Cadelga (input provider) to finance inputs for smallholders. FUNDER has joined forces with COMSA (an organic coffee cooperative) to provide financing to up to 150 coffee producers to maintain their coffee plantations (Multilateral Investment Fund 2014).

Implementation: Delivering Value to the Poor

Awareness

Financial intermediaries generally work with field agents (their own or those of their partner financial institutions) to build the initial critical mass and then tap into networks of existing customer base of farmers to reach other farmers. In-person, on-the-ground relationships are very important in local communities and field force networks led by groups from financial institutions or NGOs can harness the power of these relationships. FarmDrive identifies and works with Youth Farmer Leaders, typically young farmers, to spread awareness and organize trainings. Presently, FarmDrive has on-boarded 15 farm leaders, each responsible for his/her own locality.

With the development and expansion of mobile solutions, the process of coordinating and communicating with these networks is becoming more efficient. For example, myAgro has field agents who hold weekly meetings with farmer cooperatives to onboard farmers. It relies on the farmers' local networks and partners with savings groups to increase awareness of the benefits of using mobile layaway as a financing option. For example, myAgro taps into an existing program run by Oxfam America and other aid groups called Saving for Change, where farmers in a community meet regularly and pool their money in a joint savings plan. In Senegal, many existing farmers have become champions of the myAgro model.. These farmers receive training by myAgro to be vendors. They go door-to-door and mobilize farmers to sign up for the program in return for a commission per farmer acquisition. myAgro also leverages radio for advertising its program.

Acceptance

The recent surge of mobile money in Africa is under-leveraged because farmers are wary of using electronic money. Hence, financial intermediaries begin by establishing trust and sensitizing farmers about the benefits of savings and mobile payments. Tigo partnered

with non-profit organizations such as ASI (a subsidiary of ACDI VOCA) to leverage its relationships and goodwill with farmers and conduct financial literacy events. Tigo also appointed local farmer 'ambassadors', who were literate and technologically savvy, to explain the concept of e-money and PINs to other farmers. The enterprise opted for a routine of weekly trainings to ensure that farmers are not overwhelmed by the new concepts, and get time to apply them in real-life situations and experience the benefits.

SmartMoney works with NGOs, savings group, schools, agri-companies, women SHGs and local churches to help mobilize the Ugandan farmers and build the trust among customers. It has launched an academy, which works in 5 Ugandan constituencies. The enterprise also provides a call center facility to farmers seeking information. Smallholder receptiveness to mobile financial services is correlated with the general adoption of such services already operating in the country. In countries such as Nigeria, where less than 1 percent of adults are active mobile money users, farmers have been reluctant to adopt mobile wallets. In the absence of a nationwide mobile money infrastructure, smallholder farmers have little incentive to use mobile money services. Farmers have been more receptive in Ghana, where mobile money adoption is increasing rapidly and approximately 8 percent of adults are now active users.

Financial intermediaries are also adopting design thinking and innovations to encourage savings and inculcate banking among smallholder farmers. ideas42, a non-profit research firm, is working with Swisscontact (a Switzerland-based international development organization) to implement the Sustainable Cocoa Production Program in Indonesia, targeting 98,000 cocoa farmers. It plans to use behavioral science to design a banking intervention that allows farmers put away enough money to save for other critical expenses such as improvements to their businesses. For example, ideas42 identified that one key inhibitor to saving was that much of the farmers' "overspending" was a series of small, incremental purchases such as the odd pack of cigarettes, coffee outside the home, and snacks for children on market days. The intervention includes an opportunity for farmers to make a savings deposit every time they sell cocoa beans to traders—the point when they have the most cash on hand. In three months, the farmers observed increased savings of up to USD 150 that could be used to purchase new cocoa seedlings or pay for their children's school fees.

Accessibility

Financial intermediaries improve the accessibility of their products by adopting an omnichannel strategy to serve a wide variety of farmers. For example, FarmDrive's services are available over SMS, USSD, and Android. This ensures that even farmers with the most basic phones are able to access the FarmDrive platform.

Accessibility is also important for financial institutions and other value chain players that work with smallholder farmers to expand credit uptake and make better lending decisions. SCOPEInsight enables access to its assessment tools and reports that are priced differently for Pro, Basic and Agent assessments. These tools can be accessed by any agriculture stakeholders interested in working with the smallholder farmers, but lack the data to make tailored products. These stakeholders include capacity builders such as NGOs, extension service providers and consultants; value chain players such as traders, processors or input suppliers; and financial institutions. The price per assessment is around USD 1.70 (excluding training and data

collection costs). The price of training depends on the number of trainees that SCOPEInsight's clients select to access the assessment tools, ranging from USD 280 to USD 840.

F3 Life has a unique selection methodology whereby it facilitates cash microloans from partner financial institutions in the range of USD 20-180 on soft terms in return for simple conservation measures and climate-smart agricultural practices by farmer borrowers. Their credit scoring is based on the environmental protection milestones that farmers achieve. Farmers are also given technical assistance and incentivized to repay on time through conditional decrease in interest rates.

Enterprises also combine loan facilitation with due diligence for credit worthiness using technology. In Kenya, the Grameen Foundation has partnered with Farm Concern International (FCI) to develop an e-Warehouse pilot program for maize farmers. Farmers are able to store their grain at home or collectively with other farmers or, in some cases, the e-Warehouse program sets up village-level warehouses. The innovation behind e-Warehouse lies in Grameen Foundation's mobile-based data collection tools (TaroWorks) that are used by trained village knowledge workers to collect and upload farmer storage information: the amount, the storage method (to indicate risk of pests or spoilage), and the moisture content (to indicate propensity toward rot or disease). A global positioning system device records location at the time of the data input, helping to ensure that those inputting data are not remotely inventing information and that the grain can be tracked down if needed.

Based on the data collected and the value of the stored grain at harvest time, Grameen and FCI determine the loan eligibility amount. They share this information with a partner financial institution, which relies on this data to make a final credit decision and disburses an advance to the farmers against the value of their stored crop. The lender's financial exposure is limited; the loan exposure is typically equivalent to only a third of the value of the grain at sale time.

Affordability

Financial intermediaries make financial services affordable for smallholder farmers by aligning the quantum and frequency of repayment to the farmers' ability, provide flexibility in amounts saved and paid, and make the repayment more convenient through mobile wallets. In the case of myAgro, the mobile layaway allows the customer to make small payments for the product until the purchase price is paid in full. Farmers also get flexible saving options. For example, farmers can save at flexible frequencies and in varying amounts: USD 2 every week or USD 10 in 1 week and no payment for the following several weeks. Farmers can save according to the payment goal that they fix for themselves.

Some intermediaries also support farmer households to help them save for non-farm activities too, so that farmers are able to better invest the earnings from agricultural activities and then plough the savings back to productive uses. For example, Save 4 School (currently under development and testing) uses Econet's EcoCash mobile money platform to connect smallholders to a mobile savings account that lets them make flexible monthly contributions as low as USD 2, with the option to deposit larger amounts. When school fees are due, the account transfers the savings to a chosen school. Transfer fees are paid by the schools, which see value in the product as they often receive fee payments late, in-kind, or not at all.

A credit scoring algorithm will also give customers the choice to apply for a microloan to cover the remaining balance if they miss their savings target. Rent-to-Own (RTO) is a social

enterprise that supports micro entrepreneurs in rural Zambia by providing micro-leasing and access to small to medium productive assets (e.g., bicycles and drip irrigation kits) at affordable prices, typically in the range of USD 100 to USD 1,500. It employs local agents who leverage their social networks to determine client credit-worthiness and incentivizes repayment by enabling the farmers to own the asset eventually. RTO also uses DropBox and TaroWorks to provide client information to its field officers, and sends SMS reminders and updates to clients on their application status.

Many farmers do not have adequate infrastructure (mobile phone, digital platform and agent network) to transact using digital payments. Financial intermediaries, especially mobile network operators (MNOs), can increase the acceptance of mobile money to facilitate deposits, withdrawals, transfers and savings for small-holder farmers. For example, Uganda Telecom (UTL), a small MNO in Uganda, launched M-Sente, a USSD-based mobile wallet, in partnership with the Uganda Coffee Farmers Association. The wallet was aimed at reducing delays in payments to farmers (usually eight to ten weeks) and minimizing the need to handle cash. UTL, by leveraging their agent network and offering low-cost phones, was able to enable salary distribution to around 250 coffee farmers through M-Sente.

Results and Cost Effectiveness

Scale and Reach

The business model of financial intermediaries allows them to scale exponentially across geographies and reach a substantial number of farmers (table 4).

Increasingly, companies such as Esoko and Manobi are emerging to provide short message service (i.e., texting) information for market prices of different crops in regional and national markets, as well as local weather conditions. These technology platforms can allow financial institution clients to access critical information such as planting, harvesting, and marketing seasons, and thus design financial products better.

Connected Farmer Alliance (CFA) is a 3-year partnership between USAID and Vodafone Group plc, focused on designing, developing, and scaling mobile solutions for agriculture in Kenya, Mozambique and Tanzania. Implemented by TechnoServe, a non-profit consulting firm, CFA is targeting 500,000 smallholder farmers (including 150,000 women) with two types of solutions. Connected Farmer, the mobile supply chain solution developed by CFA and recently offered in the market commercially, enables agribusinesses to engage more effectively with their smallholder suppliers. By facilitating payment and loan transactions via M-PESA, digitizing farmer data management, and creating an easy platform for direct-to-farmer communication, Connected Farmer lowers the cost of doing business with smallholders. CFA also offers mobile financial services to smallholders, including savings, insurance and credit, leveraging the existing M-PESA mobile money platform from Vodafone.

Zoona, a third party provider of mobile payments, partners with value chain players that contract with smallholder farmers. Such value chain players make one payment to Zoona, which then makes e-voucher or mobile payments to each of the contracted farmers. E-voucher recipients can redeem the vouchers at input retailers or at cash-in/out agents. On

Table 4. Scaled reach of financial intermediaries

Company	*No. of years of operations*	*Countries of operation*	*Scale and reach*
SCOPEInsight	6	Netherlands, Kenya	2 million farmers (20 countries, 800 assessments*, 30–40 clients)
Musoni	5	Kenya	110,000 farmers (Outstanding value of loans facilitated: Ksh 2.6+ billion (USD 25+ million)
myAgro	5	Mali, Senegal	25,000 farmers (in West Africa)
FarmDrive	1	Kenya	2,500+ farmers
SmartMoney	4	Kenya	140,000+ farmers (2 countries)
F3 Life	3	Kenya	100+ farmers
Rent-to-own	5	Zambia	2000+ farmers

* Assessment done at a farmer cooperative level

a monthly basis, the Zoona platform currently supports 50,000 transactions valued at USD 3.5 million and reaches over 60,000 people. Zoona began in Zambia and has expanded into Zimbabwe, Mozambique and Malawi.

Improving Outcomes

The key outcome that all financial intermediaries work towards is a smoother and assured flow of financial services from formal financial institutions towards smallholder farmers. Although it is too early to attribute accurate impact figures and draw correlation of the financial empowerment of smallholder farmers and the role of financial intermediaries in causing these outcomes, there is an increased acceptance among farmers to approach such intermediaries and willingness among banks to push agri-based financial products through these specialized enterprises. Agricultural finance in Kenya increased from USD 335 million in 2007 to USD 620 million in 2011, and is attributed mostly to the introduction of mobile banking and other technology solutions (Ndung'u 2011). In India, the State Bank of India has been able to add 100,000 villages to its service network through a combination of mobile phone technology and cash points (within shops) in the village. This has brought millions of smallholder farmers into the banking network.

First Access, a data analytics company in Tanzania, predicts risk for farmers who have never had a bank account or credit score by using their prepaid mobile data. Their clients are banks and MFIs, agricultural input/equipment suppliers as well as solar/biofuel suppliers. Their credit scores have informed 350,000 loan applications, mostly of smallholder farmers.

Banks and MFIs in African countries (e.g. Albania, Malawi, Senegal) have also experimented with mobile service points as intermediaries, whereby a van visits the villages once or twice a week to offer financial services (van Manen, Bert et al. 2012). This allows clients to withdraw or deposit cash, make payment transfers, make loan repayments or receive other services. There are even ATMs on wheels. There have also been experiments with biometric technology (fingerprints, eye scan) to better identify clients to avoid

identity fraud and to prevent serial defaulter farmers from taking loans from many MFIs simultaneously in India. In Malawi, the use of biometric identity verification was found to reduce loan default (van Manen, Bert et al. 2012). Borrowers were also more careful in their loan applications (asked for smaller loans) and more diligent in repayment.

Mobile wallets can bring about a rapid transformation in the livelihoods of smallholder farmers, especially if adopted by the Government for national subsidy schemes. The efforts of the Federal Government of Nigeria (FGN) provides a good case study on how the cost of administering such subsidies, a key component of financing the value chain, can be reduced through digital financial services (CGAP 2014). In Nigeria, only 11 percent of poor smallholder farmers received government subsidized inputs because the government input procurement and distribution system was very inefficient and costly, suffered from corruption, and displaced private commercial sales of fertilizers. Majority of the inputs were re-sold in the open market at high profit margins. Despite the huge sums spent on fertilizer subsidies, fertilizer use was still less than 10 kg/ha, compared to the global average of over 100 kg/ha (Kayode 2016). Cellulant, a digital e-wallet services provider, helped streamline the disbursement of fertilizer subsidies under the Nigerian Government's Growth Enhancement Support (GES) scheme.

In the first 20 months of implementation of the e-wallet, 6 million farmers (which include more than 450,000 women) participated in GES and received subsidized fertilizer and improved seeds. In less than 160 days, though the e-wallet, 150,000MT of fertilizer and about 10,000MT of seeds were supplied to agro-dealers, and distributed to 1.2 million farmers. Today, FGN and relevant Nigerian state governments each contribute 25 percent of the fertilizer cost resulting in a 50 percent subsidy provided directly to smallholder farmers. In the period 2011-2013, the number of smallholders benefitting increased from 800,000 to 4.3 million, while the cost per smallholder receiving the fertilizer fell from USD 225-300 to USD 22 (CGAP 2014).

In Zambia, by using Zoona, Dunavant (the leading cotton producer in country) was able to lower its costs, provide discounts to farmers while increasing their access to inputs, reduce side-selling and improve the recordkeeping and sales of input suppliers. The e-voucher and mobile payment transaction histories through Zoona can also be used to build a financial identity for the farmer that will help with future access to credit.

MyAgro gets farmers in the program to move from subsistence farming to selling produce in markets and making a profit. With the increased income, the farmers often reinvest in their farms and make other investments, such as building roofs, sending their children to high school and buying motorcycles to get their goods to markets more easily. MyAgro is now working with around 15,000 farmers. MyAgro's mobile layaway platform has helped thousands of smallholders purchase income-boosting agricultural inputs without loans or handouts (myAgro n.d.).

Cost-Effectiveness

Agricultural value chain finance may provide a cost-effective and commercially sustainable solution for reaching greater numbers of farmers in rural areas. For example, in Mexico, the government used to channel credit directly to producers through Banrural, the national agri-bank. Financed with practically unlimited government funds, Banrural lent at below-market interest rates and had default rates upwards of 50 percent in some years. Banrural's

lack of due diligence and minimal efforts to recuperate losses created a culture of non-repayment and discouraged many financial institutions from entering those markets. With post-crisis reforms, banks such as NAFIN, Bankaool and Finterra started capitalizing on existing agricultural value chain financing arrangements by using medium and large agro-processors as intermediaries for lending transactions with their smallholder suppliers (Multilateral Investment Fund 2014).

For example, Bankaool utilizes the agro-processor to identify potential farmer borrowers, originate and distribute loans, and collect payments. Thereby reducing the costs of loan origination, administration, and collection for banks, and also reduces the amount of capital the agro-processor has tied up in supplier finance, and providing smallholding producers with entry point to access long-term credit while building credit histories with formal financial institutions.

AgriLife (in Kenya, Uganda and Indonesia) has enabled financial institutions to increase their loans to farmer participants. The AgriLife platform developed by Mobipay and EcoFarmer platform developed by the MNO Econet provides low-cost methods to reduce risks in agricultural lending through mobile-enabled transaction history, and through low-value deposits and withdrawals. One of the three banks currently using the AgriLife platform, Century Microfinance Bank, lends to individual farmers via farmer cooperatives and other aggregators, from whom it obtains a loan guarantee. In 4–5 months, Century's outstanding loan portfolio had risen from KSh 25.2 million to KSH 88.6 million (250 percent increase) with minimal extra costs.

In the absence of such enterprises, smallholders generally borrow from moneylenders, friends or family at interest rates of 40–60 percent. Some farmer cooperatives are able to secure finance from financial institutions but on a very limited basis (criteria include collateral, cash crops, and strict repayment dates). Also, value chain players such as input suppliers and supermarkets that provide trade credit to the farmers have a small reach and limited potential to create impact. Dedicated intermediaries, on the other hand, are able to reach up to 50,000–1 million farmers each, thus creating a much more significant impact. However, most such intermediaries require support from donors or Government on initial mobilization, piloting and financial literacy of farmers.

Scaling Up

Challenges

Most financial intermediaries face challenges in achieving the critical mass that allows them to be sustainable. They also face infrastructural issues such as low internet connectivity, lack of internet-enabled phones and on-ground field agents to enable last-mile reach. Financial illiteracy and lack of technical understanding among farmers also hamper their adoption of technology-enabled financial services. Many financial institutions are also wary of agricultural finance and hesitate to partner with small intermediaries and startups to on-lend to smallholder farmers.

Financial intermediaries with overarching objectives such as environmental protection for sustainable agriculture face an additional challenge in aligning these with financial

institutions. For instance, F3 Life faces the challenge of onboarding financial institutions that understand the need to benchmark loans against climate-smart techniques adopted by borrower farmers. Many financial institutions fail to acknowledge the underlying correlation between effective resource management by the farmer and his ability to repay the loan. F3 Life conducts workshops for financial institutions to explain the credit-risk mitigation linked to sustainable practices. F3 Life has an eco-credit mechanism under which credit scores, interest rates and credit limits are set according to the quality of environmental management practiced by the borrower. This system helps a financial services provider disburse soft loans to farmers due to the reduced perceived risk.

SCOPEInsight faces the challenge of donor capital distorting the adoption rate of its assessment tools by agricultural stakeholders. With donor funding, many stakeholders do not assess the credit risk and farmers' performance adequately, leading to an issue of adverse selection.

Role of Government and Policy

In most developing countries, Government sponsored risk mitigation tools can be more efficient than direct lending programs. For example, Government guarantee programs in Mexico have significantly helped financial institutions manage the risk of lending to small and medium producers. These guarantees require less government involvement and fewer funds, thus avoiding bureaucratic delays. On the other hand, in Peru and Honduras, the Government policy has traditionally been to finance farmers directly through programs run by state-run banks. However, the result is that banks focus more on commercial farmers, not subsistence farmers. Also as most banks mandate collateral, guarantee programs give the banks more flexibility to increase their risk appetite to include smallholder farmers in their portfolio.

In Nigeria, the Government-promoted Nigeria Risk Incentive System for Agriculture Lending, or NIRSAL, enables key agricultural sector participants, including farmers, to access finance at single-digit interest rates, using innovative forms of security for their borrowing. For example, agro-dealers can borrow funds using stock as collateral and previous trade history as a reference. For their part, farmers can borrow as groups using mechanisms such as cross-guarantees. This approach has worked so far—since March 2012, Nigeria has injected more than 20 billion naira (about USD 122 million) in loans to key agricultural sector participants.

Governments are also working with private analytics providers to increase the impact of their loans and reduce risk. In Zimbabwe, the Zimbabwe Agricultural Development Trust established the Credit for Agricultural Trade and Expansion (CREATE) fund, a revolving fund accessed by value chain actors through financial institutions. The fund provides working capital to input suppliers and off-takers whose activities ultimately benefit smallholder farmers. Genesis, a Zimbabwean analytics company, helps ZADT to develop and pilot financial products suitable for direct access by smallholder farmers. Genesis identified the 'mung' bean and sesame value chains for product development and testing.

One of the constraints restricting the growth of ICT-based financial intermediaries is the lack of clear policies around the use of mobile money. Since there are multiple stakeholders in the mobile payment ecosystem (MNOs, agents, finance providers etc.), there is often an overlap of different regulatory jurisdictions, leading to complexity. Distinct and specific Government policies and guidelines could catalyze innovation in this sector and enhance the

scalability of enterprises catalyzing the flow of financial services to smallholders. For example, in Africa, especially in Kenya, Tanzania and Uganda, the Governments have taken positive steps to encourage interoperability so that mobile money is more liquid and more users are encouraged to use it. This will encourage more value chain players to adopt mobile money and help financial institutions cater to smallholder farmers through digital payments, lowering their costs.

Conclusion

Specialized financial service intermediaries are particularly necessary when the local banking sector wishes to lend to smallholder farmers. Financial intermediaries add a number of competencies that are not the core business of a bank. Some of these competencies include mobile applications and other technology development, credit analytics, and networks and partnerships with other value chain intermediaries. The presence of a financial intermediary to facilitate financial services such as loans, payments and savings augurs well for farmers as the process is generally made smoother and faster than direct finance from banks.

Working with intermediary enterprises is also attractive for financial institutions, as it helps them develop new markets, reach the last-mile in a cost-effective way and reduce the inherent credit risk of lending to smallholder farmers. Financial intermediaries have a highly scalable and replicable model, but depends on factors such as the geography it operates in, the availability of suitable ICT infrastructure (such as internet, mobile phones etc.), the lack of farmer data, and the density of farmers.. Proprietary technology, relationships with banks, and a large base of smallholder farmers as customers are the key levers on which enterprises in this model can thrive.

Table 5. Social enterprises: Financial intermediaries

Company	*Country*	*Solution description*
Agrilife (Mobipay)	Kenya	Agrilife is a cloud-based technology platform designed to have the mobile phone & web platforms as the channels to enable smallholder farmers in groups access financial services, markets and other services that are relevant to them.
Connected Farmer Alliance (CFA)	Kenya, Mozambique, Tanzania	The Connected Farmer Alliance (CFA) is a public-private partnership that seeks to promote commercially sustainable mobile agriculture solutions and increase productivity and revenues for 500,000 smallholder farmers
F3 Life	Kenya	F3 Life enables the provision of "climate-smart" or "green" finance by companies, NGOs and financial institutions to farmers, fishermen and forest users in developing countries through credit scoring of farmers based on the environmental protection milestones that farmers achieve.
Farmable	Ghana	Farmable is a Crowdfunding platform that aims to create a new form of global collaborative farming called 'Crowdfarming'.

Table 5. Social enterprises: Financial intermediaries (continued)

Company	*Country*	*Solution description*
FarmDrive	Kenya	FarmDrive unlocks access to credit to underserved smallholder farmers by increasing the efficiency and operational capacity of financial service providers using technology
FoodTrade ESA	Burundi, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia, and Zimbabwe	FoodTrade ESA works to systemically improve the national and regional staple food market systems, directly impacting more than 400,000 households and consumers through stable markets for staple food products. The program works to enable private sector to invest and develop regional staple markets, benefiting farmers and consumers.
Joseph Initiative	Uganda	Joseph Initiative serves as a platform for delivery of financial services by pre-financing inputs at the beginning of the season while ensuring repayment at the collection centers after harvest.
Kifiya	Ethiopia	Kifiya aims to build a digital payment ecosystem by supporting agricultural actors along the value chain to switch from risky and expensive cash handling processes to digital payments. This will be supported by financial literacy training for smallholders.
Musoni	Kenya	Musoni Kenya is a microfinance institution (MFI) providing financial services through mobile payments
myAgro	Mali, Senegal	myAgro uses a mobile technology platform to provide access to fertilizer and seed packages on layaway , technical training, market access to premium buyers and access to asset loans for appropriate small-scale farm equipment.
Rent-to-own	Zambia	Rent-to-Own (RTO) is a social enterprise that supports micro entrepreneurs in rural Zambia by providing finance via micro-leasing and access to high quality, small to medium productive assets at low prices
Sarura Commodities	Rwanda	Sarura offers commercial inventory-credit financing, crop storage and trading services, known as "warrantage", to smallholder farmers.
SmartMoney	Tanzania, Uganda	SmartMoney is a third-party, savings and payment system, replacing cash with SmartMoney in the entire value chain
SCOPEInsight	Netherlands, Kenya	SCOPEinsight is the first rating organization in Agriculture, Aquaculture, Dairy/livestock and Forestry. It assesses the creditworthiness of producer organizations by profiling their organizational performance.
Zoona	Zambia	Zoona is a third party provider of mobile payments, partners with value chain players that contract with smallholder farmers

References

Consultative Group to Assist the Poorest (CGAP). 2014. *Focus Note No. 94*. "Serving Smallholder Farmers: Recent Developments in Digital Finance."

Initiative for Smallholder Finance. www.initiativeforsmallholderfinance.org.

Kayode, Abe Oluwayomi. 2016. "When Nigerian farmers went digital…" In The FARA Social Reporters Blog. https://faraafrica.wordpress.com/2016/06/21/when-nigerian-farmers-went-digital/

Multilateral Investment Fund 2014. *Financing Agricultural Value Chains in Latin America: Barriers and Opportunities in Mexico, Peru and Honduras*. Inter-American Development Bank: Washington, D.C. http://www19.iadb.org/intal/intalcdi/PE/2014/14885.pdf

myAgro. n.d. "Our mission." http://www.myagro.org/our-mission/

Ndung'u, Njuguna. 2011. Keynote Address to the Third AFRACA Central Banks' Forum.

van Manen, Bert et al. 2012. "Creating Access to Agricultural Finance: Based on a horizontal study of Cambodia, Mali, Senegal, Tanzania, Thailand and Tunisia." *A Savoir* 14. July. http://www.afd.fr/jahia/webdav/site/afd/shared/PUBLICATIONS/RECHERCHE/Scientifiques/A-savoir/14-VA-A-Savoir.pdf

CASE STUDY

SmartMoney

Founding year: 2012
HQ: Kampala, Uganda
Countries of operation: Uganda, Tanzania
Orientation: For-profit
Employees: 80 full-time, 150 part-time
Turnover: USD 10,000 (projected for 2016)

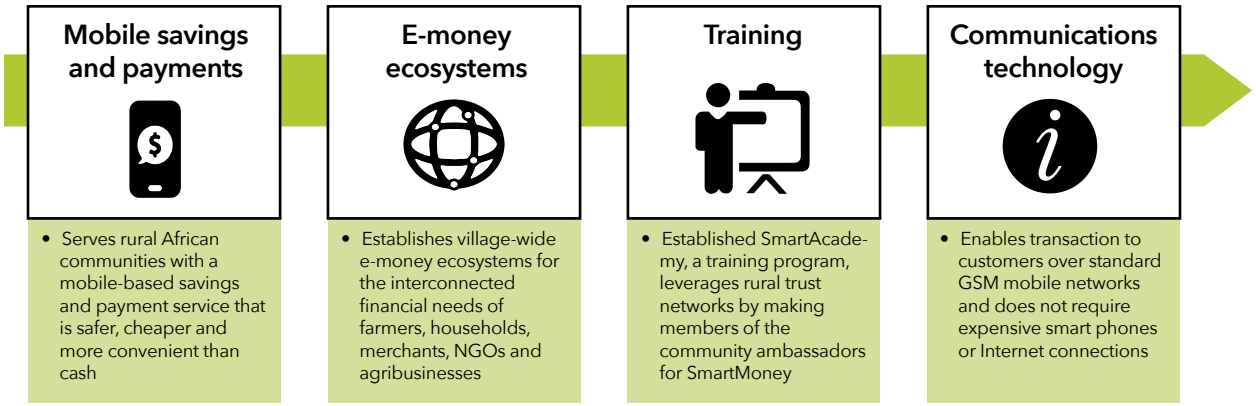
Transporting cash over long distances to make payments is dangerous and expensive. Storage of cash presents other problems such as theft, violence, and rampant corruption.

SmartMoney is a mobile money company with experience developing mobile money solutions. It economically empowers smallholder famers by promoting savings, increasing security, and reducing payment costs. SmartMoney pioneers a unique model geared at driving uptake among rural customers and market access to these retail customers to rural institutions. The business model is based on providing free retail services to farmers and rural households while generating revenue from institutional customers such as agribusiness and banks. SmartMoney generates revenue from payment customers (agriculture companies, schools, churches) and deposits (currently marketing fee from banks).

Operating Model

Theft is prevalent and banks are practically non-existent across rural Africa. Transporting cash over long distances to make payments is dangerous and expensive. The lack of secure places to store cash increases the vulnerability of rural farmers to theft and the temptation to spend, and they find it difficult to save the money they work so hard to earn. SmartMoney, a third party provider of mobile money, aims to digitize payments to various actors across the agricultural value chain, and thus, eliminate the transactional costs and risks from dealing in cash.

SmartMoney was founded in 2012 with initial capital of USD 500,000 provided by its founder, Michael Borse. Agribusinesses can use SmartMoney's web interface to transfer electronic funds into the mobile wallet of their intermediary buyers. These buyers purchase



crops by transferring money to the mobile wallets of the farmers. Farmers can choose to cash out from another SmartMoney user or maintain the stored value in the mobile wallet and pay cashlessly at rural shops, schools or transfer money to other retail customers. Other users of SmartMoney include retail customers (e.g. farmers) as well as rural merchants such as rural shops, restaurants, butchers, kiosk vendors, input suppliers, and cooperatives. SmartMoney has an agent network to infuse liquidity into its digital payments ecosystem. SmartMoney's rural merchants are fundamentally different from conventional mobile money "agents" – SmartMoney does not pay them commission. Instead, it trains them on the benefits of using e-money and provides incentives such as inventory payments through the SmartMoney application. Nearly 95 percent of SmartMoney merchants have switched over from using cash for inventory payments to electronic transactions.

SmartMoney has partnered with the Ministry of Trade, Industry and Cooperatives (MTIC) to introduce the service to more than 13,000 cooperatives throughout the country. Together with the MTIC point of contact, SmartMoney conducted pilots in northern and eastern Uganda and began implementation in August 2013 with coffee and cotton buyers in the Kasese district in western Uganda. The five SmartMoney community operations managers (COMs) serve as relationship managers for the SmartMoney CICO retail shops, SACCOs, cooperatives, large buyers and users. The COMs also manage the 38 independent community representatives (CRs) who register new users on a fee-per-new-user basis that illustrates the potential of digital payments to boost job creation.

The SmartMoney sales and marketing team works with selected large buyers to determine their cash usage behaviour patterns, their intermediary buyers, as well as their farmers. This analysis of the entire cash value chain considered the number, frequency and average amount of transactions incurred by a large buyer. As of August 2014, SmartMoney entered into a contractual relationship with four large coffee buyers.

By driving the use of cashless payments and savings among all key economic stakeholders within a remote rural community, SmartMoney establishes holistic village-wide electronic money ecosystems, called E-Village. These ecosystems address the diverse and interconnected financial needs of farmers, households, merchants, schools, agriculture companies, NGOs and other rural institutions. SmartMoney customers can purchase goods such as salt, sugar and sodas at more than 2,600 rural merchants across Uganda and Tanzania. To drive large scale awareness, trust and usage, SmartMoney has also devel-

oped "SmartAcademy", a comprehensive training programme that leverages existing rural institutions and trust networks (cooperatives, schools, churches) to cost-effectively deliver training to rural households and farmers. SmartAcademy's constituency managers recruit and train institutional registration agents who in turn train and register retail customers. Institutional registration agents are drawn from SmartMoney's partners such as agriculture companies, schools, churches and NGOs.

Another major differentiating factor is that SmartMoney facilitates access from all available mobile networks through USSD, which allows farmers without internet-enabled smartphones to transact using SmartMoney as well. SmartMoney reaches a large number of rural customers with a proprietary cloud-based platform designed to work with the minimum bandwidth and technology available in rural communities – a low-cost GSM mobile phone and a SIM card. No smartphones or internet access are required.

SmartMoney operates with cotton ginneries in Tanzania serving 750,000+ farmers. In Uganda, it partners with the Ministry of Industry, Trade & Cooperatives to introduce SmartMoney to their 13,000 cooperatives throughout the country. The Ministry works with local SmartMoney staff to travel around the country to register farmers in cooperatives and SACCOs involved in coffee, maize, fish, fruit and dairy. It has also partnered with USAID and GIZ that help SmartMoney partner with offtakers. It also works with churches, NGOs, savings group, schools, women SHGs and local churches to help mobilize the Ugandan farmers and build the trust among customers.

Financial Sustainability

SmartMoney offers the retail savings and payment services to farmers free of cost. By additionally providing training and setting up holistic e-money ecosystems in remote rural communities, SmartMoney is able to drive uptake of digital finance at scale across rural markets. SmartMoney covers this cost through the institutional payment services which generate fee revenues from large rural economic actors (agriculture companies, schools, traders) as well as through marketing fees that SmartMoney charges its partner banks for mobilizing rural deposits on their behalf.

SmartMoney has two revenue streams - payments and deposits. It charges offtakers (agribusinesses), and not the farmers. It collects a 3 percent fee from the agribusiness each time they transfer money, while there is no withdrawal fee for farmers. SmartMoney provides a wallet to farmers for cash-in and cash-out. On deposit side, it works with banks to help them with last-mile access to rural areas. Thus, it acts as the marketing front-end for its partner banks, who pay marketing fees, which is around 9 percent of the deposit.

Agricultural buyers are expected to replace cash payments with e-payments only if the e-payment solution is accepted by and affordable to rural households. SmartMoney is uniquely positioned to offer these actors tailored institutional payment services and generates revenue from these actors (which are SmartMoney's "institutional customers"). For agriculture companies, the solution provides the added benefit of strengthening farmer loyalty, as E-Village provides tangible value to rural farming households (free of charge savings and payment services). SmartMoney is able to negotiate a minimum fee of 3 percent of each institutional payment transaction.

Rural staff,training and transport are the major costs. SmartMoney incurs cost on training retail customers to use their payment solution and imparting financial literacy to

them. SmartMoney also invests in training the agribusinesses. It incurs capital expenditure on vehicles (for awareness visits to churches, motorcycles) and marketing material. The enterprise also invests in updating its MIS, and is seeking to use in-house data of agribusinesses for rebalancing and reconciliation.

SmartMoney has received donor funding from the MasterCard Foundation for Rural Prosperity and the Africa Enterprise Challenge Fund.

Impact

SmartMoney increases overall savings capacity by allowing rural farmers and households to pay for goods and services at local businesses with their mobile phone, thereby reducing the need to travel with cash to make payments. This allows users to not only save productive time, but also allocate more money to savings. An M&E team on behalf of the MasterCard FRP/KPMG estimates the costs savings to amount to USD 120 per retail household per year. Farmers can benefit through free and convenient access to mobile money transfer service, using it to make a number of transactions such as paying school fees at the schools that have partnered with SmartMoney.

Agribusinesses can also benefit from cost savings by removing expenses associated with handling cash. Cash handling costs are typically 7–20 percent percent of annual turnover in the countries where SmartMoney works, as compared to the 3 percent percent fee charged by SmartMoney to its partners. SmartMoney also increases efficiency, employee safety and transparency for large rural financial institutions by eliminating cash handling and disbursal.

For larger cash-out needs, SmartMoney retail shops provide robust liquidity because they take in cash for the sale of goods. These shops earn no commission, but they have multiple other benefits as a SmartMoney service centre. When liquidity is properly managed, disbursing cash-outs helps them manage their cash balances downward, reducing their risk of theft and their trips to a financial institution to deposit cash. Conversely, making electronic deposits to a financial institution allows them to manage their electronic float. Other SmartMoney shops that provide a wholesale function are strategically positioned at the junctions or crossroads between the village and the densely populated corridor on the main road. The village shop can place a voice call to the 'wholesale' shop to order three boxes of laundry detergent and then make a SmartMoney transfer to pay for the soap and a one-way motorcycle taxi transport. A key benefit is that the sole employee/owner does not need to close the village shop in order to physically procure more stock and the 'wholesale' shop increases its sales volume.

The increased foot traffic of SmartMoney users presents the opportunity to cross-sell agricultural financial products and services, increase membership, and improve loan tracking for any loans they disburse on SmartMoney. They also benefit from information provided on SmartMoney's radio, print and billboard advertising.

Challenges and Lessons

The major challenge for SmartMoney is building trust with small-holder farmers who are skeptical about formal financial services. To overcome this barrier, SmartMoney works with rural trust networks including agriculture companies, catholic and protestant churches, and NGOs to build trust within local communities. SmartMoney also faces barriers such as low

density of population, poor infrastructure of electricity and roads, and regulatory ambiguity in mobile money.

Road Ahead

SmartMoney is opening 750 new customer accounts per day, and further expansion to additional districts in Uganda is already underway. SmartMoney also plans to apply for a banking license so that it is able to have more flexibility to invest customer deposits, and on-lend customer deposists. It has detailed cash flow data on rural merchants who use the e-money to accept retail payments and to restock, as well as on its institutional customers such as agribusineses. In addition, it has established relationships with larger customers who have expressed the demand for loans. This data from savings and payment services provide an excellent foundation for future lending.

CASE STUDY

FarmDrive

Founding year: 2014
HQ: Nairobi, Kenya
Countries of operation: Kenya
Orientation: For-profit
Employees: 7 staff + 2 directors
Turnover: USD 17,000 (~KSh17 million)

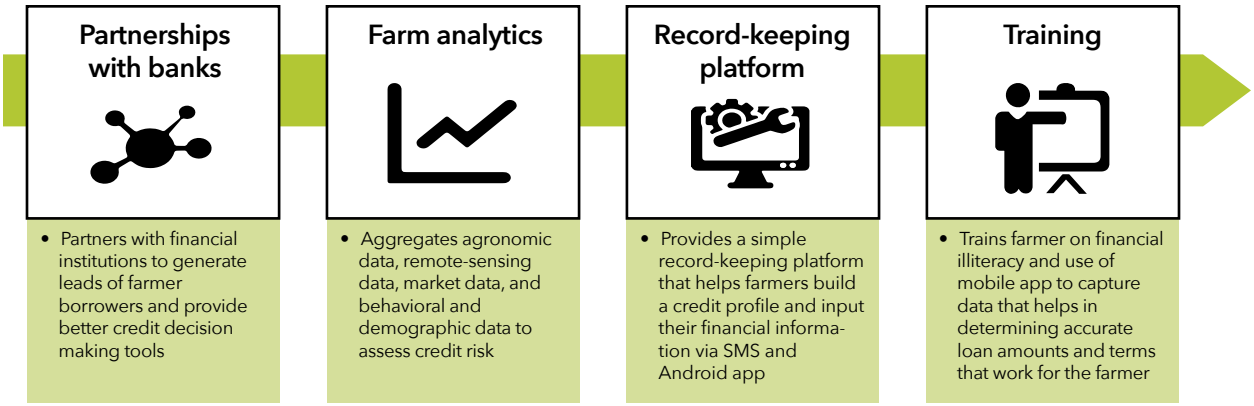
There is very little aggregated data about smallholder farmers, particularly about their financial performance and history. The lack of data makes it difficult for financial institutions to conduct credit assessments on farmers, hence they are viewed as high risk, locking them out of formal financial systems. Currently, only 1 percent of commercial loans in East Africa go to agriculture.

FarmDrive works at the intersection of technology, agriculture, and finance. FarmDrive offers products to farmers and banks to ease lending. FarmDrive has pioneered an innovative way to use data that is generate in smallholder farmers' value chains for enabling their financial inclusion. By harnessing the power of data analytics and mobile technology, it aggregates and analyzes pertinent information about smallholder farmers from dynamic traditional and alternate data point–including produce offtakers, agro-dealers, and the farmers themselves.

Operating Model

A significant amount of data is generated by smallholder farmers when they transact during the farming process, for instance, when they purchase inputs from the local agro dealer or when they sell at the farm gate. This data, which is very crucial in cash flow management and making lending decisions, is most often lost, as there are no mechanisms to capture and aggregate it. Given their proliferation in Kenya, mobile phones can be leveraged to digitize the process of capturing this data, and address the data gaps that lead to financial exclusion.

FarmDrive, a company based in Kenya, builds risk assessment models for financial institutions to evaluate farmers for making lending easier and less risky. FarmDrive's



platform harnesses the power of data analytics, machine learning and mobile technology to build innovative credit scoring models giving financial institutions an operationally efficient and cost effective way to identify and assess farmers' risks. FarmDrive has SMS and android apps that enable farmers to record revenues and expenses. It builds innovative comprehensive credit profiles used for real-time credit assessment to enable banks to serve smallholder farmers through digital financial services. It aggregates agronomic data (soil and water), remote-sensing data (weather, humidity, precipitation data), market data, behavioral data, and demographic data. It provides financial institutions credit profiles and loan terms based on the aggregate data to assess farmers' credit risk. It helps farmers, who lack access to capital, business records and fixed assets, to be evaluated on metrics that are suitable to them and information that is readily available. FarmDrive also facilitates insurance bundled with the credit from partner banks.

FarmDrive provides a simple record-keeping platform that allows farmers to input their financial information via SMS and an Android app and build a credit profile. The farmers' data combined with existing agricultural data is used to develop a comprehensive credit profile, to be used for the farmers' credit assessment by financial institutions when they need funding. In addition, FarmDrive also uses the records to understand each farmer's specific financial requirement and provide tailored information via SMS. The turnaround time for loan decision by banks through FarmDrive platform is 72 hours.approval to disbursal.

FarmDrive has also partnered with the ACP-EU Technical Centre for Agricultural and Rural Co-operation (CTA) to build the capacity of Kenyan young farmers and stakeholders and help them access finance. In partnership with CTA, FarmDrive has organized 20 mobile training sessions dubbed "Apps4Ag Learning Opportunities". These sessions help young farmers learn how to use FarmDrive's financial management tool to keep records of their farming activities, receive agronomic recommendations, and benefit from mobile money payments, access to loans and other digital financial services. The workshops are being held across different regions in Kenya. They provide hands-on experience to a total of 500 young farmers and other agricultural stakeholders. FarmDrive has created comprehensive credit profiles for the young farmers, who can apply and eventually receive credit from lending partners through their mobile phones.

FarmDrive works with 15 farmer youth leaders from the local community to spread awareness about its services. These leaders also provide training to the farmers on how to use mobile phones and educate them about the risks of borrowing. FarmDrive's training

teams help farmers gain financial literacy and skills to use the mobile app. The data helps the enterprise in determining accurate loan amounts that work for the farmer's crop, acre size, planting date, and income.

Financial Sustainability

FarmDrive earns revenues from finance providers for their use of the credit profiles (fixed fee) and from farmers (percentage of loan amount as transaction fee). It incurs negligible capital expenditure as the operations are largely digital. Its operating expenses include cost of training farmers on the use of mobile application, and the cost of creating the credit profiles. Currently, average training/profiling cost per farmer is KSh 130 (USD 1.3).

FarmDrive has participated in the Village Capital and Unreasonable Institute Accelerators. The data accuracy mitigates the risk for financial institutions and helps them maintain very low NPAs (3 defaults out of 350 loans facilitated by FarmDrive till now). As financial institutions are able to price their loans better, they are able to minimize the risk premium and still charge farmers lower than traditional loans on an average. Thus, FarmDrive is able to create a win-win situation for both, finance providers and borrowers.

Farmdrive's algorithm determines the loan amount, loan term and other parameters for financial institutions to lend to farmers. As more financial institutions and farmers are onboarded, operational costs are expected to decrease with economies of scale.

Impact

FarmDrive catalyzes financial institutions to lend more to smallholder farmers by de-risking the process through clear and transparent records. Farmer clients of FarmDrive are benefiting from financial awareness, financial management tools, farming-related recommendations, access to finance and links to profitable markets. The increase in lending to smallholder farmers positively affects the economies and food security of these regions, and has a huge economic impact and multiplier effect.. For example, working closely with Musoni Kenya, a tech -driven MFI, FarmDrive has helped facilitate a loan portfolio of more than $25,000 to some of these farmers who have never received credit before. They now are able to lease tractors to plough their farms in 30 mins, an activity that would take them 2 weeks manually, they no longer reuse seeds from previous harvests as they can afford quality seeds and fertilizer.FarmDrive has onboarded 2,500+ farmers since December 2015 and expects to serve around 10,000 by end of 2016. 60 percent of these smallholder farmers are women, who are less financially empowered because traditionally, women do not own assets. Providing a digital platform for loans that are not tied to asset ownership levels the playing field for women to access credit.

Challenges and Lessons

Lack of understanding of IT among farmers is a major challenge for the adoption of FarmDrive's solutions. To address this issue, FarmDrive has made available its tools in two languages (English and Kiswahili), and on multiple platforms, so that farmers can avail of its services with minimal training and support across different formats. Access to data is also a challenge since few available datasets are digitized. FarmDrive is also struggling to achieve a critical mass, both on the supply and demand sides so that it achieves economies of scale to sustain its business.

Index-Based Agriculture Microinsurance

Data-based claims mechanism provides automatic payouts following a disaster

HIGHLIGHTS

- Linking agricultural insurance to an index is more cost-effective than tying it to actual incurred losses.
- Mobile banking can make indexed insurance more affordable, increase availability, and speed pay-outs.
- Insurance allows farmers to invest more confidently and manage losses better, helping to improve their productivity.

Summary

Farmers in developing countries are highly vulnerable to risks, but most cannot afford commercial insurance. Schemes in which payouts are based on objective criteria, such as rainfall, are less expensive than traditional insurance, because individual claims are not assessed. Making these products available to smallholders can increase their productivity, by allowing them to engage in higher-risk/higher-return strategies.

Development Challenge

Millions of smallholders in developing countries lack irrigation systems and are unable to access or afford high-quality inputs, such as seeds and fertilizer, leaving them particularly vulnerable to weather-related risk. Unable to afford traditional insurance, they respond by

curbing their investment and investing in low-risk/low-yield crops, which lock them into a vicious cycle of poverty. Affordable microinsurance products could help break this cycle.

Business Model

Index-based agricultural microinsurance is a type of microinsurance in which pay-outs are based on publicly observable indexes rather than actual incurred losses. Compared with traditional agricultural microinsurance, the index mechanism substantially reduces transactions costs and spares low-income farmers the trouble of having to go through the onerous process of filing claims.

Farmers purchase coverage for risks related to their crops or livestock, paying their premiums in cash or via mobile banking. The most common risks are drought, excessive rainfall, storms, and pest infestation.

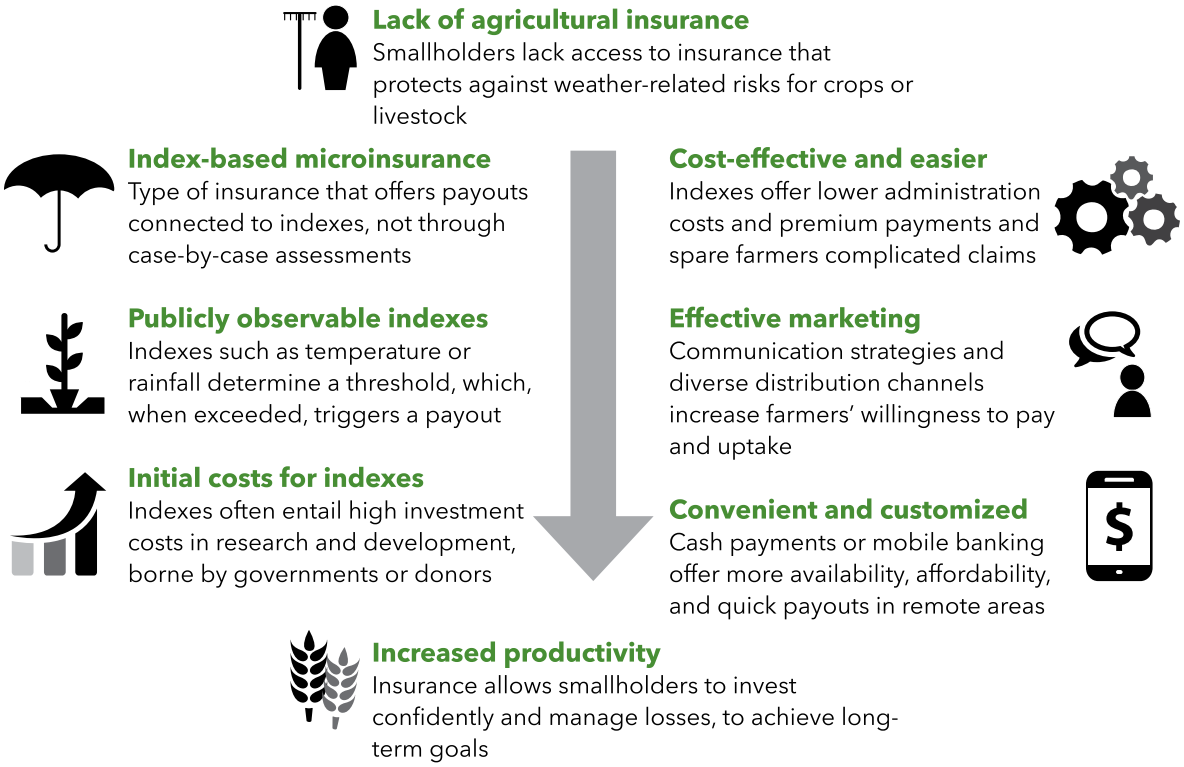
Pay-outs are made automatically made when objective criteria—such as rainfall, based on data from weather stations—exceed a certain value. Not having to assess losses on a case-by-case basis substantially reduces administrative costs, allowing insurers to charge lower premiums. Automatic pay-outs also eliminate the complicated and time-consuming claims process, which in the past caused farmers in developing countries to distrust insurance.

The design of robust indexes that reflect smallholders' as well as insurers' risk is vital to both the impact and the financial viability of the business model. The design of such indexes often entails high initial investment costs in research and development. Basing an index on rainfall, for example, requires a dense network of weather stations, which many developing countries lack. Private insurers often find developing the tools that model agricultural risk (such as catastrophe risk simulation techniques) too complex and expensive (World Bank 2010). These costs are therefore often borne by governments or international donors.

Insurers often resinsure their products. Reinsurance is particularly crucial in the agricultural sector to manage covariant risk, especially in developing countries, where insurers often operate in small areas with limited product portfolios.

Components of the Model

Figure 6. Index-based agricultural microinsurance



Cost Factors

The design of robust indices which adequately reflect smallholders' as well as the insurer's risk is vital to both the impact and the financial viability of the business model. The design of such indices often entails high initial investment costs in research and development. For example, robust indices heavily depend on the density of the weather station network, which in developing countries frequently lacks adequate coverage. Also, the development of tools that model agricultural risk such as catastrophe risk simulation techniques is often too complex and costly for private insurance companies. Therefore, these costs are commonly borne by governments or international donors. In addition, insurers frequently seek reinsurance for their products. Reinsurance is particularly crucial in the agricultural sector to manage covariant risk, and even more so in developing countries where insurers often operate in comparatively small areas with a limited product portfolio

Revenue Streams

Most index-based microinsurance models rely on two forms of revenue: premiums paid by small farmers and subsidies paid by the government. Most farmers are either unwilling or unable to cover the full premium at actuarial rates. Governments therefore subsidize the premiums (Smith and Watts 2009).

In addition to insuring farmers, some microinsurers insure microfinance or other lending institutions against loan defaults. ACRE, for instance, offers a range of such products, including directly insuring loans or bundling indexed insurance with microloans to small farmers.

Financial Viability

No model has yet shown evidence of financial viability; most schemes receive significant financial support from governments or donors. Some models (CADENA, NAIS, mNAIS) subsidize premiums directly, covering 75–90 percent of the premium cost. Others (ACRE) charge actuarial premiums and use support for research and development.

Partnerships

Index-based agricultural microinsurance schemes that have reached scale generally involve a multitude of actors working together:

- Insurers—including private insurance companies, state-owned companies, member-based organizations, and NGOs—design and operate the schemes, collecting premiums and settling claims.
- International reinsurance companies, such as Swiss Re, reinsure index-based microinsurance schemes.
- Governmental, NGO, and research institutions support the design of index-based insurance products.
- Microfinance institutions, NGOs, farmers associations, and agricultural extension staff market the policies.

Implementation: Delivering Value to the Poor

Awareness

Index-based insurance products can be difficult to explain to farmers, especially in environments where insurance culture is weak or farmers have had bad experiences in the past. Implementing organizations therefore usually disseminate information via their networks of local NGOs or member-based organizations, such as agricultural cooperatives or farmers associations. Government extension services can also be used to promote products. Potential clients usually trust these organizations, making them invaluable in creating awareness. In addition to traditional training sessions in which the product is explained, many schemes have used brochures and TV or radio advertisements.

Acceptance

The fact that pay-outs are based on an index rather than actual losses and that the two are not perfectly correlated (a problem known as "basis risk") reduces both the demand for and the effectiveness of index-based microinsurance. Technological advancements in data collection, such as satellite data, have reduced basis risk by providing data that are spatially continuous (FARM 2012). Effective communication strategies that explain how the product

works can also help build acceptance. The R4 Initiative used games that simulated financial markets to teach farmers about cost preferences and facilitate product design (World Resources Institute 2011).

Availability

Microinsurance providers use various distribution channels, including cooperatives and networks of microfinance institutions, which market insurance products separately or in combination with other products, such as credit. Mobile banking helps make the product available in even the most remote regions.

Affordability

Index-based agricultural microinsurance costs significantly less than traditional insurance, because insurers do not need to verify individual claims. To ensure affordability by the target group, governments frequently subsidize microinsurance schemes. Even so, low willingness to pay and high price sensitivity substantially hinder uptake (Biener and Eling 2012). Affordability remains a challenge.

Results and Cost-Effectiveness

Scale and Reach

ACRE covers more than 185,000 farmers in Kenya, Rwanda, and Tanzania. Guy Carpenter covered 43,000 cotton farmers in its first year of operation, paying out about USD 230,000 to beneficiaries after the drought that year.

Few schemes have achieved scale, however. Weak demand, poorly designed indexes, and smallholders' liquidity constraints mean that most smallholders in developing countries remain without insurance coverage.

Table 6. Affordability of selected index-based agricultural microinsurance models

Model/countries	*Affordability*
ACRE (formerly known as Kilimo Salama) (Kenya, Rwanda, Tanzania)	Premiums and pay-outs are processed via mobile banking. In addition to ensuring widespread availability, mobile banking helps keep transactions costs, and consequently premiums, low. Inputs (seeds) rather than outputs are insured, reducing the insured value but allowing farmers to plant the following season.
Componente Atención a Desatres Naturales (CADENA) (Mexico)	Federal government subsidizes 75–90 percent of premiums, depending on an area's level of marginalization.
Guy Carpenter (Mozambique)	"Portfolio pricing" model (which uses the insured sum in a region as the basis for risk calculation) reduces premium costs by including more smallholders and diverse areas in a group.
R4-Rural Resilience Initiative (formerly HARITA) (Ethiopia, Malawi, Senegal, Zambia)	Scheme allows farmers to pay for their coverage with their labor. Scheme is integrated into existing social safety net, disaster risk reduction scheme, or World Food Programme's Food Assistance for Assets program.

Table 7. Impact of selected index-based microinsurance schemes on farmers' productivity and income

Model/countries	*Impact*	*Reach*
ACRE (formerly known as Kilimo Salama) (Kenya, Rwanda, Tanzania)	Insured farmers invested 19 percent more and earned 16 percent more than uninsured counterparts, according to a 2012 impact study; 97 percent of farmers insured by ACRE in 2013, including many who purchased indexed insurance, received insurance linked to a loan.	About 185,000 smallholders (2013)
Index-Based Livestock Insurance (IBLI) (Kenya and Ethiopia)	Insured households are less likely to sell livestock, more likely to buy livestock, and more likely to become self-sufficient in food consumption (Janzen and Carter 2013).	More than 4,000 smallholders (2014)
R4-Rural Resilience Initiative (formerly HARITA) (Ethiopia, Malawi, Senegal, Zambia)	Insured smallholders increased their savings by 123 percent more than uninsured smallholders and owned more oxen (the most valuable assets for many farmers) than uninsured farmers, according to an evaluation in Tigray conducted between 2009 and 2012. Farmers enrolled applied five times more compost than uninsured farmers; in some districts, they increased investment in agricultural inputs, such as fertilizer or seeds, more than their peers without insurance.	24,000 smallholders in Ethiopia and 2,000 in Senegal (2014)

The degree to which index-based microinsurance reaches the poorest farmers varies greatly. Findings from the Index-Based Livestock Insurance Project (IBLIP) in Mongolia suggest that better-off farmers tend to purchase coverage. In contrast, the R4-Rural Resilience Initiative in East Africa has found it difficult to attract better-off farmers.

Improving Outcomes

Index-based agricultural microinsurance can increase farmers' income and productivity by increasing their willingness to invest and engage in riskier practices (Cole and others 2012). Insured farmers are more likely to plant higher-yield/higher-risk crops, invest more in fertilizers, and adopt other production-enhancing methods. Uptake is more common in areas that experienced several years of below-average rainfall or crop yields. It is also higher when the insurance is presented by a trusted third party, such as an NGO.

Cost-Effectiveness

In the absence of insurance, many small farmers engage in costly mitigation strategies to prevent loss, using savings or selling off assets in the event of loss. Microinsurance can prevent these losses. Indexed insurance reduces administrative costs by eliminating the need for claim inspection and verification.

Scaling Up

Models that have achieved scale share several features (IFAD and World Food Programme 2010):

- *Integrated approaches*: Insurance complements other risk-management strategies. It should be used only to offload that portion of risk that cannot be addressed by other means.
- *Participatory methods*: Drawing on farmers' knowledge in the design of products has led to improvements in indexes, especially where data are limited. Collaboration with the target group also helps create acceptance and awareness. Engaging potential clients in role-playing games in the pilot phase substantially increased demand in the R4 Initiative.
- *Supply chain approach*: ACRE's close links to the M-PESA mobile banking system reduce transaction costs and increase availability.

Challenges

The primary challenge is increasing the uptake of services. Low financial literacy prevents many farmers from participating. Many small farmers also lack the liquidity required to buy insurance. Accurate historical data on weather and crop yields are often unavailable or unreliable, making indexing difficult. Many firms are experimenting with new methods of determining yields, such as satellite imaging, but this new technology is still in the development and testing phase. Even successful cases report that basis risk remains a challenge.

Role of Government and Public Policy

Public-private partnerships can operate on a larger scale than commercial insurers, thanks to their affiliation with national social security programs and access to data (Herbold 2010). These partnerships reach millions of low-income households. Examples include NAIS and mNAIS in India and Componente Atención a Desatres Naturales (CADENA) in Mexico. Both governments subsidize up to 90 percent of the premiums.

Index-based insurance depends heavily on accurate and up-to-date meteorological and agronomic data, which governments collect. Government involvement is also crucial in providing a sound regulatory and legal framework, which determines the scope of activity of insurance companies and ensures their financial integrity. A solid legal framework fosters confidence among all actors. Regulatory frameworks may need to be revised and adjusted to reflect the specifics of index-based agricultural insurance.

Table 8. Social enterprises: Index-based agriculture microinsurance

Model	*Countries*	*Description*
ACRE (formerly Kilimo Salama)	Kenya, Rwanda, Tanzania	Offers products at actuarial premiums, using mobile banking.
Componente Atención a Desatres Naturales (CADENA)	Mexico	Index-based crop and livestock catastrophe insurance program is available in some states. In other states, farmers receive compensation payments following climate disasters.
Guy Carpenter	Mozambique	Company uses portfolio pricing model and innovative methods of data collection to keep premium costs low and accessible to large number of farmers.
Mongolia Index-Based Livestock Insurance Project (IBLIP)	Mongolia	Index-based livestock mortality insurance product encourages farmers to adopt practices that build their resilience.
R4-Rural Resilience Initiative (formerly HARITA)	Ethiopia, Malawi, Senegal, Zambia	Integrated approach to minimizing farmers' risk combines improved resource management (risk reduction), insurance (risk transfer), microcredit (prudent risk taking), and savings (risk reserves). Insurance-for-assets program allows farmers to work in community-identified projects in return for insurance coverage.
NAIS/mNAIS weather-based crop insurance scheme	India	State subsidies keep premiums low. Link with agricultural credit insurance attracts large numbers of farmers.

References

Biener, C., and M. Eling. 2012. "Insurability in Microinsurance Markets: An Analysis of Problems and Potential Solutions." *Geneva Papers on Risk and Insurance* 37 (1): 77–107.

Cole, S., G. Bastian, S. Vyas, C. Wendel, and D. Stein. 2012. *The Effectiveness of Index-Based Micro-insurance in Helping Smallholders Manage Weather-Related Risks*. Evidence for Policy and Practice Information and Co-ordinating (EPPI) Centre, Social Science Research Unit, Institute of Education, University of London.

FARM (Forum for Agricultural Risk Management). 2012. *FESA Micro-insurance: Satellite Indices Break-through*. https://www.agriskmanagementforum.org/content/fesa-micro-insurance-satellite-indices-break-through.

Herbold, J. 2010. "Crop Insurance in Developing Economies." *RURAL* 21. https://www.agriskmanagementforum.org/sites/agriskmanagementforum.org/files/Documents/R21_Crop_insurance_developing_economies_01.pdf.

IFAD (International Fund for Agricultural Development), and World Food Programme. 2010. *The Potential for Scale and Sustainability in Weather Index Insurance*. http://www.ifad.org/ruralfinance/pub/weather.pdf.

Smith, Vince, and Myles Watts. 2009. "Index Based Agricultural Insurance in Developing Countries: Feasibility, Scalability and Sustainability." http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.476.4002&rep=rep1&type=pdf.

World Bank. 2010. *Government Support to Agricultural Insurance*. Washington, DC. https://openknowledge.worldbank.org/bitstream/handle/10986/2432/538810PUB0Gove101Official0Use0Only1.pdf?sequence=1.

World Resources Institute. 2011. *Putting Vulnerable People at the Center of Communication for Adaptation: Knowledge Sharing through Participatory Games and Video Tools*. http://www.wri.org/our-work/project/world-resources-report/putting-vulnerable-people-center-communication-adaptation.

CASE STUDY

ACRE

Challenge

In the face of climate change, farmers in many developing countries are becoming increasingly vulnerable to the risks posed by extreme weather and climatic events. These adverse effects affect agricultural smallholders disproportionally, because their capacity to manage risk is limited. Smallholders often lack irrigation systems and are unable to access or afford high-quality agricultural inputs, such as seeds and fertilizer. Their increased risk exposure curbs agricultural investment and thus productivity, locking them into a vicious cycle of poverty.

Innovation

In 2009, the Syngenta Foundation for Sustainable Agriculture, in partnership with the Global Index Insurance Facility (GIIF), began providing farmers in Kenya, Rwanda, and Tanzania, with index-based microinsurance products for livestock and crops. Index-based agricultural microinsurance is a type of microinsurance in which payouts are connected to publicly observable indexes, like temperature or rainfall, rather than actual incurred losses. These efforts have continued under ACRE (http://www.acreafrica.com/), a commercial company spin-off, and its partner network, which includes insurers, reinsurers, agribusinesses, microfinance institutions, NGOs, and input suppliers. ACRE collaborates with all relevant actors along the value chain of agricultural insurance, from local insurance companies to input companies and agribusinesses. Its services range from product development and improvement to risk monitoring.

The company offers three main index-based products:

- *Loan-linked insurance:* ACRE's main product is linked to credit from microfinance institutions. ACRE insures the loan and thus the input investment, which must be at least USD 100. Depending on the crop, the premium costs 5–25 percent of the input value. It is paid for by farmers or the microfinance institution. In case of a payout, the loan is covered by the insurance product. The product also provides agronomic training for farmers by microfinance institution agents.

- *Replanting guarantee:* The replanting guarantee is offered in collaboration with seed companies. Each bag contains a scratch card with a code inside. To register for insurance, farmers message the code to ACRE via SMS, paying for the insurance—and all ACRE products—using mobile banking, especially the M-PESA scheme in East Africa. The replanting guarantee starts upon registration and ends after two weeks. If there is a drought within that period, smallholders receive a voucher for a new bag of seeds, enabling them to replant within the same season.
- *Hybrid index and multiperil crop insurance:* This product combines the traditional yield-based approach and the index-based approach. Unlike traditional insurance, it covers the entire crop cycle, starting in the germination phase, providing more comprehensive coverage.

ACRE also offers contract seed grower insurance and indemnity-based dairy livestock insurance.

ACRE has established innovative distribution channels by building strong ties with the private sector. Both input suppliers and microfinance institutions, which have access to large numbers of people who would otherwise be costly to reach, function as aggregators. They have a strong interest in insuring farmers because better-off farmers buy more and better seeds and are more likely to be able to repay their loans.

Impact

A 2012 impact study found that insured farmers invested 19 percent more than their uninsured peers and had incomes that were 16 percent higher. Virtually all insured farmers (97 percent) received loans linked to insurance. In 2013, 178,000 farmers received USD 8.4 million in financing. Many of them would not have been eligible for credit without such assistance.

Scaling Up

ACRE has scaled up substantially since the pilot phase in 2009. It now reaches about 200,000 farmers in Kenya, Rwanda, and Tanzania, making it the largest index-insurance program in the developing world in which farmers pay a market premium. By 2018 it intends to provide insurance to 3 million farmers in 10 countries.

The lack of reliable long-term data on which indexes are based is the main barrier for expansion. Even when such data exist, collecting, verifying, and analyzing them is a very time-consuming process.

From a regulatory perspective, different legal systems can be a challenge. Every country has its own laws and regulations on the role of agricultural insurance providers and lawful fee percentages. Products and partnerships must therefore be tailored to both climatic and institutional environments.

CASE STUDY

R4 Rural Resilience Initiative

Challenge

In the face of climate change, rural smallholders in many developing countries are becoming increasingly vulnerable to the risks posed by extreme weather and climatic events. The region of Tigray, in northern Ethiopia, for example, is regularly hit by severe droughts that often force smallholders to sell their assets and reduce their investments, reducing rural livelihoods and jeopardizing food security. Insuring these farmers would reduce their adoption of these deleterious coping mechanisms.

Innovation

The R4 Rural Resilience Initiative (https://www.wfp.org/climate-change/r4-rural-resilience-initiative) is a strategic collaboration between the World Food Programme and Oxfam America that takes an integrated approach to risk mitigation. R4 provides four risk-management strategies to smallholders: improved resource management (risk reduction), microcredit (prudent risk-taking), savings (risk reserves), and index-based microinsurance (risk transfer). Implementation of the program is country-specific in terms of partners involved but generally involves public, private, and nongovernmental entities.

Farmers can insure both long-cycle crops (barley, wheat, maize, sorghum) and short-cycle crops (teff), up to a maximum of USD 155. Smallholders pay premiums of 13–22 percent of the sum insured, depending on the crop, with an average payment of about USD 18. For the many farmers who cannot afford the premiums, R4 offers an "insurance-for-assets" scheme, which allows smallholders to obtain insurance coverage in exchange for their labor. Participants work in community-identified risk-reducing projects, such as creating compost pits to improve soil quality. The initiative just reaches even the poorest farmers.

R4 applies participatory methods to designing its products. It developed a farmer-inclusive index using the Social Network for Index Insurance Design, which integrates both farmers' and scientists' knowledge and expertise. Scientists and local experts visit communities to inform smallholders about index insurance, learn about their risk

Community members participate in a mapping exercise as part of a workshop to identify R4 sites in Koussanar.

perception, and obtain initial parameters for the design of the insurance, such as the timing of seasons and details about bad years. Indexes using satellite and rain-gauge information are developed. Additional field visits are conducted to understand farmers' preferences for different risk-management strategies and index designs through use of experimental economic research games.

Impact

R4 has scaled up substantially since its pilot phase, in 2009. By 2015 it was reaching more than 24,000 smallholders in Ethiopia and almost 2,000 smallholders in Senegal, and pilots were being implemented in Malawi and Zambia.

An evaluation conducted in Tigray between 2009 and 2012 showed that the project largely achieved the aim of improving farmers' livelihoods (Madajewicz, Tsegay, and Norton 2013). On average, insured smallholders increased their savings by 123 percent more than the uninsured control group. They also increased the number of oxen, the most valuable asset for many farmers.

The program has had a significant impact on agricultural practices. Farmers enrolled in the initiative applied five times more compost in their fields than other farmers. In some districts investment in agricultural inputs, such as fertilizer or seeds, also rose. Female-led

households, which initially had been among the poorest households, increased agricultural investment more than households headed by men. Households participating in the insurance-for-assets program reportedly improved their adaptive capacity to climate change at the village level, through water harvesting, agro-forestry, forage, and pasture production on wasteland.

Scaling Up

Strong institutional partnerships with public, private, and nongovernmental players have facilitated the implementation and scale-up of the initiative. The different constellation of actors in each country demonstrates that R4 is capable of adapting to various institutional environments. Creating local capacity to manage index insurance will be critical to ensuring the program's long-term sustainability.

Several challenges risk limiting scale-up. One is that problems with data quality and availability mean that farmers can incur losses without the index being triggered. Solving this issue requires substantial financial investment and technological expertise. A second issue is that the number of farmers enrolled in the insurance-for-assets program has increased. Attracting better-off farmers capable of paying for insurance with cash—which would improve the financial sustainability of the program—has proven difficult.

Reference

Madajewicz, M., H. Tsegay, and M. Norton. 2013. *Managing Risks to Agricultural Livelihoods: Impact Evaluation of the HARITA Program in Tigray, Ethiopia, 2009–2012.* http://www.oxfamamerica.org/static/media/files/Oxfam_America_Impact_Evaluation_of_HARITA_2009-2012_English.pdf

IMPROVING PRODUCTIVITY

IMPROVING PRODUCTIVITY

Sector Challenges

Subsistence farming constitutes the largest component of agriculture across most developing countries. Small-scale farmers can become integral suppliers of food and strengthen food security globally if they are provided capacity building and techniques to enhance the productivity of their farms.

Limited access to technology, lack of productivity enhancement inputs, low awareness about farming best practices, and weak linkages across the agricultural value chain are some of the major challenges that smallholder farmers face. Further, severe climatic conditions lead to crop failure when farmers are not able to take preemptive steps due to lack of weather forecast information. Improper planting and harvesting practices result in loss of productivity and lower profit margins for farmers.

Smallholder farming is characterized by heavy use of fertilizers to maximize yields from small plots and minimal use of mechanization. There are two key reasons for this poor productivity. First, smallholder farmers are unable to access quality inputs. Second, even when they can access superior inputs, they lack the know-how and expertise on how to use these inputs effectively. Further, these inputs are often unaffordable for smallholders, resulting in lower adoption rates. Use of inferior inputs or inefficiency in their use results in low yields and decreased bargaining power for farmers; poor financial returns; and consequently, lack of accumulated savings for purchase of improved inputs and farm machinery in the next crop cycle. This ultimately places these farmers in a vicious cycle of low productivity and subsistence farming.

Models that Address Rhese Challenges: Description and Analysis

I. ICT Extension

Many social enterprises have introduced ICT applications to enable farmers to access vital pre-harvest information that is both, timely and affordable. The diffusion of ICT devices and infrastructure has eased constraints in supply-chain management and farmer aggregation. ICT extension enterprises enable farmers to access information related to agricultural inputs, weather forecast, market prices, and best practices in agriculture being followed by fellow smallholder farmers in general as well as other developing countries or regions.

- *Disseminating pre-harvest related information:* Many social enterprises provide information about regional weather conditions, weather forecasts, agri-related policies, and pest and disease control. Enterprises such as Farmer's Friend enable

farmers to search for agricultural information and use SMS to provide advice and relevant information such as regional weather forecasts, planting, storage and harvesting, and pest and disease control information for crops and livestock. Digital Green disseminates targeted agricultural information via digital media to small-scale and marginal farmers in India. The solution includes a digital video database that is produced for farmers by farmers.

- *Imparting advisory and consultancy services:* Some enterprises have developed virtual platforms to disseminate expert advice and technical knowledge, cutting across geographies and time zones to reach a potentially large audience. Other enterprises have leveraged the prevalence of mobile phones to share information and have set up call centers and help lines that farmers can access for answers to specific queries. Yet other solutions involve the inventive use of videos and design thinking to develop content and material that are easy to understand and internalize. Kenya-based Farmers Helpline operated by KenCall is a call center service staffed by agricultural experts that provide information, advice and support to smallholder farmers over phone, providing voice and voice call-back facilities.
- *Providing tools for pre-harvest efficiency:* Social enterprises have adopted ICT to support farmers in achieving efficiency through information systems. Indiagriline is a web-based portal that enables farmers to forecast demand, access records of their previous transactions with the company, register their sugarcane area, submit payment information, and monitor demand, among other services. ICT enables remote agriculture extension where farmers can use email and digital cameras to reach experts and seek crop diagnostics support. Social enterprises such as Cojengo provide a smartphone based diagnostic tool for animal health to improve disease diagnosis, surveillance and treatment of cattle in sub-Saharan Africa.

II. Non-ICT Extension

Agriculture extension is the application of scientific research and knowledge to agricultural practices through farmer education. Enterprises that provide farmers income-generating or productivity-enhancing products and services, such as agricultural inputs, direct from farm market linkages, or contract farming procurement models, bundle extension services in their service offerings to farmers. The activities by these enterprises can be classified as follows:

- *Information dissemination:* Enterprises selling productivity enhancement agricultural inputs include high-touch information and capacity building services as part of their farmer awareness building and marketing activities. The Real IPM and Hydroponics Africa conduct demonstration plot sessions related to the products that they sell. Peer-to-peer learning workshops involve training select village level farmers who disseminate the insights and information to other farmers in their communities.
- *Advisory and consulting services:* Enterprises engage with farmers on a contract basis or provide direct-from-farm market linkages collectivize farmers and provide capacity building and training on aspects related to production, collection, storage, and processing. Babban Gona franchises farmer groups and markets maize on their behalf. Members get access to development and training in agronomy, financial literacy, business skills and leadership skills.

III. Productivity Enhancement

The productivity enhancement business model encompasses activities related to providing farmers with access to low-cost quality inputs and agricultural machinery, and capacity building services to use these yield-enhancing solutions effectively. Several enterprises address challenges faced by smallholder farmers in the pre-harvest stage. They provide access to inputs, make inputs affordable and disseminate information about solutions to enhance agricultural productivity.

- *Provide access to inputs:* Most commercially available farm equipment is unsuitable for small plots. In order to address this challenge, a number of enterprises design inputs and machinery for use in small plots. For instance, Kamal Kisan's products, such as the Vegetable Planter and Mulch Layer are designed for use in farms that are smaller than two hectares and enable farmers to substitute labor-intensive processes thereby decreasing dependence on labor and associated labor costs. Driptech manufactures and distributes micro-irrigation kits that are suitable for use in small fields.
- *Make inputs affordable:* Enterprises enable marginal farmers in reducing costs incurred on inputs and farming. They manufacture low-cost products that are sold in smaller affordable packages; provide installment financing to lower the burden of upfront costs and sell inputs to a group of farmers who share the costs and further lease it to other farmers. myAgro, a company operating in Mali and Senegal provides a savings-based mechanism for farmers to buy input packages of their choice—input packages could include different types of seeds, fertilizers, and training services. Farmers identify an input package that they would like to purchase and set a savings target to match the cost of the inputs package.
- *Deliver information:* Enterprises such as Eruvaka Technologies, a company based in India offers data-analytics-supported aquaculture equipment that enables farmers to monitor their ponds through a smart-phone and adjust the amount of fish feed based on water quality and weather data. The real-time monitoring mechanism helps farmers increase yields and reduces unnecessary input costs.

Analysis of the Models

Analyzing the three models across different parameters brings up interesting findings and implications for implementation and scale up.

Comparative Analysis of Capacity Building and Productivity Models

Model	*Ease of Implementation*	*Effectiveness*	*Financial Viability*	*Scalability*	*Need for Government Support*
ICT Extension	Medium-High	Medium-High	High	High	Medium
Non-ICT Extension	Medium	Medium-High	Low	Medium	High
Productivity Enhancement	Medium-High	Medium-High	Medium-High	Medium-High	Medium

Ease of Implementation

ICT Extension

ICT extension services have gained traction in developing countries in the past few years because of the increasing penetration of mobile and other telecommunication channels and decreasing digital divide in these countries. ICT extension enterprises are changing the manner in which smallholder farmers communicate with stakeholders and access requisite information to improve their agricultural productivity.

Enterprises adopt several measures to reach and connect with their target customers and beneficiaries. Many of them now use streaming media to make non-text, i.e., video and audio information, more widely available to illiterate audiences. The integration of ICT in agriculture extension, especially through the use of videos and other visuals depicting stories similar to those of the regional farmers, increases the possibilities of a direct connect with the smallholder farmers. Enterprises also leverage interactive applications over one-way communication tools. These interactive media, including radio messages, feedback pamphlets, and call-center services help the enterprises understand the local context and provide requisite consulting services.

Internationally acclaimed ICT extension service providers such as Digital Green emphasize a lot on the content and delivery quality to provide global services at local levels. Digital Green and Shamba Shape Up present stories and instance of some of the role models that help the smallholder farmers grasp the message.

Non-ICT Extension

Stand-alone non-ICT agricultural extension services tend to remain as not-for-profits or government programs. Farmers' belief in traditional agricultural practices is deep rooted, and their adoption is instinctive; hence, providing information alone will not encourage them to make the shift to consistently use modern and efficient practices. They lack the willingness to pay for information not linked with visible positive outcomes, and do not trust extension agents who are not from within their communities. Therefore, despite the need to bolster existing government agricultural extension services, providing solely non-ICT extension services is not a sustainable model for private enterprises.

Productivity Enhancement

Enterprises focused on productivity enhancement interact with farmers to educate them on the benefits and value of using better quality inputs. Field agents conduct frequent meetings with farmer communities to disseminate information about the enterprises' products. They demonstrate the inputs and equipment in training sessions and engage trained agro-experts to sell their inputs—these experts educate farmers on the advantages of using quality inputs vis-à-vis counterfeit inputs and help to build trust amongst farmers. Some enterprises partner with local and popular media to showcase their products and services on information platforms or leverage radio to broadcast information on the brand in vernacular languages. For instance, Sidai partners with Mediae's TV program Shamba Shape Up and call center service I-Shamba to educate farmers on its brand. The Real IPM Company, a pest management solution provider in Kenya has created an online library—Real Insight Library

for farmers. The library provides farmers access information about the use of quality inputs and agricultural best practices.

Enterprises also rely on early adopters to spread awareness about their products within their local communities; they partner with farmer co-operatives and farmer groups to identify farmer champions who can validate the promise of productivity enhancement and spread the message among other smallholder farmers. Local government agencies, research organizations, universities and NGOs also play a pivotal role in aggregating farmers and educating them on the benefits of yield-enhancing inputs. Some enterprises partner with agro-dealers with complementary interests. For instance, myAgro partners with local village stores who have strong community networks to disseminate information on its input packages and its mobile layaway solution. Kamal Kisan partners with agro-dealers selling drip irrigation systems to increase awareness about its mulch layer

Effectiveness

ICT Extension

Strategic application of ICT has led to better information dissemination, and access to best practices in agriculture at reduced costs. It has also resulted in mobilization of farmer groups towards increased agricultural production, poverty alleviation and economic development. According to a number of sector studies, ICT intervention has dramatically improved the amount and quality of extension services in agriculture, which is the largest economic sector in most of the developing countries. For instance, an SMS based intervention that sends agricultural advice to smallholder farmers in Kenya increased yields by 11.5 percent relative to a control group who did not receive any such messages. Basic voice calls have helped smallholder farmers expand their buyer network. According to a study conducted in Benin, mobile phone usage facilitates transactions and provides producers access to relevant, timely information, allowing them to sell at a higher price improve their income. In the study, a randomized control trial of 1,000 farmers using Esoko's market information service in Ghana showed an increase of 7–11 percent in farmer's income for yams.

ICT helps the extension service providers reach rural and remote locations that are otherwise not feasible to cover by non-ICT based extension service providers. Moreover, the cost of building an extensive network of extension workers is far more expensive than investing once is technology. This is because the one-time investment in technology offsets against the increasing numbers of smallholder farmers who will start using ICT based extension services. With the rapid expansion and penetration of smartphone market in the developing countries, such solutions will be a win-win for the service providers and customers.

Productivity Enhancement

According to a 2015 study, smallholder farmers can increase net annual incomes by 80 to 140 percent with access to productivity-enhancing technologies such as improved seeds, micro-irrigation systems or improved cow breeds. Enterprises providing drip irrigation, solar-based pumps and hydroponic technology enable farmers to substitute energy and water intensive farming techniques. For instance, a research study measuring the impact of efficient irrigation technology on smallholder farmers highlights cases of farmers in Andhra

Pradesh, India who adopted efficient irrigation technologies to decrease costs of labor, fertilizer and pesticides by 25 percent. They also decreased energy use by 350–450 KWh/hectare, increased water efficiency by 30–60 percent, increased yields by 40–110 percent and increased incomes by 30–100 percent. Farmers in Burkina Faso who adopted drip kits and motor pumps witnessed an increase of 395 percent in gross margins with a payback period of one year; and farmers in Zambia increased their gross margins by 68 percent using drip kits and treadle pumps.

Uptake of inputs is closely related to the cost of these solutions and the availability of end-user financing. Input manufacturers such as Hydroponics Africa use locally sourced materials to develop products to keep costs low. SunCulture partners with financial institutions to provide end-user financing to farmers. Input aggregators such as myAgro purchase inputs in bulk from larger input manufacturers in order to avail lower prices which can then be passed onto smallholder farmers.

Financial Viability

ICT Extension

Most ICT extension service providers aim to achieve financial sustainability within 2–3 years of their operation. Some of the enterprises design their financial model to achieve breakeven from the outset. They achieve this either through strategic partnerships that help the enterprises in increasing the outreach and distribution of their products and services or by developing unique solutions that provide them "first mover advantage." Other forms of partnership include those for financial support. Donor agencies and governments provide grants and debt funding to enterprises that ensure business sustainability for a few years until they start making profits. ICT extension service providers earn revenues in two ways: the first, through sale of content that includes provision of advisory services, and management information system (MIS) solutions; and second, by charging segment fees per episode of broadcast content.

Non-ICT Extension

Stand-alone non-ICT agricultural extension services tend to remain as not-for-profits or government programs. Farmers' belief in traditional agricultural practices is deep rooted, and their adoption is instinctive; hence, providing information alone will not encourage them to make the shift to consistently use modern and efficient practices. They lack the willingness to pay for information not linked with visible positive outcomes, and do not trust extension agents who are not from within their communities. Therefore, despite the need to bolster existing government agricultural extension services, providing solely non-ICT extension services is not a sustainable model for private enterprises.

Ease of access to attend training and demonstration sessions also play a role in determining the willingness to pay for non-ICT extension services. Leveraging on ICT to deliver extension services to remotely located smallholder farmers seems to be more cost-efficient for enterprises; enterprises can minimize physical visits to farms and reduce hiring extension agents to deliver training and demonstrations.

Research shows that extension services that are combined with income generating and financially effective activities for farmers are more valuable to smallholder farmers. In fact,

90 percent of farmers in Ethiopia who expressed willingness to pay for extension services suggested that they will pay only if profit was guaranteed by adopting the extension advice and if payment could be made after production. Extension services without agricultural inputs or market access is not useful to farmers.

A majority of private enterprises therefore provide non-ICT extension services as part of selling productivity enhancement inputs to farmers or engaging with farmers on contract farming models.

Productivity Enhancement

The viability of the model hinges on the uptake of improved inputs by smallholder farmers, and for this, enterprises need to understand smallholder farmer needs, design inputs and machinery specific to those needs, and engage with farmers to educate them on the benefits of adopting improved inputs.

Smallholder farmers' ability and desire to adopt yield-enhancing inputs is largely reliant on their understanding of the benefits, capacity to pay for these inputs and the ease or practicality of adopting these solutions. Farmers either have limited access to input financing or are reluctant to add to their debt burden to procure quality inputs in markets that are overcrowded with low-cost, sub-standard inputs. myAgro sells agricultural inputs using a savings-based approach whereby farmers save ahead for fertilizers, seed packages, agricultural machinery, and training services using a mobile layaway mechanism. Enterprises that operate as input aggregators purchase inputs in bulk quantities from large input manufacturers allowing them to avail discounted prices. Their ability to maintain comfortable margins between their procurement prices and the prices they charge farmers determines their financial viability.

Scalability

ICT Extension

ICT extension service providers have been able to reach a large number of smallholder farmers quickly. The viewership number of Shamba Shape Up has reached over 10 million. In a given week in Kenya, nearly 18 percent to the total TV-watching audience, which is equal to over 5 million viewers, watch the program. The program is watched by another 5 million viewers in Tanzania, one million in Uganda, and 0.5 million in Rwanda. Likewise, Digital Green has expanded its network in India and other countries in the last few years. The enterprise, along with around 58 partners has provided training to over 1.15 million farmers across India and other developing countries in the last six years.

Non-ICT Extension

Non-ICT Extension private enterprises have to deal with mistrust and prejudice associated with poor past experience of farmers with Government extension. Governments do not always take into consideration tailored needs of individual farmers while designing and delivering information and capacity building services which results in ineffective information application and dissemination to the recipient. Based on these experiences, farmers tend to mistrust the advice provided by extension agents. This means that private enterprises have to make significant effort to build trust among its target farmer base. It is a cost-intensive

service considering farmers are reluctant to pay for information and training that they have previously been receiving free of charge. A survey of Ethiopian smallholder farmers showed that only 10.5 percent of the sampled farmers were willing to pay for extension services. These challenges and high intensity efforts needed make it difficult to scale the non-ICT extension models.

Productivity Enhancement

Given the need for hi-touch engagement and farmer education, enterprises achieve scale through innovative solutions, easy to apply features and willingness to provide time and support to customers. Product demonstration allows farmers to understand the value of inputs offered by these enterprises thereby increasing the number of farmers subscribing to these solutions. Ease of product use also increases the number of buyers—SAS Motors designs its products for small farms and Kamal Kisan designs its farm equipment such that local blacksmiths can address minor repairs to the products, which has helped in building trust amongst farmers. Kamal Kisan has served over 400 smallholder farmers in Karnataka, India in over 8 months. myAgro has served over 25,000 farmers in Mali and Senegal (of which 18,000 farmers have completed paying for their packages), the enterprise wants to target reaching one million farmers by 2025 through collaborations with agro-dealers and mobile payment vendors.

Government Policy to Enable These Types of Enterprises/Models

ICT Extension

Governments can facilitate the expansion of ICT based extension services by introducing relevant policies and legislations. They can also create awareness among the farmers regarding the use of ICT extension services, through their existing on-ground agri-support presence. Governments should invest in developing the ICT capacity of their existing extension programs and services and integrate ICT in national extension system such as those adopted by some countries such as Jamaica, where The Rural Agricultural Development Authority (RADA) of Jamaica has been proactive in using ICTs in its extension programs. The ICT program is financed through its core budget and grant funding. RADA extension agents have been trained in the use of ICTs for enhancing service delivery. Social media, Skype and SMS are various communication channels used to maintain close contact between farmers and extension agents.

In India, the central and state governments have supported various initiatives to address challenges in the agriculture sector. The national policy framework for agricultural extension emphasizes the importance of increased use of ICT in communication, marketing and provision of agricultural extension services to stakeholders in the agriculture value chain. The agriculture mission mode projects (MMP) are included in the national e-governance plan (NeGP) to provide information to the farmers on seeds, fertilizers, pesticides, government schemes, soil recommendation, crop management, weather and marketing of agricultural produce. Department of Agriculture and Cooperation (DoA&C) has initiated several projects such as ASHA in Assam, KISSAN and e-Krishi in Kerala and Krishi Maratha Vahini

in Karnataka. The department has also launched two portals AGMARKNET & DACNET to lead the implementation of MMP in Agriculture.

According to some of the ICT extension service providers, although government is supportive in general; there are not many supporting extension policies and regulations that could help escalate the ICT extension business model. Governments at the central level have some programs; however, the system collapses at state or county levels. As a result, this is a private sector driven business model that rides on the back of government and donor backed agendas. In India, the umbrella program 'National Rural Livelihood Mission' provides flexibility to invest in innovative approaches in agriculture including investment in cameras and videos. There is no government subsidies offered for promotion of ICT extension service business model.

Productivity Enhancement

Given the lack of access to quality inputs, low availability of financing and limited awareness among smallholder farmers, governments have the potential to play a major role in supporting enterprises that cater to smallholder's pre-harvest requirements.

A number of governments provide exemptions on sales and value added taxes (VAT) enabling enterprises to offer high-quality inputs to smallholder farmers at lower costs. However, frequent changes in policies related to VAT might cause input price instability, ultimately leading to a loss in smallholder farmer customer base. For instance, the Government of Kenya revised its position on VAT on agricultural inputs making it challenging for input manufacturers to retain affordable prices; in 2012, it introduced a bill that proposed a tax on agricultural inputs, which resulted in a significant rise in input prices. Tegemao Institute of Agricultural Policy and Development's research on the impact of imposing the 16 percent Value Added Tax (VAT) on animal feed found that manufacturers were forced to raise their feed prices, which they passed on to consumers, resulting in a 70–100 percent decline in profits for producers. The Government reversed the VAT rule in May 2014. Similarly, the Government of Honduras is in the process of proposing a bill that will exempt payment of 15 percent sales tax on import of agricultural machinery and agricultural implements.

Bureaucracy, lack of guidelines and restrictive regulatory policies are amongst the top factors that hamper growth and scale of private enterprises in the productivity enhancing input space. For instance, a number of enterprises spend considerable time in interacting with government officials to receive subsidies and exemptions; agricultural producers in Nicaragua have cited that excessive paperwork and lack of agility delays the process in receiving tax exemptions for purchase of farm machinery and equipment. The Government of El Salvador excluded high quality seeds from its agricultural package. According to the Agricultural Suppliers Association, this move will prevent higher yields since seed varieties distributed by the Ministry of Agriculture and Livestock typically produce 20 percent less production per acre than the seeds available in international markets.

Several governments across developing countries offer subsidies in the form of targeted vouchers to enable farmers to adopt high-quality inputs and agricultural machinery. Ten African governments spend roughly USD $1 billion annually on input subsidy programs, amounting to almost 30 percent of their public expenditures on agriculture. However, it is important for governments to use input subsidies judiciously, focused on increasing trials and adoption of high-quality inputs, boosting private player participation. They should also

adopt a strategy to gradually enable farmers to move away from relying on subsidies to eventually procure yield-enhancing inputs at market prices. In addition, enabling initiatives such as the MoU between the National Seed Association of India and the Bangladesh Seeds Association help increase availability and accessibility to quality seeds. Regulatory initiatives in Philippines have enabled mechanization levels to increase from 1 hp/ha to 2 hp/ha.

Enterprises that serve smallholder farmers also benefit from partnerships with governments that involve their participation in various capacities: aggregation of farmers, awareness generation on high-quality inputs, provision of facilities that can be used by enterprises to test inputs and demonstrate product usage to farmers, marketing and distribution of inputs to remotely located farmers, installation and after-sales support to farmers. For instance, Hydroponics Africa trains government employed county extension workers in hydroponics farming and further leverages these workers in sales and marketing activities. County workers install hydroponics systems, conduct frequent consultation visits to farms and undertake after-sales services. The enterprise partners with the Ministry of Agriculture in Kenya on a non-contractual basis and provides train-the-trainer based training to staff of the Uganda National Council of Science and Technology under a MoU agreement.

Conclusion

The ICT extension services business model addresses the development challenge of information inadequacy on best practices in agriculture, weather updates and prevailing market prices that support the upliftment of smallholder farmers in a number of developing countries. The business model is very impactful if it is provided along with on-ground support.

Given the premise that the primary consumer base who require agricultural advisory services are smallholder farmers who don't possess the ability to pay, non-ICT extension services will need to be bundled with additional yield-enhancing and income-generating services in order to attract these farmers. Farmers are willing to pay for information and training if other value-added services are also provided. Private enterprises will also need to work closely with government agencies to increase their outreach. Enterprises may also leverage on technology-enabled extension support for widespread dissemination of information and training services to remotely located farmers.

Enterprises that aim to increase productivity of smallholder farmers by providing access to affordable inputs and information have structured their businesses to overcome multiple barriers in attaining financial viability and scaling their operations. Enterprises typically need to adopt a high-touch engagement model, involving frequent after-sales support in order to maintain farmers as repeat buyers; however, lack of sufficient qualified staff and personnel becomes a challenge for these enterprises. To reduce transaction costs a number of enterprises partner with local community organizations such as county workers, farmer co-operatives, non-governmental organizations and banks to undertake awareness creation, farmer education, marketing, distribution, access to finance and after-sales activities to keep costs minimal.

Agriculture ICT Extension Services

Improving smallholders' knowledge of agricultural practices and markets through innovative media platforms

HIGHLIGHTS

- Increasing penetration of budget- friendly smartphones facilitates real-time access to information.
- Up-to-date market information on prices of commodities, inputs and consumer trends can improve farmers' livelihoods substantially and improve their negotiating positions.
- Tailored content and relatable delivery is a key factor for uptake of new techniques, and in a more cost- efficient manner than standard extension services.

Summary

Millions of smallholder farmers are the foundation of agricultural and food supply chains in most developing countries. Yet, the agricultural practices of smallholder farmers are at times not economically viable and struggle to be sustainable. Small farms produce low yields, adversely affecting farmers' economic conditions. Lack of information about critical inputs and inadequate knowledge about modern and efficient agricultural practices contributes to low farm yields.

Information and communications technology (ICT) extension services involve the transfer of practical knowledge and exchange of market information through ICT platforms. These solutions are relevant to agricultural and rural transformation processes, especially for smallholders. While traditional media such as radio and television continue to play a major role in extension and development communication, growth in the use of internet and

mobile technology for communication is perceived to be a game changer in the extension services space.

ICT extension service providers offer a range of information services to the smallholder farmers, from pre-harvest stage to post-harvest stage. They help the farmers understand and adopt agricultural best practices on crop selection, input management, land selection and preparation, finance, transportation, packaging processing, and marketing of the agricultural produce. The enterprises provide these services via radio and television shows, mobile applications, digital video discs (DVDs) and interactive voice response (IVR) technology. Enterprises that provide information services can help improve agricultural yields and guide farmers in procuring and using the right inputs and participating in commercial value chains

Development Challenge

There are over 475 million smallholder farmers globally (Lowder, Raney, and Skoet 2014). Nearly 80 percent of the food supply in Asia and Sub-Saharan Africa is produced by these smallholder farmers (FAO 2012).Limited access to technology, lack of productivity enhancement inputs, low awareness about farming best practices, and weak links across the agricultural value chain are some of the major challenges that smallholder farmers face. Further, severe climatic conditions lead to crop failure when farmers are not able to take preemptive steps due to lack of weather forecast information. Improper planting and harvesting practices result in loss of productivity and lower profit margins for farmers.

ICT can facilitate wide dissemination of relevant information at the right time in a cost-effective manner. The increasing penetration of mobile phones and internet, more specifically budget friendly smartphones can support a business model that expands information sources and farmers' ability to access the same. Such solutions have significant impact in the rural and remote regions of developing countries with large farmer populations. For instance, in India, the smartphone market is estimated to grow to over 200 million by end of 2016 (Krumins 2015). ICT can be applied to address various aspects of agriculture including identification of farmers' pre-harvest needs, devising solutions to meet those needs, and collection of feedback from farmers regarding a specific service or solution (Bell 2015).

Popular information dissemination models using ICT include online platforms, mobile applications, training content through videos, personalized call centers, and radio and television programs. Some of these are interactive and help smallholder farmers solve problems in real time. The quality and type of ICT extension services vary based on telecommunication facilities and nature of demand from farmers. A critical factor for adoption of ICT extension services is the ease of use of information. Enterprises offering these services should address issues such as ICT illiteracy, and the need for relevant and localized content.

Business Model

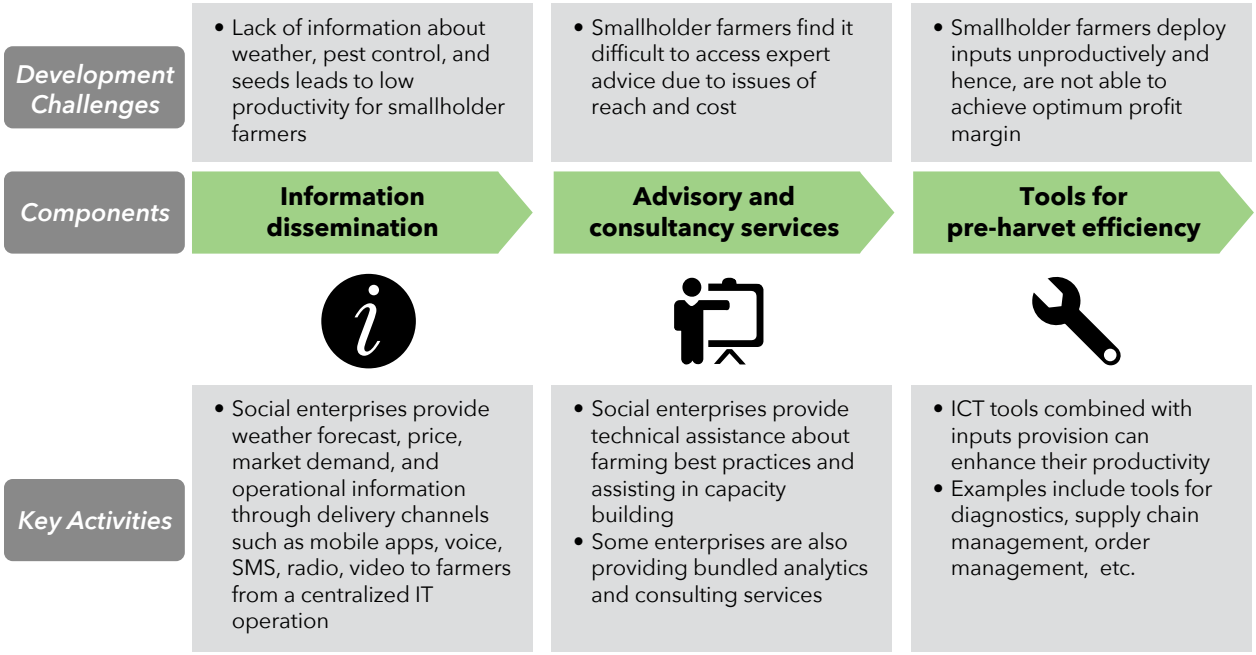
Many social enterprises have introduced ICT applications to enable farmers to access vital pre-harvest information. The diffusion of ICT devices (especially mobile phones) and infrastructure has eased constraints in supply-chain management and farmer aggregation. ICT

extension enterprises enable farmers to access information related to agricultural inputs, weather forecast, market prices, and best practices in agriculture being followed by fellow smallholder farmers in general as well as other developing countries or regions. These services connect smallholder farmers at the global level, facilitate cross-learning, and help them increase their agricultural productivity.

Components of the Model

Most ICT-based social enterprises provide extension services through one or more of the following operational phases:

Figure 7. Components of the model



Disseminating pre-harvest related information

Many social enterprises provide information about regional weather conditions, weather forecasts, agri-related policies, and pest and disease control. Enterprises such as Reuters Market Light and Farmer's Friend enable farmers to search for agricultural information and use SMS to provide advice and relevant information such as regional weather forecasts, planting, storage and harvesting, and pest and disease control information for crops and livestock.

Some enterprises leverage information technology to share and replicate best farming practices from one region or country, with smallholder farmers of other regions or countries. For instance, Digital Green disseminates targeted agricultural information via digital media to small-scale and marginal farmers in India. The solution includes a digital video database that is produced for farmers by farmers. Participating villages are provided with a TV, DVD player and camcorder operated by local NGO staff and managed by farmers, along with DVDs or flashdrives that are shipped to the village. The enterprise organizes shows in

different areas of the village for small groups of 10 to 20 farmers. Similarly, Mali Shambani is a weekly radio program featuring agricultural news and responding to the business and market access needs of rural farmers in Kenya. The hour-long program covers a wide range of topics, including market prices and trends, farming techniques, weather and seasonal issues, financing opportunities, inputs, land use, and quality standards.

Imparting advisory and consultancy services

Online dissemination and sharing of knowledge among experts, farmers, students and research scholars can encourage rapid adoption of efficient and modern farm practices. Some enterprises have developed virtual platforms to disseminate expert advice and technical knowledge, cutting across geographies and time zones to reach a potentially large audience. Other enterprises have leveraged the prevalence of mobile phones to share information, and have set up call centers and help lines that farmers can access for answers to specific queries. Yet other solutions involve the inventive use of videos and design thinking to develop content and material that are easy to understand and internalize. Kenya-based Farmers Helpline operated by KenCall is a call center service staffed by agricultural experts that provide information, advice and support to smallholder farmers over phone, providing voice and voice call-back facilities.

By applying design thinking to extension services, Kenya based Agro-Insight works closely with rural communities, using effective video and print materials. It designs and organizes tailor-made training courses for extension service providers as well as in the development of video and fact sheets for farmers. The company also offers courses in surveillance of plant pests and diseases.

Akshamaala, an agri-extension services company in India, uses its technology platform to enable knowledge sharing and farmer education on key products. To facilitate post-sales service for agri-inputs, Akshamaala provides input companies with a contact center, knowledge management system and farmer relationship management software. It also offers a fully-integrated mobility solution that has a knowledge bank for farmers who can educate themselves on input dosage, usage and risk management.

ICT enabled enterprises can also utilize their virtual platforms to provide farmers access to networks of experts. eKutir, an ICT firm in India has developed the Farmer Portfolio Management Tool (FPMT)—a system created to record individual farmer activities, advise them on how to efficiently manage their assets, and connect them to experts.

Providing tools for pre-harvest efficiency

Social enterprises have adopted ICT to support farmers in achieving efficiency through information systems. Indiagriline is a web-based portal that enables farmers to forecast demand, access records of their previous transactions with the company, register their sugarcane area, submit payment information, and monitor demand, among other services. ICT enables remote agriculture extension where farmers can use email and digital cameras to reach experts and seek crop diagnostics support. Social enterprises such as Cojengo provide a smartphone based diagnostic tool for animal health to improve disease diagnosis, surveillance and treatment of cattle in sub-Saharan Africa.

Virtual City, a private Kenyan technology startup, has developed AgriManagr software which is used by collection centers to manage the process of buying agricultural produce

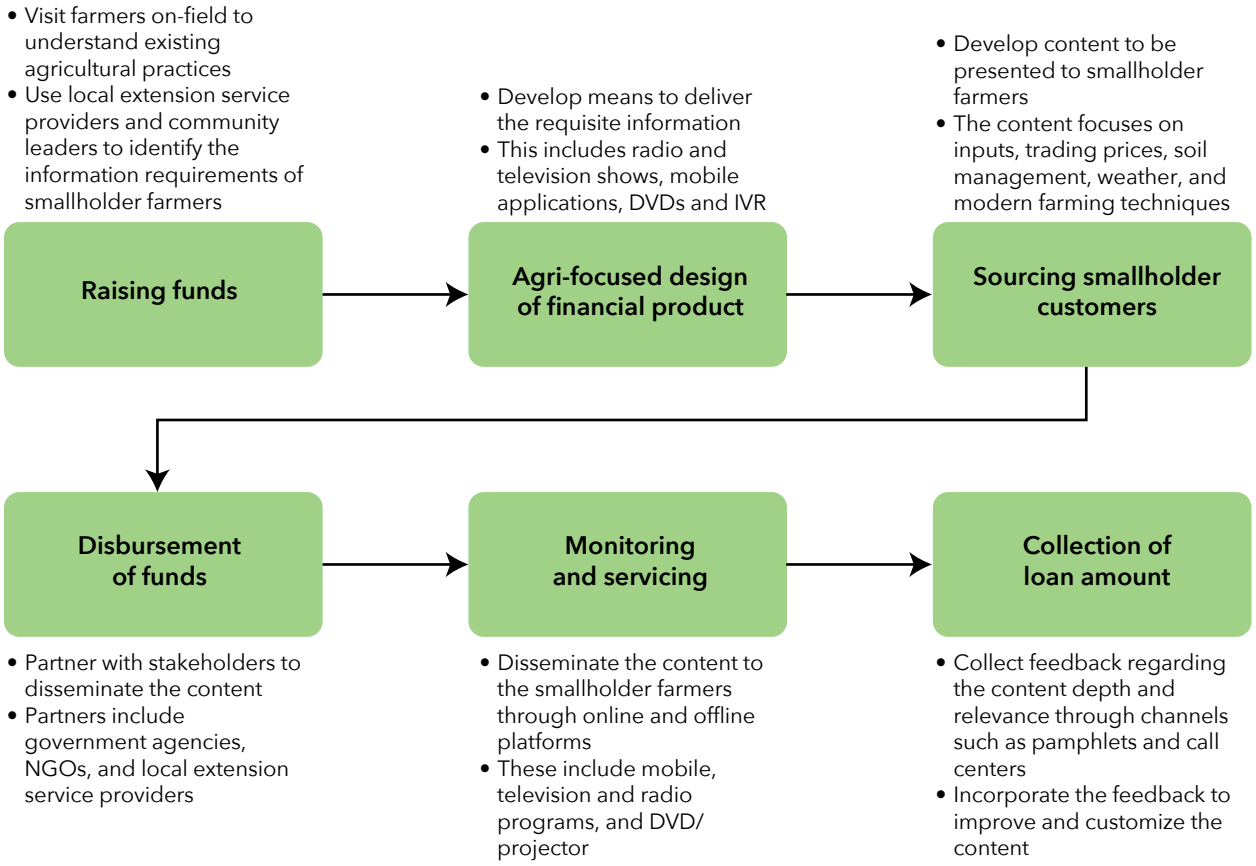
from farmers. AgriManagr has several benefits for both, the procurer and the farmer. It eliminates the manual transcription that inevitably results in record-keeping errors or fraud. It speeds procurement and ensures clarity and accuracy of information, which increases the buyers' ability to respond rapidly to bottlenecks or opportunities.

eKutir has developed several innovative productivity enhancement solutions to improve the livelihoods of smallholder farmers. For example, it has developed a tool called 'mrittik-ka' which provides soil nutrient analysis and recommendations. Another tool called 'ankur' assists farmers with better seed selection to achieve increased productivity and farm yield. On the basis of the agro-climatic analysis and the type and condition of farmland, the tool recommends the best seed type/variety for the crop, localized for each region.

Cost Factors

ICT extension service providers incur high capital expenditure for solution and platform development, and content creation (including research and development costs). Some enterprises such as Digital Green are able to cover these costs through their partners—either the government or private sector companies. Some of the operational costs include cost of acquisition of customers, cost of remuneration of staff members and cost of content enhancement. These costs constitute a smaller component of the total cost, and are also

Figure 8. Process of the model



lower compared to that incurred by non-ICT extension service providers. A number of ICT extension enterprises partner with local stakeholders to further lower these costs.

For some enterprises such as eKutir, product development, sales and marketing, and data informatics are the top three cost components. Likewise, Access Agriculture spends the most in website maintenance, and partner training followed by remuneration of field staff. The enterprise currently incurs large capital expenditure as it plans to build its umbrella of services, and expand its operations. A few enterprises such as Mediae, that presents a TV program called "Shamba Shape-up" incur expenditures in the research and understanding of the issues to be presented in the program. The enterprise terms this as the "Knowledge, Attitude, and Practice (KAP) study" that incurs nearly USD 40,000 per episode. The filming production costs per episode of Shamba Shape-up are around USD 25,000. The enterprise's prime focus has been Kenya, where it has developed six series consisting of a total of 115 episodes. It has also developed one series each in Uganda and Tanzania consisting of 13 episodes in each series.

ICT Extension Service Providers: Cost breakup[*]

As is evident from table 9, the capital expenditure incurred by the enterprises lessens with the increase in the customer base. Operating cost increases initially, however it will also decreases when the enterprises achieve economies of scale.

Revenue Streams

ICT extension service providers earn revenues in two ways: the first, through sale of content that includes provision of advisory services, and management information system (MIS) solutions; and second, by charging segment fees per episode of broadcast content. The advisory services are provided to smallholder farmers either free of cost or at very nominal rates. The enterprises sell content to government and private extension service providers. Digital Green, for instance, earns revenues from sale of videos and technology to government and private extension service agencies that work directly with farmers. The pricing depends on several factors including the partner category, duration of engagement, type and volume

Table 9. Components of the model

Company	*Current or target customer base*	*Cost per user or transaction (USD)*	
		Capital expenditure	*Operating expenditure*
b2bpricenow	26,000	31	2
DrumNet	5,000	57	45
e-Dairy	300	333	20
KACE	1,000,000	0.40	0.50
Reuters Market Light	250,000	8	4

* Qiang, Kuek, Dymond, and Esselaar (2011).

of support required by the partner (for instance the number of extension agents that need to be trained), and their density in a given market or region. Another such enterprise, eKutir, licenses the technology at a pre-decided fee to micro-entrepreneurs that provide training to smallholder farmers. Customized 'software as a service' is sold to the customers; and the customers pay for the data.

Some enterprises charge segment fees per episode. For instance, big corporates including Syngenta Foundation pay nearly USD 5,000 for a five-minute slot per episode for TV shows such as Shamba Shape-up. The corporates use this slot to describe and advertise their products and solutions for smallholder farmers. Other corporates such as Google, Oracle and Cisco sponsor shows by ICT extension providers such Digital Green. Likewise, donors and foundations also support these enterprises, given the high impact nature of their services. For instance, one of the major revenue streams for Access Agriculture is funding from the government of Switzerland, and for Digital Green is funding from The Bill and Melinda Gates Foundation and USAID.

Other innovative modes of revenue generation include sale of video content through video shacks or distributors that sell Bollywood and Hollywood movies. Access Agriculture sells the agricultural training videos in DVD format and 3GP format for mobile phone viewing for a small fee of 50 cents per video. Access Agriculture also sells smart projectors to customers who are off-grid, off-mobile and off-internet. Consultation services and advertising through social media platforms are emerging as sources of income for ICT extension service enterprises.

Financial Viability

Most ICT extension service providers aim to achieve financial sustainability within 2–3 years of their operation. Some of the enterprises design their financial model to achieve break-even from the outset. They achieve this either through strategic partnerships that help the enterprises in increasing the outreach and distribution of their products and services or by developing unique solutions that provide them "first-mover advantage". Other forms of partnership include those for financial support. Donor agencies and governments provide grants and debt funding to enterprises that ensure business sustainability for a few years until they start making profits.

The pricing strategy of ICT extension service providers such as Digital Green depends on a variety of factors such as type of partner, duration of engagement with the partner, type of support required, and number of extension agents to be trained. The enterprise does not have any real competitors, as it partners and works with local extension service providers in different geographies. It provides end to end ICT extension services including production, analysis and distribution of information, which is a distinguishing feature of the enterprise and ensure better financial viability to the enterprise.

An integrated information system reduces the cost, minimizes duplication of data, ensures consistency, and can address a wide variety of information needs. DrumNet, a network of support centers in Kenya provides hands-on assistance through the delivery of financial, marketing and other information products and services to the smallholder farmers (e-transform Africa 2012).

Partnerships

The ICT extension service providers establish partnerships with various stakeholders including government bodies, development organizations, NGOs and input manufacturers for a number of activities. For instance, Digital Green partners with government extension workers who disseminate Digital Green videos and training material to farmers in remote rural areas. Access Agriculture partners with farmer groups, universities, agriculture colleges, and other extension service providers in the video production and distribution process—the enterprise provides filming equipment to its partners and trains them to produce videos based on different agri-themes. Some enterprises such as Mediae partner with corporates such as seed companies, fertilizer companies and chicken providers to showcase their products and support associated education content on their TV show. These partners share information about their pilot programs and demo plots on the show to disseminate best practices to farmers.

Implementation: Delivering Value to the Poor

ICT extension services have gained traction in developing countries in the past few years because of the increasing penetration of mobile and other telecommunication channels and decreasing digital divide in these countries. ICT extension enterprises are changing the manner in which smallholder farmers communicate with stakeholders and access requisite information to improve their agricultural productivity.

Awareness

Nearly 60 percent of farmers lack adequate access to information on advanced agricultural technologies and best practices resulting in huge adoption gap (Tabusum, Saleem, and Batcha 2014). Some ICT extension service providers such as eKutir find it easier to establish a market for their offerings as its customers are already aware about the challenge and the need for such services. The enterprise caters to a mature customer base including multinational companies such as Starbucks, Mars, and Danone; development banks; financial service providers; and other financial institutions.

Enterprises such as Farm Radio International work with established programs and partners such as African Farm Radio Research Initiative of the Bill & Melinda Gates Foundation, and Orange-Fleshed Sweet Potato radio drama of USAID (Farm Radio International n.d.) to quickly gain access to a wide audience. Their programs are supported by advertising through mobile phone and other media.

A few associations, for instance, the Federation of Agricultural Professional Producers of Sissili Province (FEPPASI), a 96 member federation of farmers' organization, leverage ICT to train smallholder women farmers and help them professionalize their farming businesses. FEPPASI used videos, photos, and digital presentations to train farmers in their respective districts (Sphynx 2014).

Acceptance

Enterprises adopt several measures to reach and connect with their target customers and beneficiaries. Many of them now use streaming media to make non-text, i.e., video and

audio information, more widely available to illiterate audiences. The integration of ICT in agriculture extension, especially through the use of videos and other visuals depicting stories similar to those of the regional farmers, increases the possibilities of a direct connect with the smallholder farmers. Enterprises also leverage interactive applications over one-way communication tools (Richardson 2008).These interactive media, including radio messages, feedback pamphlets, and call-center services help the enterprises understand the local context and provide requisite consulting services. Internationally acclaimed ICT extension service providers such as Digital Green emphasize a lot on the content and delivery quality to provide global services at local levels. Digital Green and Shamba Shape Up present stories and instance of some of the role models that help the smallholder farmers grasp the message. A few other enterprises have to invest considerably in adapting their ICT based products and services to the local context. For instance, Access Agriculture customizes its content into local languages. It also ensures relevance with respect to the crops and geographical conditions.

Accessibility

ICT extension service enterprises reach farmers through radio, television, mobile, internet, and videos. Most of the enterprises either have an online mode to reach the farmers or take the support of local community leaders to conduct shows or screen their videos. However, the effectiveness of a video is highly dependent on the quality of the facilitator, so proper identification and training of facilitators is key. Community based tele-centers offer a way of providing affordable access to ICT services in rural areas. These centers could assist agricultural extension officers to disseminate required farming information.

Bangladesh based ICT extension service provider, mPower, has developed an integrated ICT approach that includes mobile and web applications to cater some of the agricultural challenges in the country. It addresses the issue of limited access to agri-extension service providers by means of its community based, infomediary-driven approach, in which the community selects an 'ICT leader' in each farmer group. (The ratio of agri-extension service providers to smallholder farmers is 1:2000 in Bangladesh.) These ICT leaders are trained by the mPower and are provided with a mobile application named 'Farmer Query System.' When farmers in the community face a particular agriculture challenge, the ICT Leaders send the details of this problem through the app to a call center where expert agriculturists respond to the query through a phone call, becoming a virtual extension agent (Sadek 2015). Another Bangladesh based enterprise, D-Net, implements the Microsoft Unlimited Potential Project in the form of Pallytathya Kendra, a community-based technology center. It enables rural communities to access different ICT tools including computers and internet. It also helps smallholder farmers use mobile phones to retrieve information from telecentres and other sources (Dey, Prendergast, and Newman 2008).

Some enterprises have incorporated innovative mechanisms to increase their reach. For instance, Shamba Shape-up shows are hosted by famous Kenyan actors who attract large audiences. The program also leverages its partner corporates' demonstration plots and extension workers to reach farmers. Access Agriculture has a unique distribution strategy where it leverages the inclination of Kenyan farmers towards soccer watching, and in religious belief. It partners with soccer screening establishments, and religious places such as churches and mosques to show the 'Access Agriculture' videos. Likewise, in Malawi, the

enterprise sells the content loaded on DVDs and micro SD cards through video shacks that rent/sell DVDs of Bollywood and Hollywood movies. It also provides access in multiple formats—farmers can access the free content through its website, mobile phones and television.

Affordability

ICT based extension service providers balance their infrastructure and human resource costs with their revenue model to ensure affordable services to various stakeholders including smallholder farmers. ICT extension service enterprises make their products and services affordable and often free for farmers by cross-subsidizing or charging large corporate partners and other paying customer groups. They also leverage donor and grant money to bridge the gap between costs and revenues. Some enterprises receive funding from development finance institutions (DFIs) including United States Agency for International Development (USAID), Department for International Development (DFID), and the Rockefeller Foundation (RF). For instance, USAID funded mPower to implement its Ag Extension Project in Bangladesh. Likewise, DFID, RF and USAID funded Mediae, the enterprise that broadcasts Shamba Shape Up program.

DFIs partner with the enterprises on a cost-sharing basis, and support critical activities such as filming of content, as in case of Mediae. It maintains its financial sustainability through donor funding and corporate advertisements during the airing of Shamba Shape-up program. This allows the enterprise to waive viewership fees from farmers. Digital Green also partners with governments and private sector players on a cost sharing basis. As a partner, the private sector company covers all costs including the project cost and the operational cost, while the governments cover only the operational cost.

Results and Cost-Effectiveness

The combination of traditional and modern media, such as radio and mobile phones has increased the outreach of extension services to smallholder farmers.

Scale and Reach

ICT extension service providers have been able to reach a large number of smallholder farmers quickly. The viewership number of Shamba Shape Up has reached over 10 million. In a given week in Kenya, nearly 18 percent to the total TV-watching audience, which is equal to over 5 million viewers, watch the program. The program is watched by another 5 million viewers in Tanzania, 1 million in Uganda, and 0.5 million in Rwanda (The Mediae Company n.d). Likewise, Digital Green has expanded its network in India and other countries in the last few years. The enterprise, along with around 58 partners has provided training to over 1.15 million farmers across India and other developing countries in the last 6 years. e-Krishok has addressed information inadequacy in Bangladesh and has directly impacted 375,000 farmers, while creating an indirect impact on another 650,000 farmers within 8 years of its operation (MEAS 2015).

Some enterprises plan to expand their customer base and geographic reach; some others plan to improve their partners' strengths, and a few others plan to increase their product

portfolio. Digital Green targets to reach the next one million, from the current 1.15 million, in the coming 2–3 years. The enterprise plans to leverage its network of farmers to provide them other services besides ICT extension. In India, Digital Green is in the process of extending its partnership with other NRLM states like Jharkhand through smaller pilot projects. It is also leveraging the Mahila Kisan Sashaktikaran Pariyojana (MKSP), an initiative under NRLM to empower women in agriculture, partnering with NGOs to work in three states of India—Maharashtra, Andhra Pradesh and Karnataka. The initiative, e-Krishok targets to reach 1 million farmers by 2017 (MEAS 20150.

A number of ICT extension service providers are planning to expand to other geographies in the next 2–3 years. For instance, Shamba Shape Up plans to expand to Malawi, Zambia, Ethiopia, and Nigeria. eKutir targets to increase the number of partners to 20, thereby reaching 10,000 million farmers by 2020. A few other enterprises plan to leverage their subsidiary products and services to generate other sources of revenue. Access Agriculture, for instance, plans to utilize its website AGTUBE.org, which acts as a social media platform for agricultural enterprises to raise funds through corporate sponsorships and advertisements by various corporates including telecom companies and Fast Moving Consumer Goods (FMCG) companies. The enterprise plans to enhance its financial sustainability by selling smart projectors, and by providing training and translation services.

Generally, the reach of ICT service providers is quite high. This is because of the nature of the service and the mode of delivery. Though, the above numbers reveal commendable reach and access to the smallholders, there are no third party evaluations or studies that validate the real impact in terms of adoption of best practices.

Improving Outcomes

Strategic application of ICT has led to better information dissemination, and access to best practices in agriculture at reduced costs. It has also resulted in mobilization of farmer groups towards increased agricultural production, poverty alleviation and economic development. According to a number of sector studies, ICT intervention has dramatically improved the amount and quality of extension services in agriculture, which is the largest economic sector in most of the developing countries. For instance, an SMS based intervention that sends agricultural advice to smallholder farmers in Kenya increased yields by 11.5 percent relative to a control group who did not receive any such messages (Casaburi, Kremer, Mullainathan, and Ramrattan 2014). Basic voice calls have helped smallholder farmers expand their

Table 10. Examples of companies and their reach

Company	*Country of operations*	*Years of operation*	*Number of farmers reached*
Digital Green	Afghanistan, India, Ghana, Ethiopia, Niger, Malaysia and Mozambique	10	over 1.15 million
eKutir	Bangladesh, Cambodia, India, Nepal, Republic of Macedonia, Haiti, Peru	3	nearly 61,000
e-Krishok	Bangladesh, Pakistan	8	over 1 million
Shamba Shape Up	Kenya, Tanzania, Uganda	6	~9 million viewers

buyer network. According to a study conducted in Benin, mobile phone usage facilitates transactions and provides producers access to relevant, timely information, allowing them to sell at a higher price improve their income. In the study, a randomized control trial of 1,000 farmers using Esoko's market information service in Ghana showed an increase of 7–11 percent in farmer's income for yams (USAID 2013).

One immediate benefit of ICT extension solutions to smallholder farmers is a decrease in transportation costs to obtain market information. Farmers can make a voice call to estimate the demand for a product and the price being offered on a particular day. They can then make an informed decision comparing the travel effort and the possibility of making profit that day. According to a study conducted in Niger an average trip for an agricultural laborer to a market located 65km away can take 2–4 hours round trip, as compared to a two-minute call. This results in cost savings of USD 0.50 per trip (considering daily wage of USD 1) (USAID 2013).

ICT extension service providers are also expanding their umbrella of services to continue providing incremental benefits to the farmers. eKutir has served nearly 61,000 farmers across India, Bangladesh and Cambodia. Digital Green has reached over 1 million individuals across 13,592 villages through 4,426 videos, which showcase and demonstrate best practices. Nearly 574,222 of the viewers adopted one or more of the best practices promoted through these videos. According to the post-broadcast research, 87 percent of the Shamba Shape Up audience learns something new, and 46 percent adopts a new practice as a result of watching the show (The Mediae Company n.d.). Shamba Shape Up generated a direct positive impact on nearly 428,566 households by increasing the farmer income by nearly USD 24 million (The Mediae Company 2013). VetAfrica app, produced by IT enterprise Cojengo, helped in dealing with 80 percent of cattle diseases commonly found in rural Ethiopia. There was a 70 percent level of agreement in diagnosis between the app and vets examining the animals (Strathclyde 2015).Besides creating a number of direct impacts such as increased awareness and income of smallholder farmers; ICT extension services also result in several indirect impacts such as creation of jobs for agricultural experts, targeted marketing for agricultural companies, data collection, analysis and feedback generation for further improvement of services.

In India and several countries of Sub-Saharan Africa, the contribution of agriculture to the GDP is lesser than 30 percent, however it employs a majority of the population. Therefore any impact on the sector has a huge impact on the larger population (Chavula 2013).Participatory Radio Campaigns (PRCs) have been piloted and evaluated in five countries in Sub-Saharan Africa viz Ghana, Malawi, Mali, Tanzania and Uganda. Nearly 80 percent of farmers listened to almost half of the PRC program; 40 percent direct listeners and 20 percent passive listeners adopted improved agricultural practices (Francis 2014).

Cost-Effectiveness

ICT helps the extension service providers reach rural and remote locations that are otherwise not feasible to cover by non-ICT based extension service providers. The ratio of extension service providers to smallholder farmers is worrisome. In Kenya, over 5 million smallholder farmers depend on around 5,500 extension service providers. Likewise, the extension service provider to smallholder farmer ratio is 1:2000 in Bangladesh. Moreover, the cost of building an extensive network of extension workers is far more expensive than investing

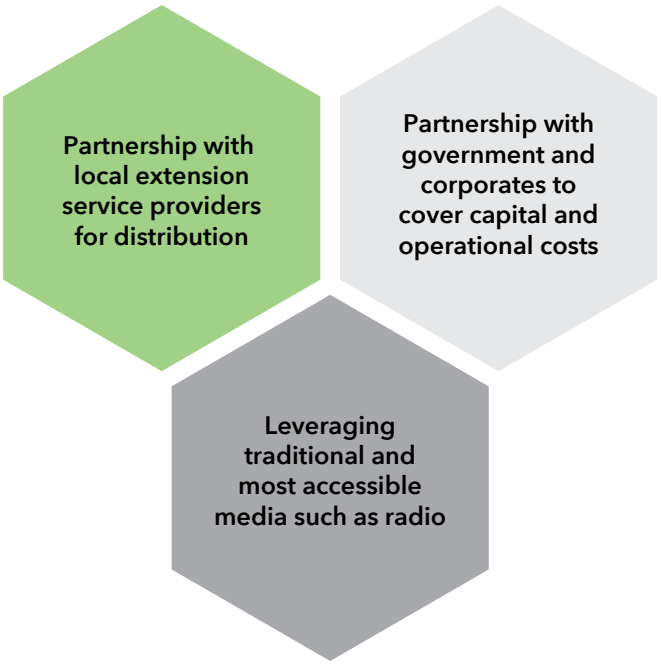
once is technology. This is because the one-time investment in technology offsets against the increasing numbers of smallholder farmers who will start using ICT based extension services. With the rapid expansion and penetration of smartphone market in the developing countries, such solutions will be a win-win for the service providers and customers. (In India, the smartphone market is estimated to grow to over 200 million by end of 2016.)

The context, choice and compatibility of tools and the communication platforms play a crucial role in ensuring the cost effectiveness of any ICT extension product or service. For instance, Some ICT extension enterprises such as Mediae partner with corporates including agricultural input companies to describe their products along with associated education content for farmers as part of the TV show episodes. Mediae recovers its cost by taking fees from these partners to be featured in the TV shows thereby reducing the operational costs for the compny.

Digital Green partners with government extension workers and NGOs to facilitate last mile reach. This improves the efficiency of existing government and NGO extension systems by a factor of 10 per dollar spent; it also helps the enterprise keep operational cost to the minimum (Gandhi 2009).While working with governments, the cost for training and technology development support provided by Digital Green is usually covered by donors including Bill & Melinda Gates Foundation, Google, Oracle, USAID, and the government covers the capital cost and operational cost. When Digital Green works with private sector agribusiness, such as JK Paper, Marcatus QED (MQED), the companies usually cover all of the costs, including that of technology development, training, capital expenditure and operational expenditure.

Moreover, the process of video screening in the enterprise model leverages low-cost, peer-to-peer video-based knowledge exchange. Local agriculture agents and peer mediators are trained to use pocket-sized cameras to produce videos starring community members

Figure 9. Partnerships for the model



about locally relevant agricultural practices and issues. Trained local farmers facilitate regular screenings of these videos with a battery-operated, mobile projector among small groups of farmers.

Likewise, the financial model of Access Agriculture works is not very cost intensive as it works with local extension service provides that are already engaged into creation of video content. Access Agriculture helps such enterprises enhance the quality of the videos. Cojengo partners with non-governmental organizations (NGOs) to ensure the charitable donations and funding is sustained and used in the most efficient way resulting in real return on investment (Cojengo n.d.).

A number of enterprises such as Farm Radio International leverage the reach of traditional communication media such as radio. This is because smallholder farmers in rural and remote locations have limited access to communication technologies; and radio reaches nearly 70 percent of the rural households (Fiafor 2014).

Scaling Up

Challenges

ICT extension services face a number of challenges that restrict the expansion of the business model. These challenges are broadly categorized as technology challenges, human resource challenges, and content development challenges. Though technology is an enabler in providing extension services, the challenge is to develop m innovative technology that can be used by smallholder farmers. Adequate internet and mobile bandwidth and connectivity is a limiting factor, especially in developing countries. Further, data is expensive in most remote rural areas and hence cost becomes a major barrier for internet or mobile usage by the smallholder farmers even where bandwidth is available. Therefore, alternate technologies such as training videos, radio and television programs are required to overcome this rural digital divide, and to ensure reach of ICT extension services to the smallholder farmers either free of cost or at nominal feeA number of enterprises use these technologies to address the bandwidth and data cost issues, and even then reach remote rural locations.

The information requirements of smallholder farmers vary depending on their current knowledge, experience and existing sources of information. The highly localized nature of agriculture means that scientific information must be tailored specifically to suit local conditions, and should be timely available.

Lack of relevant content limits the application of proposed solutions; lack of context limits uptake by farmers. It is essential to develop the solutions in local language that are up-to-date and are provided in a timely manner. A few enterprises such as Digital Green are already developing content on a crowd-sourcing basis— by the farmer, of the farmer, for the farmer. However, many ICT extension enterprises struggle with consistency and quality in content creation and dissemination (FAO 2012).

The interviewed ICT extension service providers acknowledge other challenges such as access to finance. Generally, financial insecurity is a major challenge for agricultural extension service providers who have had to depend on grant funding. In Africa, there has

been a renewed interest in funding agriculture in line with the commitment to the Malabo Declaration of using at least 10 percent of national budget for agriculture. A number of countries have met the commitment. However, currently state funding contributes only half of total requirement. The quality of funding of agriculture also varies within countries. Often, input subsidies get prioritized over strengthening of extension services for improved uses of subsidized inputs (Berthe 2015).

According to the National Agricultural Sector Extension Policy (NASEP) of Kenya, the government is the main player providing extension services. However the funding is directed mostly towards staff remuneration, rather than operations and maintenance of extension services. A few programs and projects fund extension services as a core activity (Government of Kenya 2012).Likewise, in Latin America and Caribbean (LAC), despite enormous investment in public extension programs, the impact is rarely visible. Further research is required to help policymakers and development practitioners understand the criticality of integration of ICT extension services in agriculture in LAC (Aparajita and González-Velosa 2013).

Role of Government and Policy

Governments can facilitate the expansion of ICT based extension services by introducing relevant policies and legislations. They can also create awareness among the farmers regarding the use of ICT extension services, through their existing on-ground agri-support presence. Governments should invest in developing the ICT capacity of their existing extension programs and services and integrate ICT in national extension system such as those adopted by some countries such as Jamaica, where The Rural Agricultural Development Authority (RADA) of Jamaica has been proactive in using ICTs in its extension programs. The ICT program is financed through its core budget and grant funding. RADA extension agents have been trained in the use of ICTs for enhancing service delivery. Social media, Skype and SMS are various communication channels used to maintain close contact between farmers and extension agents.

In India, the central and state governments have supported various initiatives to address challenges in the agriculture sector. The national policy framework for agricultural extension emphasizes the importance of increased use of ICT in communication, marketing and provision of agricultural extension services to stakeholders in the agriculture value chain. The agriculture mission mode projects (MMP) are included in the national e-governance plan (NeGP) to provide information to the farmers on seeds, fertilizers, pesticides, government schemes, soil recommendation, crop management, weather and marketing of agricultural produce. Department of Agriculture and Cooperation (DoA&C) has initiated several projects such as ASHA in Assam, KISSAN and e-Krishi in Kerala and Krishi Maratha Vahini in Karnataka. The department has also launched two portals AGMARKNET & DACNET to lead the implementation of MMP in Agriculture (Saravanan 2014).

According to some of the ICT extension service providers, although government is supportive in general; there are not many supporting extension policies and regulations that could help escalate the ICT extension business model. Governments at the central level have some programs; however the system collapses at state or county levels. As a result, this is a private sector driven business model that rides on the back of government and donor backed agendas. In India, the umbrella program 'National Rural Livelihood Mission' provides

flexibility to invest in innovative approaches in agriculture including investment in cameras and videos. There is no government subsidies offered for promotion of ICT extension service business model.

Conclusion

The ICT extension services business model addresses the development challenge of information inadequacy on best practices in agriculture, weather updates and prevailing market prices that support the income potential of smallholder farmers in a number of developing countries. This said, the business model is very impactful if it is provided along with on-ground support. In the absence of market linkages for the produce grown, any information, however great and useful, will not raise farmers' incomes. In spite of this, most ICT models don't focus efforts on markets or partnering with enterprises doing this.

The impact numbers outlined in the table in 'scale and reach' section provide validation for its impact potential. However, impact attribution with respect to adoption of the practices suggested by deploying ICT is not evident as it is difficult to measure. The model is heavily dependent on grants and partnerships for its operations and sustenance. The two major revenue streams include corporate sponsorships and advertising, and the model's profitability hinges on the presence of sponsors. Enterprises that provide agricultural consultancy and other extension services can leverage ICT to make the best combination of technology, sector expertise and on-ground presence.

Table 11. Social enterprises: ICT extension services

Company	*Countries*	*Solution description*
Access Agriculture	Bangladesh, Ghana, Kenya, Malawi, Mali, Tanzania, and Uganda	Access Agriculture enhances the capacity building capabilities of several local extension services providers, by helping them produce relevant content. The content is translated in local languages, and is adapted to the respective regional requirements.
Cojengo	Multiple countries in Africa	Cojengo is a smartphone based diagnostic tool used in animal heath to improve disease diagnosis, surveillance and treatment of cattle in sub-Saharan Africa.
Digital Green	Afghanistan, India, Ghana, Ethiopia, Niger, Malaysia and Mozambique.	Digital Green uses a digital platform to mobilize rural communities and provide agricultural extension services to smallholder farmers. It works closely with public, private and civil society organizations for outreach and engagement in several countries.
e-Krishok	Bangladesh, Pakistan	e-Krishok is an initiative of Agricultural Information and Advisory (Extension) and Market Linkage Services that provides extension and market linkage services to the smallholder farmers. Every farmer who buys an input package is entitled to receive an information service package, value for which depends on the value of products.

Table 11. Social enterprises: ICT extension services (continued)

Company	*Countries*	*Solution description*
eKutir Rural Management Services	Bangladesh, Cambodia, India, Nepal, Republic of Macedonia, Haiti (american republic), Peru	e-Kutir uses an entrepreneurship model combined with ICT to deliver solutions to BoP communities
Esoko	Kenya, Ghana	Esoko is a technology platform that integrates small-holder farmers into the formal value chain by leveraging mobile phone technology. The platform enables agribusinesses, governments, mobile operators and NGOs to provide critical information to small-holder farmers on market prices, agronomic and training tips. It also surveys the farmers for their needs and desires.
Farm Radio International	Tanzania, Burkina Faso, Ethiopia, Ghana, Mali, Uganda	Farm Radio supports small-scale farming and rural communities by leveraging on radio broadcasters. The organization does provides broadcaster resources, broadcaster training, and impact programming. The organization develops radio scripts, information packages, a weekly electronic news service, and a special on-line community called Barza, and shares these tools with thousands of African broadcasters. Broadcasters, in turn, use these resources to research, produce and present relevant and engaging programs for their audience.
KenCall – M-Kilimo	Kenya	M-Kilimo, launched by KenCall in Kenya, bridges farmers and agriculture experts by providing individualized answers through a call center approach.
Mobile Mandi	India	Mobile Mandi provides live updates on day-to-day commodity rates to different mandis of India. It is multilingual, and helps to track commodity rates across 500 mandis on the move. The content is updated at runtime to provide latest rates to users.
NAFIS	Kenya	NAFIS is a comprehensive information service, intended to serve the needs of smallholder farmers in Kenya including the rural areas where internet access is limited. It enables farmers' access to agricultural extension information via the internet or mobile phone. Information is updated through the web by field extension officers and disseminated through a detailed website or through mobile phones.
Shamba Shape Up	Kenya, Tanzania, Uganda	Mediae (Shamba Shape Up's parent company) supports education and development. Shamba Shape Up is Kenya's first make-over television program guiding small scale farmers on topics such as improved pest management, irrigation, cattle rearing, poultry keeping, financial education, crop management techniques.

References

Bell, Mark. 2015. "ICT-Powering Behavior Change in Agricultural Extension" Feed the Future. October. https://agrilinks.org/library/ict-powering-behavior-change-brighter-agricultural-future

Berthe, Abou. 2015. "Extension and Advisory Services Rural Extension Services for Agricultural Transformation." Delivered at the Feeding Africa Conference, October 21–23, 2015

Casaburi, Lorenzo, Michael Kremer, Sendhil Mullainathan, and Ravindra Ramrattan. 2014. "Harnessing ICT to Increase Agricultural Production: Evidence from Kenya." http://www.jblumenstock.com/files/jsde/kremer.pdf

Chavula, Hopestone Kayiska. 2013. "The Role of ICT in agricultural production in Africa." *Journal of Development and Agricultural Economics* 6 (7). http://www.academicjournals.org/article/article1403537040_Chavula.pdf

Cojengo. n.d. "Partners." http://www.cojengo.com/partners/

Dey, Bidit Lal, Renee Prendergast, and David Newman. 2008. "How can ICTs be used and appropriated to address agricultural information needs of Bangladeshi farmers?" http://www.globdev.org/files/28-Paper-Dey-How percent20Can percent20ICTs percent20be percent20used-Revised.pdf

e-transform Africa. 2012. "ICTs for Agriculture in Africa." http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/282822-1346223280837/Agriculture.pdf

Farm Radio International. n.d. "Partners." http://www.farmradio.org/about-us/partners/

Fiafor, Ben. 2014. "How radio programmes can support agriculture and market development." World Food Programme. https://www.wfp.org/purchase-progress/news/blog/how-radio-programmes-can-support-agriculture-and-market-development

Food and Agricultural Organization (FAO). 2012. "Smallholders and Family Farmers factsheet." http://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Factsheet_SMALLHOLDERS.pdf

Francis, Judith. 2014. 'Modern ICTs and rural extension: Have we reached the tipping point?' *Rural 21*. March. http://www.rural21.com/english/news/detail/article/modern-icts-and-rural-extension-have-we-reached-the-tipping-point-00001059/

Gandhi, Rikin. 2009. "Digital Green:Participatory Video and Mediated Instruction for Agricultural Extension." Microsoft Research India. https://www.microsoft.com/en-us/research/wp-content/uploads/2009/03/322-797-2-PB.pdf

Government of Kenya. 2012. "National Agricultural Sector Extension Policy (NASEP) of Kenya." https://www.kenyamarkets.org/wp-content/uploads/2016/06/National-Agricultural-Sector-Extension-2012.pdf

Goyal, Aparajita and Carolina González-Velosa. 2013. "Improving Agricultural Productivity and Market Efficiency in Latin America and the Caribbean: How ICTs can make a Difference?" *Journal of Reviews on Global Economics* 2: 172–182. http://lifescience-global.com/pms/index.php/jrge/article/viewFile/1128/643

Krumins, Carl. 2015." Smartphone Ownership, Usage and Penetration by Country." October. http://thehub.smsglobal.com/smartphone-ownership-usage-and-penetration

Lowder, Sarah, Terri Raney, and Jakob Skoet. 2014. "The Global Distribution of Smallholder and Family Farms " CGAP Blog. October. https://www.cgap.org/blog/global-distribution-smallholder-and-family-farms

The Mediae Company. n.d. "Shamba Shape Up, Center for Education Innovations." http://www.educationinnovations.org/program/shamba-shape

———. 2013. "Shamba Shape Up Series 2 and 3: KAP Report." https://cgspace.cgiar.org/bitstream/handle/10568/34824/Shamba%20Shape%20Up%20Series%202%20and%203%20KAP%20Report.pdf

Modernizing Extension and Advisory Services (MEAS). 2015. "Facilitate innovation in e-Agriculture: Sharing e-Krishok and MEAS Experiences." http://www.slideshare.net/MEAS1/june-4-at-1-pm-akbar-biid

Qiang, Christine Zhenwei, Siou Chew Kuek, Andrew Dymond, and Steve Esselaar. 2011. "Mobile Applications for Agriculture and Rural Development." ICT Sector Unit. World Bank: Washington, D.C. http://siteresources.worldbank.org/INFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/MobileApplications_for_ARD.pdf

Richardson, Don. 2008. "How Can Agricultural Extension Best Harness ICTs to Improve Rural Livelihoods in Developing Countries?" http://departments.agri.huji.ac.il/economics/gelb-how-11.pdf

Sadek, Sadman. 2015. "'Digital Extension System' in Agriculture, learning from Bangladesh.' e-agriculture.org. http://www.e-agriculture.org/blog/digital-extension-system-agriculture-learning-bangladesh

Saravanan, R. 2014. "ICTs for Agricultural Extension in India: Policy Implications for Developing Countries." http://www.saravananraj.net/wp-content/uploads/2014/12/45_AFITA_ICT-for-Agricultural-extension_India.pdf

Shabana Tabusum, Shaban, A. Saleem, and M. Sadik Batcha. 2014. "Transformation of ICT initiative for Indian Agriculture In Modern World." *International Journal of Research in Engineering & Advanced Technology*: 2(4). September. http://www.ijreat.org/Papers%202014/Issue10/IJREATV2I4009.pdf

Sphynx. 2014. "ICTs give Burkinabe Women access to the lucrative international Fair Trade and organic shea butter market." YenKasa Africa. March. http://yenkasa-africa.amarc.org/en/node/496

United States Agency for International Development (USAID). 2013. "Using ICT to Enhance Marketing for Small Agricultural Producers." https://agrilinks.org/sites/default/files/resource/files/Using_ICT_to_Enhance_Marketing_for_Small_Agricultural_Producers.pdf

University of Strathclyde, Glasgow (Strathclyde). 2015. "Clinical study proves VetAfrica app saves livestock." 2015 https://www.strath.ac.uk/sen/makingadifference/news/news2015-16/clinicalstudyprovesvetafricaappsaveslivestock/

CASE STUDY

digitalGreen

Founding year: 2006
HQ: San Francisco, CA
Countries of operation: India, Ethiopia, Malawi, Ghana, Senegal, Niger, Papua New Guinea, and Nepal

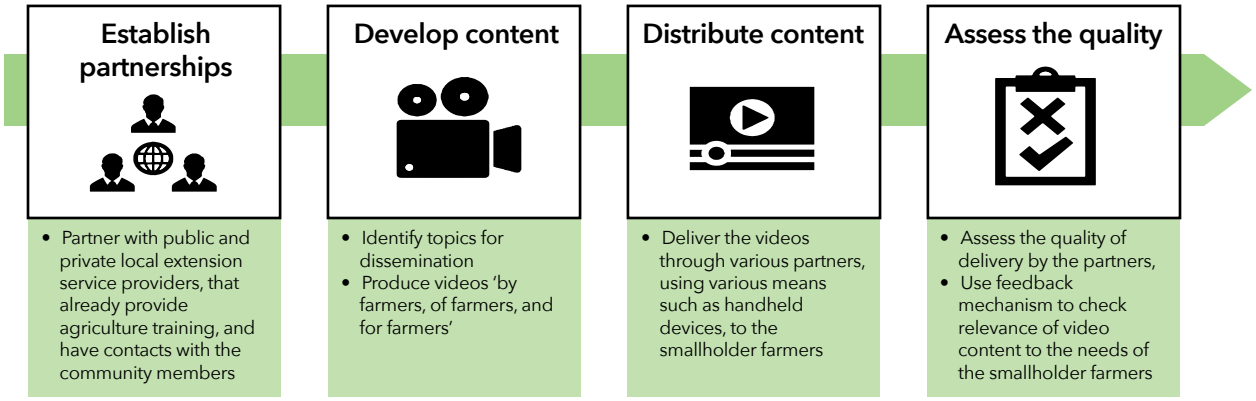
Orientation: Non-profit
Employees: 100
Turnover: USD 4 million

Lack of information about critical inputs and inadequate knowledge about modern and efficient agriculture practices is a major factor contributing to low farm yields. While traditional media such as radio and television have continued to play a major role in extension and development communication, growth in the internet and increased access to and use of mobile technology are perceived to be the game changers in the ICT extension space.

Digital Green is a not-for-profit international development organization that leverages digital means for community engagement to improve lives of rural agriculture based communities across South Asia and Sub-Saharan Africa. The enterprise partners with with local public, private and civil society organizations to share knowledge on improved agricultural practices, livelihoods, health, and nutrition, using locally produced videos and human mediated dissemination. The enterprise's approach is 10 times more cost-effective; and the uptake of new practices is 7 times higher in comparison to traditional extension services.

Operating Model

Digital Green builds and deploys information and communication technology to increase the effectiveness of extension services for the benefit of smallholder farmers. The enterprise provides training and technical support to its partners and develops technology-based solutions to empower rural farmer communities. Digital Green is supported by The Bill and Melinda Gates Foundation, USAID, Google, Oracle, and Cisco.



Digital Green screens videos on topics such as agricultural practices, livestock, agriculture inputs, and government programs in agriculture sector, is organized for farmer groups. The process leverages low-cost, peer-to-peer video-based knowledge exchange. Local agriculture agents and peer mediators are trained to use pocket-sized cameras to produce videos starring community members about locally relevant agricultural practices and issues.

Trained local farmers facilitate regular screenings of these videos with a battery-operated, mobile projector among small groups of farmers in an interactive forum and encourage them to adopt the best practices featured in the videos. Extension agents collect and analyze feedback and usage data at the community level using an information system that operates in locations with poor Internet connectivity. Digital Green's approach focuses on peer learning and involves producing videos that are by farmers, of farmers, for farmers. The enterprise taps into the ability of viewers to connect with other farmers shown in the videos to disseminate important farming practice improvements.

The enterprise also partners with the government and private sector organizations that are involved in rural development and engage in on-ground extension activities, to train smallholder farmers. These agencies also usually already employ frontline village-level workers, like agricultural extension agents and village resource persons, who facilitate the screening of videos among community groups that they are already working with closely.

In 2012, Digital Green partnered with the Government of India under the National Rural Livelihoods Mission to improve the efficiency of agriculture and livelihoods interventions by promoting relevant best practices in agriculture and livelihoods, non-farm practices, financial inclusion, and institution building. Government extension workers were provided videos and other training material by Digital Green. In 2014, Digital Green entered into a national level memorandum of understanding (MOU) with the National Rural Livelihoods Promotion Society (NRLPS) to expand the Digital Green approach to other state rural livelihoods missions and partners. Digital Green also has formal Memoranda of Understanding with NRLM's state-level implementation agencies—Society for Elimination of Rural Poverty (SERP) in Andhra Pradesh and Bihar Rural Livelihoods Promotion Society (BRLPS) in Bihar. Of the total outlay for this project, the Government of India and state governments cover almost 70 percent of the cost, while the Bill & Melinda Gates Foundation covers 30 percent of the cost.

Digital Green has defined standard operating procedures and has a variety of technology tools that are open-source and can be customized. For instance, its data collection and

monitoring system, Connect Online Connect Offline (COCO), is open source and freely available; partners can view and adapt the software code and use the software platform for its own use. Its training procedures and video content are posted on its website.

Financial Sustainability

Digital Green leverages its partners' strengths and existing infrastructure, such as local extension networks and relationships. This eliminates the possibility of parallel and unsustainable systems, and keeps the costs low for Digital Green and its partner organizations. The enterprise adopts different business models with different types of organizations. For instance, with NGOs, the enterprise follows a donor-supported model, where donors cover the capital as well as operational expenses. When working with governments, the cost of training and technology development support provided by Digital Green is usually covered by donors such as Bill & Melinda Gates Foundation, Google, Oracle, and USAID, while the government covers the capital cost and operational cost. The World Bank provides financing to some of these government programs, such as the National Rural Livelihood Mission (NRLM), which is led by the Ministry of Rural Development, Government of India (MORD, GOI). When Digital Green works with private sector agribusiness, such as JK Paper and Marcatus QED (MQED), the companies usually cover all of the costs, including that of technology development, training, capital expenditure and operational expenditure.

Digital Green incurs costs primarily for technology, human resources for technical assistance and training support, research and quality assessment. Its revenue streams include fees for providing technical assistance, and videos/ technology to the partners. Pricing of the services provided by Digital Green is a function of several factors such as the partner involved, duration of engagement with the partner, type of support required, and number of extension agents to be trained. Digital Green does not have any real competitors, as the local extension service providers in different geographies work as partners of the enterprise. Digital Green provides end to end ICT extension services including production, analysis and distribution of information. This is a distinguishing feature of the enterprise.

The enterprise has received external funding from donors such as Gates Foundation and USAID, and from corporates such as Google, CISCO and Oracle. Digital Green has won several awards; some of them include Ashoka fellow, and those from eNGO, Google, and Massachusetts Institute of Technology.

Impact

Digital Green has been shown to be at least ten times as effective, per dollar spent, as compared to traditional approaches to agriculture extension (Eikin Gandhi, Ashoka India Fellow).

The Digital Green videos empower three groups of farmers: community members involved in producing videos, members involved in screening videos, and members who watch the videos. The representatives for the first two groups may begin with limited skills and abilities. With experience, they benefit in terms of increased confidence and ability to create and share content with fellow members. The third group benefits by learning about new agriculture practices and strategies that could improve their agriculture output.

Challenges and Lessons

The foremost challenge that the enterprise faces is to maintain the quality of programs, mainly due of its scale. Although the enterprise provides requisite technical training to the partners, it does not have direct control on the quality of video screening, depth of content, and several other critical factors affecting video content quality. Digital Green addresses this issue by conducting a quality assessment at its end once it receives the videos from the partners, to ensure that the videos disseminated as Digital Green videos are of standard quality. The expansion is also a critical issue as it is a function of the number of extension services providers present in any region. In the absence of existing extension service providers in a particular area, the enterprise leverages its network from the nearest location to cater to the ICT extension service requirements in that area. Digital Green also leverages government programs and extension services to cater to this challenge and achieve the desired scale and reach.

Road Ahead

Digital Green has expanded its network in India and other countries in the last few years. It took 6 years to reaching the first million farmers. The enterprise targets to reach the next one million in the coming 2–3 years. The enterprise plans to leverage its network of farmers to provide them other services besides ICT extension.

In India, Digital Green is in the process of extending its partnership with other NRLM states like Jharkhand through smaller pilot projects. It is also leveraging the Mahila Kisan Sashaktikaran Pariyojana (MKSP), an initiative under NRLM to empower women in agriculture, partnering with NGOs to work in three states of India—Maharashtra, Andhra Pradesh and Karnataka.

CASE STUDY

Access Agriculture

Founding year: 2012
HQ: Kenya
Countries of operation: Bangladesh, Benin, Ghana, India, Kenya, Malawi, Mali, Tanzania, Uganda; and videos used in over 100 countries

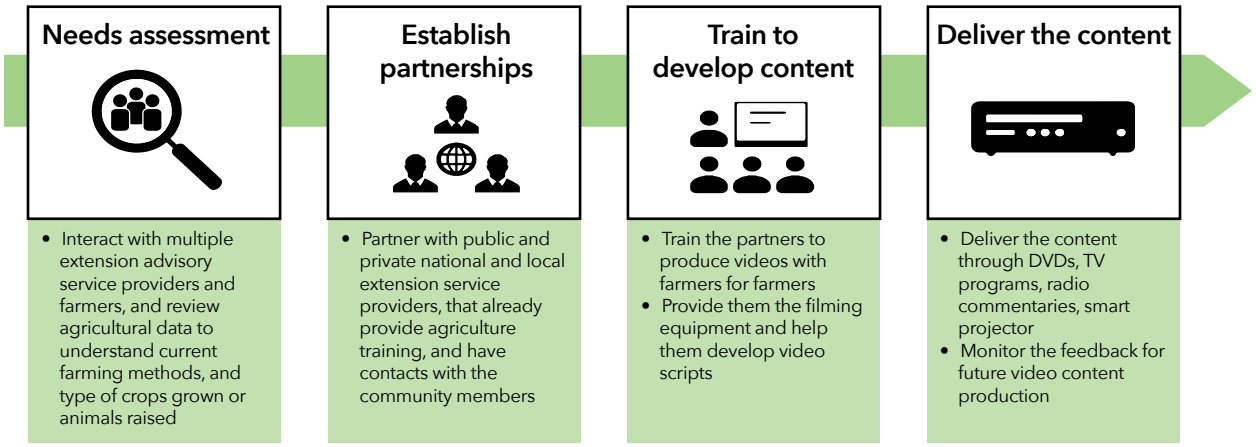
Orientation: INGO
Employees: 13
Turnover: USD 2 million

Videos are becoming increasingly popular among farmers. They are based on the concept that a farmer always looks over their fence to their neighbor's field to check what s/he can learn. In Africa where many households lack electricity or cannot afford the equipment to watch videos, many farmers are missing out on this great medium. There are now projectors with rechargeable batteries which can be used to screen farmer-to-farmer videos. With increasing mobile phone density, some farmers even watch the videos on their mobile phones.

Access Agriculture is an international NGO that works across all developing countries to enable the exchange of and access to quality audio-visual training materials to secure sustainable livelihoods of rural agriculturists. Access Agriculture facilitates and builds capacity for the production and translation of quality farmer-to-farmer training videos into local languages. It provides quality training material for rural advisory services and agricultural education systems to improve access of youth, women, and smallholder farmers to relevant knowledge.

Operating Model

Access Agriculture enables smallholder farmers in India, Bangladesh and seven African countries access to videos on best practices in agriculture. Its videos— disseminated through media including DVD, radio, television, mobile phones and solar-powered smart projectors—are scripted and filmed in a manner that is easily understandable to farmers and replicable in different geographical contexts. Primarily scripted in English and French, the



content can be translated into other languages based on the demand of local communities. Based on the medium of dissemination, the videos are provided either free of cost or by charging a nominal fee to farmers.

The videos contain information on several pre-harvest and post-harvest best practices ranging from categories like cereals, vegetables, integrated pest management, farm mechanization and livestock and are exhibited by filming experiences of smallholder farmers. Farmers participate in the video shoot to share their success story that can be attributed to training and capacity building. They also believe that the exposure via videos can bring them other financial and business benefits. The local extension service providers participate because videos align well with their work of making agricultural information accessible to farmers, and validate some of their recommendations. In addition to spreading their message, these videos also ease their task of encouraging behavior change. Online and offline distribution of such videos helps farmers learn, understand and adopt the practices suggested in the content. The enterprise encourages all extension service providers operating in developing countries to translate the videos available on the website into local languages for easy access to farmers that otherwise do not have access to such content. The enterprise assesses the videos and selects some of them for dissemination on its website.

In addition to its repository of videos, Access Agriculture offers a fee-based translation service to extension service providers and other such agencies interested in using quality videos in their own farmer training programs. The videos are available online as well in DVD format and 3GP format for mobile phone viewing. The enterprise also allows downloads of audio tracks (of the videos) by radio stations, who can feature it any time. Further, the enterprise has a network of partners who disseminate the videos in locations with no access to electricity. Trained agriculture experts use a motorized tricycle with an attached generator and sound system to project the farmer training videos to almost 200–300 villagers at once. The enterprise also sells 'smart projectors' providing access to the enterprise's video library to farmers who are not connected to electricity.

Access Agriculture operates mainly through partners that include private sector enterprises, universities, agriculture colleges, and other extension service providers. Usually, the partners engage with field staff in different regions to produce videos on any specific crop or agricultural practice. The enterprise trains these partners to produce videos, and provides

them the filming equipment. The partners spread awareness among smallholder farmers regarding the significance of ICT extension services and their role in increasing agricultural productivity. They inform the farmers about Access Agriculture; and encourage them to register on the platform and avail of the extension services. The partners also help improve or customize the video content by incorporating feedback that they receive from farmers.

In the initial stages, television stations charged Access Agriculture to showcase videos. However, as a result of the growing popularity of the enterprise and its videos, the broadcasting stations have now entered into agreements with Access Agriculture to broadcast the videos without charge. The enterprise monitors viewership rates and farmer feedback for future video content production.

The enterprise is currently operational in nine countries. As part of the first phase supported by the Government of Switzerland's grant, Access Agriculture started its operations in Benin, Kenya, Malawi, Mali, and Uganda; further leveraging on the grant, it expanded to Bangladesh, Ghana, India and Tanzania. Generally, while expanding to new geographies, Access Agriculture partners with established agricultural development organizations that are aware of local farming contexts and have an extensive network of farmers that they can reach. For instance, the enterprise has partnered with the Kenya National Farmers Federation (KENAFF), an umbrella organization of farmer groups, representing the interests of about 2.1 million farm families in Kenya. The Federation is a partner to Access Agriculture in producing and distributing agricultural videos for smallholder farmers.

Access Agriculture has also worked with government extension service providers in Bangladesh, Benin, India and Malawi. The enterprise also had discussions with the governments of Kenya and Uganda on inclusion of ICT in agriculture.

Financial Sustainability

Some of the major costs incurred by Access Agriculture include those for website maintenance, partner training, and remuneration to the field staff and partners. The enterprise earns revenues from multiple sources including funds from the Government of Switzerland, sale of video translations, and commission from the sale of smart projectors (powered through a portable solar panel). The smart projector is targeted to customers who are off-grid, off-mobile and off-internet. It also earns revenue by providing consulting services and capacity building workshops. As an international NGO, the organization raises grant capital to run its operations. It has funds in pipeline by the Government of Switzerland at least until 2018.

As Access Agriculture works with local people, the model is not very cost intensive. This is because, in many cases, the partners are already engaged in the creation of video content. Access Agriculture helps such enterprises enhance the quality of the videos. It also encourages them to make videos in local languages; and in a format that can be easily applied by the farmers.

Impact

Access Agriculture has impacted over one million farmers by making quality videos available to thousands of extension service providers across developing countries. The enterprise videos that contain information about agricultural best practices are available free of cost on the company's website. Access Agriculture remains cost effective by partnering with local

extension services providers that have established relationship and reach to smallholder farmers. Local partnerships also enhance its distribution capabilities.

Challenges and Lessons

As the enterprise operates mainly through partners, some of the major challenges are also connected with them. Access Agriculture partners with a variety of organizations that are all differently oriented, with different skills and capacities, and therefore faces a challenge in aligning them to its mission and objectives. In order to address this issue, it adjusts its operational activities and procedures, as per the speed and approach of the partners.

Another critical concern is the implementation of its process. It is quite demanding to make an agricultural training video as it requires a lot of time and invkolvement of many stakeholders, such as farmers, agricultural experts, local extension service providers, videographers, interviewers, and editors. The challenge is to integrate the knowledge of local farmers and experts in the video to be delivered in the shortest time. The enterprise partners with local extension services providers to address this challenge.

Videos from the Access Agriculture library are in the public domain, so anyone can use the videos for free. As thousands of organisations and individuals in the agricultural extension and education system use and further share the videos, it is impossible for Access Agriculture to accurately monitor video distribution and use.

Road Ahead

Access Agriculture has launched a new website, AGTUBE.org, which acts as a social media platform for agriculture stakeholders. It plans to use the platform as a social enterprise to raise funds through corporate sponsorships and advertisements on this website by telecommunication and Fast Moving Consumer Goods (FMCG) companies. The enterprise plans to enhance its financial sustainability by selling smart projectors, and by providing training and translation services.

Agriculture Non-ICT Extension Services

Development Challenge

Smallholder farmers require training and support in terms of capacity building and training in modern agricultural practices, technical support such as soil analysis, market facilitation advice, and business management skills. Historically, governments have provided agricultural extension services, including training, information, and capacity building services free of charge to small-scale farmers.

However, limited resources curtail governments' capacities to provide quality and timely extension services. For instance, despite 71 percent and 43 percent of Uganda farmers expressing interest in receiving extension services in crop and animal husbandry respectively, only 17 percent of crop and 21 percent of livestock farmers were served by extension services. Similarly, in the Democratic Republic of Congo, research showed that only 17 percent of the sampled villages reported having had visits from any extension agent in the previous five years and 83 percent of villages reported not receiving any extension visits. In India, public extension agencies, including extension workers, Krishi Vigyan Kendras (or Farm Science Centres), and State Agricultural Universities, were a source of information for a mere 10 percent of households; another 41 percent sourced their information from either farmer-to-farmer interaction or traditional and modern forms of ICT (newspapers, radio, television, and internet). The given mismatch in demand and supply of extension services may seem to warrant private sector participation in providing these services.

Business Model

Agriculture extension is the application of scientific research and knowledge to agricultural practices through farmer education. Enterprises that provide farmers income-generating or productivity-enhancing products and services, such as agricultural inputs, direct-from-farm market linkages, or contract farming procurement models, bundle extension services in their service offerings to farmers. These enterprises increase farmer awareness to increase uptake of their products and services.

Information Dissemination

Typically, enterprises whose core business model involves selling productivity enhancement agricultural inputs include high-touch information and capacity-building services as part of their farmer awareness building and marketing activities. They disseminate knowledge to farmers through various modes of delivery, including classroom workshops, demonstration plot visits, and peer-to-peer learning. As part of classroom training, agriculture experts and

technicians provide theoretical knowledge on agricultural practices to a cohort of farmers. Demonstration plots involve on-field demonstration of successful agriculture techniques that farmers can observe, test and learn about. For example, The Real IPM and Hydroponics Africa conduct demonstration plot sessions related to the products that they sell. Peer learning workshops involve training select village-level farmers who disseminate insights to other farmers in their communities. Most enterprises partner with rural government bodies and NGOs to expand the reach of farmers that are served.

Advisory and Consulting Services

Typically, enterprises that engage with farmers on a contract basis or provide direct-from-farm market links collectivize farmers and provide capacity building and training on aspects related to production, collection, storage, and processing. For example, Go4Fresh, a direct-from-farm marketplace, conducts exposure visits for farmers registered on its platform to enable these farmers to understand urban market preferences, and as result, influence their farming practices. Equator Kenya, an agricultural exporter that works with farmers on a contract farming model provides climate-smart technologies, training and market linkages to smallholder farmers in Kenya. Babban Gona franchises farmer groups and markets maize on their behalf. Members get access to development and training in agronomy, financial literacy, business skills and leadership skills.

Financial Viability

Stand-alone non-ICT agricultural extension services tend to remain as not-for-profits or government programs. Farmers' belief in traditional agricultural practices is deep rooted, and their adoption is instinctive; hence, providing information alone will not encourage them to make the shift to consistently use modern and efficient practices. They lack the willingness to pay for information not linked with visible positive outcomes, and do not trust extension agents who are not from within their communities. Therefore, despite the need to bolster existing government agricultural extension services, providing solely non-ICT extension services is not a sustainable model for private enterprises.

Private enterprises also have to deal with mistrust and prejudice associated with poor past experience of farmers. Governments do not always take into consideration the tailored needs of individual farmers while designing and delivering information and capacity-building services, which results in ineffective information application and dissemination to the recipient. Based on these experiences, farmers tend to mistrust the advice provided by extension agents. This means that private enterprises have to make significant effort to build trust among its target farmer base. It is a cost-intensive service considering farmers are reluctant to pay for information and training that they have previously been receiving free of charge.

Ease of access to attend training and demonstration sessions also play a role in determining the willingness to pay for non-ICT extension services. For example, research on farmers in Uganda showed that 36.8 percent of households that were 2 kilometers or less from the nearest road were willing to pay for extension services in crop husbandry as compared to 34.5 percent among household located more than 5 kilometers from the nearest road. Leveraging on ICT to deliver extension services to remotely located smallholder

farmers seems to be more cost-efficient for enterprises; enterprises can minimize physical visits to farms and reduce hiring extension agents to deliver training and demonstrations. In comparison to non-ICT services, ICT as a means of dissemination for extension services also enables enterprises to provide a variety of information to farmers in a timely manner that is easily accessible, relevant, and affordable to small-scale farmers.

Results and Cost-Effectiveness

Research shows that extension services that are combined with income-generating and financially effective activities for farmers are more valuable to smallholder farmers. In Ethiopia, 90 percent of farmers who expressed willingness to pay for extension services suggested they will pay only if profit was guaranteed by adopting the extension advice and if payment could be made after production.

Extension services without agricultural inputs or market access is not useful to farmers. A majority of private enterprises therefore provide non-ICT extension services as part of selling productivity enhancement inputs to farmers or engaging with farmers on contract farming models. Private commodity firms or input suppliers may provide extension services (such as pest management advice and best practices in irrigation) to their clients to create awareness and increase uptake of their products (examples include The Real IPM, myAgro and Sidai Africa).

The provision of this service may be exclusive only to an enterprise's customers or may be provided as an incentive for farmers to buy an enterprise's products or services, such as in the case of Hydroponics Africa, which conducts training in demonstration plots and then sells its hydroponic systems to interested farmers.

Conclusion

Given the premise that the primary consumer base who require agricultural advisory services are smallholder farmers who don't possess the ability to pay, non-ICT extension services will need to be bundled with additional yield-enhancing and income-generating services in order to attract these farmers. Farmers are willing to pay for information and training if other value-added services are also provided. Private enterprises will also need to work closely with government agencies to increase their outreach. Enterprises may also leverage on technology-enabled extension support for widespread dissemination of information and training services to remotely located farmers.

Table 12. Social enterprises: Non-ICT extension services

Company	*Countries*	*Solution description*
Hydroponics Africa	Kenya, Uganda, Tanzania	Hydroponics Africa specializes in manufacturing, installation and marketing of hydroponic systems. As part of its marketing strategies, it trains farmers in hydroponic farming technology. It conducts training sessions in its demonstration plots and charges a fee of USD 9.88, which is waived from the total price of a hydroponics system if a farmer opts to procure a system after attending the training.
myAgro	Mali, Senegal	myAgro is an agricultural input aggregator and distributor that uses a mobile technology platform to provide access to fertilizer and seed packages on layaway. In addition, the enterprise also provides technical training, market access to premium buyers and access to asset loans for appropriate small-scale farm equipment. The training services focus on best practices in agriculture and increasing awareness of myAgro's products to farmers.
Sidai Africa	Kenya	Sidai provides crop inputs, livestock and veterinary services to pastoralists and farmers in Kenya through franchised and branded Livestock Service Centres that are equipped to provide quality animal health products and professional technical advice. The enterprise's field agents visit crop and livestock farmers on their fields to disseminate knowledge on use of quality inputs to increase productivity and conduct demonstration on best practices in agriculture. Interested farmers can then avail Sidai Africa's pre-harvest input products.
The Real IPM Company Ltd.	Kenya, Zambia, Zimbabwe, Ethiopia, Tanzania, South Africa	The Real IPM Company Ltd. designs integrated pest management solutions for farmers in Kenya. It conducts training sessions in demonstration plots to increase awareness of smallholder farmers on best practices in agriculture and market its pest management products.

Productivity Enhancements for Smallholders

Helping to raise farmers' incomes by providing them access and training to low-cost quality inputs and agricultural machinery

HIGHLIGHTS

- Agricultural equipment designed for use in small farm plots make it feasible for farmers to shift from labor intensive practices to higher-yielding mechanized practices.
- Inputs are made affordable by providing flexible payment options and savings based input packages.
- Farmer education services bundled with inputs help farmers understand accurate usage and application of inputs, thereby increasing their trust in improved inputs.

Summary

Agricultural productivity is severely hampered by lack of quality inputs and inefficient farming practices. Smallholder and marginal farmers are particularly prone to low yields and margins emanating from limited access to inputs, lack of knowledge about agricultural best practices, and restricted financial resources. In the absence of best practices, farmers use low-quality agricultural inputs, such as poor-quality seeds, fertilizers, agro-chemicals, veterinary medicines, and cattle feed. They resort to labor-intensive processes in lieu of agricultural equipment such as cultivators, tractors, and harvesters.

The productivity enhancement business model encompasses activities that provide farmers with access to low-cost quality inputs and agricultural machinery, and capacity building services to use these yield-enhancing solutions effectively. A number of enterprises have designed low-cost inputs that they make accessible and affordable to remotely located farm-

ers. In addition, a large number of such enterprises provide capacity building services to enable farmers to make informed decisions on input usage. They often partner with agricultural experts and government programs to impart training in best practices.

Development Challenge

Approximately 80 percent of the field plots in Asia and Sub-Saharan Africa are managed by smallholder farmers (FAO 2012). Despite being predominantly agrarian economies, farmers from these regions continue to face challenges in productivity and crop quality. Smallholder farming is characterized by heavy use of fertilizers to maximize yields from small plots and minimal use of mechanization. There are two key reasons for this poor productivity. First, smallholder farmers are unable to access quality inputs. Second, even when they can access superior inputs, they lack the know-how and expertise on how to use these inputs effectively. Further, these inputs are often unaffordable for smallholders, resulting in lower adoption rates. Use of inferior inputs or inefficiency in their use results in low yields and decreased bargaining power for farmers; poor financial returns; and consequently, lack of accumulated savings for purchase of improved inputs and farm machinery in the next crop cycle. This ultimately places these farmers in a vicious cycle of low productivity and subsistence farming (Tumusiime-Mutebile 2013).

An estimated 500 million farmers (IFAD 2011)constitute the world's smallholder population—they cultivate crops or produce livestock on farm lands that are lesser then two hectares in size (IFC 2013). Modern technologies are typically designed for use in larger farms, for instance irrigation equipment caters to field sizes over four hectares (Acumen n.d.), thereby forcing smallholder farmers to resort to flood irrigation. Research (Tagar et al. 2012) shows that using drip irrigation over the traditional flood irrigation method results in higher crop yields, increased fertilizer efficiency, reduced energy consumption, improved tolerance to salinity, and improved disease and pest control. In Sub-Saharan Africa, only 3 percent of the cultivated land is irrigated (Gradl et al. 2012).Smallholder farming is also predominantly labor-intensive; farm workers provide 65 percent of the power required for land preparation in Sub-Saharan Africa, this figure stands at 40 percent in East Asia, 30 percent in South Asia and 25 percent in Latin America and the Caribbean (FAO 2015).

Smallholder farmers and pastoralists are often remotely located and underserved by input retailers. These farmers therefore lack access to crop productivity boosters such as climate-resistant seeds and organic fertilizers, and critical livestock inputs such as animal health services and nutritious feed. For example, limited availability of crop protection products leads to pest-related crop losses globally varying from approximately 50 percent for wheat to over 80 percent in cotton production, which with the use of pest management products could be reduced to 26–40 percent (Gradl et al. 2012).Limited presence of agro-retailers coupled with lack of monitoring and law enforcement result in presence of counterfeit products in rural markets. Their poor performance reduces farmers' trust in input effectiveness. Smallholder farmers are also unable to access timely and sufficient information on effective usage of inputs, better farming practices and financial advice that ultimately result in untapped opportunities for these farmers to enhance productivity.

Business Model

Several enterprises address challenges faced by smallholder farmers in the pre-harvest stage. They provide access to inputs, make inputs affordable and disseminate information about solutions to enhance agricultural productivity.

Components of the model

Figure 10. Components of the model

	Provide access to inputs	Make inputs affordable	Deliver information
Development Challenges	• Social enterprises design farm equipment that cater specifically to small plots. Examples include micro-irrigation kits, small tractors and plows. • Enterprises partner with local retailers and technicians for last-mile distribution of inputs • Enterprises work with regulators in establishing input standards to enable access to genuine inputs	• Enterprises have designed solar powered irrigation kits and hydroponics technology inputs that reduce related operational costs • Enterprises manufacture drip irrigation and climate resilient technology that can be used throughout the year by farmers • Enterprises provide inputs through rent-to-own micro-leasing and savings based mobile layaway options to finance input purchases	• Some enterprises have designed equipment that provides yield analysis and suggests appropriate amounts of inputs • Most enterprises that provide inputs to small holder farmers and pastoralists offer on-farm training services in partnership with agronomists, animal health experts and rural government programs that help in expanding the reach of information delivery
Components	**Provide access to inputs**	**Make inputs affordable**	**Deliver information**
			
Key Activities	• Unavailability of inputs customized for smaller plots • Remotely located smallholder farmers lack access to high-quality inputs owing to sparsely stocked agro-retailers • Unregulated inputs market result in distribution of counterfeit inputs and mistrust within the farmer community	• High-costs associated with modern inputs and mechanization equipment • Excessive dependence on rains curtail incomes of smallholder farmers and restrict purchasing power for inputs in the next season • Marginal farmers are reluctant to take large amounts of credit for high-quality input purchase	• Lower productivity and yield due to limited information on effective use of inputs • Lack of awareness on mechanisms to address effects of climate change on productivity • Remotely located smallholder farmers lack access to information and capacity building extension services on input usage, financing options, and input availability

Provide access to inputs

Most commercially available farm equipment is unsuitable for small plots. In order to address this challenge, a number of enterprises design inputs and machinery for use in small plots. For instance, Kamal Kisan's products, such as the Vegetable Planter and Mulch Layer are designed for use in farms that are smaller than two hectares, and enable farmers to substitute labor-intensive processes thereby decreasing dependence on labor and associated labor costs. Driptech manufactures and distributes micro-irrigation kits that are suitable for use in small fields. Some enterprises provide agricultural inputs to rural farmers through partnerships with local retailers and technicians. Sidai provides livestock and veterinary services to farmers through franchised Livestock Service Centers that are managed by local, trained technicians. The enterprise also works with regulators to advocate for improved law enforcement measures to monitor standards for veterinary services thereby increasing trust with smallholder farmers.

Make inputs affordable

Enterprises enable marginal farmers in reducing costs incurred on inputs and farming. They manufacture low-cost products that are sold in smaller affordable packages; provide installment financing to lower the burden of upfront costs, and sell inputs to a group of farmers who share the costs and further lease it to other farmers. myAgro, a company operating in Mali and Senegal provides a savings based mechanism for farmers to buy input packages of their choice—input packages could include different types of seeds, fertilizers, and training services. Farmers identify an input package that they would like to purchase, and set a savings target to match the cost of the inputs package. They then purchase myAgro 'planting cards'—scratch cards from local vendors at flexible amounts and frequencies and continue to add money to this card until the savings target is reached. Once the target is reached, the famer can avail of the inputs package. myAgro's mechanism allows farmers to access quality inputs without availing credit financing. KickStart's rent-to-own model provides farmers a micro-leasing option to acquire inputs.

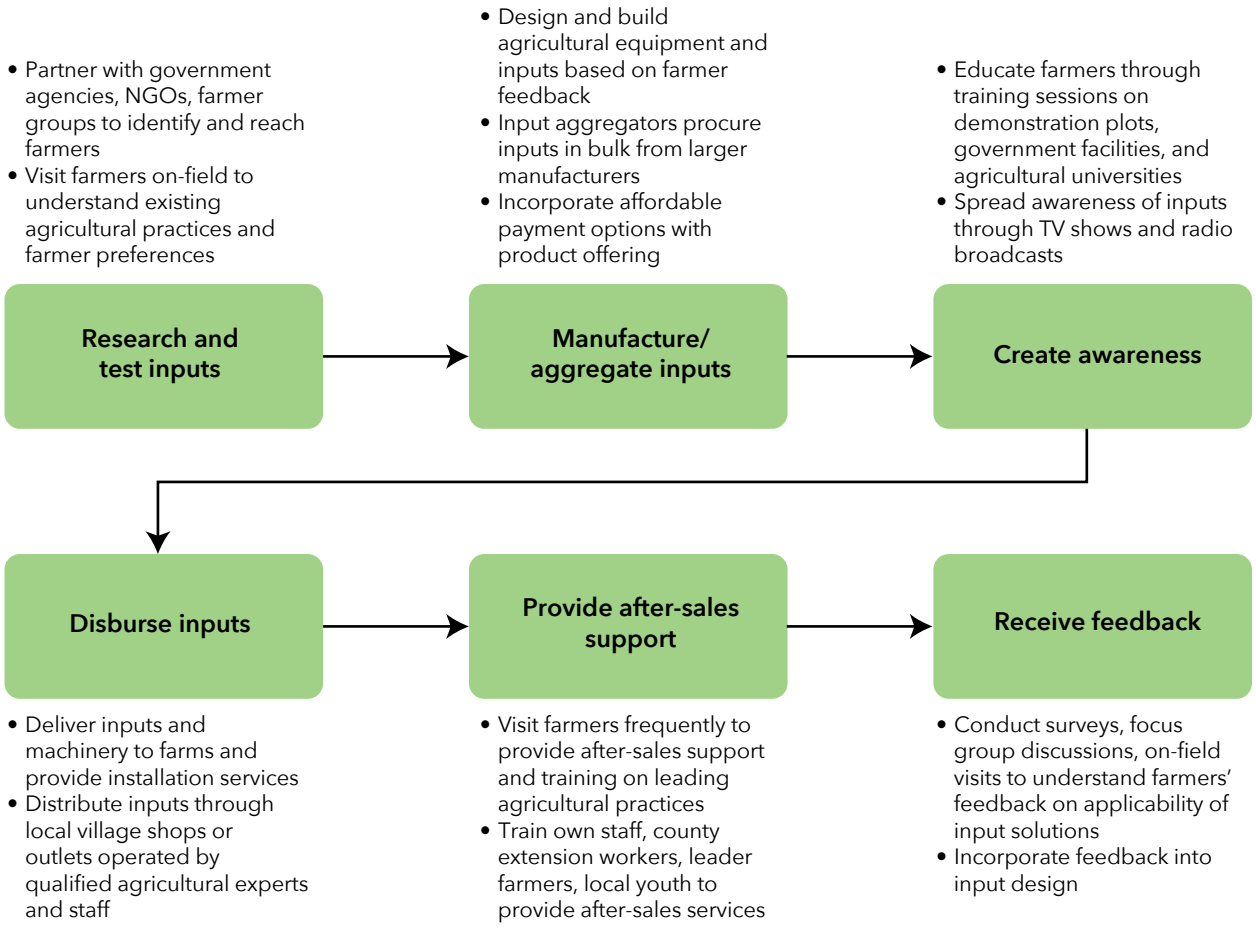
Deliver information

Enterprises such as Eruvaka Technologies, a company based in India offers data-analytics-supported aquaculture equipment that enables farmers to monitor their ponds through a smart-phone and adjust the amount of fish feed based on water quality and weather data. The real-time monitoring mechanism helps farmers increase yields and reduce unnecessary input costs. Micro Drip, a drip irrigation manufacturer and supplier trains farmers in using its irrigation solution effectively; the enterprise also partners with stakeholders such as Thardeep Rural Development Program and Universal Agro Chemicals to provide technical training on crop productivity.

Cost Factors

Solutions to improve agricultural productivity include providing access to quality inputs and suitable equipment, and improved knowledge to use inputs effectively. Many enterprises design and manufacture farm equipment and inputs by engaging with farmers and incorporating their suggestions. Costs incurred on research & development, product

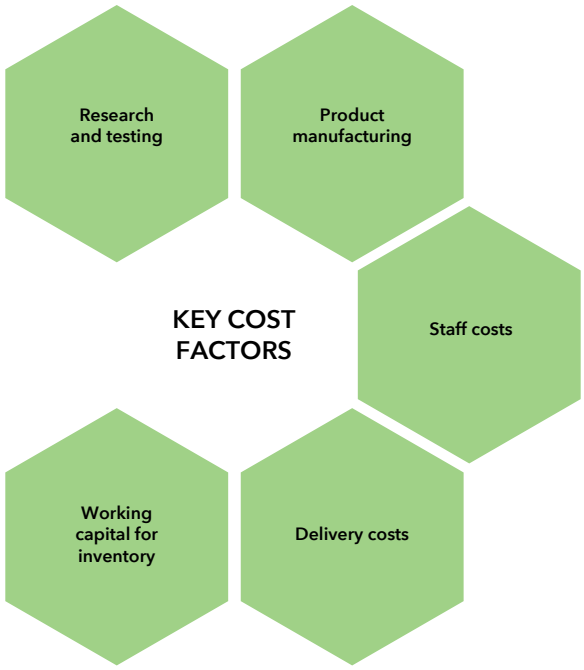
Figure 11. Process of the model



design and testing constitute a significant share of the overall costs for enterprises providing productivity enhancement solutions (figure 12). The team interacts with smallholder farmers to understand the nature of labor intensive activities, prevalent cropping methods and the intended benefits of mechanizing an activity. For example, Kamal Kisan incurs over 30 percent of its total costs on pre-design research and 25 percent on product development.

Enterprises also require significant working capital to maintain inventory and ensure continuous supply of inputs to farmers in remote areas. Since enterprises need to educate smallholder farmers about the benefits of quality inputs and equipment before they acquire them as customers, they also incur costs towards hiring field agents and agronomy experts, and establishing demonstration plots to conduct training sessions. Distribution costs comprise a significant share of total costs; enterprises either directly undertake last-mile delivery to farms or partner with farmer groups, farmer co-operatives and local village stores for distribution in remote areas. In addition to these costs, input aggregators incur costs in purchasing bulk quantities of seeds, fertilizers, animal feed and other agricultural inputs from input manufacturers, repackaging them and selling these inputs to small-scale farmers.

Figure 12. Cost factors of the model



Revenue Streams

Revenues are generated through sales of pre-harvest inputs such as seeds, feed, fertilizers, crop protection solutions, irrigation systems, farm machinery and equipment. Enterprises such as Proximity Design, Sun Culture, SAS Motors and Micro Drip manufacture and sell inputs to small-scale farmers while others like Sidai and myAgro aggregate inputs from large input manufacturers and sell these inputs to farmers. Enterprises also earn revenues by providing training and agronomy support to farmers; these services are provided either as part of the package with inputs or as a stand-alone service to farmers who may choose to purchase inputs after undergoing the training. For instance, Hydroponics Africa conducts training sessions on hydroponics farming in its demonstration plots and charges a fee of KSH 1000, which is waived from the total price of a hydroponics system if a farmer opts to procure a system after attending the training. Hydroponics Africa's hydroponics systems range from USD 50 for small farms to USD 29,000 for commercial size farms

Financial Viability

The viability of the model hinges on the uptake of improved inputs by smallholder farmers, and for this, enterprises need to understand smallholder farmer needs, design inputs and machinery specific to those needs, and engage with farmers to educate them on the benefits of adopting improved inputs. Donor grants are important in supporting research, development and awareness creation activities prior to the actual sale of inputs and agricultural equipment to smallholder farmers. Enterprises providing yield-enhancing inputs and equipment have to engage extensively with farmers to understand their specific needs and preferences—this process often takes over a year.

In order to be cost efficient, enterprises aggregate farmers for research and testing of inputs, leveraging partners such as non-governmental organizations, government employed county extension workers and farmer co-operatives who engage directly with farmers, thereby decreasing costs incurred in reaching remotely located farmers. Enterprises such as Kamal Kisan ensure cost-effectiveness by designing and developing farm machinery based on farmer demand and competitor solutions. It develops machinery only if a majority of farmers perceive a cost benefit to substitute labor-intensive activities with mechanization and if the market is not already over-crowded.

Another effective mechanism is the integrated value chain model that companies like Siddhivinayak Agro employ. With the help of a bank loan, they provide 100 percent of the inputs and advice to farmers for potato cultivation–no cash goes to farmer only inputs and then they buy back all the harvest and give to the farmer net income after deducting all the input and other costs. This model reduces the risk for a bank and makes it easier to provide input finance.

Smallholder farmers' ability and desire to adopt yield-enhancing inputs is largely reliant on their understanding of the benefits, capacity to pay for these inputs and the ease or practicality of adopting these solutions. Farmers either have limited access to input financing or are reluctant to add to their debt burden to procure quality inputs in markets that are over-crowded with low-cost, sub-standard inputs. SunCulture's target farmers typically do not have the necessary capital to afford inputs; this is reflective in the fact that despite 65 percent of Africa's labor force employed in agriculture, less than 1 percent of outstanding loans are provided to the sector (Ibrahim 2016).

Even when farmers have the capital, they would rather deploy it in competing uses as they are unaware of the benefits of these solutions and therefore, are reluctant to lock funds in for an entire growing season (Ibrahmi 2016). In response to this challenge, SunCulture is currently designing its own flexible payment asset-financing product. This will ensure customer stickiness and continuous sale of products. myAgro sells agricultural inputs using a savings based approach whereby farmers save ahead for fertilizers, seed packages, agricultural machinery, and training services using a mobile layaway mechanism. They save towards a selected inputs package, can avail of it once they reach their savings goal; 35 percent of myAgro's operations are currently covered by farmer payments, and the remaining costs are covered by donor funding.

Enterprises that operate as input aggregators purchase inputs in bulk quantities from large input manufacturers allowing them to avail discounted prices. Their ability to maintain comfortable margins between their procurement prices and the prices they charge farmers determines their financial viability. This is further strengthened by ensuring low costs on maintaining inventory and repackaging inputs. Enterprises also require significant funding support during the initial years of operation to support their research and design activities. This is particularly so for enterprises that manufacture agricultural machinery as they spend considerable time conducting in-depth research on smallholder farmer practices and developing inputs and machinery that cater specifically to smaller plot sizes, and intensive farming practices. Typically, they ensure financial viability by leveraging grant funds for these activities.

Partnerships

Pre-harvest input enterprises partner with various ecosystem players in order to understand smallholder farmer needs, establish trust with the farmers and promote awareness to enable adoption of the productivity enhancement solutions. Enterprises partner with farmer co-operatives, farmer groups, agricultural research organizations and rural agriculture universities to conduct research and test prototypes of inputs and farm equipment. For instance, Sidai works with research organizations such as Diagnostics For All to conduct field testing and co-design pregnancy diagnostics for livestock, and DSM for feed quality testing. Some enterprises partner with research centers and universities to source data such as region-specific types of crops, total cultivated land use, land holding size, and agronomic conditions to inform new product development.

It is important for input enterprises to demonstrate the value of their solutions to smallholder farmers—enterprises use demonstration plots and training facilities of government research centres and agriculture incubators to showcase their products to farmers. They also provide training sessions to farmers on leading agricultural practices: for instance, Hydroponics Africa conducts training sessions on hydroponics farming in Kenya Climate Innovation Centre's demonstration plots and Kamal Kisan leverages Krishi Vigyan Kendra's facilities to train farmers on the benefits and appropriate usage of agricultural mechanization. Enterprises market and distribute their products to farmers through partnerships with farmer co-operatives, local government agencies, agriculture universities and media-based agricultural information service providers. Some enterprises partner with buyers of smallholder agricultural produce, such as sugarcane mills and greengrocers to reach potential farmer customers. Enterprises also find it beneficial to partner with non-governmental organizations (NGOs) to increase their market access to farmers located in remote areas. Multiple input enterprises partner with financial institutions to provide end-user financing to farmers for purchase of inputs and agricultural machinery.

Partnership models may also involve contractual agreements between the enterprise and the partner stakeholder; for instance Hydroponics Africa provides train-the-trainer sessions on hydroponics farming to staff of the Uganda National Council of Science and Technology under a Memorandum of Understanding (MoU) agreement, Sidai's partnership with Global Good for fertilizer quality testing involves a MoU.

Implementation: Delivering Value to the Poor

Awareness

Improved inputs and machinery can lead to increased productivity for smallholder farmers. However, limited access to pre-harvest credit, uncertainties in payback periods, existence of counterfeit products, and lack of knowledge on yield-enhancing products leads to resistance towards adopting improved inputs and agricultural equipment.

In order to address these challenges, enterprises interact with farmers to educate them on the benefits and value of using better quality inputs. Field agents conduct frequent meetings with farmer communities to disseminate information about the enterprises' products.

They demonstrate the inputs and equipment in training sessions, and engage trained agro-experts to sell their inputs—these experts educate farmers on the advantages of using quality inputs vis-à-vis counterfeit inputs and help to build trust amongst farmers. Some enterprises partner with local and popular media to showcase their products and services on information platforms or leverage radio to broadcast information on the brand in vernacular languages. For instance, Sidai partners with Mediae's TV program Shamba Shape Up and call center service I-Shamba to educate farmers on its brand. The Real IPM Company, a pest management solution provider in Kenya has created an online library—Real Insight Library for farmers. The library provides farmers access information about the use of quality inputs and agricultural best practices.

Enterprises also rely on early adopters to spread awareness about their products within their local communities; they partner with farmer co-operatives and farmer groups to identify farmer champions who can validate the promise of productivity enhancement and spread the message among other smallholder farmers. Local government agencies, research organizations, universities and NGOs also play a pivotal role in aggregating farmers and educating them on the benefits of yield-enhancing inputs. Some enterprises partner with agro-dealers with complementary interests. For instance, myAgro partners with local village stores who have strong community networks to disseminate information on its input packages and its mobile layaway solution. Kamal Kisan partners with agro-dealers selling drip irrigation systems to increase awareness about its mulch layer.

Acceptance

Close interaction with smallholder farmers and customization of inputs and equipment to suit farmer preferences are key factors in winning acceptance amongst smallholder farmers. Even though mechanization might save labor and energy, crop production will not intensify if the equipment is not adapted to social, economic and environmental conditions (FAO 2015). SAS Motors develops machinery that is suitable for use in small-scale plots in India; the enterprise's Angad Diesel Hal is a low cost light-weight mechanized plough that is specifically designed for use by women working in small fields. Some enterprises, such as SunCulture and Kamal Kisan, co-create agricultural machinery with smallholder farmers, taking into consideration their views on plot sizes, design preferences, applicability to prevalent farming practices and trade-offs between mechanization and labor intensive processes Constant engagement with farmers through SMS, surveys and on-field visits also enable enterprises to improve their products over time and gain customer acceptance.

Enterprises engage with local champions including village leaders, notable farmers, and Self-Help Group (SHG) leaders to educate farmers and receive feedback. Some enterprises customize their products based on the different regions that they serve; myAgro customizes its input packages which typically comprise seeds, fertilizers and training services, providing peanut packages for women in Mali, vegetable packages for women in Senegal, and maize and shorgum packages for men in Mali. In addition, an important factor determining smallholder acceptance is the time taken for inputs to reach farmers—easier access to inputs increases acceptance rates amongst farmers.

Accessibility

Enterprises need to establish effective last-mile delivery channels to reach smallholder farmers in remote rural areas. Some enterprises adopt a high-touch model wherein they deliver productivity enhancement solutions directly to farmers. For instance, in its initial stage of operations, farmers who purchased SunCulture's irrigation system had to collect the product from a central location and install it in their fields—this process could take up to eight days. However, based on customer feedback, SunCulture amended the process by redesigning the product to fit into modular boxes that could be reassembled at site. It also transported the product directly to the farm where a SunCulture trained technician installed the product, reducing total delivery time to one day.*

Other enterprises build innovative partnerships for effective distribution. Hydroponics Africa partners with the Ministry of Agriculture in Kenya and trains its local county extension workers to deliver and install systems in farms. Sidai identifies and trains 'Sidai Model Farmers', who deliver the enterprise's products to farms and provide training and after-sales support. Some enterprises partner with remotely located village shops or operate outlets on a franchisee basis to sell their products. For example, myAgro identifies local vendors who have strong community networks and also operates a network of Livestock Service Centres, fitted with small diagnostic laboratories to support farmers with product selection.

Affordability

High costs associated with modern inputs, compounded with limited availability of credit deter smallholder farmers from purchasing productivity enhancement inputs. Enterprises serving smallholder farmers address these barriers in innovative ways. A number of enterprises sell inputs in different package sizes at differentiated prices, thereby allowing farmers to purchase inputs in smaller increments at prices that they can afford. Enterprises such as Kick Start International and myAgro provide innovative financing options such as savings based payments, rent-to-own models and variable pay-as-you-go strategies, to make inputs affordable to farmers. Bundling value-added services such as delivery, installation, after-sales services and agronomy support makes it cost-effective and simpler for smallholder farmers to trust and adopt productivity enhancing inputs (Ibrahim 2016).SunCulture's drip irrigation kit, which is priced at USD 900/acre and its solar water pump, which costs USD 1500 include delivery and installation costs along with additional agronomy support accessible via SMS and call centres. Its competitors provide similar products priced at USD 1300/acre and USD 2600 but only cover product costs, offering no value-added services.

Results and Cost Effectiveness

Access to affordable high-quality inputs coupled with supporting knowledge on sustainable agricultural practices results in increased yields, better incomes for farmers, increased bargaining power, and higher standards of living for farmer families.

* Self-reported.

Table 13. Reach of example companies

Company	*Country of operations*	*Years of operation*	*Number of farmers reached*
Kamal Kisan	India	1	Over 400 small-scale farmers in Karnataka
myAgro	Mali, Senegal	5	Over 25,000 farmers (of which 18,000 have completed paying for their packages)
Sidai	Kenya	5	100,000

Scale and Reach

Enterprises providing quality inputs and mechanized solutions to smallholder farmers scale through increasing uptake within their existing markets and widening their reach into new markets. Given the need for hi-touch engagement and farmer education, enterprises achieve scale through innovative solutions, easy to apply features and willingness to provide time and support to customers. Product demonstration allows farmers to understand the value of inputs offered by these enterprises thereby increasing the number of farmers subscribing to these solutions. Ease of product use also increases the number of buyers—SAS Motors designs its products for small farms and Kamal Kisan designs its farm equipment such that local blacksmiths can address minor repairs to the products, which has helped in building trust amongst farmers. Sidai has been able to rapidly scale its operations in Kenya through its direct delivery options and network of livestock service centres in remote areas; it is exploring opportunities to expand to Uganda and Tanzania.

Improving Outcomes

Productivity enhancement input enterprises not only tailor agro-inputs and machinery for use on smallholder farms. They also make these inputs cost-effective for farmers to use and invest time in imparting the requisite knowledge on the benefits of using these inputs. Farmers in turn are able to access low-cost quality inputs, make their pre-harvest processes more energy and water efficient, increase their families' food security, health and nutrition. Apart from cost saving for farmers, SunCulture's irrigation kits enabled saving of 171 million liters of water and 360000 liters of diesel fuel in a year; using its systems as an alternative to traditional irrigation kits also helped in reducing 397,440 kilograms of carbon dioxide emissions (Ibrahim 2016). Similarly, Hydroponics Africa enabled urban slum households to install its systems on rooftops and vertical walls thereby increasing food security for low-income urban farmers. The enterprise's systems also helped farmers conserve water in their cultivation processes—they utilized 220 liters of water through hydroponics systems in comparison to 500 liters by using traditional irrigation kits.†

† Self-reported.

Cost Effectiveness

According to a 2015 study, smallholder farmers can increase net annual incomes by 80 percent to 140 percent with access to productivity-enhancing technologies such as improved seeds, micro-irrigation systems or improved cow breeds (Hystra 2015). Enterprises providing drip irrigation, solar-based pumps and hydroponic technology enable farmers to substitute energy and water intensive farming techniques. For instance, a research study measuring the impact of efficient irrigation technology on smallholder farmers highlights cases of farmers in Andhra Pradesh, India who adopted efficient irrigation technologies to decrease costs of labor, fertilizer and pesticides by 25 percent (Colback and Nagayets 2014). Farmers in Burkina Faso who adopted drip kits and motor pumps witnessed an increase of 395 percent in gross margins with a payback period of one year; and farmers in Zambia increased their gross margins by 68 percent using drip kits and treadle pumps (Colback and Nagayets 2014).

SunCulture's impact measurement shows that its AgroSolar irrigation kit saved farmers USD 10,416 per acre per year as compared to the costs incurred in using a traditional petrol pump and furrow irrigation. Maize farmers who used the enterprise's equipment earned an annual revenue of USD 14,000 as compared to USD 600 using traditional irrigation methods (Ibrahim 2016). Improved irrigation methods also allow farmers to grow water-intensive crops such as watermelons and cotton, in addition to the regular crops that they grow, resulting in additional sources of income. A number of farm input enterprises focus on organic agriculture, using non genetically-modified seeds, organic fertilizers and agro-inputs which leads to an increase in potency of crops, restoration of soil fertility, health advantages and preservation of bio-diversity (Bhatt et al. 2013). Farm mechanization enables farmers to decrease their dependence on labor and its associated costs; for example, farmers in India spend over 40 percent of their cultivation costs on labor (Kamal Kisan n.d.).In addition, agricultural mechanization helps in increasing the area under cultivation, improving quality of cultivation increasing yields, reducing excessive workload and in some cases, providing an additional source of income for farmers who rent their equipment to other farmers in their communities (FAO 2005).

Scaling Up

Challenges

Large input providers have typically been reluctant to address the needs of smallholder farmers due to challenges in their ability and willingness to pay. Additionally, the lack of awareness about agricultural best practices and the remoteness of these markets also add to the cost of servicing this customer group. Against this background, enterprises that have structured their businesses to serve smallholder farmers need to overcome multiple barriers in attaining financial viability and scaling their operations.

Difficulty in regulating remote markets and the low margins on inputs allow inferior quality and counterfeit products to thrive and be accepted by farmers. For instance, a number of input suppliers in Cambodia sold inferior inputs to farmers by visiting them at their homes (USAID 2015). Such information asymmetries create lack of trust in farmers and

resistance towards buying reasonably priced and good quality productivity enhancement inputs, Enterprises therefore work closely with input manufacturers to ensure consistency in quality and works with trained personnel to serve smallholder farmers.

Enterprises typically need to adopt a high-touch engagement model, involving frequent after-sales support in order to maintain farmers as repeat buyers; however, lack of sufficient qualified staff and personnel becomes a challenge for these enterprises. Reaching remotely located farmers increases transaction costs for enterprises serving smallholder farmers—a number of enterprises partner with local community organizations such as county workers, farmer co-operatives and non-governmental organizations to undertake awareness creation, farmer education, marketing, distribution and after-sales activities to keep costs minimal. In addition, weak infrastructural facilities increases logistics costs, a challenge that is particularly applicable for bulky products (USAID 2015).Lack of accurate data on smallholder farmer practices and preferences makes it difficult for enterprises to design productivity enhancement solutions, estimate demand and gauge optimal levels of inventory.

Farmers often require financing support to fund upfront costs associated with inputs, even in cases that involve shorter pay-back periods. However, due to the limited understanding of smallholder farming practices and the perceived risks in lending to these farmers, most financial institutions fail to provide end-user financing to farmers making it difficult for enterprises to sell inputs to such farmers. In addition, many enterprises lack access to capital which restricts them from providing leasing or variable payment strategies to farmers in order to afford upfront costs of inputs. Limited finance support also prevents enterprises from stocking sufficient inventory, conducting awareness activities, hiring qualified staff and expanding to other markets.

Role of Government and Policy

Given the lack of access to quality inputs, low availability of financing and limited awareness among smallholder farmers, governments have the potential to play a major role in supporting enterprises that cater to smallholder's pre-harvest requirements.

A number of governments provide exemptions on sales and value added taxes (VAT) enabling enterprises to offer high-quality inputs to smallholder farmers at lower costs. However, frequent changes in policies related to VAT might cause input price instability, ultimately leading to a loss in smallholder farmer customer base. For instance, the Government of Kenya revised its position on VAT on agricultural inputs making it challenging for input manufacturers to retain affordable prices; in 2012, it introduced a bill that proposed a tax on agricultural inputs, which resulted in a significant rise in input prices. Tegemao Institute of Agricultural Policy and Development's research (USAID 2014) on the impact of imposing the 16 percent value added tax (VAT) on animal feed found that manufacturers were forced to raise their feed prices, which they passed on to consumers, resulting in a 70–100 percent decline in profits for producers. The Government reversed the VAT rule in May 2014. Similarly, the Government of Honduras is in the process of proposing a bill that will exempt payment of 15 percent sales tax on import of agricultural machinery and agricultural implements (CentralAmericaData.com 2016).

Bureaucracy, lack of guidelines, and restrictive regulatory policies are amongst the top factors that hamper growth and scale of private enterprises in the productivity enhancing input space. For instance, a number of enterprises spend considerable time in interacting with

government officials to receive subsidies and exemptions; agricultural producers in Nicaragua have cited that excessive paperwork and lack of agility delays the process in receiving tax exemptions for purchase of farm machinery and equipment (CentralAmericaData.com 2015).The Government of El Salvador excluded high quality seeds from its agricultural package. According to the Agricultural Suppliers Association, this move will prevent higher yields since seed varieties distributed by the Ministry of Agriculture and Livestock typically produce 20 percent less production per acre than the seeds available in international markets (CentralAmericaData.com. 2013).

Several governments across developing countries offer subsidies in the form of targeted vouchers to enable farmers to adopt high-quality inputs and agricultural machinery. Ten African governments spend roughly USD 1 billion annually on input subsidy programs, amounting to almost 30 percent of their public expenditures on agriculture (Belt et al. 2015). However, it is important for governments to use input subsidies judiciously, focused on increasing trials and adoption of high-quality inputs, boosting private player participation (World Bank 2008). They should also adopt a strategy to gradually enable farmers to move away from relying on subsidies to eventually procure yield-enhancing inputs at market prices. In addition, enabling initiatives such as the MoU between the National Seed Association of India and the Bangladesh Seeds Association help increase availability and accessibility to quality seeds (Mathew 2015). Regulatory initiatives in Philippines have enabled mechanization levels to increase from 1 hp/ha to 2 hp/ha (PHilMech n.d.).

Enterprises that serve smallholder farmers also benefit from partnerships with governments that involve their participation in various capacities: aggregation of farmers, awareness generation on high-quality inputs, provision of facilities that can be used by enterprises to test inputs and demonstrate product usage to farmers, marketing and distribution of inputs to remotely located farmers, installation and after-sales support to farmers. (Partnership between enterprises and government entities may be contractual or non-contractual in nature.) For instance, Hydroponics Africa trains government employed county extension workers in hydroponics farming and further leverages these workers in sales and marketing activities. County workers install hydroponics systems, conduct frequent consultation visits to farms and undertake after-sales services. The enterprise partners with the Ministry of Agriculture in Kenya on a non-contractual basis and provides train-the-trainer based training to staff of the Uganda National Council of Science and Technology under a MoU agreement.

Conclusion

Enterprises that manufacture and distribute yield-enhancing inputs open up the market for quality inputs to small-scale farmers. Farmers benefit in terms of reduced costs and increased productivities. However, uptake of such inputs is closely related to the cost of these solutions and the availability of end-user financing. In order to keep costs low and ensure high quality, input manufacturers may use locally sourced materials, partner with financial institutions to provide end-user financing to farmers, and cross-subsidize their product offerings to smallholder farmers as well as commercial farmers at differential prices. Input aggregators may

purchase inputs in bulk from larger input manufacturers in order to avail lower prices that can then be passed onto smallholder farmers.

With low-quality alternatives available in the market and farmers resistant to changing traditional cultivation practices, it is imperative for enterprises to educate and persuade farmers on the benefits of their products in order to increase uptake and enable scale. Partnering with NGOs, government agencies, farmer co-operatives, research organizations and agricultural universities helps enterprises in reducing farmer training, marketing, distribution, and after-sales costs and reaching a larger farmer audience.

Table 14. Social enterprises: Productivity enhancement

Company	*Countries*	*Solution description*
Driptech	India, China, multiple African countries	Driptech produces affordable, high-quality irrigation systems designed for subsistence and small-plot farmers. The company's system can be scaled up or down depending on the size of the field, thus giving it a technological advantage over both capital intensive commercial drip irrigation and water intensive flood irrigation.
Eruvaka Technologies	India	Eruvaka Technologies develops on-farm diagnostic equipment for aquaculture farmers. The enterprise integrates sensors, mobile connectivity and decision tools for affordable aquaculture monitoring and automation.
Hydroponics Africa	Kenya, Uganda, Tanzania	Hydroponics Africa specializes in manufacturing, installation and marketing of hydroponic systems. It trains farmers in hydroponic farming technology, which is not only resilient to climate change but also provides superior nutritional value and growth at cheaper input costs.
Kamal Kisan - Simple Farm Solutions Private Limited	India	Kamal Kisan develops cost-effective mechanization solutions for India's small and marginal farmers, to reduce labor dependence and increase profitability.
KickStart International	Kenya, Zambia, Ghana, Democratic Republic of Congo, Burkina Faso, Ethiopia, Malawi, Mali, Mozambique, Nigeria, Rwanda, Senegal, South Sudan, Tanzania, Uganda, Zimbabwe	KickStart develops and mass produces high quality irrigation tools that meet the needs of the poorest farmers in Africa. KickStart offers mobile layaway and rent-to-own models as financing options to farmers.
LishaBora Hydroponics Ltd.	Kenya	LishaBora manufactures hydroponically-grown dairy feed that is nutritious and affordable in order to raise the amount of milk produced by smallholder dairy farmers.

Table 14. Social enterprises: Productivity enhancement (continued)

Company	*Countries*	*Solution description*
Mekelle Farms PLC	Ethiopia	Mekelle Farms PLC is a poultry company that operates a breeding farm and hatchery in Ethiopia. It distributes live chickens to a network of rural farmers. The Company produces highly fertile, disease-resistant chickens and sells them to smallholder farmers in Ethiopia.
Micro Drip (Pvt) Ltd.	Pakistan	Micro Drip develops and manufactures drip irrigation systems along with agricultural training and after-sales support to small-holder farmers in Pakistan.
myAgro	Mali, Senegal	myAgro uses a mobile technology platform to provide access to fertilizer and seed packages on layaway. In addition, the enterprise also provides technical training, market access to premium buyers and access to asset loans for appropriate small-scale farm equipment.
Proximity Design	Myanmar	Proximity Design designs and manufactures affordable and energy-efficient irrigation products for farmers.
SAS Motors	India	SAS Motors develops low cost agricultural machinery such as the Angad Diesel Hal and power tiller for use in small farm plots.
Sidai Kenya Ltd.	Kenya	Sidai provides livestock and veterinary services to pastoralists and farmers in Kenya through franchised and branded Livestock Service Centres that are equipped to provide quality animal health products and professional technical advice.
SunCulture	Kenya	SunCulture designs and sells low-cost solar powered water pumps and drip irrigation kits to smallholder farmers in Kenya. The company delivers the products to the farmers and provides installation and after-sales support.
The Real IPM Company Ltd.	Kenya, Zambia, Zimbabwe, Ethiopia, Tanzania, South Africa	The Real IPM Company Ltd. designs integrated pest management programs for farmers in Kenya. It also conducts training sessions on agricultural practices in demonstration plots.

References

Acumen. n.d. "Global Easy Water Products." http://acumen.org/investment/global-easy-water-products-gewp/

Belt, John, et al. 2015. "Market-based solutions for input supply: making inputs accessible for smallholder farmers in Africa." KIT Working Papers 2015-5. http://www.snv.org/public/cms/sites/default/files/explore/download/snv-kit_wps_5-2015-web.pdf

Bhatt, Anar et al. 2013. *Pathways to Progress: A Sectoral Study of Indian Social Enterprises*. http://www.intellegrow.com/images/download/publication/Publication%20-%20Pathways%20to%20Progress_Revised_Web.pdf

CentralAmericaData.com. 2013. "High Quality Seeds Excluded From Agricultural Package." http://www.centralamericadata.com/en/article/home/High_Quality_Seeds_Excluded_From_Agricultural_Package

———. 2015. "Nicaragua: Excessive Bureaucracy in Exemptions for Agriculture." http://www.centralamericadata.com/en/article/home/Nicaragua_Excessive_Bureaucracy_in_Exemptions_for_Agriculture

———. 2016. "Honduras: Tax Exemptions for Agriculture." http://en.centralamericadata.com/en/article/home/Honduras_Tax_Exemptions_for_Agriculture

Colback, Richard, and Oksana Nagayets. 2014. "Impact of Efficient Irrigation Technology on Small Farmers." International Finance Corporation: Washington, D.C.

Food and Agriculture Organization (FAO). 2005. Contribution of farm power to smallholder livelihoods in sub-Saharan Africa. http://www.fao.org/docrep/009/a0229e/a0229e00.htm

———. 2012. "Smallholders and Family Farmers factsheet." http://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Factsheet_SMALLHOLDERS.pdf

———. 2015. "New partnership to promote sustainable mechanization of agriculture." http://www.fao.org/news/story/en/item/334988/icode/

Gradl, Christina, Christina Kükenshöner, Juliane Schmidt, and Christiane Ströh de Martínez. 2012. *Growing Business with Smallholder Farmers: A Guide to Inclusive Agribusiness*. http://www.inclusivebusinesshub.org/wp-content/uploads/2016/05/giz2012-0304en-growing-business-smallholder.pdf

Hystra. 2015. "Smallholder farmers and business" http://hystra.com/smallholder/

Ibrahim, Samir. 2016. "SunCulture Annual Letter 2016." https://medium.com/@samiribrahim/sunculture-annual-letter-2016-ccfa78e45f62#.frk16vli3

International Fund for Agricultural Development (IFAD). 2011. "Smallholders can feed the world." https://www.ifad.org/documents/10180/ca86ab2d-74f0-42a5-b4b6-5e476d321619

International Finance Corporation (IFC). 2013. *Working with smallholders: A Handbook for Firms Building Sustainable Supply Chains*. http://www.ifc.org/wps/wcm/connect/8dc5628042112fdbba2fff494779b2ad/Handbook+-+Working+with+Smallholders.pdf?MOD=AJPERES

Kamal Kisan. n.d. http://kamalkisan.com/

Mathew, Susan. 2015. "Agricultural Input Trade and Food Security in South Asia." CUTS International Discussion Paper. http://www.cuts-citee.org/sdip/pdf/Agricultural_Input_Trade_and_Food_Security_in_South_Asia.pdf

Philippine Center for Mechanization and Postharvest Development (PHilMech). n.d. http://www.philmech.gov.ph/

Tagar, A., F.A. Chandio, I.A. Mari, and B. Wagan. 2012. "Comparative Study of Drip and Furrow Irrigation Methods at Farmer's Fields in Umarkot." *International Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering* 6 (9).

Tumusiime-Mutebile, Emmanuel. 2013. "The challenge of modernising smallholder agriculture in East Africa." Keynote address at the International Symposium on Agricultural Developments in the EAC Partner States, Kampala. http://www.bis.org/review/r131108a.pdf

United States Agency for International Development (USAID). 2015. "Scaling Impact: Extending Input Delivery to Smallholder Farmers at Scale." Leveraging Economic Opportunities Report No. 7. http://marketshareassociates.com/wp-content/uploads/2015/07/Scaling_Impact_-_FINAL_508_Compliant_updated.pdf

———. 2015. "Scaling Impact: Extending Input Delivery to Smallholder Farmers at Scale." Leveraging Economic Opportunities Report No. 7. http://marketshareassociates.com/wp-content/uploads/2015/07/Scaling_Impact_-_FINAL_508_Compliant_updated.pdf

———. 2014. "Tegemao Agricultural Policy and Research Analysis." https://www.usaid.gov/sites/default/files/documents/1860/Tegemeo.pdf

World Bank. 2008. *World Development Report: Agriculture for Development*. World Bank: Washington, D.C.

CASE STUDY

Kamal Kisan

Founding year: 2013
HQ: Bangalore, India
Countries of operation: India
Orientation: For-profit
Employees: 10
Turnover: INR 10 Lakhs

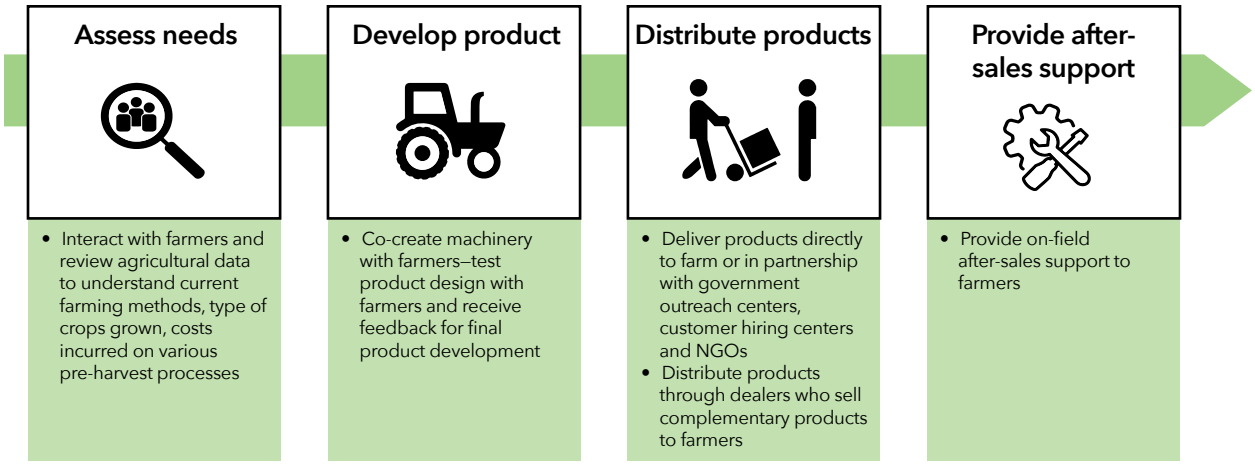
Farmers in developing countries predominantly practice smallholder farming, cultivating crops in plots smaller than two hectares in size. Modern machinery is typically built for use in large farms and don't match traditional farming processes followed by farmers in these countries. In India, the lack of access to suitable mechanization equipment, coupled with high levels of migration of labor force from rural areas results in farmers spending up to 40% of total cultivation costs on labor.

Kamal Kisan is a social enterprise that designs and builds agricultural machinery for India's small and marginal farmers. The enterprise's approach includes understanding relevant needs and preferences of smallholder farmers and co-creating cost-effective and energy efficient machinery.

The products offered by the enterprise include a vegetable planter, mulch layer and sugarcane planter. It has sold its products to 385 farmers in Karnataka. Kamal Kisan's solutions have helped farmers decrease labor costs by 50% and saved over INR 14 Lakhs for its customer farmers.

Operating Model

Kamal Kisan designs and manufactures cost-effective and energy-efficient farm mechanization solutions for small and marginal farmers in India, with the aim to decrease labor costs by 50 percent and increase productivity by 50 percent. The enterprise identifies the products for development based on factors including crop land under cultivation, crops and agricultural



processes that are heavily labor dependent, processes that contribute significantly to the total cost of cultivation, and existing availability of solutions in the market.

The enterprise co-creates agricultural machinery with farmers by incorporating their views on the applicability of the farm equipment to their current farming processes and small plot sizes. By incorporating customer feedback on product design, the enterprise makes it easier for farmers to adopt its products. It identifies farmers who are willing to participate in the research and testing phase by leveraging on the farmer network of Krishi Vigyan Kendra - a government based agricultural extension center, agricultural universities, and agricultural businesses such as sugarcane mills. In addition, it partners with Krishi Vigyan Kendra for state and district level data related to current agricultural practices adopted by smallholder farmers, and potential areas of intervention to improve agricultural technology and productivity of smallholders.

Kamal Kisan adopts various strategies to create awareness, generate demand and sell its products. It conducts on-field visits to rural farms, interacts with farmers and farmer co-operatives on the issues that they face due to labor-intensive cultivation processes and provides knowledge on the benefits of adopting the enterprise's simple technology as a substitute to human labor. The enterprise works with local community leader farmers to further engage in farmer-to-farmer demonstrations of its products. It partners with agro-equipment dealers, who sell complementary products to farmers, to expand its marketing reach. In addition, Kamal Kisan partners with agricultural universities and local government organizations to reach remotely located farmers. The enterprise either delivers its products directly to farmers or sells its products via partner agro-dealers.

The Vegetable Planter (USD30) allows 1 laborer to plant 1 acre of vegetables within 4 hours as compared to 4 laborers using a conventional planter. The Mulch Layer (USD525) can lay 1 acre of mulch film in 3 hours using 2 laborers instead of 6 laborers. The Sugarcane Planter (USD 1425) combines the processes of creating ridges, dropping cane material and covering with soil into a single pass within 4 hours per acre.

Kamal Kisan provides on-farm after-sales services. The uncomplicated design of its farm equipment allows farmers to seek maintenance and repair support from local blacksmiths. This is a key factor in building farmer confidence.

Financial Sustainability

Farmers are able to relate to the value of substituting expensive labor-intensive processes with Kamal Kisan's affordable mechanized solutions since the enterprise involves farmers in the product design and development stage, As a result, smallholder farmer are more open to purchasing the enterprise's products. However, this interactive process requires significant upfront research and testing costs to be incurred by the enterprise prior to the sale of solutions.

Kamal Kisan receives financial support (debt) from IIT Madras' Rural Technology Business Incubator. The enterprise has also received funding and is incubated by the Villgro Innovation Foundation. In addition, it has received grant funding by the Ministry of MSME for research and development activities.

Impact

Kamal Kisan's affordable and sustainable mechanized solutions have enabled 50 percent reduction in labor costs which results in 10-50 percent reduction in total cultivation costs. The use of machinery has also led to a significant reduction in the time spent on farming operations. The energy-efficient mulch layer, in combination with drip irrigation, has helped farmers reduce water usage by 50 percent to 80 percent allowing farmers to grow additional water-intensive crops such as watermelon and cotton. Kamal Kisan also engages village level entrepreneurs to lease it's equipment on a rental basis to farmers to generate additional income.

Challenges and Lessons

Owing to its high-touch operating model, Kamal Kisan faces challenges in providing personalized post-sales support to farmers. Reaching remotely located farmers has also proven to be time-consuming and resource-intensive for the enterprise. Currently, it deploys its own team to provide after-sales services. However, going forward, the enterprise plans to partner with dealers who could provide last-mile support services.

In addition to farmer feedback on product design, the enterprise also heavily relies on data to support the initial assessment of product development. However, a severe lack of reliable data on agriculture in India makes it difficult for Kamal Kisan to efficiently conduct its preliminary gap assessment and product research.

CASE STUDY

Sidai

Founding year: 2011
HQ: Nairobi, Kenya
Countries of operation: Kenya
Orientation: For-profit
Employees: 58
Turnover: USD 5.84 million

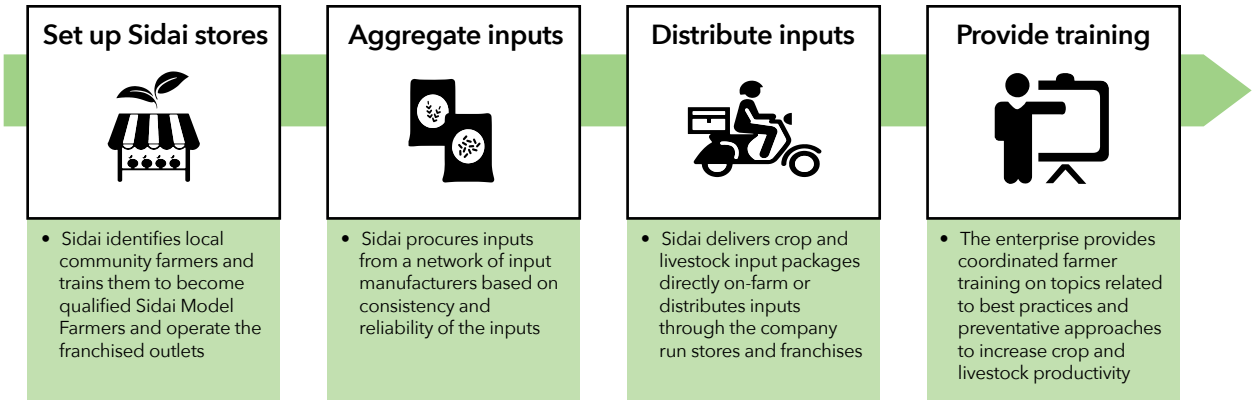
Remotely located farmers in Kenya lack access to high-quality crop inputs, veterinary and on-farm services at fair prices. Lack of regulations related to input standards further accentuates the problem of unqualified sellers hawking counterfeit goods and low-quality products to ill-informed smallholder farmers and pastoralists. In addition, the nature of the inputs market is largely government-driven or donor-aided resulting in distorted markets.

Sidai is a social enterprise that aggregates inputs from its network of input manufacturers and distributes inputs to small-scale farmers through its franchisee outlets or through on-farm delivery. In addition, the enterprise also provides on-farm training services to farmers on crop and livestock practices.

The enterprise serves as a one-stop-shop for farmers, stocking over 400 products including crop inputs, animal feed and veterinary medicines. Sidai has sold inputs to over 100,000 farmers and has trained 39,738 farmers on improved practices to increase crop and livestock yield.

Operating Model

Sidai provides quality tested inputs to smallholder farmers and pastoralists in Kenya. The enterprise purchases inputs from local suppliers as well as some of international manufacturers that are interested in entering the Kenyan market. Sidai aggregates and sells these inputs in small pack sizes. It distributes products to farmers either directly to their farms or through its outlets and Livestock Service Centres located in remote areas. Sidai has 12 company run stores, 117 franchises, and 350 stockists.



Sidai's model focuses on driving uptake of yield-enhancing inputs by building trust among farmers and creating awareness on the benefits of using improved crop and livestock inputs. The enterprise adopts various strategies to educate farmers.

- It includes supporting description and guidance on proper use of inputs on the product packaging.
- Sidai outlets and stores are run by trained personnel who provide information on product selection to farmers. Most outlets are fitted with small diagnostic laboratories to ensure that diseases are diagnosed correctly and the right product is used.
- It trains field staff that educates farmers through workshops and demonstration sessions on field.
- It broadcasts training information on the radio in vernacular languages.
- Sidai advertises its brand and products on television programs such as *Shamba Shape Up*, and provides information updates to farmers through iShamba—an SMS and call centre service.
- It coordinates group activities and leverages on local brand ambassadors to generate awareness in their communities.

The enterprise is a Kenya Veterinary Board accredited CPD training provider and trains all its franchisees on customer service standards and standard operating procedures in order to enable quality and reliable service to customers. Given the inability of the government to provide veterinary services to remotely-located pastoralists in Kenya, Sidai has partnered with the Director of Veterinary Services and GALVmed to distribute East Coast Fever (ECF) vaccines to livestock farmers. The benefit of Sidai's de-centralized model is that it allows smallholder farmers to organize themselves in groups that procure inputs in a cost-effective manner. For instance, each ECF vaccine can treat 40 cattle, making it economical for a larger group of farmers to purchase.

Financial Sustainability

Currently operating at a 14 percent margin, the company expects to grow at a CAGR of 76 percent and profit margins of 25 percent in the next 4 years. The enterprise incurs significant personnel costs towards employing technically-qualified professionals such as qualified veterinarians, and animal health technicians who operate Sidai shops, and provide

on-farm extension services and farmer training services. The business model also requires sufficient working capital to stock inventory in the Sidai shops in order to cater to remotely-located farmers. In addition to revenues generated through sale of crop and livestock inputs, Sidai receives some funds from donors to support farmer training and public information campaigns. The growth of the company is financed by debt and equity investments.

Impact

Sidai has provided access to high-quality animal health products to remote parts of Kenya, including northern Kenya that were previously un-served by input dealers with the market dominated by unsustainable donor-funded handouts of free products. Through its network of franchised and company-managed branded stores, Sidai has served over 100,000 farmers with genuine inputs and farmer training sessions. It has created 343 jobs, with women constituting 30 percent of its workforce. The vaccine distributed by the enterprise has protected 7,000,000 animals; farmers who have used Sidai's vaccines have seen livestock losses reducing from 30 percent to 5 percent. Sidai has also provided training related to technical and business skills to veterinarians and animal health professionals. Through its partnerships with other stakeholders, Sidai has provided market linkages and capacity building on specialist areas to farmers.

Challenges and Lessons

Sidai's primary challenge relates to pricing its products competitively, in comparison to prevailing prices of inferior inputs available to farmers. In response to this low-price environment, the enterprise focuses on delivering genuine products to farmers, complemented by supporting information and guidance by trained experts—an approach that will drive farmers to understand the added-value and long-term benefit of purchasing Sidai inputs.

Last-mile distribution and on-farm training services to the enterprise's target customer base of remotely-located smallholder farmers in Kenya result in higher operational costs. The founding team would like to reinvest profits in their long-term social benefit initiatives.

INCREASING POST-HARVEST VALUE

INCREASING POST-HARVEST VALUE

Sector Challenges

Globally, food wastage amounts to a monetary loss of USD 1 trillion. In developing countries, this loss is estimated to be high at around USD 310 billion; and 40 percent of the losses occur at post-harvest and processing levels. In Sub-Saharan Africa, approximately 150 kilograms of food produced is lost per person per year. FAO estimates that saving one-quarter of the food lost annually would be enough to feed the world's hungry.

Moreover, smallholder farmers are forced to sell quickly after harvest as they lack storage facilities that will retain the quality of their produce. As they sell small quantities and in unpacked, mixed grade lots, they are unable to negotiate better prices or wait for better market conditions. Challenges such as short shelf life of some agricultural produce, risk of spoilage, pest attacks, and quality deterioration, lead to distress sales and lower prices for farmers. Access to better post-harvest management solutions would help to reduce wastage, pest attacks, increase self-life and hence enable farmers to also earn a better income.

Models that Address These Challenges: Description and Analysis

There are two models that address the issues of post-harvest management.

I. Post-Harvest Service Providers

In an attempt to address this gap in the agricultural value chain, social enterprises offer processing and packaging solutions to increase the shelf life of agricultural produce. They share the higher market prices of processed and packaged agricultural products with smallholder farmers by paying them premium procurement rates at the farm gate. Quality assessment conducted by these enterprises also contributes to transparent and often, improved prices for farmers, which motivates them to invest in better quality inputs so that they grow better produce, qualify for higher quality benchmarks, and reap the benefits of premium prices.

- *Processing:* Is an activity which arguably, adds the maximum value to fresh agricultural produce, thereby improves farmer incomes. This is particularly so for perishables with short shelf lives such as fruit and milk. Processing not only ensures

longer shelf life, but also higher valued output that fetches better prices. Tanzania based Brookside Dairy collects and processes milk from smallholder farmers. It markets value added milk and dairy products such as cheese, butter, ice cream, and flavored milk at higher prices. It distributes the dairy products through distribution depots, agents and sub-agents to retail outlets, passing on market prices to farmers.

- *Packaging:* Social enterprises support farmers with sorting and packing, which improves the shelf life of agricultural produce. The process also involves branding that guarantees a certain quality for a certain premium. Indonesia based PT. Bimandiri Sedaya Agro supplies a range of fresh fruits and vegetables to supermarkets in the country. It selects and grades the fresh produce from the farmers and packs them in different sizes before selling them to the supermarkets.
- *Quality assessment:* Social enterprises also add significant value to farm produce by undertaking quality assessment and certification. This allows for significant transparency in the quality (for example, percentage of fat in milk, grade and size of fruit), which determines fair market prices of the produce. It not only allows farmers to negotiate better prices, but also motivates them to focus on enhancing productivity and quality as they see realizations improve with better quality.

II. Storage Solutions

Social enterprises that reduce post-harvest losses offer storage solutions that are general as well as sector-specific. General storage solutions can be used for different types of agricultural produce and comprise large facilities that farmers can lease as well as local storage that farmers can purchase and own. Specific solutions cater largely to the dairy sector for milk chilling.

- *Demand aggregation for storage solutions:* Enterprises provide innovative strategies and solutions that include large warehouse units that can be leased to farmers, and small on-farm solutions that can be bought or rented by either individual farmers or groups of smallholder farmers. Commercial and large-scale warehousing facilities either have a logistics wing that functions as a procurement agent and collects fresh farm produce from agriculturists or have an aggregation center within the village cluster where farmers bring their produce. Some enterprises provide warehousing as a component of their larger pool of extension and consultancy services. Baridi Stores and Kilimo Markets are examples of such solutions.
- *Design of smart solutions:* Access to electricity is a major concern across all developing countries, and smallholder farmers use expensive fossil fuels to power their few farming tools and implements. Therefore, even if farmers can access warehouse and cold storage facilities, they cannot effectively use them due to poor grid connectivity. To prevent such instances, enterprises innovate and develop renewable energy operated storage solutions. For instance, Wakati's storage solution can protect up to 200 kg of fresh produce without cooling, using a small solar panel.
- *Delivery of storage solutions:* Post-harvest value addition companies, such as processors, packagers, and exporters, hesitate to deal directly with smallholder farmers. Instead, they establish contracts with the warehouse companies, who provide them the required agricultural output in the desired quality. The warehouses

are often centrally located from a cluster of areas that lack local storage facilities, often close to transportation hubs such as airports.

Analysis of the Models

Analyzing the two models across different parameters brings up interesting findings and implications for implementation and scale up.

Comparative Analysis of Agricultural Finance Model

Model	*Ease of Implementation*	*Effectiveness*	*Financial Viability*	*Scalability*	*Need for Government Support*
Post-Harvest Service Providers	Medium	High	High	High	Low
Storage Solutions	Low-Medium	Medium	Low	Medium	High

Ease of Implementation

Post-harvest services models are relatively easier to introduce, as they are generally low cap-ex and can be catered to the needs of the local farming communities and market demand. Storage solutions are critical to reduce wastage especially in tropical countries with extreme climates. Traditional storage solutions are capital intensive, centralized and operations heavy, requiring the help of Government subsidies or a mature farming sector to make them viable. Low-cost, decentralized storage solutions are easier to implement. Supportive government policies and access to finance to enable farmers to avail the above models can play a critical role in their success and scale.

In the absence of post-harvest services, smallholder farmers will continue to sell their agricultural produce, mostly through middlemen. The post-harvest services business model is cost-effective as most enterprises procure inputs from smallholder farmers in large quantities, add value to the inputs by processing, packaging, branding and labeling, and sell the same at higher prices in local and international markets. The end-customers for these value-added products are willing to pay a premium for good quality produce, organic certifications and packaged and processed milk. For instance, Milk Mantra marks up the price of its product by 10–20 percent as against the price offered by the state cooperatives and is still financially sustainable. Claphijo Enterprises has a profit margin of 60–70 percent on its solar drier, which is priced at about TZS 700,000 (USD 390). The enterprise strategizes its financing in such a manner that even after earning this high profit margin, the driers are affordable to farmers.

Storage Solutions

Post-harvest storage solutions are very useful to smallholder farmers, who had no option but to sell their agricultural produce immediately after harvest at prevailing local market

prices, for fear of it getting spoiled. By offering storage solutions, the enterprises have helped farmers become "price makers" instead of "price takers."

Although not many enterprises have conducted social and environmental impact assessment, most of them aim to reduce post-harvest losses by at least 20–25 percent. Ecozen's solution, for instance, provides direct benefits by preserving the quality of fruits and vegetables until market prices are attractive. It also offers indirect benefits such as savings on electricity bills and diesel costs, as it operates on solar energy. Ecozen's solution results in an increase of farmers' profits by nearly 40 percent. Promethean Power Systems has installed over 100 milk chilling systems across rural India. Each system serves approximately 20-30 farmers who can now deliver more milk to quality conscious dairy processors. The dairies in turn collect more milk and produce higher value and higher quality products for Indian consumers.

Availability and reliability of solar cold storage increases the average incomes of agricultural enterprises such as exporters of fruits and vegetables, farmers' associations and large-scale farmers especially those with rural operations by at least 30 percent because they can bargain for higher prices from buyers. Cold storage also stabilizes prices for fruits and vegetables across seasons of high and low supply. Fairly moderate prices of foodstuffs ensure Ugandans can afford to buy foodstuffs reducing infant malnutrition. Wakati is located in Haiti, Uganda, Tanzania, Kenia, Benin and Sierra Leone and is setting up new pilot projects in China and India. It has already sold nearly 150 cold storage units that helped the local farmers in the respective countries receive higher prices for the crops, ultimately resulting in higher incomes. Inspira Farms creates at least 28-30 jobs in each of the rural agricultural communities, further increasing their avenues of income. As the direct customers of the enterprise include rural businesses, and small and medium enterprises, and co-operatives such as dairies, horticulture companies and agri-export companies, it focuses is on the jobs created by these clients.

The larger enterprises, particularly those that have scaled significantly focus on technological innovation to increase customer experience and improve their operational efficiency. SLCM, for instance, established a centralized management information system that provides real-time information on the multi-location holdings of customers. It has also devised its own Standard Operating Practices (SOP) called 'Agrireach' that significantly brings down wastage during storage. The company uses a coded warehouse system wherein customers can track the movement of their products. This process reduces theft, and also checks the quality of the food grains. The product also enables farmers to reduce electricity costs. The cold storage solution leads to over 40 percent increase in the profits of the smallholder farmers, after a 2-year breakeven.

Some storage solution enterprises offer forward linkage services to ensure cost-effectiveness. Ergos currently works with NCDEX e-market Limited (NeML) to provide warehouse receipts to smallholder farmers, but plans to directly issue the receipts going forward, thereby reducing intermediary cost. Tessol also worked with financial institutions and helped facilitated a few loans to the customers. Inspira Farms works on Just-In-Time (JIT) model to lessen its inventory cost and provide customized solutions to the clients. Some enterprises lease, maintain and operate local warehouses in rural areas that are located closer to the farms. This prevents initial capital expenditure on infrastructure and it also keeps the operational costs, mainly those related to the transportation from farms to warehouse, low.

Financial viability

Post-Harvest Service Providers

The profit margins of the interviewed post-harvest service enterprises range from 10 to 70 percent. Enterprises that only sort and package for on-selling earn lower margins while those that invest in processing and convert the produce into food products are able to charge a significant mark-up over cost of production. Post-harvest service providers incur fixed costs on rent of the establishment, equipment expenses, utilities, management salaries, insurance and cost of interest on borrowed funds. Variable cost includes cost of raw materials, packaging material, transportation, contract labor/ seasonal employees, and marketing.

Storage Solutions

Post-harvest storage solutions, specifically large warehouses and cold storage units are generally characterized by low margins. For instance, in India, the cost of a 20,000 sq. ft. warehouse is in the range of USD 1.05 million and USD 1.5 million, and it takes 10–12 years to achieve break-even with a 12–14 percent return on investment, which does not seem profitable in a shorter span of time. A utilization of 70 percent is considered the best possible average in a year. Large warehouses have to incur expenses such as human resources, monthly rental, cleaning and housekeeping, and auditing fees. To tackle this situation, post-harvest solution providers have adopted a number of innovative strategies including bundling of various services such as warehousing, logistics, procurement, collateral management and quality testing, and commodity pest management to build revenues and profit.

Scale

Post-Harvest Service Providers

The post-harvest services serve as a link between the agriculture and industrial segments of the economies of most developing countries. Enterprises in this business model tap into growing and lucrative commercial demand even as they ensure fair and equitable distribution of the benefits to smallholder farmers. Given that its end customers are mainstream, and often global, this business model has significant potential for scale. Milk Mantra, sources milk from over 40,000 small dairy farmers, and has resulted in financial inclusion of the community. Brookside Dairy, the largest producer and supplier of dairy in Kenya has impacted nearly 45,000 Kenyan and 55,000 Ugandan dairy farmers and has together provided them KES billion (USD 99 million) for milk delivered to the enterprise over its 23 years of operation.

Storage Solutions

Given the global interest to reduce food wastage, this business model could potentially scale in terms of technologies and infrastructure in the future. In India, the public sector accounts for around 72 percent of agriculture warehousing capacity and there is a gap of 35 million tons of warehousing capacity. One of the biggest agriculture storage providers, StarAgri, which was set up in 2006, operates over 1,200 warehouses across 300 locations with a total warehousing capacity of more than 1.7 million tons. The Indian Government's

enabling role through investment in infrastructure via subsides for warehouse construction and the adoption of Public Private Partnerships (PPP) models are some of the key drivers for this growth.

Government Policy to Enable These Types of Enterprises/Models

Post-Harvest Service Providers

Governments across the board from Kenya to India to Tanzania and Peru have been very supportive of the small-scale food processing industry in most developing countries. Different agricultural-support programs have connected smallholder farmers to mainstream processing, packaging and exporting partners; provided them facilities either directly or in partnership with other stakeholders in the system, such as finance providers and FMCG companies; and supported them with incentives and subsidies.

Several governments collaborate with development finance institutions for financial support. For instance, in Kenya, the government is executing a project commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) for private sector development in agriculture. One of the outcomes includes provision for training in hygienic butchery techniques such as processing, and packaging as per national standards. This simple practice has brought a 5 percent reduction in meat wastage per day. Kenya based Nu Bree indicated that government support to startups in the country has improved; licensing used to be a challenge earlier (the enterprise requires a trading license and distribution license for its operations) but is easier now.

In Peru, indirect government support and benefits such as incentives, 50 percent rebate on tax, and permission to employ workers on flexible contracts, helps the agribusiness firms benefit. Peruvian enterprises seek general assistance from the government such as access to finance, better infrastructure, and adequate research and development in modern technology to uplift the post-harvest value-chain activities in the sector.

Tanzania based enterprise Claphijo highlights the promising prospects of government industrialization policy in the country. The policy emphasizes on technology innovation in the agriculture sector, and more specifically post-harvest value-addition component. Kilimo Markets, also based in Tanzania, is of the view that government should start identifying and providing requisite business opportunities to local companies that impact smallholder farmers. It also suggests establishment of a trade desk that could provide continuous assistance to private sector for market access in other countries.

The Government of India has supported the food processing industry for several decades – the National Dairy Development Board and Nagpur Orange Grower's Association are examples of government-run processing establishments that positively impact the lives of several smallholder farmers, while adding to the country's GDP. In addition, the Government permits 100 percent FDI in this sector, and has developed agri export zones. The central government has established 3.2 million tons of food processing capacity with an investment of about INR 2,000 crore in last two years (USD 300 million). It further plans to establish 250 small agro-processing clusters at an estimated cost of over INR 5000 crore (USD 750 million). The clusters will reduce post-harvest wastages, worth INR 9,000 crore (USD 1.35 billion) per annum, will help increase farmers' income and will also keep the prices

of perishables under check. A number of states including Jharkhand , Odisha and Bihar launched their food processing policies in 2015, 2013 and 2009 respectively.

Storage Solutions

Government strategies and policies related to post-harvest infrastructure and solutions vary across developing countries. In some countries, such as India and Kenya, the governments are cognizant of the critical issue of post-harvest losses, and hence, are keen to take appropriate steps for the same. They seek to address the issues of access to finance, development of technology, and provision of adequate infrastructure to build robust post-harvest storage systems. However, Governments need to develop specific strategies to prevent food loss and waste reduction in a number of Latin America and Caribbean countries.

In India, the central government has devised several strategies including the Warehousing Development Act and permitting 100 percent FDI investment in the warehousing segment. The segment has grown at a CAGR of over 16 percent from 2012 to 2016. Government investment in infrastructure and the adoption of Public Private Partnerships (PPP) models are considered to be the key drivers for this growth. However, most of these storage capacities are located in states producing majority of the crops. In August 2016, the Ministry of New and Renewable Energy, Government of India, (MNRE, GOI) extended its subsidy scheme to solar refrigeration units to boost the use of solar-powered cold storages. Currently, banks and other financing institutions do not provide priority funding to cold-chain projects as this segment is considered nascent in meeting its operational challenges. The Finance Act of India also does not acknowledge services provided for storage of agricultural produce or any service provided by a cold storage in the definition of "storage and warehousing service." However, service tax is applicable to various services provided at cold storages, specifically those included in the definition of "agricultural produce." This increases costs for the enterprises and prices for farmers.

In Kenya, the agriculture policy, which is determined by the Ministry of Agriculture, Livestock and Fisheries (MALF) has some strategic objectives for the agriculture sector including improved market access and trade, increase in productivity and outputs of the produce, and hence increase in food security. Further, corruption remains a problem according to Transparency International's Corruption Perception Index, which ranked Kenya 139 out of 168 countries in 2015. In Kenya, there are a few food related regulations that have contributed to the development of the post-harvest storage solution model in general. According to one of these regulations, it is mandatory to pasteurize the raw milk before its sale. In Ghana, the government has made a number of infrastructure and policy interventions to reduce post-harvest losses. These include creating storage facilities and development of a commodity exchange. In Mozambique, although, it is not a policy requirement, farmers are encouraged to produce in quantities as per demand, given the relatively small market for agricultural produce, and lack of post-harvest storage facilities.

In Latin America and the Caribbean, there is no specific strategy to prevent food loss and waste reduction; governments are implementing several measures to address this issue. One such measure is the food banks that collect food for redistribution. Public and private sectors establish alliances in various countries such as Costa Rica, Chile, Guatemala, Argentina, the Dominican Republic, Brazil and Mexico, to tackle the situation. The Association of Food

Banks of Mexico, for example, is a non-profit organization which coordinates a network of 61 food banks all over the country to prevent food loss at various stages of the value chain.

Storage enterprises have shared mixed experiences regarding role of government and policies in facilitating the activities of the business. According to the founder of Ergos, the current policies in India do not cater to the requirements of smallholder farmers, and appropriate institutional measures are required to address their needs. He also believes that there is a huge gap in terms of awareness regarding government initiatives in the agriculture sector, and farmers do not know of the different programs that they can avail of. On the other hand, enterprises such as Ecozen underscore the inclusion of on-farm cold storage facilities in the subsidy scheme of Ministry of New and Renewable Resources, Government of India (MNRE, GOI). The Ministry of New and Renewable Energy, Government of India (MNRE, GOI) has approved 30 percent subsidy from the central government for micro cold storage (mCS) solution of Ecozen.

Conclusion

The success of the post-harvest services business model depends on critical factors such as access to good quality agricultural produce to ensure end-product quality; supply contracts for key produce to mitigate price volatility; strong forward contracts with buyers for on-selling processed and packaged produce, and sufficient stability in demand to be able to charge prices that provide reasonable margins. The model has adequate regulatory support in a number of developing countries but faces liquidity challenges as it must pay farmers upfront at the farm gate. On the other hand, enterprises face payment delays from its end-customers, who are large corporates and supermarket chains. This model is highly scalable considering the indispensable requirement of post-harvest services in most developing economies to leverage their agricultural potential and augment GDP through value-added agricultural exports.

Solutions to address post-harvest losses using storage solutions, therefore, are critical to reduce the potential demand-supply gap in agriculture. A number of social enterprises across the globe have addressed this challenge with post-harvest logistics and storage solutions that allows them to simultaneously create positive environmental and social impact. Enterprises provide stationary and mobile post-harvest storage solutions such as warehouses with cold storage facilities, solar-powered on-farm cold storage units, and air-conditioned vegetable carts. In addition, some of the enterprises also offer collateral management and market linkage services. In several countries such as India there is a strong support from the government to expand both public and private delivery of storage solutions. Even though the industry is capex heavy, the model is highly scalable but limited by the ability of the organization to raise capital.

Post-Harvest Service Providers

Improving smallholder incomes by grading and increasing the shelf-life of their produce

HIGHLIGHTS

- Post-harvest service providers perform value-adding activities, such as sorting, packaging, labeling, and branding farmers' produce, which enhances the market price of the produce.
- Some enterprises use cluster farming to address meager smallholder margins on produce and post-harvest losses.
- Post-harvest service providers often make upfront payments to the farmers at the farmgate, which helps the farmers maintain financial sustainability and invest in better inputs and equipment.

Summary

In the post-harvest phase, smallholder farmers typically off-load their produce to middlemen at the earliest. Given the reduced shelf life of produce that is not stored appropriately and the lack of standard assessment or grading, they are forced to accept prices that are offered to them. The middlemen and subsequently, the agribusinesses that procure from the supply chain, unlock the true value of the produce by undertaking value addition activities like sorting and grading, packaging and processing before they sell at best market prices. Smallholder farmers do not get a share of these profits, and continue to engage in the cycle of low investment-low productivity-low income farming.

Note: 1 INR = 0.015 USD; 1 KES = 0.0099 USD; 1 TZS = 0.0005 USD

In a bid to address this market gap, social enterprises (SEs) have developed solutions to include farmers in reaping the benefits of value addition services such as processing, packaging, quality assessments, and market linkages. The enterprises help increase the price realization of agricultural outputs by collectivizing farm produce, and adding value through sorting, packaging, labeling and branding. The enterprises either connect the smallholder farmers directly with large corporate buyers, supermarkets, and other such customers, or sell to these customers on the farmers' behalf.

Development Challenge

Smallholder farmers are forced to sell quickly after harvest as they lack storage facilities that will retain the quality of their produce. As they sell small quantities and in unpacked, mixed grade lots, they are unable to negotiate higher prices or wait for better market conditions. Challenges such as short shelf life of some agricultural produce, risk of spoilage, pest attacks, and quality deterioration, lead to distress sales and lower prices for farmers.

In the absence of pricing information and standard quality assessment tools, smallholder farmers often accept lower prices because they do not know whether they deserve better, based on the quality or grade of their produce. An MIT study across 72 villages among potato farmers in West Bengal, India found that average middlemen margins averaged 50-60 percent of farm gate prices in 2008. What was even more worrying was the fact that access to price information was unable to improve the situation when farmers were locked into relationships with the traders or where other market imperfections existed. Access to information, however, did increase the likelihood that farmers would attempt to deal with wholesalers or retailers directly (Mitra, Mookherjee, Torero, and Visaria 2013).

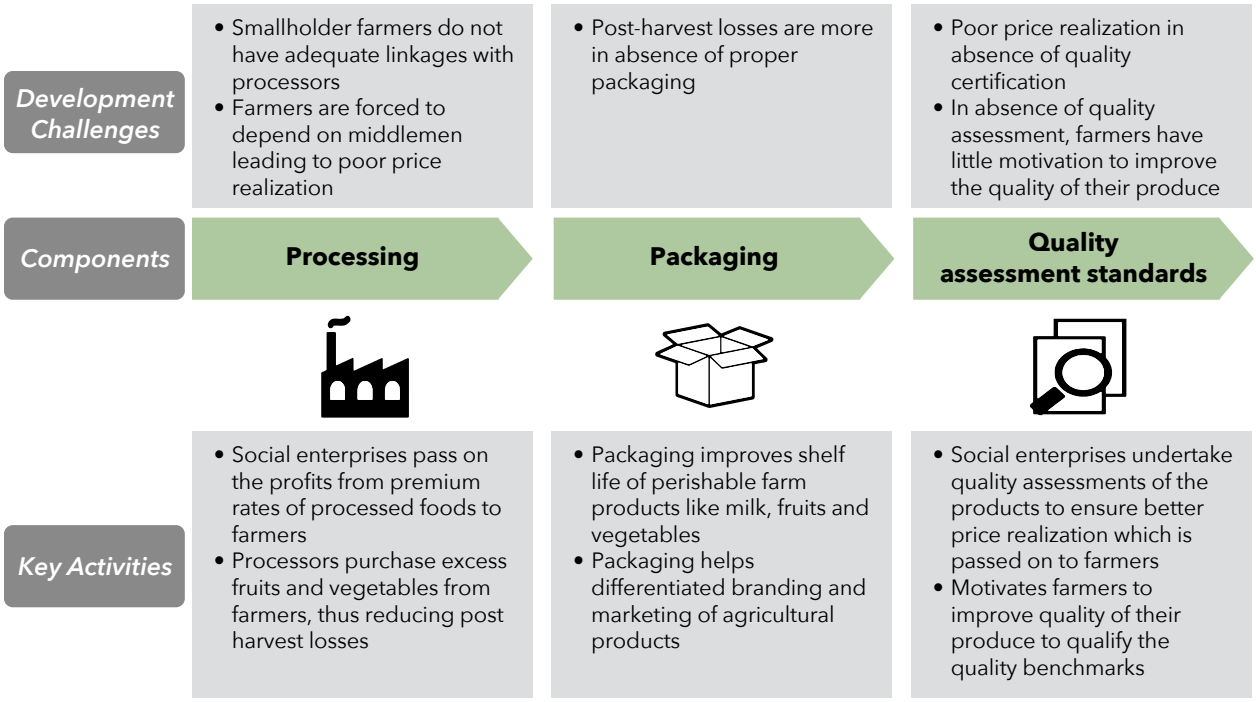
Inadequate linkages with value chain players, like processors, limit the value addition farmers can bring to the basic farm produce. By turning farm produce to food, farmers can increase their share of every dollar that end consumers spend on food. As per USDA's Economic Research Service, only 16 cents from every dollar spent on food goes to the farms. The rest accrues to value adding activities (Canning 2013). Smallholder farmers can only increase their share of food dollars by participating in the value addition process.

Business Model

Components of the Model

In an attempt to address this gap in the agricultural value chain, social enterprises offer processing and packaging solutions to increase the shelf life of agricultural produce. They share the higher market prices of processed and packaged agricultural products with smallholder farmers by paying them premium procurement rates at the farm gate. Quality assessment conducted by these enterprises also contributes to transparent and often, improved prices for farmers, which motivates them to invest in better quality inputs so that they grow better produce, qualify for higher quality benchmarks, and reap the benefits of premium prices.

Figure 13. Components of the model



Processing

Processing is an activity which arguably, adds the maximum value to fresh agricultural produce, thereby improves farmer incomes. This is particularly so for perishables with short shelf lives such as fruit and milk. Processing not only ensures longer shelf life, but also higher valued output that fetches better prices. Tanzania based Brookside Dairy collects and processes milk from smallholder farmers. It markets value added milk and dairy products such as cheese, butter, ice cream, and flavored milk at higher prices. It distributes the dairy products through distribution depots, agents and sub-agents to retail outlets, passing on market prices to farmers. Tanzania based Claphijo Enterprise specializes in processing of fruits and vegetables to prolong their shelf life using a solar drying mechanism which it developed in-house. Other enterprises, like eKutir, organize farmers into collectives and provides them with decentralized processing equipment, thereby increasing the capacity of the farmers and gives a greater share of the value to them upfront.

Packaging

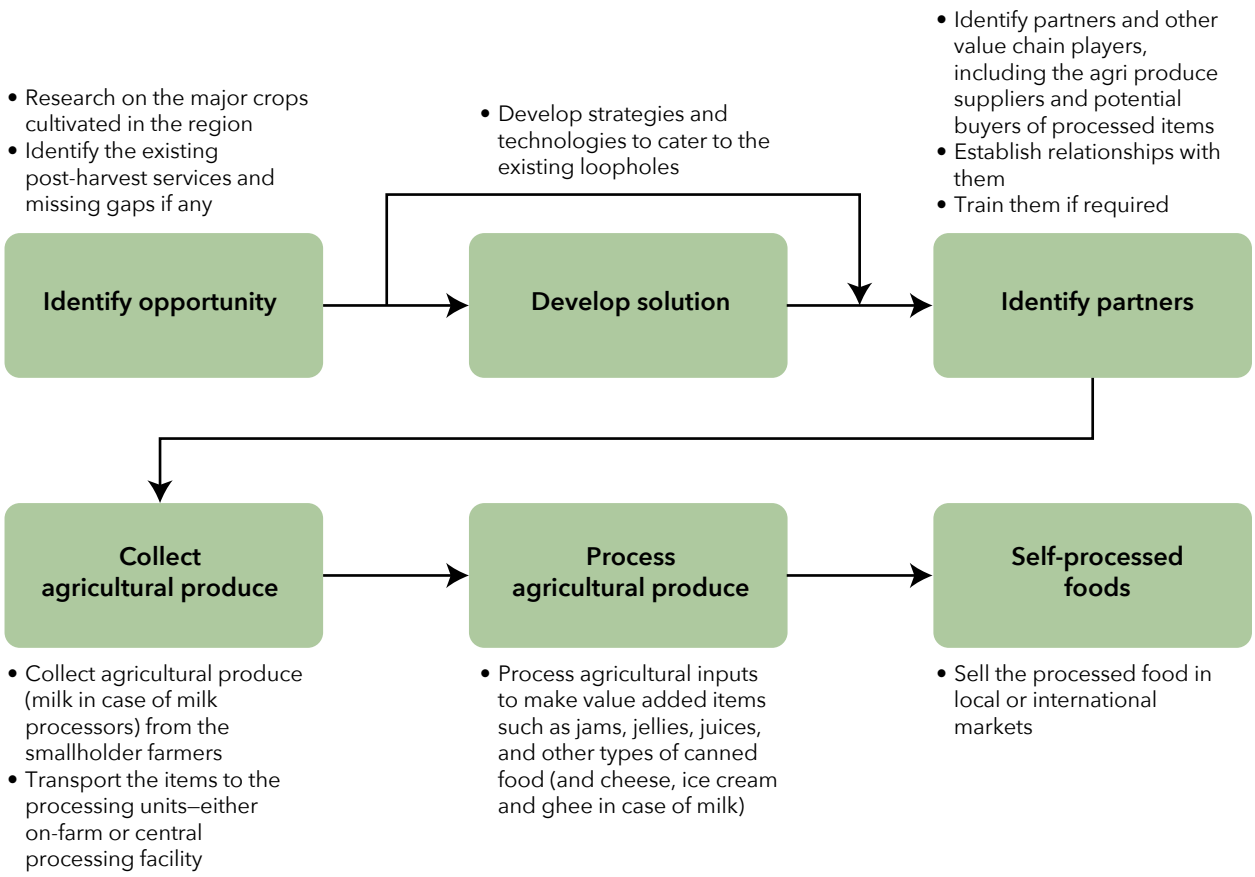
Social enterprises support farmers with sorting and packing, which improves the shelf life of agricultural produce. The process also involves branding that guarantees a certain quality for a certain premium. Indonesia based PT. Bimandiri Sedaya Agro supplies a range of fresh fruits and vegetables to supermarkets in the country. It selects and grades the fresh produce from the farmers and packs them in different sizes before selling them to the supermarkets. Another social enterprise in India, Parvata Foods is dedicated to building integrated value chains for the organic produce of farmers residing in the hilly areas of Northeast India.

The enterprise packs and brands organic fruits, vegetables and spices collected from the smallholder farmers and supplies at premium prices to leading retail chains in urban areas.

Quality Assessment

Social enterprises also add significant value to farm produce by undertaking quality assessment and certification. This allows for significant transparency in the quality (for example, percentage of fat in milk, grade and size of fruit) which determines fair market prices of the produce. It not only allows farmers to negotiate better prices, but also motivates them to focus on enhancing productivity and quality as they see income gains improve with better quality. By eliminating about ten layers of middlemen and offering differentiated packaging, branding and marketing of certified organic products, Parvata Foods pays 70 percent of its receipts from retails chains to farmers at the farm gate during collection (Artha Venture Challenge 2014). Kenya based Nu Bree Dairy delivers pasteurized milk to retail customers and businesses in the country. The stringent quality assessment undertaken by the enterprise ensures that its network of dairy farmers consistently receive premium prices for the milk they supply.

Figure 14. Process of the model



Cost Factors

Post-harvest service providers incur fixed costs on rent of the establishment, equipment expenses, utilities, management salaries, insurance and cost of interest on borrowed funds. Variable cost includes cost of raw materials, packaging material, transportation, contract labor/ seasonal employees, and marketing. Table 15 shows the typical project cost incurred to establish a small-scale fruit processing unit (NABARD 2014).

Milk, fruit and vegetable processing enterprises have to make significant investments in establishing the plant (including processing and quality assurance equipment), and in collection and distribution vehicles. Kenya based Nu Bree made an initial capital investment of approximately USD 250,000 for the processing plant, and spent USD 550,000 to buy collection and distribution trucks. It incurred an initial expense of USD 5,000 in marketing activities to create demand for its solution. Its operational expenses include the maintenance of the machinery and equipment and payment to farmers. India based post-harvest dairy

Table 15. Typical project cost for a fruit processing unit

S. No.	*Particulars*	*Amount (USD)*
1	Land	3,750
2	Land development	7,500
3	Civil work	34,650
4	Plant and machinery	60,345
5	Miscellaneous fixed assets	3,000
6	Preliminary and preoperative expenses	2,925
	TOTAL	112,170

enterprise Shree Kamdhenu Electronics Private Limited (SKEPL) also incurred similar capital expenses in buying machinery and development of technology. Human resource costs are a major operational cost component for SKEPL. Tanzania based food processing enterprise Claphijo incurred initial capital expenditure in developing and manufacturing of solar driers. Its major operational costs include buying produce (fruits and vegetables) for processing, and transportation cost to transfer the processed food to its target customers including supermarkets and boarding schools.

Other variable costs include packing material and transportation. Enterprises also need to make upfront payments to farmers and laborers, while their clients that include big corporates defer payments. The enterprises need to maintain high working capital and liquidity that add to their costs.

Revenue Streams

Grocery wholesalers, supermarkets and convenience stores are some of the major customers of post-harvest service providers (IBISWorld 2016). The end-consumers for post-harvest service providers include upper-middle income to high-income populations that are able and willing to pay a premium for quality products and services.

Some enterprises clean and sort the grains obtained from smallholder farmers and charge a premium for the product when they on-sell to other wholesalers and retailers. Other enterprises process the grains into flour and sell it to Fast Moving Consumer Goods (FMCG) companies that in turn either brand the products and retail them, or use the produce as raw material for producing other processed ready to eat food products such as biscuits. A number of other post-harvest service companies process fruits and vegetables into juices, jams, jellies, and pickles, and sell these in the local and international markets.

Milk processing enterprises earn revenues by direct sale of milk and higher value milk products. Branding allows these enterprises to earn higher revenues as well as build customer loyalty for new products. India based Milk Mantra collects the milk from small dairy farmers, a part of which is sold directly. The enterprise earns additional revenues from value added products such as buttermilk, yoghurt and milkshakes that it sells under the Milky Moo brand. It uses innovative packaging, which increases the shelf life of milk by up to four days and packaged paneer up to 21 days (Singh 2016).

Governments in developing countries are supporting small scale and micro food processing businesses by farmer families (particularly women) through aggregator models, such as eKutir (Dietz 1999). A few enterprises however, engage in sale of small scale food-processing solutions to farmers. Tanzania based Claphijo Enterprise, for instance, earns revenues by selling solar driers that reduce postharvest losses and domestic food waste. The drier brings down the moisture content of fresh produce from 60 percent to less than 10 percent and are priced at about USD 400, making them affordable to smallholder farmers given the reduction in post-harvest losses. The solar driers require minimum technical expertise for operation (Global Horticulture Initiative 2017).

Financial Viability

The profit margins of the interviewed post-harvest service enterprises range from 10 percent to 70 percent (self-reported). An indicative set of food processing industry profitability ratios globally is shown in table 16 (CSIMarket 2016).

According to Model Project Report on Fruit and Vegetable Processing Unit by National Bank for Agriculture and Rural Development (NABARD), India (NABARD 2011), the profit after depreciation, interest and tax generally increases year-on-year as indicated in table 17.

Enterprises that only sort and package for on-selling earn lower margins while those that invest in processing and convert the produce into food products are able to charge a significant mark-up over cost of production. Table 18 shows the margin earned on processed foods against the cost incurred in processing the agricultural produce (Daniel and Dudhade 2007).

A number of enterprises in this business model have been able to attract equity funding in the early stages. SKEPL received early stage investment from two impact investors, Aavishkaar and Grassroots Business Fund. Another Indian milk-processing enterprise Milk Mantra has attracted multiple rounds of investments. In 2014, it secured an investment for the fourth time from Aavishkaar, and has also attracted the interest of mainstream private equity investors including Fidelity. Securing investment from big investors, in addition to continued support from existing investors endorses Milk Mantra's growth potential and strategy of focused functional innovation and its 'ethical sourcing' initiative (Gupta 2014).

Interestingly, not all post-harvest enterprises benefit from branding and selling to retail customers. Often, the costs outweigh the returns. Enterprises that have adopted a business-

to-business approach have found it easier to achieve financial viability. This approach reduces the need for investments in branding and marketing, and also ensures them stable contracts for longer durations. For instance, Kenya based Nu Bree shifted from a business to customer model to a business to business model. Currently, the enterprise sources milk from small dairy farmers; it processes and packages the milk, and sells the milk to commercial customers such as hotels, restaurants, schools, universities, hospitals and corporates. The enterprise has also changed its engagement model with farmers. Instead of sourcing milk from dispersed farmers, the enterprise operates under a cluster contract farm model. In this model, Nu Bree owns one large scale farm cluster with a network of 100 small farmers. The farmers pay 2.5 million KES (USD 24,750) for a contract, against which the enterprise provides 10 cows, cattle feed and adequate fodder to each dairy farmer. Nu Bree then buys milk from these dairy farmers at market prices. With this innovative strategy, the enterprise achieved break-even within three months of its operations.

Other enterprises focus on maintaining high quality standards and adopted innovative technologies to ensure financial viability. Tanzania based Brookside Dairy has developed

Table 16. Food processing industry profitability ratios

Product	*2015 Q4*
Gross margin (annual TTM)	22.7 percent
Operating margin (annual TTM)	12.5 percent
Net margin (annual TTM)	8.7 percent

Source: CSIMarket 2016.

Table 17. Profit year-on-year (percent)

Year 1	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*
–5.8	3.3	9.5	10.5	11.5	11.9	12.2	12.8

Source: NABARD 2011.

Table 18. Margin earned on processed foods, for example, 100kg of tamarind fruit

Product	*Costs of agricultural produce + processing cost (USD)*	*Retail value of processed items (USD)*	*Value addition (USD/kg of tamarind fruit)*
Powder	21	45	0.24
Sauce	50	98	0.48
Pulp	63	112	0.50
Toffee	201	292	0.92

Source: Daniel and Dudhade 2007.

key performance indicators to ensure consistent high quality production. The high quality ensures minimum reject, hence reducing the losses for the non-salable items, thereby ensuring financial viability. The enterprise is not only focused on the volume of milk produced and sold, but also closely monitors its products for fat content and bacteria levels. It works closely with its farmers to ensure that the quality and quantity of the milk delivered to its collection centers remain consistent. Likewise, Dutch Agricultural Development & Trading Company (DADTCO) has developed a patented 'split' processing technology that helps on-farm processing of fresh cassava, instead of attempting to transport the perishable crop over long distances to a central processing plant. (Cassava is a highly perishable crop. The mobile cassava starch factories process the harvested cassava into cassava cake and/or cassava starch flour which can be used by the brewing industry, bakeries or other starch related businesses.) The loss figure estimates ranged between 10–12 percent in India, 6.2 percent in Java, and 5.3 percent in Indonesia (Wenham 1995).

Partnerships

Post-harvest enterprises engage in different partnership models to maximize individual and common financial benefits. A number of them establish partnerships for business development and other associated activities, especially when replicating their model in a different market. For instance, SKEPL partners with milk co-operatives for its business development in Nepal. The enterprise also forged an alliance with the international NGO, Winrock International, which helped it in running a pilot in Nepal (IFC 2015).

A few enterprises establish partnerships for financial support while others seek technical knowledge and training support as these are not skills they can recruit in-house. Some enterprises leverage these partnerships to startup the business. For instance, Claphijo Enterprise partners with various stakeholders including business associations for information exchange, and donors for funding, trainings, workshops, and exchange visits. The enterprise also partners with the University of Agriculture, Tanzania for its support in the testing and analysis of its solar drier. Similarly, in its early stages, Milk Mantra was established in collaboration with global processing and packaging technology experts, Tetra Pak, Multivac and DeLaval. The enterprise leveraged the association to develop its ready to drink packaged milk under the Milk Moo label (MoneyControl 2013). Arusha Women Entrepreneur together with its partner World Vision, provides technical and management skills training to women farmers. It trains them on various topics including microenterprise development, marketing skills, conflict resolution, and food processing skills.

Enterprises form partnerships with forward and backward value chain stakeholders to increase business profitability. For instance, Nu Bree partners with dairy meal manufacturers to get better prices on dairy meals. The manufacturers provide dairy meal at subsidized rate of KES 1800 (USD 17.82) for a 90 kg bag of dairy meal. A number of enterprises in this business model aggregate farm produce, sort, grade and package it, and deliver in bulk quantities, thereby saving transportation and transaction costs. Normin Veggies, an association of various vegetable industry stakeholders including independent and small farmers, development foundations, corporate farms, input and service providers and local government units, performs these activities. The enterprise then ships the aggregated cluster produce to institutional buyers such as supermarkets, hotels, restaurants, and fast food chains.

Implementation: Delivering Value to the Poor

Awareness

Smallholder farmers in most developing countries are unaware about the benefits of packaging, processing and quality certification. Even if they understand any of these benefits, they do not know how to avail the benefits for their own financial betterment. A number of enterprises support the smallholder farmers by providing requisite training and guidance. For instance, Cameroon based Guiding Hope builds capacity amongst the rural communities by providing technical training in all aspects of honey collection, storage, and processing, to improve product quality. Likewise, SKEPL conducts practical trainings showcasing and comparing both the traditional and electronic methods of measurement and quality assessment.

Enterprises adopt innovative strategies and build innovative partnerships to build awareness. Claphijo Enterprise takes help from local women self-help groups (SHGs) that create awareness about its solar drier. Milk Mantra conducts demonstrations at parks, schools and tennis courts across the state, and sampling at temples such as Lingaraj Temple in Bhubaneswar regarding the importance of appropriate packaging to prevent spoilage of perishable items such as milk and milk products (Singh 2016).

Acceptance

Smallholder farmers find it easier to go through the middlemen route, as they have been doing historically. It is a paradigm shift for some of them to move away from these relationships or adopt different approaches to packaging and processing to increase the value of their produce and reach the market directly. Enterprises adopt different strategies to make it easier for the farmers to make this shift. SKEPL allows milk cooperative members to test the product for 2 months. This trial period allows the customers to test the machines and get familiar with modern methods of calibration of milk quality and quantity.

A number of enterprises leverage local connections to understand customer requirements. This helps them design appropriate solutions and also engage with farmers more closely. Nu Bree works with farmer leaders in rural communities to increase acceptance of the enterprise's model. The farmer leaders educate fellow farmers on the benefits of working with the enterprise under the cluster contract model, under which the farmers can increase their income by a factor of 10 times vis-à-vis being a stand-alone supplier.

Accessibility

Post-harvest service providers eliminate middlemen and facilitate direct access to markets. In order to do this, they need to build or organize the supply chain from farm to processing unit, and finally to buyers. Often, the ease that they provide encourages farmers to shift from transacting with a known trader. Parvata Foods, for instance, is building integrated value chains for the organic farmers in Sikkim, by providing market linkages along with packaging and branding of the products obtained from them. The enterprise collects produce from farmers directly from the farms, where it is weighed and assessed for quality. The produce is then transported to a central processing plant for processing, packaging and distribution.

The enterprise supplies organic agricultural products such as fruits, vegetables and spices (both fresh and processed), sourced from farmers located in hilly and inaccessible areas to retail outlets.

Affordability

The business model helps to build financial sustainability of the smallholder farmers. A number of enterprises make payments for the agricultural produce at the farm gate, providing much needed liquidity and working capital. Parvata Foods pays 70 percent of the total value of the produce at the farm gate of the organic farmers in Sikkim (Artha Venture Challenge 2014). Likewise, SKEPL's solutions ensure payment to the dairy farmers as soon as they supply milk to the milk-co-operatives.

A few enterprises provide value-added food products at affordable prices to the financially weaker sections of the society. These organizations aim to fight malnutrition and poverty, in addition to helping farmers earn better incomes. Prosoya Kenya, for instance, buys maize, sorghum, soya beans and finger millet from smallholder farmers, extrudes the composite, fortifies the extrudate with vitamins and minerals and sells it at affordable prices to the people living below poverty line. Similarly, Mali based enterprise Malo Traders sells locally grown fortified rice to consumers at an affordable price. It trains farmers to improve the production process and reduce rice wastage. It fortifies the rice with nutrients to provide affordable food to the poor.

Results and Cost Effectiveness

Scale and Reach

The post-harvest services serve as a link between the agriculture and industrial segments of the economies of most developing countries. Enterprises in this business model tap into growing and lucrative commercial demand even as they ensure fair and equitable distribution of the benefits to smallholder farmers. Given that its end customers are mainstream, and often global, this business model has significant potential for scale. This business model is also mature, with many enterprises that are over a decade old. Their reach and engagement with communities and end-buyer markets is therefore, significantly stronger than enterprises in less mature business models.

Most of the milk processing enterprises have created innumerable impacts while providing financial upliftment to small dairy farmers. SKEPL works with nearly 7000 partners, each impacting at least 300 farmers. The enterprise has directly impacted nearly 2.1 million small dairy farmers in India. Geographically, the enterprise has reached over 8750 villages located in 72 districts in 17 states of the country (self-declared). Milk Mantra, sources milk from over 40,000 small dairy farmers, and has resulted in financial inclusion of the community (Singh 2016). Brookside Dairy has impacted nearly 45,000 Kenyan and 55,000 Ugandan dairy farmers, and has together provided them about USD 100 million for milk delivered to the enterprise.

Other enterprises have also created commendable impacts on the lives of smallholder farmers in remote rural areas. Parvata Foods supports livelihood of nearly 300 organic farmers in the state of Sikkim (Chauhan 2016). Another Indian enterprise, Moksha Yug Access (MYA) works with over 15,000 farmers across 1,110 villages in the state of Karnataka. Enterprises operating in Africa, Guiding Hope and DADTCO have also significant impact on the lives of the rural smallholder farmers in Cameroon and Mozambique. Guiding Hope has impacted 1,000 beekeepers and their families, totaling to nearly 10,000 individuals. In 2011, DADTCO entered in partnership with SABMiller to produce cassava beer, 'Implala,' which has created a sustainable source of income for 4500 smallholder farmers in Mozambique. Mobile processing units in Mozambique have benefited nearly 6000 smallholder farmers with average 1.2 hectare of farm land.

The business model is readily adaptable, that a number of enterprises that provide post-harvest services report that they have or plan to expand geographically. SKEPL built a strategic partnership with Winrock International to foray into Nepal. The absence of competition and presence of dairy farmer cooperatives also made Nepal a favorable destination (IFC 2015). Kenya based Brookside Dairy, has become the largest producer and supplier of milk and milk products in the country, plans to expand to countries in West Africa. Another Kenya based enterprise Prosoya Kenya plans to expand its operations to East and Central Africa. Likewise, India based Parvata Foods aspires to expand into exporting processed spices to Europe and US. Likewise, Nu Bree plans to leverage technology to strengthen linkages between farmers and finance providers as well as end-customers. It is in the process of developing 'Lima Soko,' an e-commerce platform to connect farmers to buyers in domestic and export markets, 'Lima Lending' to connect farmers to finance partners, 'Lima Insurance' where farmers can access affordable insurance policies than there are in the market, and 'Lima Logistics' to connect its transportation partners with farmers.

The dairy sector is well developed in several countries, with successful national and local brands. Given the extremely local context in milk consumption, there is room for small enterprises to develop niche markets. In India, mature value chain enterprises such as Parag

Table 19. Examples of companies and their reach

Company	*Country of operation*	*Years of operation*	*Number of farmers reached*	*Other impact parameters*
Brookside Dairy	Kenya, Tanzania, Uganda	23	1 million	–
Guiding Hope	Cameroon	10	10,000	–
Milk Mantra	India	7	40,000	–
Moksha Yug Access	India	10	15,000+	1,100 villages in Karnataka, India
SKEPL	India, Nepal	20	2.1 million	8,750+ villages in 72 districts in 17 states in India
T'ikapapa	Peru	10	500+ farmer families	–

Milk Foods are seeking to build local brands for value-added products such as cheese, ice creams, varieties of yogurt and milk-based beverages. Likewise, for Prabhat (Dairy), only 18 percent of its total revenue of INR 1,440 crore (USD 216 million) comes from liquid milk, while the rest is from value-added products such as cheese, milk beverages and yogurts under the GO brand (Shashidhar 2016).

Improving Outcomes

The post-harvest services model has direct and indirect impacts on the lives of smallholder farmers that were otherwise delinked from the value chain. Given the labor intensive nature of the business model, post-harvest enterprises also provide employment to women and youth from rural communities, thereby improving smallholder household incomes and training them for non-farm livelihoods (In India, food processing industry is one of the major employment intensive segments that contributed to 11.69 percent of employment generated in all registered factory sector in 2012–13 [Make in India. n.d.].) Tanzania based Arusha Women Entrepreneur, for instance deals in processing of peanut butter made from locally grown groundnut. The enterprise employs low-income women from peri-urban Arusha. Likewise, Kenya based Stawi Foods creates jobs for youth and smallholder farmers in Kenya. In addition, it provides women access to improved seeds, better techniques and technology, thereby contributing to increase in incomes within poor families.

Several interventions have led to direct increase in the incomes of smallholder farmers, although most of these impact figures are self-reported by the enterprises. Nu Bree, for instance, has helped increase the income of small dairy farmers by a factor of 10. Likewise, Normin Veggies secures increased price premium of 10–20 percent for smallholder farmers compared to traditional supply chains. Parvata Foods creates value for the farmer by increasing incomes and by providing the necessary market linkage and a brand to sell their organic produce in larger markets. The enterprise pays farmers 70 percent of the total payable amount at farm-gate, which is one of the highest in fruit and vegetable category in India. The enterprise ensures that farmers get about USD 0.08 to USD 0.15 more per kilogram than that paid by middlemen and unorganized procurers.

Cost Effectiveness

In the absence of post-harvest services, smallholder farmers will continue to sell their agricultural produce, mostly through middlemen. The post-harvest services business model is cost-effective as most enterprises procure inputs from smallholder farmers in large quantities, add value to the inputs by processing, packaging, branding and labeling, and sell the same at higher prices in local and international markets. The end-customers for these value-added products are willing to pay a premium for good quality produce, organic certifications and packaged and processed milk. For instance, Milk Mantra marks up the price of its product by 10–20 percent as against the price offered by the state cooperatives, and is still financially sustainable (MoneyControl 2013). Claphijo Enterprises has a profit margin of 60–70 percent on its solar drier, which is priced at about USD 400 (self-reported). The enterprise strategizes its financing in such a manner that even after earning this high profit margin, the driers are affordable to farmers.

Scaling Up

Challenges

Post-harvest value addition enterprises face market challenges, farmer challenges, and enterprise challenges. Market challenges include the dominance of middlemen and large corporates that inhibit the scaling of social enterprises. Despite the low prices offered to them, farmers find it easier to sell their produce to middlemen rather than reaching out to the post-harvest service providers. Given the large scale of their operations, large corporates can cross-subsidize their products and services, thereby challenging the pricing strategy of post-harvest service providers.

Farmer challenges include the need for farmer education, the inadequate access of farmers to finance to improve crop quality. Milk processing enterprise Nu Bree underscores the challenge of inconsistencies in quality and quantity of milk supply that impacted its overall quality. To address this, the enterprise introduced cluster contracting model, where farmers enter into contracts with Nu Bree and are provided cows, feed and fodder requirements. They are required to sell the milk back to the enterprise thereby ensuring consistent quality and supply of milk. Other specific challenges linked to milk processing include inappropriate collection system of raw milk that leads to delay in the collection process and often results in spoiling of milk before it is processed. Therefore, enterprises need to establish collection points with a robust collection infrastructure.

Enterprise challenges include the need for investments in equipment, quality assurance, working capital and manpower. Working capital is needed as farmers need to be paid upfront, while the larger companies that buy the products have longer credit periods. SKEPL highlights that skilled manpower is a key challenge, given that rural semi-skilled labor is migrating to peri-urban and urban areas to work in malls and quick service restaurants. SKEPL tackles this issue by offering market based compensation to the workers.

Role of Government and Policy

Governments have been very supportive of the small-scale food processing industry in most developing countries. Different agricultural-support programs have connected smallholder farmers to mainstream processing, packaging and exporting partners; provided them facilities either directly or in partnership with other stakeholders in the system, such as finance providers and FMCG companies; and supported them with incentives and subsidies.

Several governments collaborate with development finance institutions for financial support. For instance, in Kenya, the government is executing a project commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) for private sector development in agriculture. One of the outcomes includes provision for training in hygienic butchery techniques such as processing, and packaging as per national standards. This simple practice has brought a 5 percent reduction in meat wastage per day (GIZ n.d.). General improvements in the business climate can be conducive to growth of these enterprises. Kenya-based Nu Bree indicated that government support to startups in the country has improved; licensing used to be a challenge earlier (the enterprise requires a trading license and distribution license for its operations) but is easier now.

In Peru, indirect government support and benefits such as incentives, 50 percent rebate on tax, and permission to employ workers on flexible contracts, helps the agribusiness firms benefit. Peruvian enterprises seek general assistance from the government such as access to finance, better infrastructure, and adequate research and development in modern technology to boost post-harvest value-chain activities in the sector (Oxford Business Group 2016).Tanzania based enterprise Claphijo highlights the promising prospects of government industrialization policy in the country. The policy emphasizes on technology innovation in the agriculture sector, and more specifically post-harvest value-addition component (The Citizen 2016).

The Government of India has supported the food processing industry for several decades—the National Dairy Development Board and Nagpur Orange Grower's Association are examples of government-run processing establishments that positively impact the lives of several smallholder farmers, while adding to the country's GDP. In addition, the Government permits 100 percent FDI in this sector, and has developed agri export zones. The central government has established 3.2 million tons of food processing capacity with an investment of about USD 300 million in the last two years (PTI 2016). It further plans to establish 250 small agro-processing clusters at an estimated cost of over USD 750 million. The clusters will reduce post-harvest wastages, worth USD 1.35 billion per annum, will help increase farmers' income and will also keep the prices of perishables under check (PTI 2016). A number of states including Jharkhand (Government of Jharkhand 2015), Odisha (Government of Odisha 2013), and Bihar (Government of Bihar 2009) have also launched food processing policies.

Conclusion

The success of this business model depends on critical factors such as access to good quality agricultural produce to ensure end-product quality; supply contracts for key produce to mitigate price volatility; strong forward contracts with buyers for on-selling processed and packaged produce, and sufficient stability in demand to be able to charge prices that provide reasonable margins (IBISWorld 2016). The model has adequate regulatory support in a number of developing countries but faces liquidity challenges as it must pay farmers upfront at the farm gate. On the other hand, enterprises face payment delays from its end-customers, who are large corporates and supermarket chains. This model is highly scalable considering the indispensable requirement of post-harvest services in most developing economies to leverage their agricultural potential and augment GDP through value-added agricultural exports.

Table 20. Social enterprises: Post-harvest service providers

Company	*Country*	*Solution description*
Arusha Women Entreprenuer	Tanzania	Arusha Women Entrepreneurs trains and employs women in the production and marketing of peanut butter. Smallholder farmers supply the peanuts which are processed into peanut butter and sold in bulk to a large wholesaler as well as to supermarkets and kiosks, and through door-to-door sales.
Brookside Dairy	Kenya, Tanzania, Uganda	Brookside Dairy Limited is a dairy processing enterprise that produces, processes, and markets milk and dairy products. The enterprise offers fresh pasteurized milk, cream, butter, yogurt, ghee, and long life milk products in Indian Ocean Islands, East Africa, Rwanda, Burundi, Egypt, and the Middle East.
Claphijo Enterprise	Tanzania, Namibia, Kenya, Uganda	Claphijo Enterprises specializes in offering post-harvest management of crops by processing dry foods through dehydration of fruits and vegetables using a solar drying mechanism. It markets the products using an in-house brand known as Mama's Flavours.
Dutch Agricultural Development & Trading Company (DADTCO)	Netherlands, Nigeria, Mozambique and Ghana	DADTCO together with its partners covers the whole cassava value chain, from agricultural production with smallholder farmers, input supplies, processing and the marketing of the final product in local and international markets.
eKutir	India	eKutir uses an entrepreneurship model combined with ICT to deliver solutions to BoP communities. The model involves partnerships with domain experts, service providers, and market players, who provide a suite of products and services through a distribution network of local, village-level entrepreneurs. These entrepreneurs connect suppliers, aggregators and distributors to this network of smallholder farmers.
Guiding Hope	Cameroon	Guiding Hope engages with local bee farmers in Cameroon to trade organic honey, beeswax, and propolis. It helps in building technical capacity of small bee-farmers to increase their product quality and range.
Kilimo Markets	Tanzania, Kenya	Kilimo Markets is an outgrower engaged in trading of grains and pulses, sesame, groundnuts, beans and maize. It exports to different markets including South Africa and Kenya for maize; South Asia, Africa and Europe for beans; and India for pulses.
Malo	Mali	Malo Traders sells locally grown fortified rice to consumers at an affordable price. The organization aims to fight malnutrition and poverty in Mali by helping farmers to increase their incomes through improving the production process to reduce rice wastage and by enriching the rice they produce with nutrients.

Table 20. Social enterprises: Post-harvest service providers (continued)

Company	*Country*	*Solution description*
Malo	Mali	Malo Traders sells locally grown fortified rice to consumers at an affordable price. The organization aims to fight malnutrition and poverty in Mali by helping farmers to increase their incomes through improving the production process to reduce rice wastage and by enriching the rice they produce with nutrients.
Milk Mantra	India	Milk Mantra focuses on the dairy supply chain across urban supermarkets in Eastern India, particularly Odisha. Its strategies include developing products with a longer shelf life to cater to consumers in major Indian cities.
Moksha Yug Access	India	Moksha Yug Access provides market linkage to small dairy farmers through its supply chain network. MYA also provides technological support that seeks to improve the quality of milk and dairy products sold in the network.
NorminVeggies	Philippines	Northern Mindanao Vegetable Producers Association Incorporated (Normin Veggies) is an association of various vegetable industry stakeholders that facilitate cluster farming, thus saving transportation and transaction costs for the smallholder farmers.
Nu Bree	Kenya	NuBree sources milk from small-holder dairy farmers, processes and packages the milk and distributes it to consumers in Nairobi and neighboring regions. The enterprise distributes milk to hotels, restaurants, schools, universities, hospitals and corporates.
Parvata Foods	India	Parvata Foods supplies organic produce like fruits, vegetables and spices sourced from farmers in inaccessible areas to retail outlets through a farm-to-store model. It supplies the produce to organized retailers such as Reliance, and Mother Dairy. It also sells directly to exporters.
Parag Milk Foods	India	Parag Milk Foods holds a diverse portfolio in over 15 consumer centric product categories. The enterprise manufactures and promotes cow's milk and milk products, under brand names such as Gowardhan, Go, Topp Up and Pride of Cows. Its product portfolio includes ghee, fresh milk, milk powder, milk powder, processed and natural cheese, butter, dairy whitener and gulab jamun mix.
Prabhat Dairy	India	Prabhat Dairy provides a range of products in the ingredient business category (such as sweetened condensed milk, dairy whitener), and consumer business category (such as flavored milk, yoghurt, cheese). The enterprise has over 450 milk collection centres, over 15 milk chilling plants and over 80 bulk milk coolers.
Prosoya Kenya	Kenya	Prosoya Kenya buys maize, sorghum, soya beans and finger millet from small scale farmers, extrudes the composite, fortifies the extrudate with vitamins and minerals and sells it at affordable prices.

Table 20. Social enterprises: Post-harvest service providers (continued)

Company	*Country*	*Solution description*
Shree Kamdhenu Electronics Private Limited (SKEPL)	India, Nepal	SKEPL has conceptualized the need of an Automatic Milk Collection System (AMCS) in early 1990 for ensuring transparency, mutual faith and error-free operations of Milk Collection. It also manufactures Electronics Weigh Scale with Quality testing equipment (EMT or Milk Analyzer). SKEPL sells its products under the brand name of Akashganga.
Stawi Foods and Fruits	Kenya	Stawi Foods and Fruits is a food processing business that involves milling of nutritious porridge flours, sold in the Kenyan market.
T'ikapapa	Peru	The T'ikapapa model links small operation farmers, who preserve and produce hundreds of native Andean potatoes varieties, with other potato chain partners to take advantage of high-value niche markets in urban centers.
The Bimandiri company	Indonesia	PT. Bimandiri Sedaya Agro supplies various kinds of fresh fruits and vegetables to modern market or super market. It selects and grades the fresh produce from the farmers and packs it in different sizes before selling it to super markets.

References

Artha Venture Challenge. 2014. "Parvata Foods." http://www.arthaventurechallenge.com/selectedventuredetails/32/4eo2zC4b2nU=

Canning, Patrick. 2013. "ERS Food Dollar Series Allows an In-depth Look at Farm Level Components of the U.S. Food Dollar." United States Department of Agriculture Economic Research Service. https://www.ers.usda.gov/amber-waves/2013/july/ers-food-dollar-series-allows-an-indepth-look-at-farm-level-components-of-the-us-food-dollar/

Chauhan, Ashish. 2016. "'Mann ki Baat' praise for IIM-A alumni's Sikkim firm." *The Times of India*. February 1. http://timesofindia.indiatimes.com/city/ahmedabad/Mann-ki-Baat-praise-for-IIM-A-alumnis-Sikkim-firm/articleshow/50802755.cms

The Citizen. 2016. "Tanzania: Industrial Policy Execution Tanzania's Big Challenge." http://allafrica.com/stories/201605041028.html

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). n.d. "Private Sector Development in Agriculture." https://www.giz.de/en/worldwide/19701.html

Global Horticulture Initiative. 2017. "GlobalHort News." http://globalhort.org/news-events/news/

Gupta, Bhawna. 2014. "Orissa-based Milk Mantra raises $13M in Series C led by Fidelity Growth Partners." *VCCircle*. http://www.vccircle.com/news/food-agri/2014/06/29/orissa-based-milk-mantra-raises-13m-series-c-led-fidelity-growth-partners

CSIMarket. 2016. "Food Processing Industry, Profitability Information and Trends, 2016." http://csimarket.com/Industry/industry_Profitability_Ratios.php?ind=505

Daniel, Joshua and Prashant Dudhade. 2007. "Analysis of economic characteristics of value chains of three underutilized fruits in India." The International Center for Underutilized Crops. http://bit.ly/2wTukVv

Dietz, Martin H. 1999. "The potential for small scale food processing for rural economies." *The Courier* No. 174. http://ec.europa.eu/development/body/publications/courier/courier174/en/089_en.pdf

IBISWorld. 2016. "IBISWorld Industry Report: Global Fruit & Vegetables Processing." https://www.scribd.com/document/319218398/Global-Fruit-and-Vegetables-Processing

International Finance Corporation (IFC). 2015. *Corridors for Shared Prosperity: Transfer Journeys of Indian Inclusive Business Models*. International Finance Corporation: Washington, D.C. https://www.ifc.org/wps/wcm/connect/30589480472ffabc84fbec57143498e5/Corridors+for+Shared+Prosperity.pdf?MOD=AJPERES

Make in India. n.d. "Food processing." http://www.makeinindia.com/sector/food-processing

Mitra, Sandip, Dilip Mookherjee, Maximo Torero, and Sujata Visaria. 2013."Asymmetric Information and Middleman Margins: An Experiment with West Bengal Potato Farmers." http://economics.mit.edu/files/8720

MoneyControl. 2013. "How Srikumar Misra's Milk Mantra fights adulteration menace." http://www.moneycontrol.com/news/business/how-srikumar-misras-milk-mantra-fights-adulteration-menace_881167.html?utm_source=ref_article

National Bank for Agriculture and Rural Development (NABARD). 2014. "Model Project Report on Fruit & Vegetable Processing Unit." http://agricoop.nic.in/imagedefault1/Medium percent20Fruit percent20and percent20Vegetable percent20Processing percent20Unit.pdf

Oxford Business Group. 2016. "Agricultural Exports on the Rise in Peru." http://www.oxfordbusinessgroup.com/overview/fresh-horizons-agricultural-exports-are-taking-place-traditional-foreign-currency-earners

PTI. 2016. "Government to establish 250 agro processing clusters all over India." *The Economic Times*. June 2. http://economictimes.indiatimes.com/news/economy/agriculture/government-to-establish-250-agro-processing-clusters-all-over-india/articleshow/52553625.cms

Shashidhar, Ajita. 2016. "The INR 80,000 crore milk business." *Business Today*. http://www.businesstoday.in/magazine/cover-story/indian-dairy-market-is-on-a-tear-due-to-new-players/story/232545.html

Singh, Rajiv. 2016. "Start-up Milk Mantra churns Rs 120 cr in 4 years, compelling Raghuram Rajan to take notice." *The Economic Times*. June 22. http://economictimes.indiatimes.com/articleshow/52849123.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

Wenham, J.E. 1995. "Socio-economic importance of rapid post-harvest deterioration of cassava: quantitative and qualitative losses." In *Post-harvest deterioration of cassava: A biotechnology perspective*. Food and Agriculture Organization: Rome. http://www.fao.org/docrep/v4510e/V4510E08.htm

CASE STUDY

Shree Kamdhenu Electronics Private Limited (SKEPL)

Founding year: 1996
HQ: Anand, Gujarat, India
Countries of operation: India, Nepal, Vietnam
Orientation: For-profit
Employees: 85
Turnover: USD 2.1 million

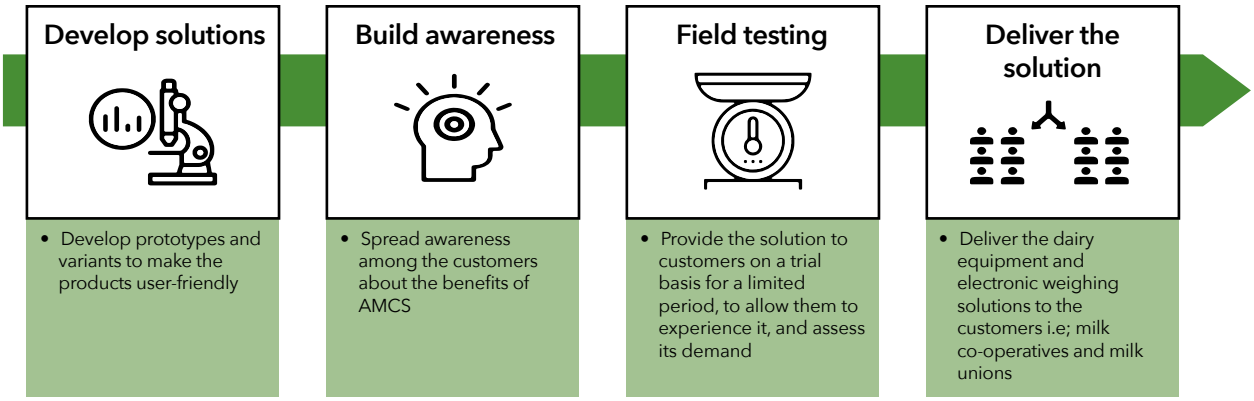
Almost in every village of India, there is milk co-operative that collect milk from farmers. In the past, it was manual collection. A passbook was maintained to record the quality and the amount paid to the farmer. This often caused mistrust due to lack of transparency, and delays in payments.

SKEPL has developed a solution "Akashganga" to measure the volume, and quality of milk. The solution is targeted at milk co-operatives or milk unions that measure and assess milk quality, and pay farmers based on the report that the machine generates real-time. It has also reduced the time lag between the collection of milk at the collection point and receipt of money by the farmers from nearly 10 days to almost zero.

The enterprise has directly impacted nearly 2.1 million small dairy farmers in India.

Operating Model

Shree Kamdhenu Electronics Private Limited (SKEPL) recognized the need of an Automatic Milk Collection System (AMCS) in early 1995 in order to ensure transparency, trust and error-free operations in the milk collection process. The enterprise provides dairy equipment and electronic weighing scales to dairy farmers through dairy co-operatives and milk unions. It is an ISO 9001:2008 certified enterprise that integrates the electronic weighing scale with quality testing equipment such as electronic milk tester or milk analyzer, and data processor or computer. SKEPL delivers products and services under the brand name of AKASHGANGA.



SKEPL leverages technology to provide customized solutions for milk collection. Some of the products and services include nano-based (hand held device) milk collection systems, solar operated milk collection systems, daily SMS-based milk quality reports, USB drive-based data transfer for integrating with payment gateway, financial accounting software (with regional language support) to draw up to balance sheet. General Packet Radio System (GPRS) and File Transfer Protocol (FTP) based data transfer from collection point to chilling plants or bulk milk coolers or dairy plants.

SKEPL allows milk cooperative members to test the product for 2 months. This trial period allows the customers to test the machines and get familiar with the modern methods of calibration of milk quality and quantity. The milk co-operatives that are interested in adopting the technology on a permanent basis can purchase the machines after this test phase. Farmers test the product and share feedback with other farmers – and SKEPL leverages this word-of-mouth marketing to increase sales of its product. The enterprise has also explored other avenues for business development, such as participation in government tenders. It engages with local communities such as milk unions in Nepal for business development activities in the country.

The enterprise educates its customers regarding the significance and use of the electronic machines. It provides practical training to customers and allows them to experience the difference between the traditional and electronic method. This helps in building trust with the customers. SKEPL also customizes the solution as per farmers' requirements. For instance, quality reporting requirements are different across Indian states such as Gujarat and Maharashtra; therefore the solutions provided are also different. The enterprise supports its customers regarding the best use of the product, and according to the enterprise, customers can recover the cost of the product within 6-7 months if they follow the suggestions of SKEPL.

Financial Sustainability

SKEPL incurs most of its operational costs in human resource management, and most of the capital costs in technology development. Its sources of revenue include annual contracts with the milk unions, and fees obtained for after-sales service support. The enterprise has raised money from two investors - Aavishkaar and Grassroots Business Fund. The price range of

the solution ranges between USD 1050 and USD 1800, based on the configuration, with the enterprise making a gross profit margin of around 20 percent on each AMCS.

Impact

SKEPL works with nearly 7000 partners, each impacting at least 300 farmers. Therefore, the enterprise has directly impacted nearly 2.1 million small dairy farmers in India. The intervention has eliminated low payment to farmers and adulteration of milk, thereby increasing farmers' income.

The enterprise was the implementation partner in a project funded by Department for International Development (DFID) through a Poorest Area Civil Society (PACS) program. SKEPL provided manufacturing, installation and maintenance services for Automatic Milk Collection Units (AMCUs) installed at village cooperative societies as part of the project. The model demonstrated that the investment made through the program ensured 26 percent increase in income for the dairy farmers, reduced their challenges in selling the milk and increased transparency at the collection point. Dairy farmers used to receive an average of INR 3114 (USD 47) per month by pouring milk into the Dairy Co-operative Societies (DCS). With this intervention, the amount increased to INR 3981 (USD 60) per month. There was also an average 20 percent increment in the amount of milk poured into the DCS by an individual dairy farmer, and around 6 percent increase in the rate of milk because of the improvement in the quality of milk and good dairy practices.

Challenges and Lessons

Skilled manpower is a key challenge for SKEPL, given that rural semi-skilled labor is migrating to peri-urban and urban areas to work in malls and quick service restaurants. Another important challenge is capital and management of its funds. SKEPL lacks collateral securities and finds it difficult to avail working capital loans for its business. To manage funds and raise working capital, SKEPL's promoters have had to provide personal assets as a collateral security. SKEPL addresses the issue of human resource management by providing appropriate compensation and growth opportunities to its people.

CASE STUDY

Kilimo Markets Ltd

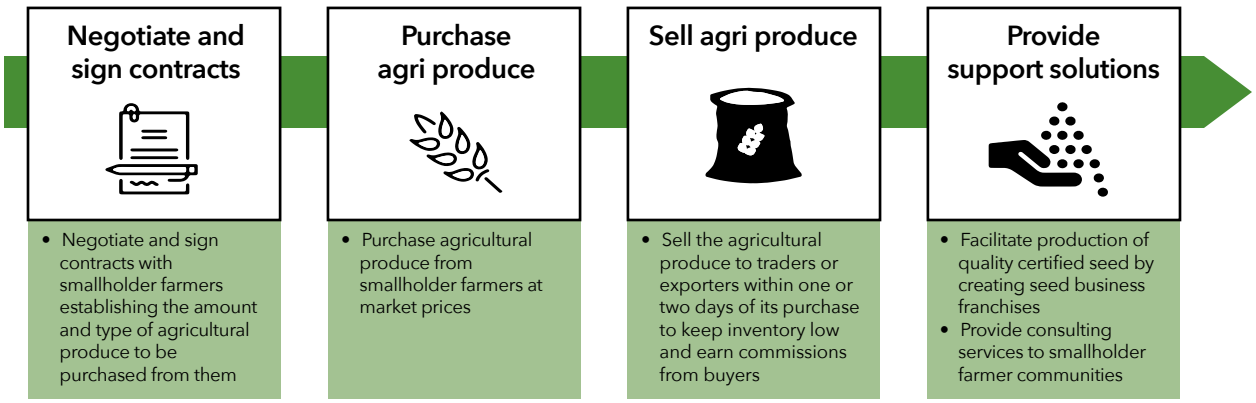
Founding year: 2010
HQ: Arusha, Tanzania
Countries of operation: Tanzania, Kenya
Orientation: For-profit
Employees: 224
Turnover: USD 6.6 million

Local buyers and middlemen exploit farmers by paying them less than market prices for the agricultural produce. In the absence of adequate information and access to markets, farmers are forced to sell the produce to them.

Kilimo Markets provides comprehensive post-harvest business solutions for smallholder farmers in Tanzania. It is a farmer-owned business model that is replicable and scalable over a wide area, and aims to benefit smallholder farmers. It partners with farmers to provide quality inputs, contract management services to small hold farmers, and warehouse operation and logistics support. It buys and aggregates agricultural produce from smallholder farmers at market prices and sells it to traders, thereby earning a commission from them. The enterprise promotes sustainable development in its areas of operation by providing smallholder farmers confirmed linkage to markets to sell their agricultural produce. This results in increased agricultural production and increased income of smallholder farmers. It has served over 2600 smallholder farmers in its areas of operation.

Operating Model

Kilimo Markets engages in trading of grains and pulses, sesame, groundnuts, beans and maize. It exports to different markets including South Africa and Kenya for maize; South Asia, Africa and Europe for beans; and India for pulses. It procures raw produce from smallholder farmers through buyback arrangements at fixed prices, and exports it through forward contracts. It thus connects farmers to better market opportunities. In addition, Kilimo Markets provides extension services.



Kilimo Markets has several subsidiaries, one of which is Kilimo Markets Limited Market Brokerage Service (KMB), which is licensed as a warehouse operator that provides both, access to affordable finance and efficient warehousing for smallholder farmers. It brokers contracts with smallholder farmers and also manages grain as collateral. KMB operates in the Tanzania warehouse receipt system in partnership with a leading national bank. The bank provides finance to the entire value chain of this business unit. This arrangement helps smallholder farmers have access to easy and affordable finance by depositing their agricultural produce in the Kilimo Markets warehouse.

Another subsidiary, Kilimo Markets Seed Growers Services (KMSG) facilitates production of quality certified seeds by creating seed business franchises owned and managed by the Farmer Marketing Associations (FMAs) and the parent company Kilimo Markets. Kilimo Markets also provides consulting services to smallholder farmer communities organized into FMAs. It provides training on various topics including savings-led microfinance, farmer financing solutions, agriculture best practices, productivity, and resource management. The enterprise also provides training to smallholder farmers in enterprise development and management, agribusiness registration, supply chain management, and entrepreneurship. Kilimo Markets leverages partnerships with government extension agencies and research institutes to ensure sustainability. It is actively developing partnerships with private and NGO partners.

Financial Sustainability

Kilimo Markets ensures financial sustainability using its strategy of aggregating smallholder produce in large quantities, and maintaining low inventory through efficient matching of contracts. The enterprise buys produce from the smallholder farmers at market prices and sells it within one or two days. The high volumes afford economies of scale which helps the enterprise negotiate better prices from the buyers. In 2015, it sold nearly 300–500 tons in single contracts. The primary source of revenues for the enterprise is income from the sale of exports. Other sources include fee for training and advisory services, and rent for warehousing facilities.

Some of the top cost components for the enterprise include transportation of produce, payment to farmers. Another important cost component is the cost of finance loaned from banks. Some of the initial funding sources of Kilimo Markets include finance from a bank

that the enterprise had partnered with in the first two years of operation, and grant money from a challenge. The bank provided USD 90,000 to Kilimo Markets over a period of two years. It also received USD 150,000 from African Enterprise Challenge Award in 2011. Kilimo Markets achieved break-even last year; however it is not yet profitable.

Impact

Kilimo Markets has already served over 25,000 smallholder farmers, and has paid them over USD 3 million in premiums for their agricultural produce. In the absence of the enterprise, the smallholder farmers would receive at least 30 percent lower price from the local buyers. The enterprise promotes sustainable development in its areas of operation by providing smallholder farmers confirmed linkage to markets to sell their agricultural produce. This results in increased agricultural production and increased income of smallholder farmers.

Challenges and Lessons

Kilimo Markets faces a dearth of qualified personnel, who could support business activities in several ways including the operational activities and specific activities such as keeping a note of the subsidies permitted for the business model. The enterprise also mentions inadequate access to capital and infrastructure, bureaucratic struggles, and policies at regional level as other critical challenges.

The enterprise is planning its expansion, especially in South Asian countries including India. However, it has been facing several roadblocks. The enterprise has limited understanding of government policies, taxation rules and regulatory framework in India. It also faces challenges because of bureaucratic inefficiencies, and instability in prices due to trader cartel. Kilimo Markets has also gone through extreme situations wherein the enterprise encountered, non-adherence and breach of contractual agreements by buyers, including large processor firms.

Storage Solutions

Reducing post-harvest losses by providing on- and off-farm affordable storage

HIGHLIGHTS

- Annual post-harvest food losses are as high as 30 percent of the total produce in Sub-Saharan Africa.
- Enterprises provide affordable post-harvest storage solutions, both on-farm and near transportation hubs.
- Innovations include centralized management information systems to help track real-time information on the multi-location holdings of customers and solar power in cold-storage solutions to save electricity and diesel costs.

Summary

The United Nations estimates that by 2050, total world population will increase to 10.5 billion. In developing countries, increased demand for food and competition among the different uses of land, such as industries and residential areas, has made efficiency an imperative for food security. Post-harvest losses are especially significant in developing countries where rural areas lack basic infrastructure to store agricultural produce.

Annual post-harvest food losses are as high as 30 percent of the total produce in Sub-Saharan Africa (Costa 2015). Latin America and the Caribbean are responsible for 6 percent of global food losses; the region loses nearly 15 percent of the total agricultural produce. Of this loss, 28 percent occurs at produc-

Note: INR to USD rate conversion = 1 INR = 0.015 USD

er level and 22 percent during the post-harvest handling and storage (FAO 2014). In developing countries, nearly 90 percent of the food wastage occurs within the value chain. It directly impacts smallholder farmers whose incomes are reduced by at least 15 percent because of the post-harvest food losses. Globally, a quarter of smallholder farmers also constitute the population that is food insecure. If the current rate of food loss continues, by 2050, food production would need to be increased by 70 percent, which would require an annual investment of USD 83 billion (Korberg 2014).

Solutions to address post-harvest losses, therefore, are critical to reduce the potential demand-supply gap in agriculture. A number of social enterprises across the globe have addressed this challenge with post-harvest logistics and storage solutions that allow them to simultaneously create positive environmental and social impact. Social enterprises provide stationary and mobile post-harvest storage solutions, such as warehouses with cold storage facilities, solar-powered on-farm cold storage units, and air-conditioned vegetable carts. In addition, some of the enterprises also offer collateral management and market linkage services.

Development Challenge

Globally, food wastage amounts to a monetary loss of USD 1 trillion. In developing countries, this loss is estimated to be high at around USD 310 billion; and 40 percent of the losses occur at post-harvest and processing levels. In Sub-Saharan Africa, approximately 150 kilograms of food produced is lost per person per year. FAO estimates that saving one-quarter of the food lost annually would be enough to feed the world's hungry (FAO n.d.). Amongst the Latin America and Caribbean countries such as Ecuador, Paraguay and Haiti, post-harvest losses range between 35 percent-50 percent of the total produce. Lack of adequate information, inappropriate use of technology, transportation barriers and climate change are some of the factors that result in such huge losses in the region. The environmental footprint of food wastage is also very high. According to FAO, water used for irrigation to grow crop that is eventually wasted is enough to meet the domestic water needs of 9 billion people.

In developing countries, significant post-harvest losses from farm to depot are caused due to financial and structural limitations in harvesting, storage, packing, and transportation. Further, challenges in institutional and regulatory frameworks, market mechanisms, and climatic conditions also contribute to food spoilage. It is difficult to penetrate the vast and fragmented smallholder farmer population, and small and upcoming companies find it cost-prohibitive to reach thousands of dissimilar farms, while big companies encounter a number of logistics issues (Mendoza 2016). A major drawback in agriculture supply chains in developing nations is limited access to a formalized cold-storage network, especially for smallholder farmers. Inadequate infrastructure including roads, electricity supply, and inadequate handling of post-harvest agricultural produce adds to the challenges (energypedia.com n.d.). For instance, in India, there is a need to double the cold storage capacity to prevent further food wastage (Emerson Climate Technologies n.d.).

Post-harvest losses have dire economic implications on farmers. When a kilogram of produce is wasted, losses accrue through the production process, including the cost of inputs such as land, seeds, water, fertilizers and pesticides as well as the effort that the farmer and his family puts into production. Lack of storage and warehousing facilities also impacts farmers' incomes as they are often compelled to sell their produce at very low prices to avoid losses due to spoilage. For example, in East Africa, during the very short banana harvest season, supply outstrips demand, and market prices fall. Within a month after harvest, there is very limited produce for sale. Given the short shelf life of bananas, farmers are forced to accept the prevailing low market prices during harvest season. Most of the produce is purchased by bigger enterprises at extremely low prices. These enterprises process and market the produce and earn higher margins, while farmers find it difficult to even cover their cost of production.

Business Model

Components of the Model

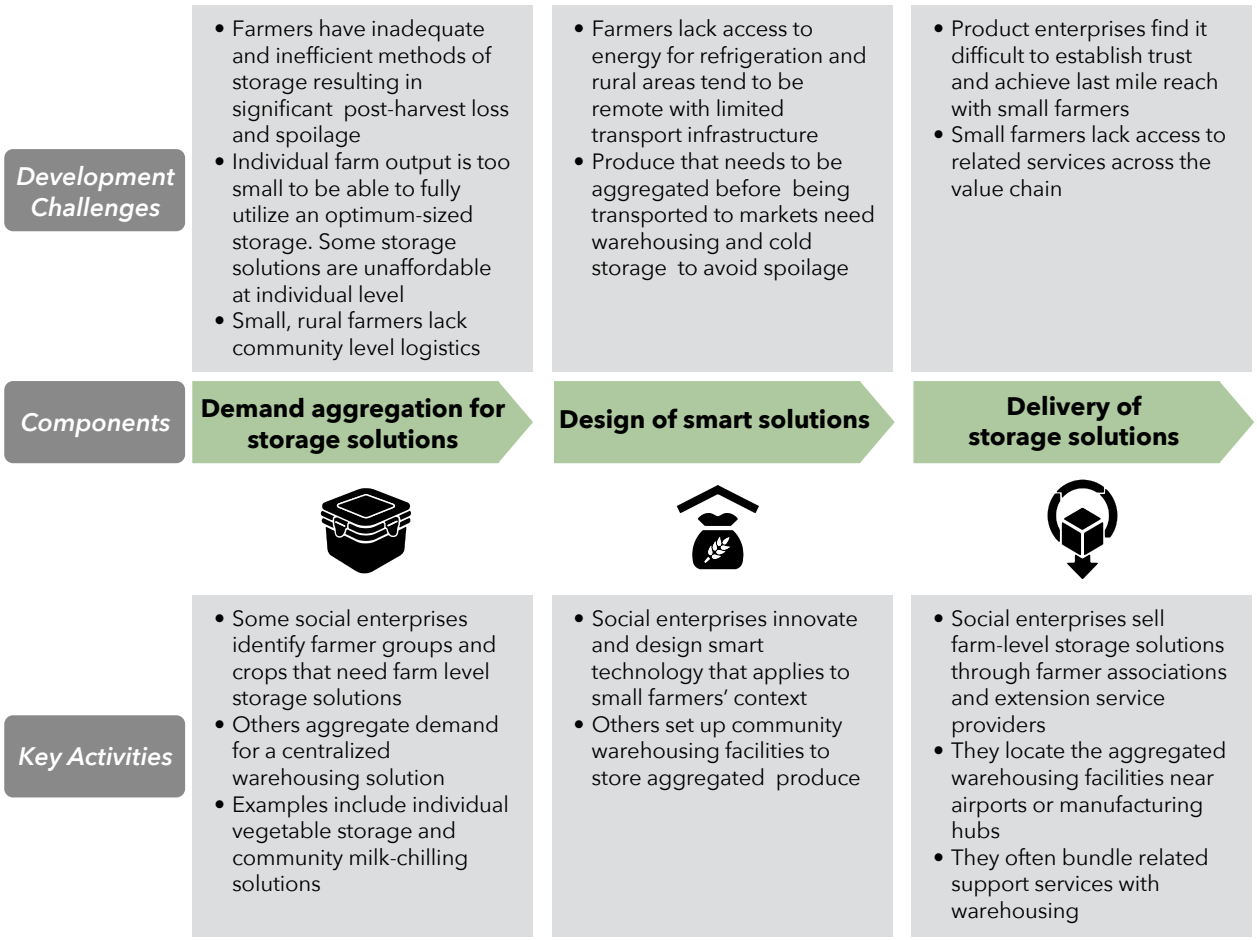
Social enterprises that reduce post-harvest losses offer storage solutions that are general as well as sector-specific. General storage solutions can be used for different types of agricultural produce, and comprise large facilities that farmers can lease as well as local storage that farmers can purchase and own. Specific solutions cater largely to the dairy sector for milk chilling. Enterprises providing storage solutions often cut through several levels of middlemen by procuring agricultural products directly from farmers on behalf of processors, traders and government bodies, thereby ensuring better prices to smallholder farmers. Some of them also provide extension services in the pre-harvest phase and/or market linkage and collateral management services in the post-harvest phase. A number of these storage and warehousing solutions are powered by clean energy to cater to farmers in areas with limited or no grid connectivity.

Demand aggregation for storage solutions

Insufficient awareness regarding efficient handling of post-harvest agricultural produce, inadequate post-harvest storage facilities in rural and remote locations, smaller outputs of individual smallholder farmers, and inadequate transport facilities result in significant food spoilage globally. Enterprises address this issue by providing innovative strategies and solutions that include large warehouse units that can be leased to farmers, and small on-farm solutions that can be bought or rented by either individual farmers or groups of smallholder farmers. Commercial and large-scale warehousing facilities either have a logistics wing that functions as a procurement agent, and collects fresh farm produce from agriculturists or have an aggregation center within the village cluster where farmers bring their produce. Some enterprises provide warehousing as a component of their larger pool of extension and consultancy services. Baridi Stores and Kilimo Markets are examples of such solutions.

On-farm storage solutions scale down the concept of large scale refrigeration to protect perishables against spoilage before they reach the market. They are sold through retail distribution models as stand-alone products directly to farmers, and involve inventive use

Figure15. Components of the model



of technology to ensure the product is easy to use. Greenpath for instance, uses Coolbot, a cold storage product that enables small farmers to build their own cold storage using an air conditioner, as opposed to purchasing a refrigeration system.

Design of smart solutions

Access to electricity is a major concern across all developing countries, and smallholder farmers use expensive fossil fuels to power their few farming tools and implements. Therefore, and particularly for perishable produce, even if farmers can access warehouse and cold storage facilities, they cannot effectively use them due to poor grid connectivity. To prevent such instances, enterprises innovate and develop renewable energy operated storage solutions. For instance, Wakati's storage solution can protect up to 200 kg of fresh produce without cooling, using a small solar panel. The solution can serve the storage needs of a group of smallholder farmers simultaneously.

Delivery of storage solutions

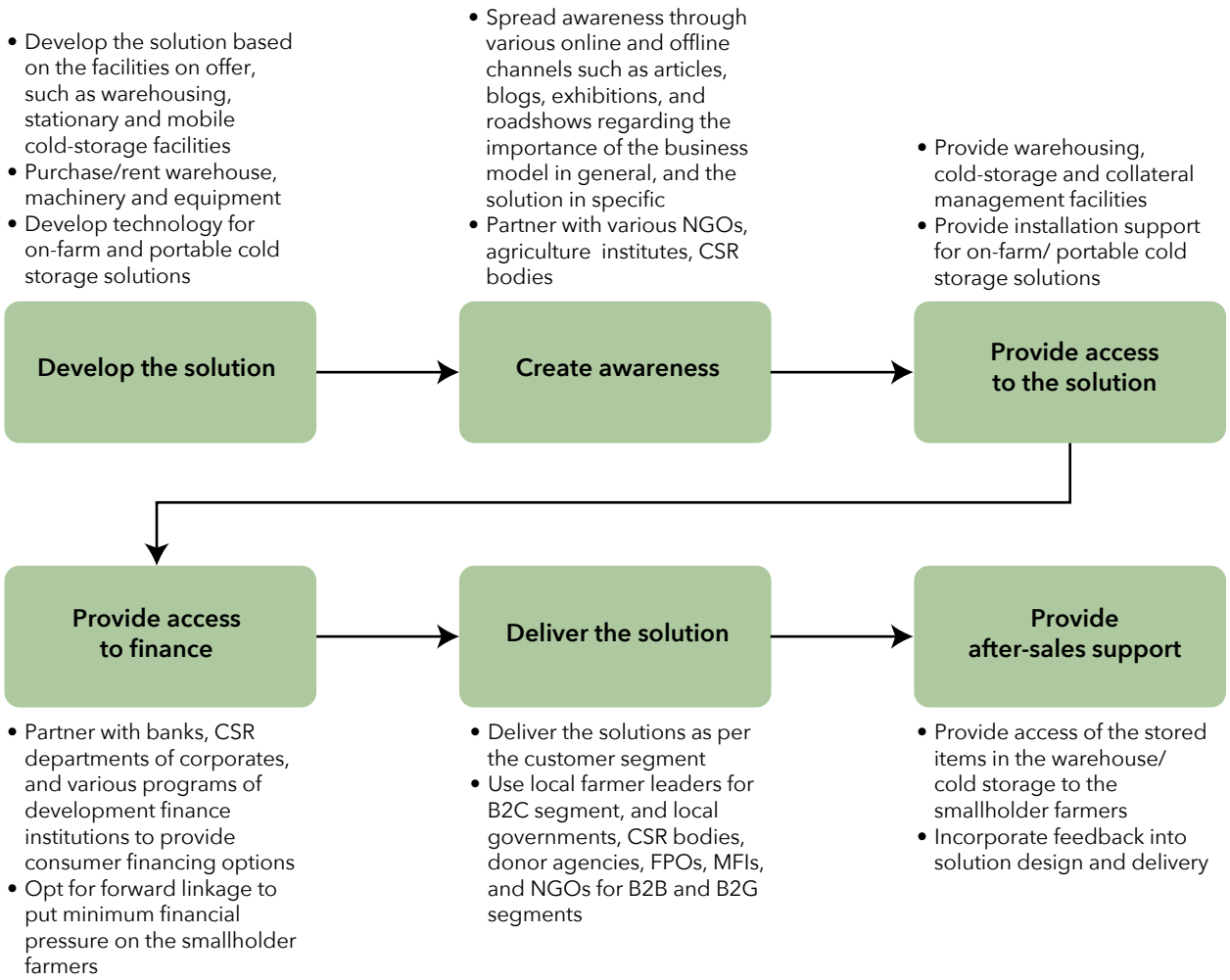
Post-harvest value addition companies, such as processors, packagers, and exporters, hesitate to deal directly with smallholder farmers. Instead, they establish contracts with

the warehouse companies, who provide them the required agricultural output in the desired quality. The warehouses are often centrally located from a cluster of areas that lack local storage facilities, often close to transportation hubs such as airports. Many of these enterprises also connect farmers with potential buyers of their stored commodities. On-farm storage solution providers reach the customers mainly through village leaders or farmer co-operatives. Once they sell the product, enterprises such as Ecozen provide robust after-sales support, wherein the technical representatives from the company visit the customers, and check and guide them to how to use the solution in the most optimum manner. The enterprise also provides technical support to the users through its mobile application.

Cost Factors

The major cost components for the enterprises include cost of goods produced, warehouse rent, manpower, logistics, and business development expenses. Currently, a number of post-harvest storage solution providers offer either cold storage warehousing or

Figure 16. Process of the model



cold storage units. These enterprises incur very high costs on refrigeration, its control mechanisms and electricity. Therefore, they need to invest in energy efficiency, automation systems, and roofing while designing a cold storage (Netting 2014). Enterprises such as India based Ecozen and UK based Inspira Farms incur expenses for in-house research and development, prototype development, field testing, and certifications, apart from vendor development, and client scouting/servicing.

The initial capital expenditure in establishing a warehouse, especially a cold storage, is very high. For instance, in India, the cost of establishing a cold storage facility of 6,000 metric tons is USD 750,000. High costs make it difficult to undertake the investment, particularly as it is perceived to have a long payback period. Therefore, a number of enterprises are exploring opportunities to establish smaller cold storage facilities, or on-farm cold storage units that incur relatively less capital expenditure (Netting 2014).

Table 21 illustrates typical investment and working capital incurred by an apple cold storage facility (Kart and Demircan 2015).

Revenue Streams

The primary sources of revenue for post-harvest storage solution providers include rental fees from warehousing services, and sale of cold storage products and equipment. However, enterprises have innovative means of collecting their fees, in order to make it affordable

Table 21. Typical investment and working capital for a cold storage facility

Particulars	*Expenses (USD)*
Land	57,101
Construction	1,690,494
Equipment	1,322,574
Trucks	19,461
Working capital	47,376
Total	3,137,006

for their customers. Enterprises such as Tessol include fees obtained from renting out cold storage products such as portable cold storage and walk-in cold rooms. Ecozen provides on-farm solar-powered cold storage solutions and earns revenues from the sale of its cold storage solution, Ecofrost. A few India based enterprises such as Ergos and Tessol offer service packages that the customers can choose from, as per their requirements. For instance, some farmers may choose to only avail of warehousing solutions, while others may opt for consulting services along with warehousing solutions. Ergos and Inspira Farms provide consulting services to farmers about best practices in agriculture, specifically post-harvest storage; however this is not a major revenue stream for the enterprises.

Some larger enterprises such as India-based StarAgri and SLCM support farmers by facilitating loans. They work with banks to disburse loans and help with documentation,

earning a fee on the loan origination and collateral management. Farmers can choose to store agricultural produce in the warehouse for three to four months and sell at better prices later. They receive credit against the warehousing receipts from banks and financial institutions. In 2014, SLCM forayed into warehouse receipt financing through its wholly-owned subsidiary, KissanDhan (Mahalingam 2014).

Financial Viability

Post-harvest storage solutions, specifically large warehouses and cold storage units are generally characterized by low margins. For instance, in India, the cost of a 20,000 sq. ft. warehouse is in the range of USD 1.05 million and 1.5 million, and it takes 10–12 years to achieve break-even with a 12–14 percent return on investment, which does not seem profitable in a shorter span of time. A utilization of 70 percent is considered the best possible average in a year. Large warehouses have to incur expenses such as human resources, monthly rental, cleaning and housekeeping, and auditing fees. Maintaining a large warehouse also involves dealing with a number of middlemen, besides building a network of buyers and suppliers. Another critical challenge in the warehousing and storage segment is the domination by unorganized players that operate with low capacities and have inadequate handling, stacking and monitoring facilities. These unorganized enterprises compete with organized players by charging significantly lower prices (ValueNet 2013).

To address this situation, post-harvest solution providers have adopted a number of innovative strategies including bundling of various services such as warehousing, logistics, procurement, collateral management and quality testing, and commodity pest management to build revenues and profit. A majority of the service providers therefore follow an asset-light strategy by leasing out existing warehouses to public and private warehousing companies on a monthly or yearly rental. Some enterprises procure agricultural products directly from farmers on behalf of processors, traders and government bodies, thereby ensuring better prices for farmers and better margins to the company. A few enterprises also take up third party warehouses on rent to extend their reach into villages to maximize business volumes. Some companies establish their own commodity research desk to provide adequate prices to customers and partners, which in turn increases their business volumes and margins.

Enterprises also use mobile and web technology including SAP solutions to make the system more efficient while requiring lesser manpower, which further saves the cost to the companies. Some enterprises have forayed into warehouse receipt financing and added another revenue stream with high margins. Other strategic measures to ensure financial viability of the enterprise include optimum capacity utilization of the warehouse units, and minimum bad debts. Availability of low-cost and long-duration funds is critical for the agri-warehousing sector. Regulatory and financial support from the government could improve the financial sustainability of this model. For instance, measures such as granting infrastructure status (Budget 2011–12) and providing viability gap funding to post-harvest agriculture warehouses and cold chains (Government of India n.d; Kulkarni 2016) ensure commercial viability, in turn resulting in increased private sector investment to provide a vital service to farmers.

Enterprises are increasingly considering renewable energy to power their storage solutions. The shelf life of solar cold storages is around 15 years, which is comparatively lower than the conventional cold storages which is around 20 years (as shared by an

enterprise, Ecozen). The cost of conventional cold storages is almost 50 percent lower than solar-powered ones. However, they require grid power for operation, which comprises around 20-30 percent of the running cost. Solar cold storages not only remove this cost, but can also make a key difference in remote rural areas such as Uganda, where 87 percent of the total population lives in rural areas while rural access to electricity is estimated at just 7 percent (Sseguya 2015; Chandrasekaran 2016). Currently, Uganda based Baridi Stores earns nearly 12 percent profit on each sale of solar cold storage products. The price of its solar cold storage ranges from USD 50,000 to 200,000. It also deals in large projects that cost nearly USD 500,000 to 1 million to the customers. The current clientele of the enterprise includes large companies. In the near future, Baridi plans to operate large cold storage warehouses, and rent out storage space to agricultural enterprises and smallholder farmers at an affordable rate of 4 cents per kilogram per day.

Currently, storage solution providers adopt several measures to ensure financial sustainability. These include steps to ensure lower default, higher uptake and financial liquidity. Ergos, for instance, has an innovative mechanism of providing forward links for the agricultural produce, where buyers pay Ergos an advance for the agricultural output purchased; and the enterprise pays back to the farmers. This allows the enterprise to maintain liquidity for working capital. Ergos also facilitates finances to smallholder farmers through National Collateral Management Service Limited (NCML), which decreases the chances of bad debts or delinquency for the enterprise. On-farm cold storage solution provider, Inspira Farms partners with banks to facilitate consumer financing to farmers, where risk is shared between the enterprise and banks.

Storage solution providers have been able to raise debt and equity capital for long term growth as well. Inspira Farms has raised debt and equity investment in the last two years. Tessol has attracted equity investment, and has also received small amounts of grants to explore opportunities for providing on-farm products. Ecozen is supported financially by various investors and incubation hubs at premier institute such as Indian Institute of Technology Kharagpur. Some enterprises also operate as part of various programs of development finance institutions such as those by the World Bank to raise debt and equity investment. National Bank for Agriculture and Rural Development (NABARD) plays a critical role to support creations of post-harvest storage infrastructure in India (NABARD n.d.).Several finance institutions in other countries such as the UK also facilitate development of post-harvest infrastructure and solutions. For instance, UK based Inspira farms has also established contact and partnerships with diverse finance institutions including banks that provide asset financing, impact investors that cater to mezzanine finance and equity finance, and impact lenders that lend long-term loans to the customers of the enterprise.

In the last few years, there is a positive trend of investment, both public and private in African agriculture, including development of infrastructure to prevent the significant amount of post-harvest losses. African governments are prioritizing agricultural sectors such as horticulture in Kenya, and value addition to staple food crops in Nigeria. Other public and private organizations, such as the United States Agency for International Development (USAID), the Swiss Agency for Development and Cooperation (SDC), the African Development Bank (AfDB), the Food and Agriculture Organization (FAO), the World Food Program (WFP), and the Gates Foundation, are either already investing or exploring investments in postharvest storage solutions (Rockefeller Foundation 2015).

Partnerships

A number of post-harvest storage service providers have been established in the past few years in response to the need for curtailing post-harvest losses and ensuring food security. These enterprises depend on strategic partnerships to increase awareness, acceptance, accessibility and affordability of their products and services, thereby creating maximum impact on smallholder farmers. They partner with federal and state governments, financial institutions such as MFIs and banks, industry associations, and development finance institutions' programs such as JEEViKA by the World Bank that supports the Bihar Rural Livelihoods Project. For instance, Ergos works with public sector banks such as IDBI and SBI to facilitate consumer financing. Tessol engages with non-government organizations (NGOs) to reach out to smallholder farmers and farmer collectives. It has also worked with financial institutions to facilitate loans to its customers. Inspira is a part of 'Sustainable Fruit Lab', an industry association in the US that helps increase its outreach.

Implementation: Delivering Value to the Poor

Awareness

Most developing countries are unable to ensure food security, primarily due to lack of appropriate post-harvest storage facilities. Farmers are often unaware of the benefits and availability of post-harvest storage solutions, and the availability of finance to access them. They either do not avail the post-harvest storage services at all, or compromise the quality by using sub-optimal solutions.

Efforts to increase awareness that incorporate essential features of modern storage facilities, including the significance of gently handling fresh fruits and vegetables, and need and importance of cold storage to reduce post-harvest losses, would increase adoption of storage solutions. Enterprises adopt several mechanisms to spread awareness about the significance and long-term benefits of storing agricultural produce. Ergos and Tessol conduct outreach programs such as exhibitions, demonstrations, and roadshows to showcase their solutions. They also establish partnerships with educational institutions, government, and civil society organization for awareness building activities. For instance, Ergos has tied up with Rajendra Central Agriculture University, Pusa for conducting awareness programs. Tessol works in association with ASHRAY and Ministry of Food Processing to spread awareness regarding cold chain application. Tanzania based Kilimo Markets is in partnership with government extension agencies and research institutes, and actively develops potential partnerships with private players and NGOs to spread awareness regarding post-harvest storage solutions.

Acceptance

Storage enterprises have to break age-old practices and habits of farmers and help them understand that modern storage solutions provide them an opportunity to reduce wastage and get better prices for their agricultural produce. For this, the enterprises bank on their local knowledge and contacts to build trust, and engage with smallholder farmers. To ensure adequate marketing and acceptance of its warehousing solutions, Ergos utilizes its local

knowledge of the agricultural setting, and farmers' attitude. Similarly, to ensure effective business engagement and development of its on-farm cold storage solutions, Inspira Farms engages marketing executives who have local knowledge and understanding. Farmers are also unaware of convenient solutions such as low cost modular options for cold storage provided by enterprises such as Tessol and Inspira Farms, and the availability of finance for the same, resulting in low adoption of such solutions. Tessol plans to cover the entire value chain from source to-end customer and facilitate the adoption of cold storage facilities at the last mile level.

Accessibility

Enterprises such as Wakati and Promethean Power Systems engage with local farmer leaders and dealers for distribution. Ecozen reaches its customers through in-bound calls and face-to-face meetings, exhibitions, events, seminars and workshops; news-paper articles, and blogs. Its distribution strategy includes both, Business-to-Customer (meeting with customers/ smallholder farmers), and Business-to-Business/ Government (meeting with local governments, CSR departments, and donor agencies). The enterprise is also in discussion with Farmer Producer Organizations (FPOs), Farmer Producer Groups (FPGs), Microfinance Institutions (MFIs), Non-Government Organizations (NGOs), and Energy Saving Companies (ESCOs) to build the market and increase access to its storage solutions.

Affordability

Storage solution enterprises offer significant cost benefits to smallholder farmers, and price their services and products at nearly 35–50 percent lower rate, in comparison to mainstream competitors. A few enterprises have their own research and development (R&D) teams that continuously innovate to make their storage solutions more affordable to the farmers. Ecozen is in discussion with several financial institutions and Corporate Social Responsibility (CSR) departments of corporate firms to help facilitate loans to customers.

Some enterprises leverage renewable energy technologies to provide affordable post-harvest storage solutions to smallholder farmers. For instance, Inspira Farms provides pre-fabricated, standard storage solutions that operate on an automatic mechanism that sources energy first from renewable energy sources. Once the renewable energy is exhausted or is not available, it sources from non-renewable energy sources, thereby reducing electricity bills. In some cases, smallholder farmers get together and buy a cold storage unit with their consolidated funds and mutual understanding to share the storage unit as per their requirement. As these products can serve a number of customers, they are affordable on a per unit basis. Promethean Power Systems provides low-cost energy efficient refrigeration facilities in rural locations. It uses a mix of thermal-power batteries and solar energy, which is inexpensive compared to other diesel powered facilities.

In contrast, Tessol's stationary storage solution is expensive on a capital expenditure basis, and makes a difference when a big customer such as any government agency buys at least 500 units. The price range for its mobile on-farm solutions is 10–20 percent higher than its competitors. The enterprise clarifies the reason for the higher price citing differentiation which includes energy storage and real time performance monitoring. Ergos offers warehousing solutions and collateral management facility to smallholder farmers in India

at reasonable rates. It helps farmers in better price discovery, where they become the 'price makers' in the market. It provides loans to the farmers at attractive rates of 10–10.5 percent.

Results and Cost-Effectiveness

Scale and Reach

In most developing countries, agricultural storage facilities are owned, operated and maintained by the public sector. Increasing demand for food coupled with lack of adequate post-harvest storage facilities challenges the government's capacity to sustainably meet the requirement. Private sector enterprises present effective storage solutions and have the potential to expand their scale and reach, considering the burgeoning demand.

Some of the 'reach' indicators include number of warehouse facilities and establishments, capacity of these warehouses, and throughput of the warehouses. Scale of the storage business model is mainly measured in terms of increase in income and profits of farmers. Most of the storage solution providers interviewed for this research needed a minimum of two years to create considerable impact. Currently, Baridi Stores plans to set up a solar—three phase hybrid powered cold storage facility for Mbarara District Farmers' Association of over 10,000 farmers in Western Uganda. The member farmers, after harvesting their fruits and vegetables, will take them to the cold storage facility where they will be stored until they are transported to the airport and then airlifted to buyers in Europe or United States who pay premium prices for them. The incomes of these farmers will increase by at least 20 percent because they do not have to sell to local brokers or middle men at significantly lower prices and risk food spoilage if they delay sale or consumption. In five years, Baridi Stores is planning to own and operate large cold storage warehouses in Uganda where farmers will be able to store their perishables for a handling fee (Sseguya 2015). On-farm post-harvest storage solution providers such as Ergos, Tessol and Ecozen, currently operate in fewer markets, but plan to expand geographically within their countries of operation and beyond in the next couple of years. Most of these enterprises in the last 2–3 years, and have achieved outstanding scale and reach in these years. The enterprises also want to build up their umbrella of services. For instance, Ergos plans to set up its own Non-Banking Financial Company (NBFC) in the future.

Improving Outcomes

Post-harvest storage solutions are very useful to smallholder farmers, who had no option but to sell their agricultural produce immediately after harvest at prevailing local market prices, for fear of it getting spoiled. By offering storage solutions, the enterprises have helped farmers become "price makers" instead of "price takers."

Although not many enterprises have conducted social and environmental impact assessment, most of them aim to reduce post-harvest losses by at least 20-25 percent. Ecozen's solution, for instance, provides direct benefits by preserving the quality of fruits and vegetables until market prices are attractive. It also offers indirect benefits such as savings on electricity bills and diesel costs, as it operates on solar energy. Ecozen's solution results in an increase of farmers' profits by nearly 40 percent. Promethean Power Systems has installed

Table 22. Examples of companies and their reach

Company	*Country of operation*	*Years of operation*	*Scale and reach*
Baridi Stores	Uganda	2	Increase in income of agricultural enterprises[a] by at least 30 percent[b]
Ecofrost Technologies	India	6	0.48 Increase in the top-line of farmers by over 20–40 percent and profit by 80–100 percent[c]
SCLM	India	8	Technology enabled network of 1303+ warehouses and 19 cold storages across India with a total capacity of over 3.3 million metric tons spread over 18.5 million sq. ft. and a throughput of more than 373 million metric tons[d]
StarAgri Warehousing	India	10	• 1,200+ warehouses across 300 locations with a total warehousing capacity of over 1.7 million tons[e] • Collateral management portfolio increased from USD 75 million in 2012 to USD 1.35 billion in 2014[f]

a. Such as exporters of fruits and vegetables, farmers' associations and large scale farmers especially those with rural operations
b. Sseguya 2015.
c. Singhal 2014.
d. Sohan Lal n.d.
e. Self-reported.
f. Mahalingam 2014.

over 100 milk chilling systems across rural India. Each system serves approximately 20-30 farmers who can now deliver more milk to quality conscious dairy processors. The dairies in turn collect more milk and produce higher value and higher quality products for Indian consumers. A number of other enterprises such as Baridi Stores and Tessol also provide affordable energy-efficient refrigeration or cold storage solutions that result in direct and indirect economic impacts.

Availability and reliability of solar cold storage increases the average incomes of agricultural enterprises such as exporters of fruits and vegetables, farmers' associations and large scale farmers especially those with rural operations by at least 30 percent because they can bargain for higher prices from buyers. Cold storage also stabilizes prices for fruits and vegetables across seasons of high and low supply. Fairly moderate prices of foodstuffs ensure Ugandans can afford to buy foodstuffs reducing infant malnutrition (Sseguya 2015). Wakati is located in Haiti, Uganda, Tanzania, Kenia, Benin and Sierra Leone and is setting up new pilot projects in China and India. It has already sold nearly 150 cold storage units that helped the local farmers in the respective countries receive higher prices for the crops, ultimately resulting in higher incomes (Changemakers 2015). Inspira Farms creates at least 28–30 jobs in each of the rural agricultural communities, further increasing their avenues of income. As the direct customers of the enterprise include rural businesses, and small and medium enterprises, and co-operatives such as dairies, horticulture companies and agri-export companies, it focuses is on the jobs created by these clients.

The larger enterprises, particularly those that have scaled significantly focus on technological innovation to increase customer experience and improve their operational efficiency. SLCM, for instance, established a centralized management information system that provides real-time information on the multi-location holdings of customers. It has also devised its own Standard Operating Practices (SOP) called Agrireach, which significantly brings down wastage during storage. The company uses a coded warehouse system wherein customers can track the movement of their products. This process reduces theft, and also checks the quality of the food grains (Mahalingam 2014). The product also enables farmers to reduce electricity costs. The cold storage solution leads to over 40 percent increase in the profits of the smallholder farmers, after a 2-year breakeven.

Cost Effectiveness

Post-harvest storage solutions are the responsibility of the public sector in a number of developing countries. With increasing population and growing demand for food, there is excess pressure on agriculture production. In Sub-Saharan Africa (SSA), the amount of food loss exceeds the value of total food aid received, and is equal to the annual value of cereal imports to the region (World Bank 2011). Reduction in post-harvest losses can help cater to the problem of malnutrition and hunger in most developing countries. However, there has not been any significant improvement in the public storage facilities in these countries in the last few years. Private enterprises offering storage solutions can support public facilities in providing sustainable and cost-effective solutions.

Some storage solution enterprises offer forward linkage services to ensure cost-effectiveness. Ergos currently works with NCDEX e-market Limited (NeML) to provide warehouse receipts to smallholder farmers, but plans to directly issue the receipts going forward, thereby reducing intermediary cost. Tessol also worked with financial institutions and helped facilitate a few loans to the customers. Inspira Farms works on Just-In-Time (JIT) model to lessen its inventory cost and provide customized solutions to the clients. Some enterprises lease, maintain and operate local warehouses in rural areas that are located closer to the farms. This prevents initial capital expenditure on infrastructure and also keeps the operational costs, mainly transportation from farms to warehouse, low. A few enterprises also adopt the outsourcing and partnership model in areas that are cost-ineffective to serve otherwise. Technologically advanced enterprises deploy automated quality control measures to prevent spoilage of food items and the cost attached to it.

Scaling Up

Challenges

Enterprises that plan to provide and expand post-harvest storage solutions face several challenges including that of real estate and access to finance. High cost of real estate, especially in peri urban areas where land is expensive, can make the financial viability of the warehouse low. In Kenya, small and medium enterprises (SMEs) providing post-harvest storage facilities use Savings and Credit Cooperative Organizations (SACCOs) and funds from family and friends to invest in the businesses. The interest rate offered by SACCOs are

almost half (around 8 percent per annum) compared to that offered by the banks (around 15.75 percent per annum) (Central Bank of Kenya 2015). These sources of funds, however, will not be able to help enterprises scale rapidly.

Enterprises also face significant challenges that hinder day-to-day business operations such as cash flow maintenance, especially in case of small sized warehouses. They need funds to ensure continuous customer engagement by means of training and awareness building activities, and to attract and retain talent. Other important challenges that restrict expansion include inadequate financing for farmers to avail of storage solutions; and the need for behavior change among smallholder farmers to appreciate the importance of post-harvest storage. Post-harvest storage service providers must also build strong geographical presence and then expand offerings to ensure multi-revenue streams. For instance, in addition to post-harvest storage facilities, enterprises such as Ergos and Inspira Farms are foraying into other associated services such as consulting and advisory support to farmers regarding best practices in agriculture. However, this does not result in significant revenue.

Role of Government and Policy

Government strategies and policies related to post-harvest infrastructure and solutions vary across developing countries. In some countries, such as India and Kenya, the governments are cognizant of the critical issue of post-harvest losses, and hence, are keen to take appropriate steps for the same. They seek to address the issues of access to finance, development of technology, and provision of adequate infrastructure to build robust post-harvest storage systems. However, Governments need to develop specific strategies to prevent food loss and waste reduction in a number of Latin America and Caribbean countries.

In India, the central government has devised several strategies including the Warehousing Development Act and permitting 100 percent FDI investment in the warehousing segment (The Hindu 2012). The segment has grown at a CAGR of over 16 percent from 2012 to 2016 (Ken Research Private Limited 2013). Government investment in infrastructure and the adoption of Public Private Partnerships (PPP) models are considered to be the key drivers for this growth (ValueNotes 2013). However, most of these storage capacities are located in states producing majority of the crops. In August 2016, the Ministry of New and Renewable Energy, Government of India, (MNRE, GOI) extended its subsidy scheme to solar refrigeration units to boost the use of solar-powered cold storages (Chandrasekaran 2016). Currently, banks and other financing institutions do not provide priority funding to cold-chain projects as this segment is considered nascent in meeting its operational challenges (NCCD 2012). The Finance Act of India also does not acknowledge services provided for storage of agricultural produce or any service provided by a cold storage in the definition of 'storage and warehousing service'. However service tax is applicable to various services provided at cold storages, specifically those included in the definition of 'agricultural produce'. This increases costs for the enterprises and prices for farmers (NCCD 2012).

In Kenya, the agriculture policy, which is determined by the Ministry of Agriculture, Livestock and Fisheries (MALF) has some strategic objectives for the agriculture sector including improved market access and trade, increase in productivity and outputs of the produce, and hence increase in food security (Global Cold Chain Alliance 2016). Further, corruption remains a problem according to Transparency International's Corruption Perception Index, which ranked Kenya 139 out of 168 countries in 2015 (Transparency

International n.d.). In Kenya, there are a few food related regulations that have contributed to the development of the post-harvest storage solution model in general. According to one of these regulations, it is mandatory to pasteurize the raw milk before its sale. In Ghana, the government has made a number of infrastructure and policy interventions to reduce post-harvest losses. These include creating storage facilities and development of a commodity exchange. In Mozambique, although, it is not a policy requirement, farmers are encouraged to produce in quantities as per demand, given the relatively small market for agricultural produce, and lack of post-harvest storage facilities (GrowAfrica 2015).

In Latin America and the Caribbean, there is no specific strategy to prevent food loss and waste reduction; governments are implementing several measures to address this issue. One such measure is the food banks that collect food for redistribution. Public and private sectors establish alliances in various countries such as Costa Rica, Chile, Guatemala, Argentina, the Dominican Republic, Brazil and Mexico, to tackle the situation. The Association of Food Banks of Mexico, for example, is a non-profit organization which coordinates a network of 61 food banks all over the country to prevent food loss at various stages of the value chain (FAO 2014).

Storage enterprises have shared mixed experiences regarding role of government and policies in facilitating the activities of the business. According to the founder of Ergos, the current policies in India do not cater to the requirements of smallholder farmers, who have difficulty accessing storage for a variety of reasons, and appropriate institutional measures are required to address their needs. He also believes that there is a huge gap in terms of awareness regarding government initiatives in the agriculture sector, and farmers do not know of the different programs that they can avail of. On the other hand, enterprises such as Ecozen underscore the inclusion of on-farm cold storage facilities in the subsidy scheme of Ministry of New and Renewable Resources, Government of India (MNRE, GOI). The Ministry of New and Renewable Energy, Government of India (MNRE, GOI) has approved 30 percent subsidy from the central government for micro cold storage (mCS) solution of Ecozen.

Conclusion

There is significant interest in preventing post-harvest losses in developing countries, both from governments and the private sector. Given this interest, this business model (both variants—on-farm modular solutions as well as large facilities for lease) can potentially scale, and build on existing technologies as well as infrastructure.

The model is financially viable as a number of storage enterprises are leveraging strategies such as bundling of services, forward linkages, collateral management, and facilitating consumer financing. Although the payback period is considerably long for storage solutions, a number of financial institutions are actively supporting enterprises in this business model, further contributing to their financial sustainability.

Table 23. Social enterprises: Post-harvest storage solutions

Company	*Country*	*Solution description*
Baridi Stores	Uganda	Baridi Stores provides low-cost energy efficient storage facilities. It offers solar commercial refrigeration technology solutions for perishable food items. These include solar-three phase hybrid cold storage warehouses and ice plants that help reduce risk and improper management.
Ecozen	India	Ecozen provides on-farm solar-powered cold storage solutions to the rural smallholders farmers in India. The cold storage unit is solar powered, and has a back-up of 30 hours. It can easily be transported from one farm to another, and after a 2-year breakeven, leads to over 40 percent increase in the profits of the farmers.
Ergos	India	Ergos offers warehousing solutions and collateral management facility to smallholder farmers in India at reasonable rates. It helps farmers in better price discovery and makes them 'price makers'. It provides loans to the farmers at attractive rates of 10-10.5 percent.
Inspira Farms	Central America, and East Africa, Southern Africa	Inspira Farms operates on Just-In-Time (JIT) model that designs, develops and supplies affordable small scale cold storage facilities to its customers primarily consisting of including rural businesses, SMEs and co-operatives.
Kilimo Markets Ltd	Tanzania	Kilimo Markets provides a range of agricultural services, including warehouse facilities. It also facilitates production of quality certified seeds, provides agri-training, and market brokerage services to smallholder farmers.
Promethean Power Systems	India	Promethean Power Systems is a provider of low-cost energy efficient refrigeration facilities designed for rural applications in post-harvest functions. This solution uses thermal-power batteries and solar energy to provide energy efficient storage facilities. This technology is low cost compared to other diesel powered facilities used by farmers who have little or no access to grid electricity.
Rebound Technology	Multiple developing countries	Rebound Technology is an innovator in the refrigeration and storage space for both urban and rural sectors. Its technology is based on a thermally-driven heat pump model that provides practical solutions. It is developing two types of technologies - IcePoint and SunChill to serve the urban and rural markets respectively.
Samriddhii (Kaushalya Foundation)	India	Samriddhii is an integrated vegetable supply chain model that allows farmers and vendors to bypass intermediaries and establish direct market linkages. It sells produce in self branded AC push carts.
StarAgri Warehousing	India	StarAgri provides integrated post-harvest management solutions including warehousing, procurement and collateral management of agricultural commodities. In addition to their management services, StarAgri also provides access to a range of financial services such as risk management, retailing and logistics.

Table 23. Social enterprises: Post-harvest storage solutions (continued)

Company	*Country*	*Solution description*
Tessol	India	Tessol is a cold chain equipment provider and deals with both stationary and mobile cold chain solutions, the technology for which is based on energy storage. Stationary cold chain solution is useful in places of irregular power supply; it can work on solar or any other energy source. While the mobile solution offers lesser cost in comparison to its competitors.
Wakati	Haiti, Uganda, Tanzania, Kenia, Benin, Sierra Leone, India, and China	Wakati provides low-cost and energy efficient post-harvest storage solutions to smallholder farmers at the farm level.

References

Chandrasekaran, Kaavya. 2016. "Government extends subsidy scheme to solar-powered cold storages." The Economic Times. August 18. http://economictimes.indiatimes.com/articleshow/53747502.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

Changemakers. 2015. "Wakati: Post-harvest storage solutions for smallholder farmers." https://www.changemakers.com/globalgoals2015/entries/wakati

Costa, Simon J. 2015. "Taking it to scale: Post-Harvest Loss Eradication in Uganda 2014–2015." World Food Programme Project Implementation Report. https://www.wfp.org/sites/default/files/20160107%20Uganda%20PHL%20implementation%20Report_Final.pdf

Ecozen n.d.

Emerson Climate Technologies. n.d. "The Food Wastage and Cold Storage Infrastructure Relationship in India: Developing Realistic Solutions." http://www.emerson.com/SiteCollectionDocuments/India%20Cold%20Storage%20Report%202013/Report_layout_Reduced.pdf

energypedia.com. n.d. "Small-scale Cold Storage For Fruit and Vegetables in India" https://energypedia.info/wiki/Small-scale_Cold_Storage_For_Fruit_and_Vegetables_in_India

Food and Agriculture Organization (FAO). n.d. "Key Findings, SAVE FOOD: Global Initiative on Food Loss and Waste Reduction." http://www.fao.org/save-food/resources/keyfindings/en/

———. 2014. Food Losses and Waste in Latin America and the Caribbean. FAO: Rome. http://www.fao.org/3/a-i3942e.pdf

Global Cold Chain Alliance. 2016. "Kenya Cold Chain Assessment." http://www.gcca.org/wp-content/uploads/2016/02/KenyaColdChainAssessment2016_02_23.pdf

Government of India. n.d. "Public-Private Partnerships in India." http://www.pppinindia.gov.in

GrowAfrica. 2015. "Reducing Post Harvest Loss." https://www.growafrica.com/node/22961

The Hindu. 2012. "Post-harvest Supply Chain, Poor Warehousing Woes Of Agri Sector." http://www.thehindubusinessline.com/economy/agri-business/postharvest-supply-chain-poor-warehousing-woes-of-agri-sector/article3996911.ece

Kart, M. Cagla Ormeci, and Vecdi Demircan. 2015. "Analysis of investment cost of apple cold storage facilities." Custos e @gronegócio 11(1). Jan/Mar. http://www.custoseagronegocioonline.com.br/numero1v11/OK_4_apples_english.pdf

Ken Research Private Limited. 2013. India Logistics & Warehousing Industry Outlook to 2016 - Focus on Cold Storage Chains. http://www.researchandmarkets.com/reports/2373227/india_logistics_and_warehousing_industry_outlook.pdf

Korberg, Rachel. 2014. "For Smallholder Farmers, Food Loss Hits Twice As Hard." Rockefeller Foundation. https://www.rockefellerfoundation.org/blog/smallholder-farmers-food-loss-hits/

Kulkarni, Sateesh. 2016. "Cold Chain Industry in India – Present Status and Future Prospects." FnB News.com. http://www.fnbnews.com/Top-News/cold-chain-industry-in-india--present-status-and-future-prospects-38621

Mahalingam, Kripa. 2014. Outlook Business. "Emerging Business: A Storehouse of Growth." http://www.outlookbusiness.com/enterprise/emerging-business/a-storehouse-of-growth-4

Mendoza, Naki B. 2016. "Reducing Post-Harvest Losses: What is the Next Breakthrough?" https://www.devex.com/news/reducing-post-harvest-losses-what-is-the-next-breakthrough-88080

National Bank for Agriculture and Rural Development (NABARD). n.d. "NABARD Warehousing Scheme, 2013–14." http://agritech.tnau.ac.in/amis/pdf/nabard/NABARD_WAREHOUSING_SCHEME.pdf

National Centre for Cold Chain Development (NCCD). 2012. "Challenges to cold-chain development, etc." http://www.nccd.gov.in/PDF/ChallengeColdChain-Development.pdf

Netting, Mike. 2014. "Five Budget Factors to Consider When Designing Cold Storage Warehouses." http://stellarfoodforthought.net/five-budget-factors-to-consider-when-designing-cold-storage-warehouses/

Rockefeller Foundation. 2015. "Perspectives to Reducing Post Harvest Losses of Agricultural Products in Africa." http://www.afdb.org/fileadmin/uploads/afdb/Documents/Events/DakAgri2015/Agriculture_Industrialization_and_post-harvest_losses.pdf

Singhal, Prateek. 2014. "Ecofrost Technologies: Solar micro cold storage." https://www.changemakers.com/sustliving2014/entries/ecozen-solutions-private-limited

Sohan Lal Commodity Management Pvt Ltd. n.d. "About us." http://sohanlal.in/about-us.html

Sseguya, Raymond. 2015. "Baridi Stores: solar powered cold storage warehouses." https://www.changemakers.com/globalgoals2015/entries/baridi-stores

Transparency International. n.d. "Corruption by Country." https://www.transparency.org/country/#KEN

ValueNotes. 2013. "Warehousing Industry in India 2013-2017." http://www.slideshare.net/ValueNotes/warehousing-industry-in-india-2013-2017-slideshare

World Bank. 2011. "Missing food: The case of postharvest grain losses in Sub-Saharan Africa." Report No. 60371-AFR. http://siteresources.worldbank.org/INTARD/Resources/MissingFoods10_web.pdf

CASE STUDY

Ergos

Founding year: 1992
HQ: Bangalore, India
Countries of operation: India
Orientation: For-profit
Employees: 31
Turnover: USD 1.35 million

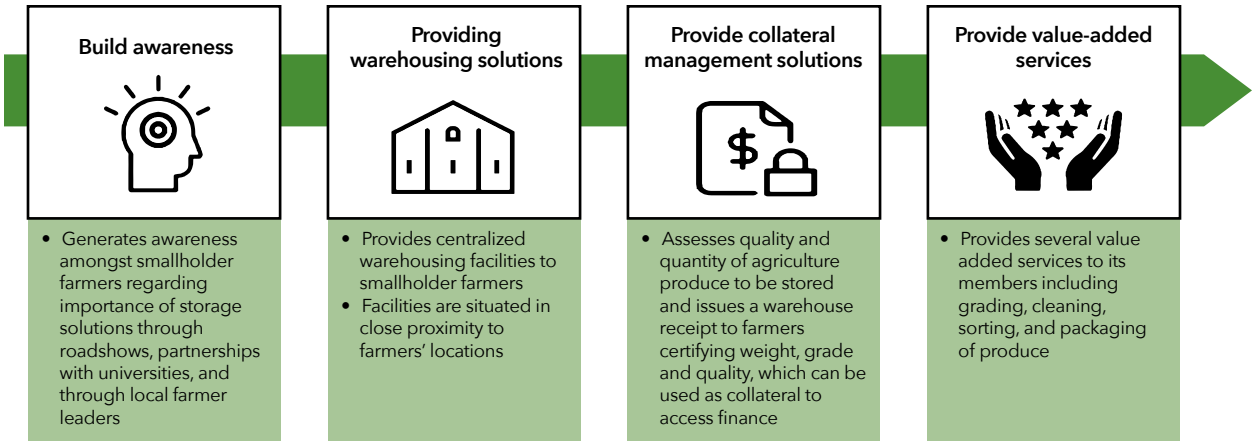
In India, the government provides for around 72 percent of agriculture warehousing capacity leaving a gap of 35 million tons of warehousing capacity. The average cost of establishment of a 20,000 sq. ft. warehouse in India ranges between USD 1.05 million to USD 1.5 million, takes 8–10 years to break even with a 12–14 percent return on investment, coupled with low levels of awareness amongst the smallholder farmers regarding warehousing and cold storage facilities, there is limited private sector interest to enter this market.

Ergos offers warehousing solutions and collateral management facility to smallholder farmers in India at reasonable rates. It helps farmers in better price discovery and in making them 'price makers.' The enterprise provides continuous access to the farmers to visit the warehouse to check, sell or retain the stored items. Aside, it also connects the farmers to finance providers that could help them with the working capital till they sell the produce.

Operating Model

Ergos offers scientific warehousing solutions and collateral management facilities to smallholder farmers in rural districts of Bihar. The enterprise operates a chain of efficient and hygienic warehousing facilities situated within a range of three to four kilometers from the farmers' locations. It provides 24/7 access to farmers to transact, sell or hold the commodities. Farmers can thus track market movements and sell when they can realize better prices.

The enterprise runs a network of micro-warehouse-based "farmer offices" that works in tandem with the retail partners of Ergos to build capacities of smallholder farmers, and to expand the existing user base. At present, there are nearly 21 farmer offices, and the



enterprise plans to increase this number to 500 in the next couple of years. The micro-warehouse is a low-cost format that operates at the village level and helps the enterprise to directly bond with the farmers. The enterprise signs agreements with several smallholder farmers who store their agricultural produce in the warehouse. Once farmers deposit stock in the warehouses, Ergos checks the quality and quantity of the items and issues a warehouse receipt to the farmers certifying the weight, grade and quality. The enterprise is able to negotiate better prices on behalf of the farmers, based on this data. The micro warehouse network helps Ergos accomplish business development as well as transaction execution. This arrangement also ensures optimum capacity utilization of the warehouse, and low wastage and higher price realization for the farmers. Ergos is able to achieve higher turnover with limited capital. It has also achieved greater price efficiency in certain crops such as maize, wheat and paddy as these are the major crops cultivated in the region.

Ergos has introduced a unique concept of farmers' portfolio management, wherein its software application captures basic information about all associated farmers. The software captures information related to various business transactions between the farmer and Ergos. The enterprise also provides several value added services including grading, cleaning, sorting, and packaging to its members. It also trains farmers on various in all aspects of financial transactions, contracts and markets.

The enterprise makes use of technology such as SAP and other web applications. It has also developed a mobile app for farmers, end users and internal staff to ensure minimum turnaround time on any service request, and to make the operations easy and transparent. Ergoslive, a webapp for forward link, is a unique portal linked to SAP core database. The application runs on all browsers and can be accessed by users even remotely.

Ergos generates general awareness among smallholder farmers regarding the importance of storage solutions. It showcases the significance of storage solutions through videos, roadshows, and midnight cafes. It works with local farmer leaders to mobilize interest, and has tied up with Rajendra Central Agriculture University, Pusa to conduct awareness programs in its different markets.

It was founded with the support of some donor and government initiatives such as JEEViKA (a World Bank project to support Bihar Rural Livelihoods Project), and NABARD producer groups. National Collateral Management Service Limited (NCML) helped the

enterprise to understand warehousing and credit access, and also provided access to finance to Ergos associated smallholder farmers. Ergos collaborated with National Commodity and Derivatives Exchange e-Markets Limited (NeML) for forward linkage to access the national platform. It also partnered with LTC Commercial to adopt better warehousing practices. Ergos received an investment from Aavishkaar, an early-stage investor in March 2015. It works with the government, banks such as Industrial Development Bank of India (IDBI) and State Bank of India (SBI), and World Bank (WB) programs to facilitate consumer financing.

Financial Sustainability

Ergos, being a smallholder farmer focused social enterprise, ensures that the base price charged to the farmers is almost half in comparison to other warehouses. For instance, it charges USD 0.09 to USD 0.18 per quintal as against USD 0.25 to USD 0.27 charged by others. The enterprise also offers various packages that customers can choose according to their requirements. These packages include warehousing, loans and linkages to processors. In addition, the enterprise facilitates loans at 10-10.5 percent as it has access to the collateral stored in its warehouses.

Ergos currently works with NCDEX e-market Limited (NeML) to provide electronic warehouse receipts (e-WHR) that farmers can use as collateral with banks to access credit. Through this platform, it connects the rural warehouses to national market that helps discover better prices for farmers. Going forward, the enterprise will directly issue the warehouse receipt, which will reduce the intermediary cost.

Ergos' micro warehouse network helps to achieve procurement and transaction execution, and ensures maximum capacity utilization of the warehouse. Some of the major costs incurred by the enterprise include warehouse rent, relationship managers' salaries, operations fee, and insurance fee. This amounts to nearly USD 3,000 to USD 3,750 per annum for a 200 metric ton (MT) capacity warehouse, USD 4,500 to USD 6,000 per annum for a 500 MT capacity warehouse, and USD 7,500 to USD 9,000 per annum for a 2000 MT capacity warehouse. The major revenue streams of the enterprise include warehousing services and advance advisory and processing fee. Ergos plans to achieve break-even by December 2016.

Impact

Ergos' warehousing and collateral management solution has innumerous direct and indirect impacts on the lives of the smallholder farmers. Some of the direct benefits include support in better price discovery. The indirect benefits include providing better access to finance, and inculcating the habit of storing the agricultural produce and not selling immediately after harvest. This reduces post-harvest loses by 20 percent to 25 percent, and prevents a situation of distress sale. Reduction in post-harvest losses increases the disposable income of the smallholder farmers that they can invest in their family's health and education.

Challenges and Lessons

Ergos faces several challenges linked to financing, marketing and distribution. Some of the major financial challenges include maintenance of cash-flow and operational expenses, especially for small-size warehouses. This is due to the gap in the meticulous calculations required while managing the consumables, safety and security of the warehouses. The

enterprise also faces marketing and distribution challenges related to customer engagement, awareness and trust building, and the need for behavior change amongst the smallholder farmers to adopt warehousing practices. The enterprise also finds it difficult to attract, train and retain suitable talent, as the concept is new, and people with desired skill-sets are rarely available. The enterprise needs to recruit the right talent, and train them professionally, to obtain the required business outputs.

Road Ahead

By next year, Ergos plans to rent 30-35 additional warehouses; and expand its operations to Karnataka, by replicating the Bihar model. The enterprise wishes to explore various other opportunities under the project JEEViKA, whereby it plans to scale up warehousing capacity to 5000 MT to connect with one lakh farmers by 2017, and subsequently to a capacity of one million MT to connect a million farmers in the next 2–3 years.

By 2020, Ergos aims to reach 500,000 farmers and 5,000,000 ton warehousing capacity. It plans to establish a unique procurement process in India that can be replicated globally. The enterprise has a long term vision to establish a Non-Banking Financial Company (NBFC) to further support smallholder farmers to have better access to finance. This initiative will impact the farmers who do not comply with banks' norms for access to credit, forbidding them to access finance.

CASE STUDY

ecoZen Solutions

Founding year: 2009
HQ: Pune, India
Countries of operation: India
Orientation: For-profit
Employees: 100
Turnover: USD 1.43 million

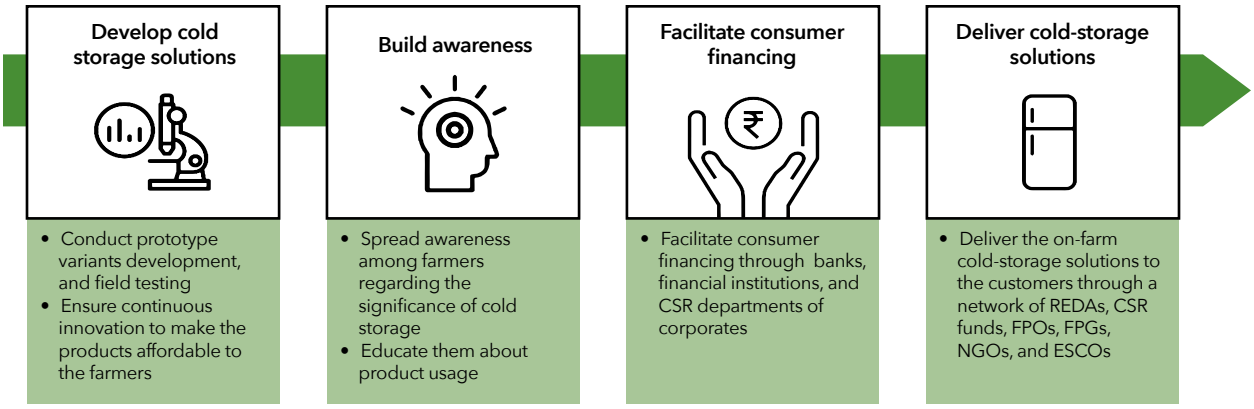
India, despite being the second largest horticulture producer in the world, is not able to meet the domestic demands owing to over 35% of total produce, worth USD 2 billion wasted annually due to inadequate infrastructure for storage. The lack of electricity across the major horticulture cultivation areas in India restricts the effective functioning of cold chain facilities .

Ecozen Solutions, a renewable energy company, has developed solar micro cold storage systems for use in agriculture and rural communities. Ecozen's solution is as useful for smallholder farmers as it is for big farmers and agriculture based institutions. The micro cold storage units help in increasing the income of smallholder farmers who previously didn't have access to on-farm storage solutions, leading to huge amount of wastage of perishable agriculture produce. The enterprise has served 400 farmers.

Operating Model

Ecozen manufactures on-farm solar-powered cold storage—micro cold storage (mCS) systems and solar powered irrigation products. Ecofrost can be used by farmers located in remote rural areas.

Farmers can monitor the temperature of the cold storage unit using sensors attached to the unit and regulate the temperature using their mobile phones or any hand-held devices. The unit can be used without a battery and has a back-up capacity of 30 hours It is portable and easy to transfer from one field to another, which enables a group of smallholder farmers to buy the product together, and share it.. The enterprise uses ICT for 'remote monitoring', 'predictive analytics' and 'preventive maintenance metrics.'



Ecozen continuously educates the customers regarding the product, usage models and value-addition because of the solution. The company's personnel provide after-sales support as well. The enterprise leverages corporate social responsibility (CSR) and sustainability initiatives of corporate partners, various programs of municipalities, state government, renewable energy development agencies, community organizations and non-governmental organizations (NGOs) to increase its market reach. For donor based initiatives, partners fund the capital cost, while Ecozen covers the operating expenses including installation, commissioning, and maintenance of the product at nominal cost. For community owned initiatives, the capital cost is borne by the partners as per pre-determined installments, and the enterprise undertakes training of the operators or village level entrepreneurs (VLEs) on the usage models.

Ecozen reaches its customers by means of several online and offline modes including articles, blogs, field surveys, exhibitions, seminars and workshops. The sales team of Ecozen also conducts face to face meetings and calls with the customers. Ecozen offers a quarterly lease to farmers, which helps in increasing the affordability of its products among small-scale farmers. Farmers are encouraged to lease the product on a trial basis for a quarter, post which the farmer acquires the product if there is a visible cost-benefit attached.

Ecozen either distributes its products to farmers directly or through its corporate and institutional buyers. Under the partnership model, the distribution process involves State Renewable Energy Development Agencies (REDAs), CSR funds, local governments, and donor agencies. The enterprise is also in discussion with Farmer Producer Organizations (FPOs), Farmer Producer Groups (FPGs), Microfinance Institutions (MFIs), NGOs, and Energy Saving Companies (ESCOs) to build up the market and increase accessibility to its storage solutions.

Financial Sustainability

Some of the major expenses of the enterprise include those for research and development, prototype variants/version development, field testing, acquiring certifications, marketing and product promotion, vendor development, and client scouting & servicing expenses. Ecozen prices its products based on survey outcomes, price elasticity of clients and product costs involved.

In April 2015, Ecozen raised about USD 1 million from Omnivore Partners. With this funding, Villgro, which had invested in Ecozen in March 2014 through a combination of equity and grant, exited the company with a profitable return. Ecozen planned to utilize the funding from Omnivore Partners to strengthen the business structure and supply chain including logistics and production, increase the production capacity, and widen the market reach.

The enterprise is an approved supplier for Chhattisgarh state government and it receives a subsidy of 40 percent each from the state and central governments respectively. It is also an approved supplier under National Bank for Agriculture and Rural Development (NABARD) supported subsidy scheme for solar pumps in Madhya Pradesh, Chhattisgarh, Maharashtra and Bihar, and it receives 40 percent subsidy from the state governments. The subsidy for micro cold storage (mCS) from Ministry of New and Renewable Energy, Government of India (MNRE, GOI) is approved for 30 percent central assistance. Ecozen's revenues have quadrupled from USD 360,000 in financial year 2015 to USD 1.43 million in financial year 2016.

Impact

The enterprise's micro cold storage units help in increasing the income of smallholder farmers who previously didn't have access to on-farm storage solutions. A group of smallholder farmers collate funds to buy the storage unit to store perishable fruits and vegetables instead of being forced to sell their produce at low prices in the market. The product also enables farmers to reduce electricity costs. The cold storage solution leads to over 40 percent increase in the profits of the smallholder farmers, after a 2-year breakeven.

Ecozen Solutions has won several awards and recognitions including the Dow Sustainability Innovation Challenge at California Institute of Technology, Pasadena Ecozen Solutions received *Economic Times*-Power of Ideas award from DST, Government of India. Ecozen Solutions' idea was ranked among the world's top 30 business ideas at Stanford's E-bootcamp. Ecozen Solutions was awarded the Technology and Sustainable Development Award 2011 at Eureka IIT Bombay and was covered as a Pioneering Product by CNBC TV18.

Challenges and Lessons

The company's primary challenges relate to the high upfront cost of the system to smallholder farmers. The enterprise faces difficulties in ensuring end user financing for its smallholder farmer customer base. Ecozen also finds it challenging to make the products affordable to the lower income consumers; however the in-house R&D team is focusing its efforts to devise cost-effective technology solutions that it can leverage to decrease the price of the product.

Road Ahead

Ecozen targets to expand its reach in Maharashtra, and surrounding areas, while exploring the opportunity to make direct sales to big farmers and agriculture based institutions. It aims to reach a revenue scale of USD 3 million by the end of 2016. By 2017, Ecozen plans to complete nearly 500 installations in India. It targets to reach a turnover of USD 11.7 million

by the end of financial year 2018. It also wishes to expand geographically, into Africa and East Asia. The enterprise targets to achieve break-even by mid-2017. The enterprise is in discussion with banks, financial institutions, and CSR departments to facilitate financing options for its customers.

CREATING VALUE CHAIN AND MARKET LINKAGES

CREATING VALUE CHAIN AND MARKET LINKAGES

Sector Challenges

Around 84 percent of all farms worldwide (estimated to be around 570 million), are smaller than two hectares. Most of these smallholder farmers reside in underdeveloped and developing countries. Agricultural markets have not worked efficiently for smallholder farmers, and the lack of market linkages has proved to be a key bottleneck for efficient market access. Poor market linkages substantially increase transaction costs and post-harvest losses. Marketing chains are characterized by the existence of agents and middlemen at every stage of the supply chain. Each of these middlemen retains a margin, allowing only a fraction of the final price of the crops to reach the smallholder farmers.

Often remotely located and disconnected from mainstream market information, smallholder farmers rely on middlemen who are better informed about market conditions, especially about the prices further down the supply chain. However, this knowledge is not transferred to farmers who are forced to accept prices offered to them by middlemen. Lack of price information coupled with limited access to alternative buyers can lead to high price dispersion in rural areas. Further, smallholder farmers rely on these middlemen for loans to fund their agricultural and personal activities. Subsequently, farmers become indebted to these agents. Smallholder farmers are also unable to negotiate fair prices for their produce as they can only offer small volumes in individual capacity.

In addition, smallholder farmers face several challenges that restrict their growth and sustainability. At the pre-harvest stage, their farm productivity is impacted by information asymmetry about yield-enhancing inputs and farming practices, markets, prices, certification standards and government policies. Farmers suffer from inadequate market linkages, both with input suppliers and with end buyers. Poor connect to markets impacts their incomes more directly and keeps them in the cycle of low investment, low productivity and low incomes.

Models that Address These Challenges: Description and Analysis

I. Direct-from-Farm Market Models

Social enterprises are leveraging technology to improve market linkages for smallholder farmers and meet the growing demand for fresh farm produce from consumers. They have developed internet (e-commerce) and mobile (m-commerce) based platforms to market fresh

farm products directly to consumers. The enterprises receive orders placed by customers on the technology platforms and collect the produce from the smallholder farmers for distribution. Their activities can be classified as follows:

- *Collection:* These models are paving the way for efficient market linkages for smallholder farmers, by removing middlemen from the distribution chain and securing higher prices for the farmers. Enterprises procure produce from farm gates, and weigh, grade and package it at the farm. These enterprises pay farmers immediately on purchase of the produce. For example, India-based Go4Fresh procures the entire harvest from farmers at wholesale prices.
- *Marketing:* Enterprises have leveraged the deep penetration of mobiles phones to connect smallholder farmers and buyers. For example, MLouma in Senegal provides small scale farmers a mobile and online platform to upload information about availability of their produce for sale enabling buyers to connect with them directly. The enterprise also allows farmers to market their produce leveraging on the enterprise's call center.
- *Distribution:* A number of enterprises use algorithms to match farmers to buyers based on requirements and prices that farmers and buyers are willing to transact at. Upon sale, farmers either deliver the produce to buyers directly or seek support from the enterprises to transport the produce from farm gate to end buyer. In Indonesia, Kecipir engages community hosts to operate centrally located delivery hubs where consumers can collect their orders or have their produce orders delivered to their door step directly at a fee.

II. Multi-stakeholder Platforms

Several enterprises have designed integrated electronic and digital platforms that connect farmers, input suppliers, agriculture experts, finance providers, logistics companies, processors, distributors, government entities and NGOs. These platforms enable streamlined forward and backward linkages along the value chain, facilitating information flows and business transactions. They encourage collaborative communication amongst different stakeholders and increase transparency in supply-chain management.

- *Integrated platforms enabling backward linkages:* In the pre-harvest phase, all platforms enable farmers and stakeholders to exchange information with each other and transact goods and services leveraging ICT. The platforms enable farmers to interact with other farmers, input suppliers, extension agents, NGOs, governments and finance providers on information regarding farming best practices, quality inputs, and input credit. For example, Kenya based, Cowsoko's digital platform enables farmers to connect with different value chain actors including input suppliers, veterinary specialists, and dairy experts. Farmers can purchase cows on the platform, use the platform to identify practical training programs and source dairy related information.
- *Integrated platforms enabling forward linkages:* Farmers can leverage these platforms to directly communicate with processors, and quality assessment certifiers to enhance the value of post-harvest products. They can also directly engage with buyers (both, domestic and global) and connect with transporters on the platform to deliver produce. Cowsoko connects farmers to buyers and transporters to undertake

delivery of produce. Esoko, based in Africa, connects farmers to agro-processors and exporters who can use the tool to track their produce across the supply-chain.

On these platforms, stakeholders can communicate with each other through SMS, voice calls, interactive voice response (IVR), call centre, smartphone applications and online web-based portals. The platforms facilitate exchange of information and transactions between all registered participants. Typically, stakeholders register on the platform by paying a subscription fee. Enterprises earn a commission on every transaction made between farmers and other stakeholders on the platform.

Analysis of the Models

Analyzing the two models across different parameters brings up interesting findings and implications for implementation and scale up.

Comparative Analysis of Agricultural Finance Model

Model	*Ease of Implementation*	*Effectiveness*	*Financial Viability*	*Scalability*	*Need for Government Support*
Direct-from-Farm Market Link	Medium-High	High	High	High	Low-Medium
Multi-Stakeholder Platform	Medium-High	Medium-High	Medium-High	Medium	Low-Medium

Ease of Implementation:

Direct-from-Farm Market Link

Direct from farm platforms are critical for the agriculture sector as they break down physical barriers to access and provide an opportunity for farmers to sell their produce directly to end customers on the basis of transparent price information. They can be implemented with relative ease provided some of the enabling factors like technology, awareness and trust of farmers and access to finance are in place.

Enterprises identify local farmer leaders and community champions, who interact with farmers and help in spreading awareness about the direct market linkage service. Enterprises such as Go4Fresh leverage partners such as farmer producer organizations, co-operatives, government agencies, and agro-input dealer companies to spread awareness amongst farmers. Enterprises also engage in conducting marketing and awareness campaigns targeted towards on-boarding end customers. The penetration of mobile and internet in smallholder farmer communities, and the ability and ease of farmers to use technology often dictates the uptake of direct-from-farm platforms.

Enterprises need to demonstrate the benefits of direct from farm platforms in comparison to traditional trading models in farmer communities. This includes the availability of real-time price information as compared to physical market yard auctions, and the ability to receive payments immediately upon the sale of produce in comparison to staggered payments by middlemen.

Enterprises need to build trust amongst smallholder farmers for them to accept the model. Enterprises partner with banks to access continuous supply of working capital to pay farmers without delay. Partnering with local government agencies and local community leaders helps in establishing farmers' trust in direct from farm platforms. In addition, building trust between buyers and sellers is imperative in setting up a direct from farm model, given that buyers often prefer establishing contact through face-to-face interaction first.

Multi-stakeholder Platform

Enterprises market their platforms to a wide variety of participants across the agriculture value chain. Once the upfront investment costs for creating a platform are taken care of, the model is can be implemented with moderate ease provided there is a thriving ecosystem of organizations engaging with farmers and cost effective mobile and internet facilities available.

Typically, these models conduct training and education programs on the role of internet and mobile technology in partnership with rural government agencies, NGOs and farmer co-operatives. They conduct training sessions for farmers and traders on effective market linkages and mentor traders in undertaking transparent trading without manipulating farmers. They broadcast their services on local radio, newspaper and market price information boards. Most enterprises involve local farmer leaders in spreading awareness about their platforms. Ricult identifies middlemen that farmers are comfortable trading with and train these middlemen in using the technology; the middlemen visit farmers and on-board them to the Ricult platform. Cowsoko markets its platform on Facebook and other social media platforms.

Prior to product design and deployment, enterprises invest time to understand pre-harvest and post-harvest support required by farmers, mobile and internet penetration levels, local languages, and key participants in the agricultural value chain. Farmers are more receptive to platforms that allow two-way communication. Enterprises, therefore, create open communication platforms. Prior to listing agricultural experts on Cowsoko's platform, the enterprise trains them on basic business and farmer interaction skills. It is also critical for them to offer their tools in local languages. For example, Farmforce works across Latin America, Africa and Asia. The enterprise offers its platform in English, Spanish, French and Portuguese to cater to farmers and agribusiness clients in these regions. WeFarm has a network of volunteer translators for international answers. Farmers from across the globe interact with each other; for example, a Kenyan farmer's reply in English or Swahili is translated to Spanish for a farmer in Peru. The platform also offers French and Haitian Creole as language options.

Effectiveness

Direct-from-Farm Market Link

While direct from farm platforms are nascent and are yet to scale, they have been able to deliver significant impact to farmers in increasing their market access in comparison to traditional models. A study conducted by International Research Development Centre (IRDC) found that produce typically changes hands 3 or 4 times from farm-gate to buyer;

middlemen in Kenya, on average, take 23 percent of the wholesale market price and 14 percent of the price is directed towards packaging, grading, market access fees and transport resulting in farmers retaining only 63 percent of the produce price.

Direct-from-farm services enable farmers to realize maximum farm-gate prices by eliminating middlemen in the long supply chain. The model has also helped farmers reduce post-harvest wastages. Dialog Telekom's model has enabled farmers in Sri Lanka to increase incomes by 40 percent due to elimination of middlemen. In Colombia, according to SiembraViva, farmers receive 25 to 35 percent of the amount paid by the end buyer. By using its model, farmers have been able to receive 48 percent of the price paid by consumers. Ekgaon Technologies, through its online marketplace and advisory services has increased farmer incomes by USD 127 or 67 percent on average.

Enterprises buy farmers' entire harvest, regardless of the grade, and then sell it at differentiated prices to end customers. Under the traditional model, smallholder farmers sell their produce to agents who transport it to market yards. Typically, crops that have physical or aesthetic defects, such as being the wrong shape or size, broken or having a blemish are rejected. Farmers therefore have to bear the post-harvest quality related losses. Direct-from-farm platforms allow farmers to sell such produce too.

Enterprises have also contributed to creating other positive impacts on the lives of small-scale farmers besides enabling them to earn higher incomes. For instance, Kuchara, an online marketplace connecting farmers with buyers in Peru allows consumers to buy subscriptions to crowdfund education of future farmers, in exchange of long-life discounts on their purchases.

In summary, direct from farm platforms can be a cost-effective alternative to selling to private traders and auctioning in government operated marketplaces when their entire produce is bought by the enterprise and there is no produce that is rejected at farm-gate. Many enterprises work on an aggregator model, wherein orders are placed by buyers on the platform, demand is aggregated and produce is transported by enterprises from farms or centrally located collection points to buyers. They create efficiencies in this process to keep their costs low—they aggregate collection, consolidate groups of farmers growing crops with similar production cycles, and use technology to group orders for collection so they reduce costs across transactions.

Multi-stakeholder Platform

Multi-stakeholder platforms decrease information and market access search costs for farmers. For example, estimates show that farmers in Niger spend USD 0.8 in per-search costs to travel to central markets to gather information, whereas the cost of using mobile technology to obtain this information is USD 0.2. Another study showed that information search costs across the value chain amount to more than 69 percent of total transaction costs for farmers in Sri Lanka. This study suggested that an integrated system using a mobile phone platform that provides information to farmers and other stakeholders from the planting stage to selling stage will significantly reduce information search costs and associated transaction costs.

Financial Viability

Direct-from-Farm Market Link

Depending on the business model startup costs include setting up of a technology platform, warehouse and equipment for sorting and grading. Several enterprises incur costs on hiring field agents to train farmers on the use of the platform. Enterprises spend 15 to 18 percent of their total revenue on transportation and logistics costs and up to 50 percent on marketing costs towards on-boarding buyers on the platform. Enterprises require significant working capital to pay farmers at the time of procurement of produce at the farm; any delay in payments to farmers results in a loss of farmers' trust in this model.

Enterprises that allow farmers to directly upload their produce on the platform charge farmers a transaction fee per upload and charge them a commission fee if the transportation of produce from farm to end buyer is undertaken by the enterprise. Some enterprises, such as Go4Fresh, buy products from farmers and sell to customers at a margin over the prices paid to farmers.

Most enterprises that provide direct farmer to buyer linkages operate as for-profit businesses. They ensure sustainability and profitability by adopting differentiated pricing strategies, effectively forecasting demand and generating sufficient demand. The financial viability of direct from farm platforms corresponds to the amount of demand that it generates for farmers' produce.

Multi-stakeholder Platform

The financial sustainability of the model hinges on multiple factors: using the appropriate technology that enables maximum reach, structuring profitable revenue-share models with mobile network operators to enable enterprises to earn higher margins on communication costs, attracting higher number of paying customers in comparison to non-paying customers, and providing a combination of information and transaction related services for all stakeholders. However, once these elements are in place, recurring costs are limited to upgrades, maintenance and staff salaries, resulting in high margins. Most enterprises try to create diversified revenue streams to ensure consistent revenue flow. Most ICT platform enterprises design their marketing and pricing strategies to acquire farmer groups and agribusinesses that work with farmers as opposed to acquiring individual farmers; this helps in reducing the cost of services to each farmer while increasing revenue earning potential for the enterprises. For instance, Esoko charges individual farmers USD 36, while farmer groups with up to 200 members pay USD 250 (translates to USD 1.25 per farmer).

Scale

Direct-from-Farm Market Link

Leveraging on technology, enterprises providing farmers with direct access to buyers have removed price and demand information asymmetries; this has helped farmers realize higher farm-gate prices and increased their sales volumes. With the increase in uptake of mobile and internet technology across developing countries, a number of enterprises have adopted the direct-from-farm model, primarily to enable disintermediation. Senegalese direct from

farm platform provider, MLouma grew from under 1000 farmers to 75,000 farmers within 2 years of operation.

Direct from farm platforms in India have been able to reach a large base of smallholder farmers within a few years in operation; this may be attributed to the density of farmers in the country, their transition from subsistence to commercial farming practices on a small-scale, and their awareness of growing urban consumer demand coupled with their desire to circumvent existing imperfect supply chains and adopt technology to shorten the distribution process. The growth in scale is reflective of the multiple forms of technology used to connect farmers to buyers. For instance, within 3 years of operating its platform, Mandi Trades has 10,000 registered farmers in India and has enabled USD 7.47 million worth of trade.

Multi-stakeholder Platform

The increasing spread of mobile and internet technology in developing countries is promoting the uptake of these platforms among small-scale farmers. With the increased scrutiny on food safety standards, agribusinesses are keen to adopt tools that allow them to monitor and trace smallholder farmer activity without involving a high-touch on-ground model. Generally, platforms that are free of cost or heavily subsidized to farmers are able to on-board a large number of farmers immediately following the launch of the platform. For example, in just one year, since 2015, WeFarm has on-boarded 69,000 small-scale farmers and 10.1 million interactions have taken place between farmers and other stakeholders listed on the platform.

However, given that costs involved in development and maintenance of multi-stakeholder ICT platforms are high, enterprises face difficulties in accessing credit to fund these operations. Data in most developing countries continues to be expensive and unaffordable for smallholder farmers. As a result, although access to these platforms is free or affordable for farmers, they find it expensive to communicate using SMS or voice services. Taking into consideration that reliable information to all stakeholders is the backbone of such platforms, enterprises face difficulties in sourcing consistently dependable data at low costs.

Government Policy to Enable These Types of Enterprises/Models

Direct-from-Farm Market Link

Given that farmers in developing countries predominantly practice subsistence farming due to lack of efficient market linkages, they would benefit from policies that foster transparency in price and demand information available to farmers, establish clear standards and create a market environment that embraces technology.

For instance, in India, the government is leveraging technology to provide transparent markets for previously underserved farmers. Until recently the Government, under the Agriculture Produce Market Committee (APMC) Act had mandated that the first sale of crops can only take place in regulated market yards or mandis within the same state. This mandate curtailed the market for farmers and forced them to sell to traders or commission agents licensed to operate in APMC markets. In some cases, licenses were required to trade in different yards within the same state. As a step towards expanding markets for farmers, the Central Government of India has advised states to allow free exchange

of agricultural produce across states; farmers can use a common electronic platform – e National Agricultural Market (e NAM) – to sell their produce to local traders or to online buyers across India. Under a USD 30 million scheme as part of the Digital India campaign, the Government plans to bring 585 regulated wholesale markets across the country on an electronic platform by 2018.

The Unified Market Platform (UMP) launched by Rashtriya e-Market Services is an example of a public-private partnership between the Government of Karnataka, India and Mumbai-based NCDEX Spot Exchange. The platform enables farmers and end buyers to negotiate on prices directly without the presence of an intermediary or agent. Circumventing middlemen allows farmers to receive payments in their bank accounts within an hour of the trade as compared to being paid in installments over a month.

There are some gaps that governments across developing countries are yet to bridge—enterprises providing technology-based platforms to directly link farmers with consumers have cited challenges in terms of receiving government financing, delays in provision of licenses, prohibitive tax structures and high-levels of corruption and bureaucracy. For instance, in Kenya, SokoNect incurs a license fee to operate its online and SMS based platform, pays an annual transportation fee of KSH 5000 and KSH 2500 to procure a license to distribute marketing brochures in Nairobi. Given the need to have sufficient end buyers on a farmer to buyer platform, marketing to urban consumers is essential for its business model.

Governments need to strengthen data collection and dissemination processes in order to promote enterprises providing direct market linkages to farmers cut off from mainstream markets. For instance, in Fiji, there are limited sources of accurate price information available to the private sector. Fiji AgTrade, a division within the Ministry of Agriculture, maintains a record of weekly market prices across Fiji. However, farmers located in interior rural areas can seldom access this information. There are no available data sets of farm gate prices and, at present, Fiji AgTrade appears to be the only source of local market prices. In Nigeria, daily information on market prices can be found in newspapers for traditional export crops such as cocoa, but is unavailable for other crops such as rice, sorghum, cassava, maize, and horticultural crops. Public agencies publish information on a monthly basis which is of limited use to farmers. Enterprises require credible data on prices and market trends so that they can build trust among smallholder farmers who are otherwise subject to information asymmetries.

Multi-stakeholder Platforms

Government processes and regulations related to affordability of mobile communication, and availability of reliable data with minimal bureaucracy play a pivotal role in the manner in which enterprises structure their multi-stakeholder ICT platforms.

Governments in some countries, have structured policies that promote healthy competition amongst mobile network providers, and boosted availability of reliable data sources to feed into the ICT platforms. For instance, in Kenya, the open and enabling ICT regulatory environment has helped to increase competition among mobile network operators and reduce mobile phone tariffs. Enterprises can leverage on low mobile communication costs to attract more farmers to the platform. In Turkey, emanating from a need to strengthen weather data and expand data collection beyond urban areas, a publicly funded project set

up 5 small meteorological stations and 14 small reference farms. The establishment of these rural data collection points helped in providing accurate microclimate forecasts to dispersed small-scale farmers. Enterprises can source information from the government, thereby decreasing costs on information acquisition from third party private organizations.

Governments can leverage these platforms to disseminate data on weather, pest management and other farming best practices to a wider network of farmers.

Enhancing telecom infrastructure in rural regions helps multi-stakeholder ICT platforms flourish. Governments can work with mobile network operators to expand their services to remote areas. They can also influence network providers to lower SMS and communication costs. A research study to understand the impact of mobile-phone technology platforms on smallholder farmers in India showed that most farmers could not afford the services. At package prices of approximately USD 1.50 per month, only half of the sampled farmers planned to renew their package despite stating that the services had helped them negotiate better prices, gained better access to quality inputs and increased incomes. These farmers went back to relying on newspapers, radio or public information boards as sources of information. MNOs earn high margins on SMS messages; regulators can frame policies such that SMS rates for transmission of public-good information can be reduced. This will increase affordability for farmers and encourage them to use these platforms.

Research also indicates the need for governments to strengthen education services in the ICT sector. It is critical for enterprises to hire good talent to develop and maintain multi-stakeholder platforms. However, the lack of talent proves to be a challenge for these enterprises. For example, in Kenya, only 5000 of the 30,000 university graduates in 2008 were deemed suitable for employment in the ICT industry.

Conclusion

Direct from farm platforms shorten the supply chain and help small-scale farmers to realize higher revenues owing to the direct connection to end buyers and elimination of middlemen. The business model is scalable owing to the increase in adoption of mobile and internet technology in developing countries. However, reluctance of farmers to switch from middlemen, who they have built personal and social relationships with, to technology-based services may restrict the uptake of the direct from farm model. Enterprises that provide value added services that include procuring produce from farm gates, packaging it and hosting it on their platforms for sale to consumers, keeping their transportation and logistics costs low, are more profitable than enterprises that only provide direct market linkage software to farmers to upload their produce.

Multi-stakeholder platforms have the potential to reach a vast number of participants across the agricultural value-chain. The possibility of two-way communication and transaction flow between smallholder farmers and other ecosystem players is an attractive solution to all stakeholders in the chain. However, initial platform development costs, platform customizations to cater to varied segments of players in the chain, and creation of relevant content make this model significantly investment heavy. Once this initial investment barrier is crossed, this is a very cost-effective model for both forward and backward linkages. Since platform use is typically provided free of cost to farmers, enterprises must structure

their parallel sources of revenue charged to other stakeholders in a manner in which communication and data collection costs are covered, at a minimum. Region-specific policies on ICT and costs involved in service delivery have a direct impact on the uptake of the platform by stakeholders, and thereby the financial sustainability of the model. Partnerships with information sources, governments and mobile network operators influence the model's success.

Direct-from-Farm Market Link

Improving incomes by leveraging technology to connect smallholder farmers to end consumers

HIGHLIGHTS

- Farm-to-market platforms eliminate middlemen and shorten the supply chain; farmers can realize farm-gate prices for their produce and decrease costs incurred on transportation to market yards.
- Algorithms match farmers to appropriate buyers based on their price sensitivity and grade preference.
- Then, farmers have the ability to set prices for their produce and do not have to depend on price information provided by middlemen.

Summary

Globally, smallholder farmers are caught in a vicious cycle characterized by low risk taking ability, low investment, low productivity, weak market orientation, low value addition and low margins. One of the key impediments to breaking this vicious cycle is an acute lack of market linkages that deprives them of efficient market access. Middlemen bridge the gap between farms and markets, and earn margins at every stage of the distribution chain, leaving very little for the smallholder farmers.

Recognizing this market gap, social enterprises are exploring ways to leverage the power of the internet and increasing mobile ubiquity to provide direct market linkages between smallholder farmers and buyers. By removing middlemen from the distribution chain, these

Note: INR to USD rate conversion: 1 INR = 0.015 USD; KES to USD rate conversion: 1 KES = 0.0099 USD; FJD to USD rate conversion: 1 FJD = 0.49 USD

enterprises are helping smallholder farmers to secure higher prices for their produce. They also reduce farmers' working capital requirements by guaranteeing purchase and ensuring payments at the farm gate.

Development Challenge

Approximately 84 percent of all farms worldwide (estimated to be around 570 million), are smaller than two hectares (Lowder, Raney, and Skoet 2014). Most of these smallholder farmers reside in underdeveloped and developing countries. Agricultural markets have not worked efficiently for these smallholder farmers, and the lack of market linkages has proved to be a key bottleneck for efficient market access. Poor market linkages substantially increase transaction costs and post-harvest losses. Marketing chains are characterized by the existence of agents and middlemen at every stage of the supply chain leading to a long series of transactions before the farmer's produce reaches end-consumers. Each of these middlemen retains a margin, allowing only a fraction of the final price of the crops to reach the smallholder farmers.

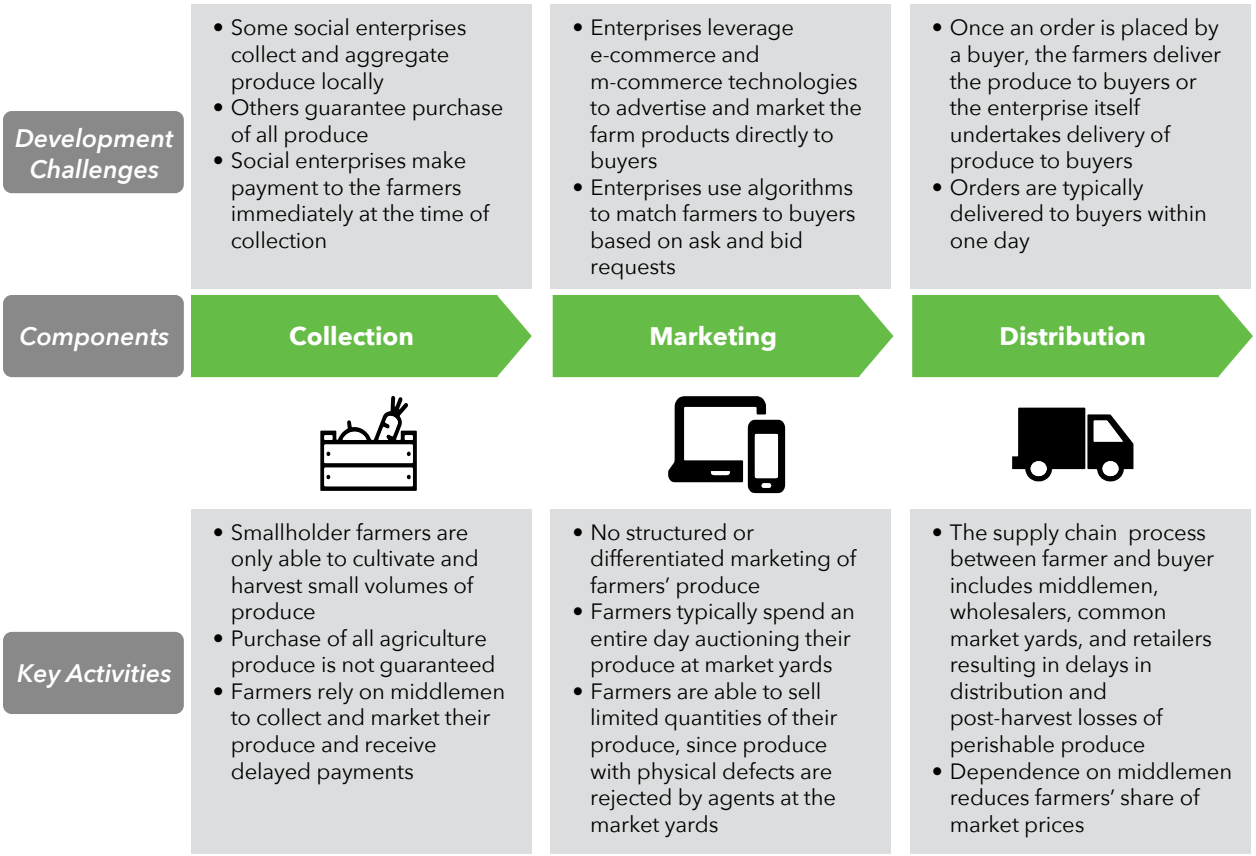
Often remotely located and disconnected from mainstream market information, smallholder farmers rely on middlemen who are better informed about market conditions, especially about the prices further down the supply chain. However, this knowledge is not transferred to farmers who are forced to accept prices offered to them by middlemen. Lack of price information coupled with limited access to alternative buyers can lead to high price dispersion in rural areas (Baumüller 2013).Further, smallholder farmers rely on these middlemen for loans to fund their agricultural and personal activities. Subsequently, farmers become indebted to these agents. Smallholder farmers are also unable to negotiate fair prices for their produce as they can only offer small volumes in individual capacity.

With an increase in urban consumers' incomes, their food consumption patterns are changing leading to an upward demand for fresh farm produce like fruits and vegetables as well as other local ingredients. While this opens up opportunities for farmers, they lack efficient market linkages to participate in market-oriented production and tap these market opportunities.

Business Model

Social enterprises are leveraging technology to improve market linkages for smallholder farmers and meet the growing demand for fresh farm produce from consumers. They have developed internet (e-commerce) and mobile (m-commerce) based platforms to market fresh farm products directly to consumers. The enterprises receive orders placed by customers on the technology platforms and collect the produce from the smallholder farmers for distribution. While this model is primarily focused on fresh produce, similar arrangements can be found for products (cereals, grains, rice, pulses, spices, tea, coffee, etc) which are also connect farmers directly to markets.

Figure 17. Components of the model



Collection

Solutions that leverage the internet to connect farmers and buyers are fast gaining currency in emerging markets, and a number of social enterprises have created online platforms to market agricultural produce directly to buyers. These models are paving the way for efficient market linkages for smallholder farmers, by removing middlemen from the distribution chain and securing higher prices for the farmers. Enterprises procure produce from farm gates, and weigh, grade and package it at the farm. These enterprises pay farmers immediately on purchase of the produce. For example, India-based Go4Fresh procures the entire harvest from farmers at wholesale prices; the enterprise partners with local aggregators to visit farms and collect the produce. Agruppa, based in Colombia, communicates orders to farmers a day prior to collecting it from their farms; it partners with local transporters to collect the produce from farms.

Marketing

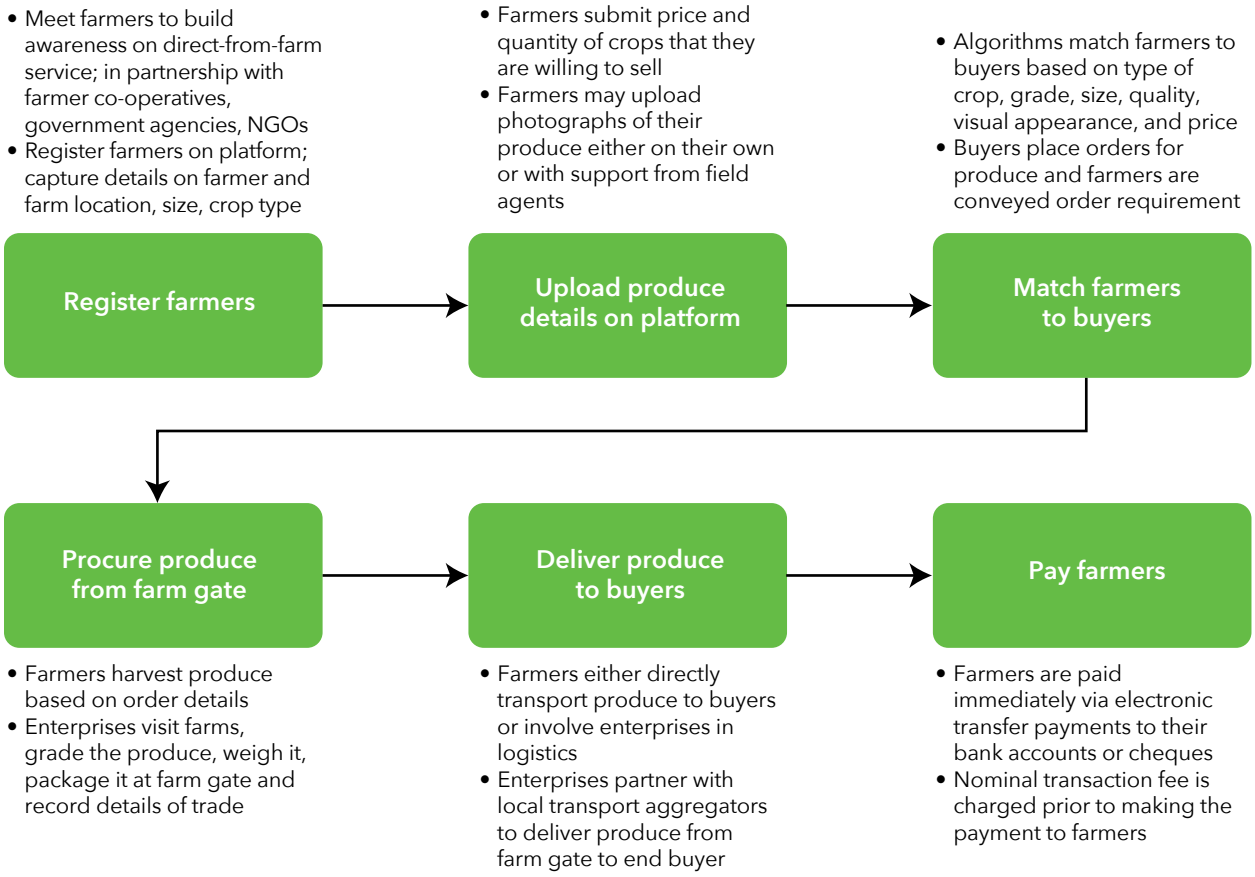
Enterprises have leveraged the deep penetration of mobiles phones to connect smallholder farmers and buyers. For example, MLouma in Senegal provides small scale farmers a mobile and online platform to upload information about availability of their produce for sale enabling buyers to connect with them directly. The enterprise also allows farmers to market their produce leveraging on the enterprise's call center. Similarly, SokoText provides an

innovative mobile-commerce platform wherein buyers can place orders for goods via SMS. This product allows buyers and sellers to communicate directly and ensures quick and easy order and delivery placements. While not all farmers and buyers have access to the internet, most of them possess a mobile phone and all mobile phones support SMS. Hence, business models attempting to leverage SMS technology can inherently reach a wider smallholder farmer base.

Distribution

A number of enterprises use algorithms to match farmers to buyers based on requirements and prices that farmers and buyers are willing to transact at. Upon sale, farmers either deliver the produce to buyers directly or seek support from the enterprises to transport the produce from farm gate to end buyer. For example, farmers on SokoNect's platform deliver produce to consumers using their own transport or have the option to pay SokoNect a nominal fee to transport the produce to the consumers. In Indonesia, Kecipir engages community hosts to operate centrally located delivery hubs where consumers can collect their orders or have their produce orders delivered to their door step directly for a fee.

Figure 18. Process of the model



Cost Factors

Costs involved in connecting farmers and buyers may depend on the type of communication technology adopted. For instance, for customers served through feature phones, enterprises could choose between using Short Message Service (SMS) or the more efficient but expensive Unstructured Supplementary Service Data (USSD), which involves an upfront booking fee for the USSD platform followed by monthly maintenance costs paid to mobile network providers. In addition, enterprises incur costs in hiring IT experts to develop and maintain the platform.

A number of enterprises provide farmers the option to either upload details related to the type of produce, prices, and quantities on the platform directly or with the support of field agents. These enterprises incur costs in hiring field agents to train farmers on the use of the platform: field agents visit farmers and educate them on topics related to the use of internet and mobile technology, platform navigation, the manner in which harvested products could be photographed, and methods of pricing produce. In some cases, field agents assist farmers in photographing the produce and uploading relevant details on the platform.

Some enterprises procure the produce from farmers; sort, grade, and package it at the farm gate; and subsequently upload the details on the platform. These enterprises incur costs on equipment such as weighing scales, sorting and grading tables, packaging material and transportation from farm to end consumers. I-Say-Organic incurs 40 percent of its revenue on procuring produce and 15 percent of its revenue on transportation and logistics. Go4Fresh incurs approximately 18 percent of its total sales revenue on transportation, logistics and packaging costs. SokoNect incurs logistics costs of USD 99 to collect orders within a distance of 70 kilometers using 1 truck regardless of the quantities to be transported.

Enterprises require significant working capital to pay farmers at the time of procurement of produce at the farm; any delay in payments to farmers results in a loss of farmers' trust in this model. Marketing costs towards on-boarding end-buyers constitutes a significant share of overall costs. For instance, SokoNect incurs 50 percent of its total costs on marketing the platform to end-buyers.

Other costs include procuring licenses to operate the platform, taxes and fees to be paid to the governments and marketing expenses to acquire end customers on the platform.

Revenue Streams

Enterprises that allow farmers to directly upload their produce on the platform charge farmers a transaction fee per upload and charge them a commission fee if the transportation of produce from farm to end buyer is undertaken by the enterprise. SokoNect charges farmers a fee if they require the enterprise to collect produce from farm gate and transport to end consumers. Costa Rica based Fruitspot charges a service fee of USD 2 cents once a trade is completed. SokoNect currently charges 2 percent commission fee for products priced lower than USD 99 and 10 percent commission fee for products priced over USD 99.

A number of enterprises such as Go4Fresh procure produce in bulk from farmers regardless of the grade, shape and quality. The produce is sorted and graded either at the farm gate or in a sorting facility and subsequently sold to various customer segments at differentiated prices—the enterprise earns a margin over the prices paid to farmers.

Enterprises also charge fees for providing on-demand customized information to farmers on topics such as soil management, crop and weather conditions, disease alerts and market

prices. They earn commission fees from vendors who buy produce on the platform, like in the case of Agruppa, an enterprise that enables sale of produce from farmers to vendors in low-income communities in Colombia.

Financial Viability

Most enterprises that provide direct farmer to buyer linkages operate as for-profit businesses. They ensure sustainability and profitability by adopting differentiated pricing strategies, effectively forecasting demand and generating sufficient demand.

Enterprises that sort products at the farm gate and list it on their platforms typically procure the entire harvest from farmers at wholesale prices and sell it at a price premium to different customer segments on the basis of grade, size, quality and visual appeal. This strategy allows enterprises to price products based on the price sensitivity of customers; for example Go4Fresh and Markit Opportunity sell products based on product quality discrimination—target customers for Grade A produce includes exporters, supermarkets and retail individuals who pay premium prices, lower grades are sold to price conscious customers including processors, hotels, restaurants and canteens.

Typically, smallholder farmers sell small quantities of produce at a time which increases per unit transportation costs for the enterprises. Farmers who sell on D Market Movers, an enterprise based in Trinidad & Tobago, are encouraged to inform the enterprise about their expected production cycles; this helps the enterprise in planning its transportation requirements. Effective order forecasting enables enterprises to match demand and supply; for instance, Go 4 Fresh tracks its orders two days prior to the delivery date – in the event that there is over supply from farmers, the enterprise sells the excess produce to price conscious customers at lower prices, and in a situation of excess demand, the enterprise buys produce from the market to cover for any shortages.

Demand forecasting also allows enterprises to inform smallholder farmers about the amount and type of produce that will attract high demand in a particular season. For example, I-Say-Organic analyzes potential demand for produce based on previous season trends and communicates this information to small-scale farmers. Colombia based Siembra Viva informs farmers when to plant and when to harvest based on demand projections. It guarantees produce purchase at a pre-determined, premium price, and thus, not only builds trust amongst smallholder farmers, but also ensures consistency in supply commensurate to demand.

The financial viability of direct-from-farm platforms corresponds to the amount of demand that it generates for farmers' produce. It is therefore important for enterprises to ensure there are a sufficient number of buyers and sellers on the platform. The cost of customer acquisition and delivery, both which can be quite high, will impact financial viability. In addition, it is crucial for service providers to understand and address preferences of buyers to retain them as customers. For instance, Kudu, a mobile direct-from-farm platform in Uganda, took note that rural farmers can only post small lots of produce, while urban buyers prefer to buy in bulk, resulting in a mismatch between the quantities posted by each group. In response to this, Kudu incorporated a service called 'e-Bulking', coordinating the sales of multiple small-scale farmers to allow them to achieve the large lot sizes desired by buyers. Pakistan based Mandi Express has a presence in the local market yards as well, where it sells any produce that is left unsold on the platform.

Partnerships

It is important for enterprises to build trust with farmer communities and demonstrate the benefit of using a direct market platform to sell their produce as an alternative to depending on middlemen and agents. Social enterprises work with farmer co-operatives, farmer societies, NGOs and rural government agencies to reach smallholder farmers. In addition, a number of enterprises partner with agro-input providers such as seed and fertilizer companies to reach small-scale farmers. Enterprises like Go4Fresh partner with village-level aggregators who are familiar with farmers in rural remote areas to provide transportation and logistics services.

Enterprises such as Markit Opportunity and SokoNect identify local leader farmers and train them to be field agents. These agents conduct frequent meetings with smallholder farmers to create awareness about the platform and guide farmers on the process of uploading pictures, description and prices of the produce onto platform using feature phones and smart phones. D'Market Movers partners with local farmer leaders to increase awareness of its service in farmer communities. Some enterprises involve NGOs in farmer engagement, on-boarding and registration activities. Enterprises such as Mandi Express partners with students from agricultural universities and agricultural technical experts to reach farmers, survey farms, capture farm and farmer details and register farmers onto the platform. Kudu partners with AgriNet, a private brokerage firm in Uganda, to provide additional in-village services to farmers registered on its mobile marketplace platform. AgriNet agents provide farmers with services such as quality screening, credit lines for bulking, and insurance.

Enterprises partake in information sessions conducted by local county governments and use government facilities as demonstration plots to train farmers on good agricultural practices, uniformity in crop production, and the role of internet and mobile technology in expanding farmers' access to markets and increasing their market knowledge.

Enterprises partner with financial institutions to enable immediate payments to farmers; for example, in the case of SokoNect, financial institutions make payments to farmers upon their sale of produce to end buyers, the enterprise pays the financial institution once the buyer makes the payment on the platform. Enterprises work with banks to open bank accounts for unbanked smallholder farmers, ultimately expediting payment cycles and increasing farmers' confidence in the model.

Implementation: Delivering Value to the Poor

Awareness

The penetration of mobile and internet in smallholder farmer communities, and the ability and ease of farmers to use technology dictates the uptake of direct-from-farm platforms. Enterprises need to hand-hold farmers to navigate through platform features and learn how to use information provided on the platform to price their produce. Enterprises like SokoNect partner with government agencies in their agriculture programs and conduct sessions on the role of technology in enabling direct and transparent access to markets.

Enterprises also identify local farmer leaders and community champions, who interact with farmers and help in spreading awareness about the direct market linkage service. D'Market Movers' farmer network has grown through farmer-to-farmer recommendations and referrals; farmers share information about market demand and work towards increasing their market presence as a group and as a result attract more farmers to join the platform. Mandi Express partners with agricultural university students and agricultural experts to visit farmers and disseminate information about the service. I-Say-Organic, an organic produce platform based in India targets farmers who practice organic farming and reaches these farmers through farmer co-operatives and farmer societies who promote organic farming. Enterprises such as Go4Fresh leverage partners such as farmer producer organizations, co-operatives, government agencies, and agro-input dealer companies to spread awareness amongst farmers.

Creating awareness amongst farmers regarding what kind of products sell (which variety, grade, crop) also plays a crucial role in success. And on the consumer side, enterprises also engage in conducting marketing and awareness campaigns targeted towards on-boarding end customers and creating market demand. Enterprises must raise the awareness that shifts customer behavior and willingness to pay a premium for sustainable, directly sourced products.

Acceptance

Enterprises need to demonstrate the benefits of direct-from-farm platforms in comparison to traditional trading models in farmer communities. This includes the availability of real-time price information as compared to physical market yard auctions, and the ability to receive payments immediately upon the sale of produce in comparison to staggered payments by middlemen. Go4Fresh encourages farmers to use its platform on a trial basis alongside selling their produce through the traditional government auctions and evaluate the mechanism. The enterprise also frequently arranges farmer visits to supermarkets in order to increase their visibility of produce in end markets.

Enterprises need to build trust amongst smallholder farmers for them to accept the model. Enterprises partner with banks to access continuous supply of working capital to pay farmers without delay. Partnering with local government agencies and local community leaders helps in establishing farmers' trust in direct-from-farm platforms. In addition, building trust between buyers and sellers is imperative in setting up a direct-from-farm model, given that buyers often prefer establishing contact through face-to-face interaction first. A study of mobile marketplace Cellbazaar in Bangladesh showed that engaging farmers is likely to require some form of human mediation (Baumüller 2013). Kudu's platform has a rating feature that is meant to mimic the role that relationship-based agents and brokers traditionally play, thereby reducing the risk for farmers to transact with new buyers. Markit Opportunity incorporates high-touch interactions with farmers in the initial stages—registered farmers are provided unique codes, field agents then visit the farms, weigh the produce using digital scales and record the details on an app which is digitally signed by the farmer and buyer. This also lends transparency to the process.

Enterprises design their marketplace platforms by leveraging existing interfaces that smallholder farmers are familiar with in order to overcome the challenge of low technology literacy. For example, SokoNect conducted a survey among target farmers in Kenya and

learnt that they are familiar with the M-Pesa app. The enterprise re-designed its interface to replicate select features from M-Pesa thereby increasing farmer acceptance.

Accessibility

Direct-from-farm platforms break down physical barriers to access, and provide an opportunity for farmers to sell their produce directly to end customers on the basis of transparent price information.

Farmers are connected to end buyers through different platforms: voice calls, website, SMS on feature phones, or mobile apps on internet-enabled smart phones. Enterprises design and develop the platform layout based on the level of mobile and internet penetration amongst the farmer communities that they intend to serve. Mandi Express, Kudu and Markit Opportunity are SMS based mobile phone applications that don't require farmers to be internet savvy. MLouma provides farmers access to end buyers through multiple channels—the web, SMS service, mobile application and a call centre.

Research on providing services to rural populations showed that information must be presented in local languages for greater acceptance (IFAD 2011).Mandi Trades, an app based platform in India revised its service a year into operations to provide content in Hindi, Tamil, Telugu, Kannada and Malayalam in addition to English (Nidheesh 2015).Similarly, Sri Lanka based Dialog Telekom provides farmers and buyers access to its SMS service in English, Sinhala and Tamil.

A number of enterprises such as I-Say-Organic, SiembraViva, Veggie Kart, Markit Opportunity and D'Market Movers provide their farmers feedback on crops that are on high demand and information on how to cultivate these crops.

Affordability

Smallholder farmers located in remote rural areas are subject to weak market linkages owing to inadequate infrastructure, bad road network, and expensive transport options. For instance, farmers in Fiji residing within 500 meters of the packing sheds would incur approximately USD 15 to hire a vehicle from the farm to the facility. Direct-from-farm marketplace platforms help farmers avoid this expense as buyers source the produce at the farm gate. In Tanzania, for example, rural farmers have to invest significant time and money to reach distantly located 'kariakoos' or markets. At the market, they have to rent stall, which is often unaffordable for them. As a result, most farmers in Tanzania depend on middlemen to transport their produce to markets (Mason 2014).Small-scale farmers who sell their harvest through middlemen and agents incur costs in terms of trader and commission fee. Direct-from-farm platform services are either provided free of charge or at nominal subscription rates to farmers; for example, Fruitspot and SokoNect charge farmers only once the transaction is completed.

Many small-scale farmers rely on a limited number of middlemen or traders to receive price information, given that search costs for finding information elsewhere are often high (Baumüller 2013). In addition, these farmers are forced to sell their produce at sub-market prices to middlemen who sell it to end buyers at a premium. Farmers are able to send query messages once registered on direct-from-farm platforms for real-time information on prices, historical prices and market trends, and make informed decisions to sell their produce.

Farmers also incur significant costs in employing labor for harvesting produce, and are often strapped for funds at this time. Enterprises like Markit Opportunity match farmers with buyers and provide an advance deposit as assurance of sale, enabling farmers to pay farm laborers. The enterprise provides this free of charge to farmers, who only have to pay USD 1 cent to post their ask requests via SMS.

Results and Cost Effectiveness

Direct-from-farm platforms shorten supply chains for farmers along with providing them information on prevailing market prices, access to customer segments that command higher prices and the ability to set prices for their produce. The model enables smallholder farmers to increase their income owing to better market access, lower post-harvest losses, relevant connections with price-appropriate buyers and the opportunity to realize market prices. In addition, these platforms save farmers the time they would otherwise spend in traveling to market yards and waiting through prolonged auctions.

Scale and Reach

Leveraging on technology, enterprises providing farmers with direct access to buyers have removed price and demand information asymmetries; this has helped farmers realize higher farm-gate prices and increased their sales volumes. With the increase in uptake of mobile and internet technology across developing countries, a number of enterprises have adopted the direct-from-farm model, primarily to enable disintermediation.

MLouma, a platform connecting farmers to buyers through SMS, USSD, online website and call centers caters to 75,000 farmers in Senegal—the use of multiple modes of technology enables MLouma to reach different segments of smallholder farmers. The external financial support from AMEA Orange Developer Challenge in 2014 allowed the enterprise to integrate SMS and USSD features and resulted in expanding its reach from 1000 farmers to 75,000 farmers in Senegal.

Direct-from-farm platforms in India have been able to reach a large base of smallholder farmers within a few years in operation; this may be attributed to the density of farmers in the country, their transition from subsistence to commercial farming practices on a small-scale, and their awareness of growing urban consumer demand coupled with their desire to circumvent existing imperfect supply chains and adopt technology to shorten the distribution process. For instance, within 3 years of operating its platform, Mandi Trades has 10,000 registered farmers in India and has enabled USD 7.47 million worth of trade (Nidheesh 2015). Go4Fresh has reached over 10,000 farmers in Maharashtra, India and connected them to 8000 retail and 500 corporate customers.

Enterprises at a lower scale are either young (under 3 years) or operate in a single country or small region. SokoNect in Kenya has over 5000 registered smallholder farmers on its platform. Markit Opportunity has served 300 smallholder farmers in Kenya and intends to partner with an NGO to launch the platform to 3,000 farmers in 2017 (King-Bischof 2016). Kudu has been operational in Uganda for 18 months and has registered over 1000 farmers and traders and received USD 1 million in bids from buyers and USD 1.7 million in asks

Table 24. Examples of companies and reach

Company	*Country of operation*	*Years of operation*	*Number of farmers reached*
D'Market Movers	Trinidad and Tobago	5	60 organic farmers connected to 650 consumers on the platform
Go4Fresh	India	3	10,000 farmers connected to 8500 consumers on the platform
Kudu	Uganda	4	1,000
Mandi Trades	India	3	10,000
Markit Opportunity	Kenya	1	300
MLouma	Senegal	4	75,000
SokoNect	Kenya	3	5,000

from sellers (Bergquist 2016). D'Market Movers brings together 60 local organic producers and 650 consumers in Trinidad and Tobago on its digital platform (Cartmell-Thorp 2016).

Improving Outcomes

While direct-from-farm platforms are nascent and are yet to scale, they have been able to deliver significant impact to farmers in increasing their market access in comparison to traditional models. A study conducted by International Research Development Centre (IRDC) found that produce typically changes hands 3 or 4 times from farm-gate to buyer; middlemen in Kenya, on average, take 23 percent of the wholesale market price and 14 percent of the price is directed towards packaging, grading, market access fees and transport resulting in farmers retaining only 63 percent of the produce price (Opala n.d.).

Direct-from-farm services enable farmers to realize maximum farm-gate prices by eliminating middlemen in the long supply chain. The model has also helped farmers reduce post-harvest wastages. Dialog Telekom's model has enabled farmers in Sri Lanka to increase incomes by 40 percent due to elimination of middlemen (Masiello-Riome 2009). In Colombia, according to SiembraViva, farmers receive 25 percent to 35 percent of the amount paid by the end buyer. By using its model, farmers have been able to receive 48 percent of the price paid by consumers. Ekgaon Technologies, through its online market-place and advisory services has increased farmer incomes by USD 127 or 67 percent on average.

Enterprises buy farmers' entire harvest, regardless of the grade, and then sell it at differentiated prices to end customers. Under the traditional model, smallholder farmers sell their produce to agents who transport it to market yards. Typically, crops that have physical or aesthetic defects, such as being the wrong shape or size, broken or having a blemish are rejected. Farmers therefore have to bear the post-harvest quality related losses. Direct-from-farm platforms allow farmers to sell such produce too and cuts down on the number of intermediaries, thereby boosting farmers share of the final price.

Enterprises have also contributed to creating other positive impacts on the lives of small-scale farmers besides enabling them to earn higher incomes. For instance, Kuchara, an online marketplace connecting farmers with buyers in Peru allows consumers to buy subscriptions to crowdfund education of future farmers, in exchange for long-life discounts on their purchases.

Cost Effectiveness

In India, nearly USD 20 million worth of crops are wasted per day owing to rejection at farm-gate and delays in the distribution process. Direct-from-farm platforms can be a cost-effective alternative to selling to private traders and auctioning in government operated marketplaces when their entire produce is bought by the enterprise and there is no produce that is rejected at farm-gate.

A number of enterprises procure produce from farmers at wholesale prices; farmers are satisfied since their entire harvest is sold, regardless of the shape and visual appearance of crops and on the other hand, enterprises are able to maintain low costs of procurement. Further, farmers benefit when the enterprise matches them to buyers and undertakes the transportation and delivery of produce to customers, thereby decreasing costs incurred by farmers in transporting produce to market yards or to end buyers themselves.

Enterprises require financial support to pay for initial costs involved in building the software and hardware for the platform or mobile-based solutions. They seek grant funds, prize money from awards and support from innovation labs to improve their solutions, and achieve better reach and scale results. For instance, Senegal based enterprise, MLuoma won the 2014 AMEA Orange Developer Challenge and was able to leverage on the financial assistance to integrate SMS and USSD features, resulting in its user base growing from under 1000 to 75,000 farmers (Orange Partner n.d.). SokoNect was offered a USSD testing bed by Mlab East Africa for a period of 3 months, however, the monthly maintenance fee of USD 465 proved to be a significant expense and led to the company discontinuing this application.

To keep costs low, it is also beneficial for enterprises to partner with local stakeholders in farmer engagement, procurement and transportation activities. By leveraging on these partners, enterprises can reduce costs on employing and training staff to undertake these activities. For instance, Kecipir, an enterprise in Indonesia that enables smallholder farmers to eliminate dealing with middlemen or '*tengkulaks*,' sells organic produce via its online and smartphone application by organizing its customers based on community market clusters. It identifies local community hosts, who are paid a 10 percent commission fee on the orders, to serve as delivery hubs, customer service agents, and community organizers. Go4Fresh involves local aggregators or '*gundegaris*' to support the company in arranging transportation of produce from remotely located farms. Markit Opportunity leverages the trust that NGOs have with their farmer beneficiaries and involves these NGOs as field officers to facilitate farmer registration and trading activities, thereby reducing the enterprise's agent costs.

Many enterprises work on an aggregator model, wherein orders are placed by buyers on the platform, demand is aggregated and produce is transported by enterprises from farms or centrally located collection points to buyers. They create efficiencies in this process to keep their costs low - they aggregate collection, consolidate groups of farmers growing crops with similar production cycles, and use technology to group orders for collection so they

reduce costs across transactions. For instance, Agruppa creates a daily collective order based on orders placed on the platform and buys wholesale quantities from farmers generating discounts of up to 30 percent (Agruppa n.d.). It is important for enterprises that operate on an aggregator model to track location-based orders in a timely manner so as to enable optimal scheduling of produce collection from remotely located farms which will result in lowering transportation and logistics costs. SokoNect is working towards grouping farmers based on the types of crops they produce in order to streamline the consolidation and collection process.

Scaling Up

Challenges

Agents, brokers or middlemen who are known to exploit smallholder farmers by procuring their produce at low prices represent the main threat to enterprises connecting farmers directly to buyers. Small-scale farmers are reluctant to change traditional practice and switch over to technology platforms that enable direct access to buyers. A study on TradeNet, a Sri Lankan based mobile platform showed that farmers continued to sell to the same traders because they depended on them as a source of loans and information (Baumüller 2016). Enterprises find it difficult to build trust with farmers who have traditionally built personal relationships and social ties with middlemen (Veit 2009).

The uptake of direct-from-farm services relies on farmers' familiarity and comfort with adopting mobile and internet based technology. Small-scale farmers in developing countries are typically illiterate, making it easier for them to interact with middlemen instead of adopting a technology based service to connect with end customers. In response to this challenge, enterprises have incorporated user-friendly design features that mimic widespread internet and mobile platforms that farmers are familiar with, such as M-Pesa. A number of enterprises such as Mandi Trades and Dialog Telekom introduced their services in different local languages. Markit Opportunity and SokoNect send field agents to visit farmers and educate them in using their technology platforms to sell produce directly to buyers.

Many enterprises have cited that securing funds for working capital is a major challenge. An essential component to building trust amongst smallholder farmers is linked to timely payments. Enterprises require significant working capital to support immediate payments to farmers, with the risk of losing them as suppliers. Enterprises also face challenges in sourcing funds for their marketing activities—a critical requirement in generating demand and growing the end customer base on their platforms.

Role of Government and Policy

Given that farmers in developing countries predominantly practice subsistence farming due to lack of efficient market linkages, they would benefit from policies that foster transparency in price and demand information available to farmers, establish clear standards and create a market environment that embraces technology.

For instance, in India, the government is leveraging technology to provide transparent markets for previously underserved farmers. Until recently the Government, under the

Agriculture Produce Market Committee (APMC) Act had mandated that the first sale of crops can only take place in regulated market yards or mandis within the same state. This mandate curtailed the market for farmers and forced them to sell to traders or commission agents licensed to operate in APMC markets. In some cases, licenses were required to trade in different yards within the same state (Express News Service 2015). As a step towards expanding markets for farmers, the Central Government of India has advised states to allow free exchange of agricultural produce across states; farmers can use a common electronic platform—e National Agricultural Market (e NAM)—to sell their produce to local traders or to online buyers across India. Under a USD 30 million scheme as part of the Digital India campaign, the Government plans to bring 585 regulated wholesale markets across the country on an electronic platform by 2018 (Nidheesh 2015).

The Unified Market Platform (UMP) launched by Rashtriya e-Market Services is an example of a public-private partnership between the Government of Karnataka, India and Mumbai-based NCDEX Spot Exchange. The platform enables farmers and end buyers to negotiate on prices directly without the presence of an intermediary or agent. Circumventing middlemen allows farmers to receive payments in their bank accounts within an hour of the trade as compared to being paid in installments over a month (Towary 2016).

There are some gaps that governments across developing countries are yet to bridge—enterprises providing technology based platforms to directly link farmers with consumers have cited challenges in terms of receiving government financing, delays in provision of licenses, prohibitive tax structures and high-levels of corruption and bureaucracy. For instance, in Kenya, SokoNect incurs a license fee to operate its online and SMS based platform, pays an annual transportation fee of KSH 5000 and KSH 2500 to procure a license to distribute marketing brochures in Nairobi. Given the need to have sufficient end buyers on a farmer to buyer platform, marketing to urban consumers is essential for its business model.

Governments need to strengthen data collection and dissemination processes in order to promote enterprises providing direct market linkages to farmers cut off from mainstream markets. For instance, in Fiji, there are limited sources of accurate price information available to the private sector. Fiji AgTrade, a division within the Ministry of Agriculture, maintains a record of weekly market prices across Fiji. However, farmers located in interior rural areas can seldom access this information. There are no available data sets of farm gate prices and, at present, Fiji AgTrade appears to be the only source of local market prices (Veit 2009). In Nigeria, daily information on market prices can be found in newspapers for traditional export crops such as cocoa, but is unavailable for other crops such as rice, sorghum, cassava, maize, and horticultural crops. Public agencies publish information on a monthly basis which is of limited use to farmers (Prakash-Mani 2013). Enterprises require credible data on prices and market trends so that they can build trust among smallholder farmers who are otherwise subject to information asymmetries.

Conclusion

Direct-from-farm platforms shorten the supply chain and help small-scale farmers to realize higher revenues owing to the direct connection to end buyers and elimination of middlemen.

The business model is scalable owing to the increase in adoption of mobile and internet technology in developing countries. However, reluctance of farmers to switch from middlemen, who they have built personal and social relationships with, to technology based services may restrict the uptake of the direct-from-farm model. This scalability of the model is also determined by the critical number of farmers willing to move from subsistence to commercial agricultural practices and their awareness of market prices and demand. Platforms serving farmers who are only looking to sell small quantities of produce after meeting their own needs may not be financially sustainable.

Enterprises that provide value added services that include procuring produce from farm gates, packaging it and hosting it on their platforms for sale to consumers, keeping their transportation and logistics costs low, are more profitable than enterprises that only provide direct market linkage software to farmers to upload their produce. In addition, enterprises that design algorithms that consolidate individual farmers' produce and sell to consumers in larger quantities attract larger number of buyers to the platform, thereby increasing the volume of sales on the platform.

Table 25. Social enterprises: Direct-from-farm market link

Company	*Country*	*Solution description*
Agruppa	Colombia	Formerly known as SokoText Colombia, the enterprise leverages mobile technology to connect farmers with fruit and vegetable vendors serving low-income communities. Vendors place orders via WhatsApp or voice calls and the company communicates the orders to farmers through voice calls.
D'Market Movers	Trinidad and Tobago	The enterprise provides market access to farmers growing high-quality, but perishable products in more remote island areas who previously only had limited access to local markets. The enterprise has 60 local organic producers and 650 consumers.
Dialog Telekom	Sri Lanka	Dialog TradeNet is an online platform connecting farmers to buyers. The service is operated by Dialog Telekom in partnership with GoviGnanaSeva (GGS). Information on the TradeNet platform is disseminated via multiple digital communication technologies such as SMS, Unstructured Supplementary Service Data (USSD) via mobile phones, web and Interactive Voice Response (IVR).
Ekgaon Technologies	India	Ekgaon Technologies (Ekgaon) is a Delhi based social enterprise that leverages ICT to provide farm advisory services and direct market linkages to smallholder farmers.
Fruitspot	USA, Europe and Latin America	Fruitspot provides an online platform linking farmers with buyers. Fruitspot verifies every user registered on its platform using the Fruitspot Verification Program, thereby establishing trust in the trading process.
Go4Fresh	India	Go4Fresh is based in Maharashtra, India. Its model allows farmers to sell all grades of their fresh produce. Go4Fresh's customers include export companies, supermarkets and retail individuals in the premium price bracket and price-conscious customers including processors, hotels, canteens and restaurants.
I-Say-Organic	India	I-Say-Organic is an e-commerce platform for organic produce. The enterprise procures organic produce from smallholder farmers, grades and ensures quality, and delivers the produce to end-customers based on sales generated on its platform. The company also provides feedback to farmers on when to plant and when to harvest based on demand projections.
Kecipir	Indonesia	Kecipir provides an online platform for farmers to connect with end consumers. The model shortens the supply chain by eliminating the presence of traders, central market, wholesaler, and retailer in the supply chain.

Table 25. Social enterprises: Direct-from-farm market link (continued)

Company	*Country*	*Solution description*
Kudu	Uganda	The company uses a double auction system to match farmers to buyers. Buyers and sellers separately communicate their requirements and the prices they are willing to trade at. The system takes into account price, location and other factors to automatically find the best matches.
MLouma	Senegal	Mlouma functions as a virtual commodity exchange connecting farmers to buyers through various communication platforms: internet, SMS, mobile app, and call center.
Mandi Express	Pakistan	Mandi Express is an online and SMS based platform that connects remotely located farmers in Pakistan with end consumers. The model eliminates 'Arthis' or middlemen in the supply chain process. It is present in the market yards or 'mandis' as well where any excess produce is sold.
Mandi Trades	India	A multi-lingual marketplace platform where farmers can post crop details using a phone and connect with buyers and traders directly. The platform publishes prices of farm commodities as provided by the Government of India to make it easier for farmers and buyers to decide on the trade.
Markit Opportunity	Kenya	The enterprise's e-commerce platform enables smallholder farmers to access information about the markets they buy and sell in, exchange high-quality produce through a double auction platform, and procure transportation services. The enterprise oversees harvesting and transportation logistics after a match has been approved.
SiembraViva	Colombia	The enterprise uses technology and an e-commerce platform to connect smallholder farmers in rural Colombia to a consumer base in urban cities. It also provides support and assistance to allow farmers to switch from growing commodities to value-added organic products.
SokoNect	Kenya	SokoNect links small holder farmers to buyers through mobile phone technology, online website, SMS and Android application. Buyers include retail individuals, supermarkets, export companies. In addition, the enterprise also provides business capacity training to farmers.

References

Agruppa. n.d. http://www.agruppa.co/menu

Baumüller, Heike. 2013. "Enhancing smallholder market participation through mobile phone-enabled services: The case of M-Farm in Kenya." Center for Development Research: Bonn. https://pdfs.semanticscholar.org/5c92/deef78e069a06357d998b278c0c84ffe22b2.pdf

Bergquist, Lauren. 2016. "A mobile marketplace to connect smallholder farmers to markets." OpenIDEO. https://challenges.openideo.com/challenge/agricultural-innovation/improve/a-mobile-marketplace-to-connect-smallholder-farmers-to-markets

Cartmell-Thorp, Susanna. 2016. "The connected farmer: A new opportunity for the agricultural system." *Spore*. http://spore.cta.int/images/magazines/PDF/SE180-web.pdf International Fund for Agricultural Development (IFAD). 2011. "Markets for the Rural Poor." Rural Poverty Report 2011. IFAD: Rome.

Express News Service. 2015. "Agriculture reform: Government takes first step for a national farm market." *The Indian Express*.

King-Bischof, Ashley. 2016. "Markit Opportunity—Mobile Auction for Smallholder Farming Trading." OpenIDEO. https://challenges.openideo.com/challenge/agricultural-innovation/improve/markit-opportunities-for-smallholder-farmers

Lowder, Sarah, Terri Raney, and Jakob Skoet. 2014. "The Global Distribution of Smallholder and Family Farms." http://www.cgap.org/blog/global-distribution-smallholder-and-family-farms

Masiello-Riome, Charlotte. 2009. "Sri Lanka farmers get mobile phone trade service." e-agriculture. http://www.e-agriculture.org/news/sri-lanka-farmers-get-mobile-phone-trade-service

Mason, Ben. 2014. "Habari Mazao? Smallholder farmers in Tanzania can finally determine their prices themselves." betterplace lab, 2014

Nidheesh, M.K. 2015. "An app that helps farmers cut the middleman out." Live Mint. http://www.livemint.com/Consumer/nQLEyDHTQvkVAodbfA6B9L/An-app-that-helps-farmers-cut-the-middleman-out.html

Opala, Ken. n.d. "Kenyan farmers discover the Internet." International Research Development Centre. https://www.idrc.ca/en/article/kenyan-farmers-discover-internet

Orange Partner. 2016. "MLouma." https://partner.orange.com/partner/mlouma/

Prakash-Mani, Kavita. 2013. "Enabling food security through smallholder farming." Swiss Re Institute. http://institute.swissre.com/research/risk_dialogue/magazine/Strengthening_food_security/Enabling_food_security_through_smallholder_farming.html

Tiwary, Avanish. 2016. "Web platform brings Indian farmers closer to market." *Nikkei Asian Review*. https://asia.nikkei.com/Business/Trends/Web-platform-brings-Indian-farmers-closer-to-market

Veit, Richard. 2009. "Assessing the Viability of Collection Centres for Fruit and Vegetables in Fiji: A Value Chain Approach." AAACP Paper Series No. 7. Food and Agriculture Organization: Rome.

CASE STUDY

Go4Fresh

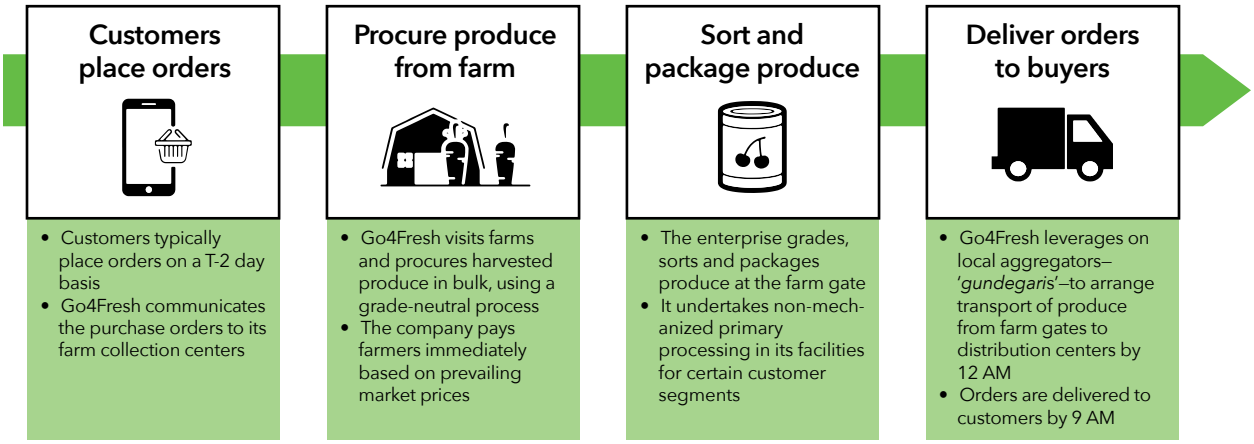
Founding year: 2013
HQ: Mumbai, India
Countries of operation: India
Orientation: For-profit
Employees: 25
Turnover: USD 1.2 million

Small-scale and marginal farmers in India are underserved by formal market linkages, which leads to post-harvest losses and excessive dependence on middlemen to price farmers' produce. The traditional procurement process involves selective procurement based on grades. Farmers are therefore left with lower-grade unsold produce that they can either sell to processors, who are typically difficult to reach, or through middlemen at significantly lower prices. In addition, farmers have to use shared transportation to reach mandis and end markets further delaying the distribution process.

Go4Fresh is a technology enabled platform that provides a direct farm to market linkage for smallholder and subsistence farmers, bypassing middlemen, traders and government operated auctions - 'mandis'. The enterprise provides a grade neutral procurement option to farmers. It visits farms and procures all the harvested produce irrespective of its grade, shape and size, and sells it to varied customer segments at differentiated prices. Go4fresh customers include exporters, resellers, grocers, hotels, canteens, restaurants, processors, juicers, and retail individuals. The enterprise has reached over 10,000 farmers and has over 8500 end customers on its platform.

Operating Model

Go4Fresh enables smallholder farmers to directly sell their fresh produce to buyers. The company transports the produce from farm gate to end customers, thereby streamlining the supply chain. It caters to diverse customer segments such as export companies, resellers, grocers, supermarkets, and individual retail customers who prefer premium grade produce; and hotels, restaurants, canteens (HoReCa segment), and processors who



are price-conscious, but not averse to buying produce that have physical defects as long as it is fresh and edible.

The model eliminates the presence of middlemen in the procurement process, reduces the burden on farmers to arrange for transport to reach government operated auction houses or 'mandis', enables farmers to realize prices upfront, and reduces post-harvest losses stemming from lengthy procurement and distribution activities. In addition, Go4Fresh's model involves grade neutral produce procurement from smallholder farmers, a diversion from the traditional selective-buying model.

Under the traditional model, smallholder farmers in India transport their produce to Agricultural Produce Market Committee (APMC) market yards, where produce is sorted and purchased based on quality, shape, size and visual appeal. Farmers are generally able to sell their premium grade produce, but find it difficult to find buyers for lower grade produce. In order to avoid complete wastage of the lower grade produce, farmers resort to selling it either at sub-par prices to middlemen or agents, or to processors. Go4Fresh provides these farmers a platform to sell their bulk produce at transparent prices to a single procurer at the farm gate.

Buyers place orders on the Go4Fresh platform, which then conveys this information to its Farm Collection Centers two days prior to order delivery date. The team then visits farmers on their fields and procures all their produce for an upfront price. The produce is then sorted, graded and packaged at the farm gate, and transported to buyers. Farmers dealing directly with the enterprise are paid immediately. Farmers who are associated with aggregators receive payment in a two-step process—Go4Fresh pays the aggregators within 15 days, who then pay the farmers.

Go4Fresh sources produce from individual smallholder and marginal farmers, farmer cooperatives, and farmer producer organizations. Local aggregators or '*gundegaris*' as they are known in Maharashtra, India, support the company in arranging transportation of produce from remotely located farms. The enterprise partners with non-governmental organizations such as the Krishi Pragati Foundation, and agro-input dealers such as Syngenta, Bayer and Marico's agricultural input subsidiary to mobilize farmers. Go4Fresh conducts sessions on demonstration plots to create awareness on the model amongst farmer communities. It also partners with local government 'taluka' officers to conduct agriculture programs and lever-

ages on the facilities of Krishi Vigyan Kendra—a government based agricultural extension center—to conduct farmer training. Go4Fresh also organizes supermarket visits to educate farmers on industry practices in packaging and resale. In an attempt to on-board farmers, it encourages farmers to evaluate its model on a trial basis in parallel with using the traditional model and subsequently choose their preferred option to sell produce.

Financial Sustainability

With 8000 retail customers and 500 corporate customers, the company generated USD 1.2 million in revenues in 2015 and is currently EBITDA positive. The company's strategy of buying produce in bulk quantities from farmers gives it a price advantage. Go4Fresh works with food companies on pre-determined buying and selling contracts that are well-matched, and hence limits the risk of carrying perishable inventory or disappointed buyers. In addition, the enterprise forms farmer groups and provides *Good Agricultural Practices* (GAP) certifications to them at a nominal fee.

The company's primary costs include farm to buyer transportation costs (USD 0.03 per kg, approximately 6 percent-10 percent of total sales), packaging costs (USD 0.01 per kg, approximately 3 percent-4 percent of total sales), non-mechanized primary processing facility cost (3 percent-4 percent of total sales), labor costs (USD 0.01 per kg) and capital expenses towards crates used in produce transportation, weighing scales, and sorting & grading tables.

The viability of the company's operations relies on the volume of demand generated on the platform and the consistency in supply. In order to ensure this balance, it is critical for Go4Fresh to create significant awareness among end-buyers and establish trust with its farmer base by paying them without delays.

Impact

Go4Fresh has enabled over 5,000 farmers in Maharashtra, India with improved access to buyers. The company's direct-from-farm model has helped small-scale and marginal farmers in reducing post-harvest losses, increasing their knowledge about market prices and industry standards, and provided them with the opportunity to realize value from their entire harvest. The company has also provided capacity building services, helped farmers receive *Good Agricultural Practices* (GAP) certification, and educated them in managing transaction records. The company has also partnered with HDFC, a private bank in India, to open accounts for unbanked smallholder farmers; the company electronically transfers payments to farmer accounts.

Challenges and Lessons

The company faces significant challenges in generating demand and on-boarding end buyers, given its minimal marketing budget. Limited financial support hinders the company's ability to secure sufficient working capital to pay farmers on an immediate basis—a pivotal factor in strengthening farmers' confidence in Go4Fresh's direct-from-farm model.

CASE STUDY

SokoNect

Founding year: 2013
HQ: Nairobi, Kenya
Countries of operation: India
Orientation: For-profit
Employees: 7
Turnover: USD 1,482

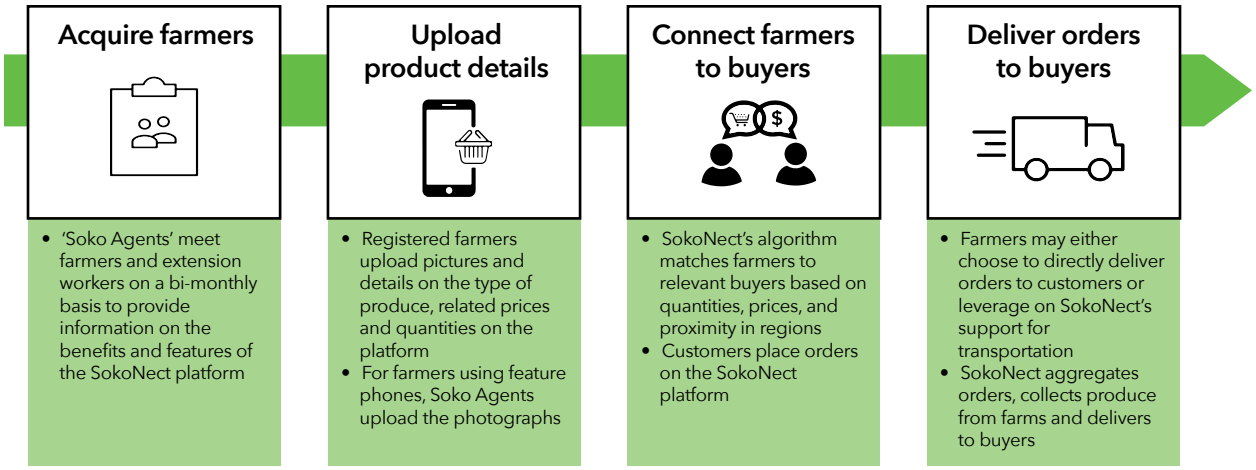
Smallholder farmers in Kenya have limited access to end markets and lack knowledge on market prices. These farmers primarily depend on middlemen who charge them high commission rates, diminishing the revenues that farmers receive. Small quantities of produce, inconsistent quality of crops, and lack of market information diminishes the buying power of farmers. In addition, fragmented distribution channels result in post-harvest losses that further decrease farmers' incomes.

SokoNect is a mobile and internet technology based marketplace that allows farmers to directly sell their agricultural produce and livestock to end buyers based on prices set by them. The enterprise provides farmers updated information on prices for crops and livestock across different markets and access to consumers located in regions that were previously difficult for farmers to directly reach.

SokoNect currently operates in 4 counties across Kenya and has over 5,000 registered farmers on its website, SMS and Android App based platforms. In addition to providing a marketplace for farmers, the enterprise has also trained farmers on the use of mobile and internet technology.

Operating Model

SokoNect's software provides smallholder farmers in Kenya a platform to sell their agricultural, horticultural and livestock products to buyers using a mobile phone. The algorithm matches farmers to potential buyers within their proximity and enables transactions without the presence of a middleman or broker. It also provides farmers with



information on market prices and agricultural news updates. Buyers on SokoNect's platform include export businesses, supermarkets and retail individuals.

The company partners with well-known farmers and makes them 'Soko Agents', who support the enterprise in its marketing and farmer interaction activities. Soko Agents visit farmers on a bi-monthly frequency to provide them with information on the use of the platform and on-board them as users. Once farmers are registered on the platform, they can upload their product details using the SMS based service on their feature phones or website and mobile application on their smart phones.

Farmers advertise their products by uploading pictures and descriptions related to type of product, quantities and prices. The algorithm then matches farmers to buyers as per their locations. Farmers using smart phones can also upload pictures, while Soko Agents assist farmers using feature phones—SokoNect charges a fee of USD 0.06 for each upload by SMS. The enterprise currently charges two percent commission fee for products priced lower than USD 99 and 10 percent commission fee for products priced over USD 99. The payments are made either by using mobile money or transactions through Equity Bank.

Following the placement of an order by a buyer, farmers may either choose to deliver the products directly to the buyer or avail of SokoNect's support for transportation from farm to buyer. SokoNect charges an additional fee to farmers or buyers who require transportation and logistics support.

Financial Sustainability

With over 5,000 farmers on its platform, SokoNect is working towards achieving break-even. The enterprise intends to operate at a sustainable level by incorporating differential quantity based pricing and transaction fee strategies. Efficient scheduling of purchase orders helps reduce logistics costs, thereby improving the model's financial viability. Typically, smallholder farmers sell small quantities of produce at a given point of time, which increases per unit transportation costs. For instance, the company incurs logistics costs of USD 99 to collect orders within a distance of 70 kilometers using one truck regardless of the quantities to be transported.

Despite the enterprise charging farmers a fee to transport their produce to buyers, it is not optimal for SokoNect to undertake frequent visits to farms to collect small quantities of produce. It encourages farmers to upload information two weeks prior to harvest, thus enabling streamlined consolidation of location-based orders that helps in planning a cost-effective logistics schedule. It also intends to cluster farmers into different groups or 'saccos' based on the types of products and harvest periods for easier aggregation and collection of orders. Nearly 50 percent of SokoNect's overall costs comprise marketing costs – the enterprise finds it more challenging to acquire buyers in comparison to acquiring farmers to register on the platform. Logistics costs and Soko Agent salaries are other major costs incurred by the enterprise.

Since the product launch in July 2013, the company has spent over USD 9881. It received USD 4940 in funds from MLab East Africa and USD 1976 from Safaricom.

Impact

SokoNect's platform currently enables 5,000 smallholder farmers in Kenya to leverage on mobile phone technology to connect with end buyers directly. The elimination of middlemen and brokers translates to increased revenues for farmers stemming from higher purchasing power and reduction in exorbitant agent fees. The efficiency in the supply chain process, backed by real-time communication between farmers and buyers, reduces post-harvest losses ultimately resulting in increased farmer incomes.

Most rural smallholder farmers in Kenya are illiterate and not internet or mobile savvy. SokoNect in partnership with the government provides knowledge and capacity building to farmers on topics related to role of technology and the internet in improving their agricultural practices and productivity.

Challenges and Lessons

SokoNect was initially developed as an Android application. However, upon realizing that most farmers in Kenya have feature phones, the enterprise introduced a version using short code SMS application—a platform it purchased for USD 1,778.* SokoNect was then offered a USSD test bed by Mlab East Africa for a period of 3 months. It later adopted the USSD (an interactive mobile phone query service application) platform, costing the enterprise USD 1,452 from Africa'sTalking Limited. Despite the benefits of USSD—an application that provides farmers a simpler query and response mechanism in comparison to SMS services, the monthly maintenance fee of USD 168 proved to be a significant expense and led to the company discontinuing this application.

The uptake of SokoNect's direct-from-farm service relies on farmers' familiarity and comfort with adopting mobile and internet based technology. It trains farmers on internet and mobile usage and role of technology in agriculture at government organized farmer meetings or '*barazas*'. SokoNect also redesigned its interface to mimic that of M-Pesa, a mobile payment platform that most farmers in Kenya are familiar with.

Limited government funding and support towards technology based enterprises in Kenya prove to be a critical challenge for SokoNect; capital is provided to companies with a minimum of 8–12 founders and there are high-levels of bureaucracy and corruption

* KES to USD rate conversion: 1 KES = 0.0099 USD

when working with county governments. In addition, it also has to pay taxes and license fees which are major expenses, for example the company pays the government USD 50 as transportation tax and USD 25 as an annual fee for distribution of marketing brochures in Nairobi.

Multi-Stakeholder Platform

Mobile- and web-based platforms enable connectivity between various actors in the agricultural value chain to improve market efficiency and farmer incomes

HIGHLIGHTS

- Multi-stakeholder ICT platforms reduce information asymmetries along the value-chain by enabling two-way communication between farmers and other stakeholders.
- These platforms facilitate management of out-grower schemes and contract farming models, thereby increasing the exportability of smallholder produce.
- Input suppliers, extension service providers, financial institutions, transporters, agro-processors, exporters, traders, governments, and NGOs can tailor their products and services to specifically suit smallholder farmer needs based on interactions with farmers on the platform.

Summary

Smallholder farmers are often subject to limited access to formal markets, excessive dependence on middlemen for post-harvest services and information asymmetries that ultimately lead to poor bargaining power and sale of produce at undervalued prices. The upsurge in stringent food safety and export standards are making it harder for uninformed small-scale farmers to sell their produce in global markets. Ultimately, the lack of integration amongst agricultural stakeholders results in eliminating smallholder farmers from global supply-chains, forcing them to operate in isolation.

Several enterprises have designed integrated electronic and digital platforms that connect farmers, input suppliers, agriculture experts, finance providers, logistics companies, processors, distributors, government entities and NGOs. These platforms enable streamlined forward and backward linkages along the value chain, facilitating information flows

and business transactions. They encourage collaborative communication amongst different stakeholders and increase transparency in supply-chain management.

Development Challenge

Smallholder farmers face several challenges that restrict their growth and sustainability. At the pre-harvest stage, their farm productivity is impacted by information asymmetry about yield-enhancing inputs and farming practices, markets, prices, certification standards and government policies. Farmers suffer from inadequate market linkages, both with input suppliers and with end buyers. Poor connectivity to markets impacts their incomes more directly and keeps them in a cycle of low investment, low productivity and low incomes. In contract farming and outgrower relationships, agribusinesses lack transparency of progress on smallholder farming activity and farmers' adherence to compliance standards, thereby forcing these farmers out of formal supply chains.

Even when there is information available, remotely located farmers have to incur high search costs, and therefore continue to operate without credible information. A study of farmers in Colombia revealed that 26 percent of the farmers were unaware of the price of their product when purchased at the farm, 43 percent were oblivious to the price of their product at the municipal market and 63 percent didn't know the price of their product in the urban markets of Bogotá (BCtA and UNDP 2015). Highly dysfunctional and disconnected agricultural value chains restrict smallholder farmers from realizing market prices for their produce.

As a result, these farmers resort to selling their produce locally or through agents and middlemen. Farmers are not presented with opportunities to exchange information directly with other ecosystem stakeholders, further restricting their awareness of market trends. On the other hand, stakeholders such as input suppliers, finance providers, extension agents and traders have limited information about smallholder farmers and struggle to design contextual products and services. In a workshop held by the Business Call to Action and UNDP in Nairobi, agricultural stakeholders cited that lack of transparency and fraud along the value-chain were one of the primary drawbacks of working with smallholder farmers (BCtA and UNDP 2015).

Stricter food safety and certification standards are creating immense challenges for farmers in terms of quality assurance and process management. After the EUREPGAP* requirements were released in January 2005, it was estimated that Kenyan smallholder farmers contributed to less than 50 percent of the total export volumes in comparison to 75 percent in the 1990s (Giné 2005). In 2013, the European Union's (EU) mandatory pesticide inspection resulted in a rejection of 10 percent of the beans and peas that arrived at EU ports from countries including Kenya. Kenya's USD 930 million horticulture export industry saw a 50 percent decline in total exports; smallholder farmers were the most affected as they produce 80 percent of these exports (Feed the Future/USAID 2016).

Agribusinesses that work with these farmers also find it difficult and cost-intensive to monitor and manage smallholder farm produce in line with compliance standards. This

* EUREPGAP or Global GAP (Good Agricultural Practices) requirements lay down the minimum standards which agricultural production must comply with in order to be accepted by major supermarket chains.

results in reluctance of large players to source produce from smallholder farmers. A case study in Yucatan, Mexico brought to light the interest that large international supermarkets like Wal-Mart had in sourcing from smallholder farmers. However, farmers' lack of infrastructure, technology and information on quality control and compliance requirements resulted in the farmers not being able to sell to these retailers (Goyal and Gonzalez-Velosa 2013). Similarly, multi-national processor, Frito-Lay, was unable to source potatoes from Ecuadorian smallholder farmers since the produce did not meet compliance requirements.

Lack of communication portals that facilitate information and transaction exchange between stakeholders engaged in agricultural activities from planting to sale of produce, combined with an increase in food sustainability and compliance standards have minimized the opportunities for remotely located smallholder farmers to be included in global agricultural value-chains.

Business Model

A number of enterprises have developed mobile and web based platforms that enable connectivity between various actors in the agricultural value chain. On these platforms, stakeholders can communicate with each other through SMS, voice calls, interactive voice response (IVR), call center, smartphone applications and online web based portals. The platforms facilitate exchange of information and transactions between all registered participants. Typically, stakeholders register on the platform by paying a subscription fee.

Figure 19. Two-way flow of information and transactions facilitated by multi-stakeholder platforms

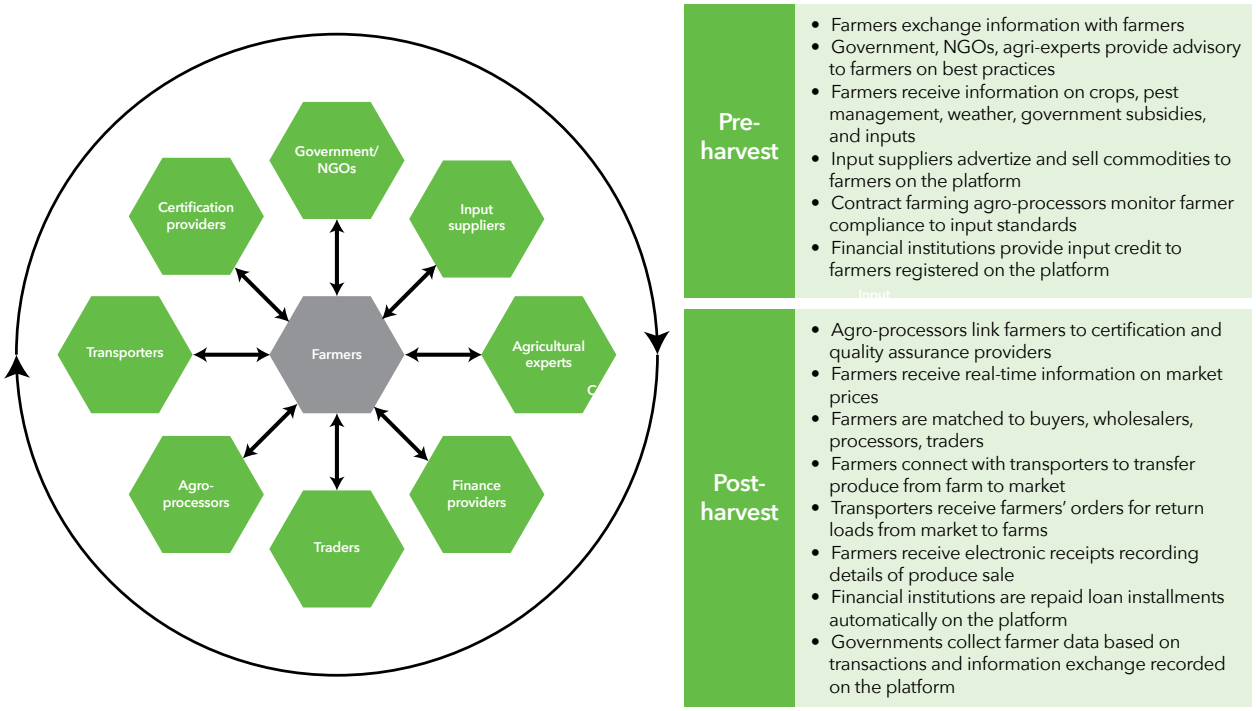
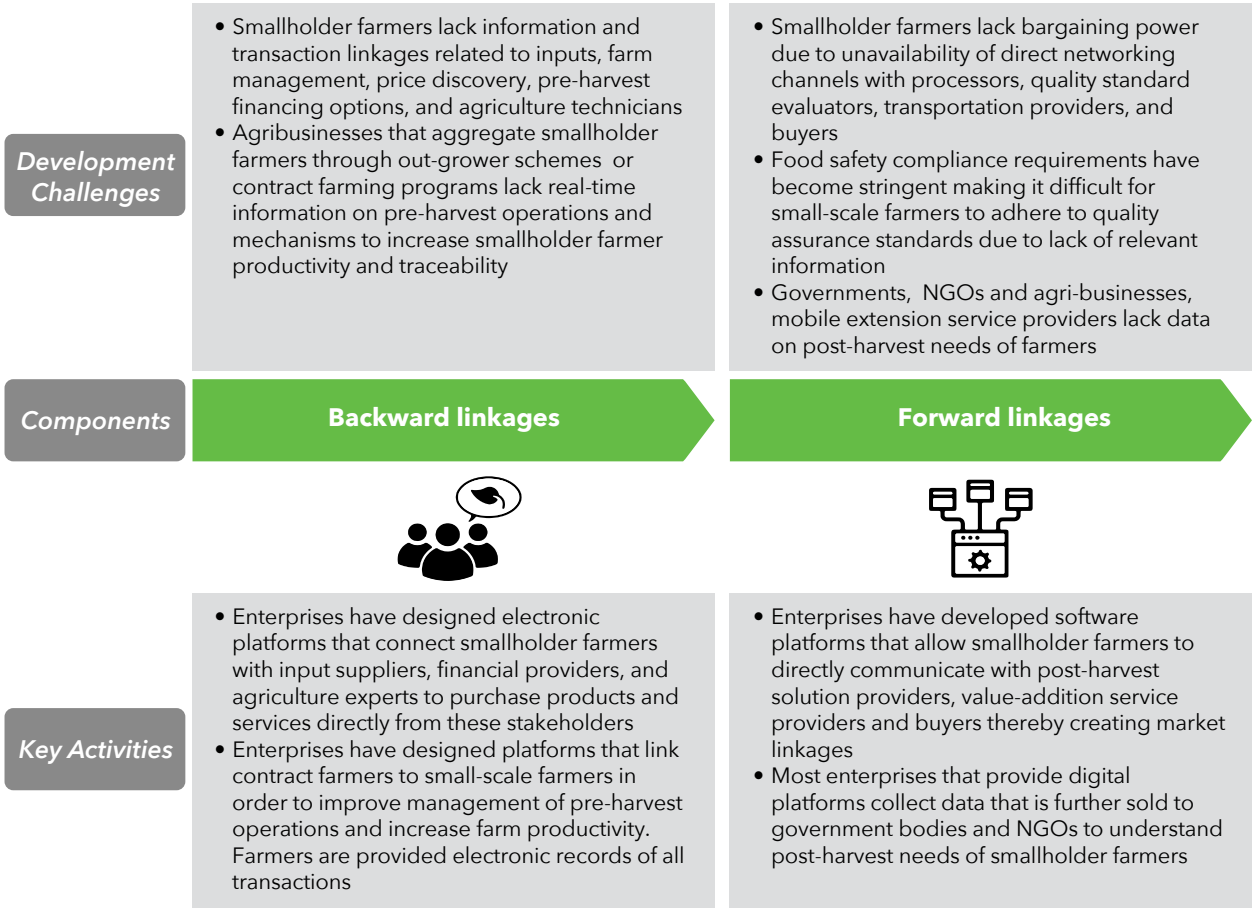


Figure 20. Components of the model



Enterprises earn a commission on every transaction made between farmers and other stakeholders on the platform. Most multi-stakeholder platforms are open group. Platforms specifically designed to support smallholder farm management are closed group; agribusiness clients select the stakeholders to register on the platform.

Integrated platforms enabling backward links

In the pre-harvest phase, all platforms enable farmers and stakeholders to exchange information with each other and transact goods and services leveraging ICT. The platforms enable farmers to interact with other farmers, input suppliers, extension agents, NGOs, governments and finance providers on information regarding farming best practices, quality inputs, and input credit. Input suppliers and extension agents advertise and sell their products and services to farmers using these platforms. For example, Kenya based, Cowsoko's digital platform enables farmers to connect with different value chain actors including input suppliers, veterinary specialists, and dairy experts. Farmers can purchase cows on the platform, use the platform to identify practical training programs and source dairy related information. Esoko allows input suppliers to advertise their commodities to farmers, provides information on weather and connects farmers to extension agents.

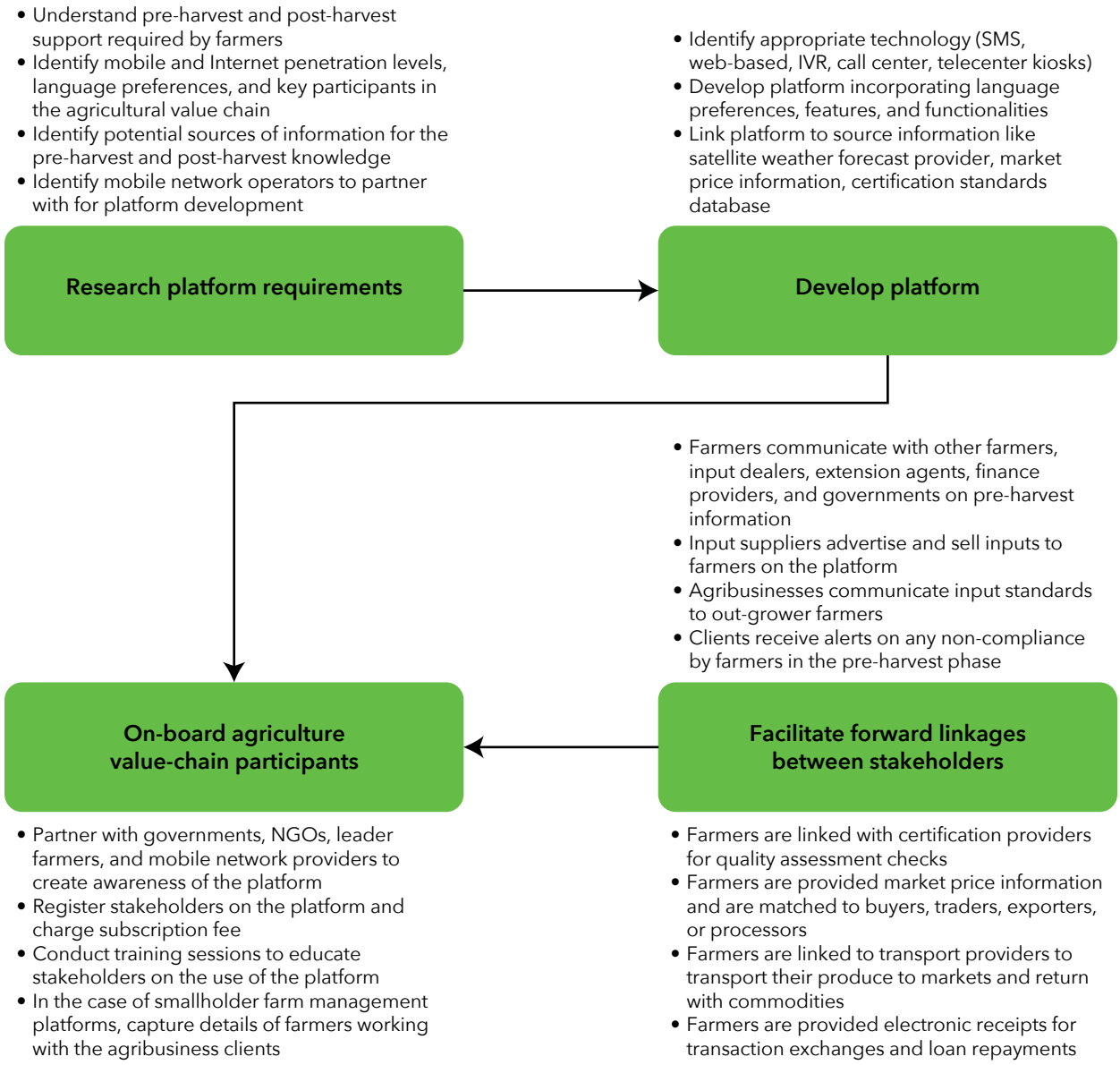
ICT enabled platforms open up the larger ecosystem to smallholder farmers, bringing in efficiencies that are either impossible or very expensive to achieve in brick and mortar fashion. WeFarm, an enterprise based in Peru and Kenya operates a multi-lingual mobile based platform that enables farmers to exchange insights with other farmers. The platform also provides linkages between farmers and other stakeholders, including governments and agricultural businesses to interact and provide information to farmers during the pre-harvest phase. Ricult, in Pakistan, provides farmers information on quality inputs and matches farmers to input suppliers. In addition, the platform enables farmers to access loans from financial institutions registered on the platform. Some platforms are designed to support agribusinesses to effectively manage their out-grower and contract-farming schemes.

These platforms connect farmers with agribusiness agents through ICT and enable them to interact with each other on pre-harvest protocols, global food safety compliance standards, and use of inputs in line with these standards. For instance, Farmforce, which operates in 25 countries across Latin America, Africa and Asia, provides agricultural businesses, aggregators, cooperatives, exporters and agricultural processors the facility to connect with farmers and receive real-time information on pre-harvest activities through a centralized platform. Clients register the farmers that they work with and receive alerts on non-compliance to input and other pre-harvest activities.

Integrated platforms enabling forward linkages

ICT enabled platforms have the potential to shrink global agriculture markets; mainstreaming smallholder farmers on a level playing field in the post-harvest stage. Farmers can leverage these platforms to directly communicate with processors, and quality assessment certifiers to enhance the value of post-harvest products. They can also directly engage with buyers (both, domestic and global) and connect with transporters on the platform to deliver produce. Thus, platforms reduce the effort (manpower, time) as well as investment (own trucks for distribution, sales force) for every stakeholder group they onboard. Cowsoko connects farmers to buyers and transporters to undertake delivery of produce. Esoko, based in Africa, connects farmers to agro-processors and exporters who can use the tool to track their produce across the supply-chain. In India, ITC's e-Choupal enables farmers to trade directly with wholesale buyers. MFarms, an enterprise that operates in multiple countries across West Africa, brings together farmers, aggregators, warehouse operators, agro-input dealers, transport companies, government and NGOs. Farmforce links farmers to certification providers who can assess the quality of the produce in line with global compliance standards.

Figure 21. Process of the model



Cost Factors

Initial technology development represents the largest capital cost borne by enterprises providing multi-stakeholder collaboration solutions. For instance, Farmforce, incurred 100 percent of its costs in initial platform design and development; over the 4.5 years of operations, the enterprise has stabilized its platform and currently incurs about 10 percent of overall costs in maintenance of the platform (self-reported). Esoko incurred an upfront investment of USD 800,000 to develop and set up its platform, including purchase of hardware, salaries for staff engaged in developing the platform and in collection of market price information (World Bank 2011).

Owing to the fast pace at which technology changes, coupled with the need to constantly enhance content on the platform, enterprises incur significant costs on maintaining their ICT platforms. Enterprises continuously upgrade platform software, features and functionalities. For example, Esoko spent USD 700,000 in 2015 to upgrade and maintain its platform. It is also in the process of integrating an input wallet solution as part of its platform. The estimated investment requirement for the m-commerce platform is USD 2 million (self-reported).Other enterprises are less capital intensive, ITC Limited incurs INR 70,000 to INR 100,000 (USD 1050 to USD 1500) to set up its e-Choupal kiosks in rural villages (Mukerji 2013).

Multi-stakeholder platforms differ from ICT extension platforms in that they enable connectivity among a larger set of agricultural vale-chain participants and provide two-way communication channels. Enterprises offering multi-stakeholder linkages on their platforms must necessarily on-board relevant stakeholders to the platform. Enterprises therefore incur significant costs in marketing and acquiring these different participants to be part of the platform. Enterprises must also design features and functionalities on the platform that will cater to different agricultural value-chain participants. Staff costs and marketing costs are other key cost components involved in this model. Enterprises incur significant costs in hiring staff that can gather and validate data on prices and demand prior to disseminating this information to farmers.

Revenue Streams

Enterprises that provide multi-stakeholder platforms earn revenues in different ways—through subscription fees, commission fees, third party license fees and fees based on revenue-share with partners. Enterprises price their services based on the customer segments as well as the services provided to clients, such as market information, or pre-harvest advisory, market access or produce tracking services. Revenue streams may differ based on customizations required by clients, including the platform technology that they select and language preferences, and number of licenses or devices provided to clients.

Typically, farmers are not charged a fee or are charged a minimal transaction fee. Cowsoko charges farmers a transaction fee for every product that they sell to end buyers registered on the platform; agricultural extension workers registered on the platform pay the enterprise a subscription fee to advertise their advisory services to farmers; agro-input dealers pay Cowsoko a subscription fee to advertise inputs on the platform and pay a commission fee on every input commodity that is sold to farmers.

Platforms draw on some anchor tenants to keep revenues flowing in, even as they leverage the presence of some stakeholders to draw in smallholders or agribusinesses by the convenience they provide. Cowsoko, for instance, currently does not charge transport and logistics providers a fee; instead, it leverages the presence of transporters to attract farmers and input dealers to the platform (self-reported).Farmforce charges agribusinesses a subscription fee to use its tool to manage their out-grower schemes, but also allows them to extend it to their partners to multiply efficiencies as well as grow the ecosystem on-board the platform. Farmforce clients, thus, extend the Farmforce license to other third-party participants such as food certification assessors, financial institutions, agronomists, input suppliers and extension service providers; in such cases the client pays Farmforce an additional third-party license fee (self-reported).WeFarm does not charge farmers to be on its platform. The enter-

prise's *WeFarm Insights* and *WeFarm Reach* business lines involve providing information about farmers to other stakeholders including agribusinesses, governments and NGOs for a fee. These stakeholders can also advertise their products and services to remotely located farmers registered on the platform (*Roast* 2013).

In order to make their paid services affordable, platforms adopt modular structures and tiered pricing to selectively charge stakeholders that will be willing to pay for a service. On Farmforce, clients can select from a range of module packages such as basic farming module, SMS communication, compliance features and other traceability solutions. DrumNet charges either a transaction fee or commission fee based on the customer segment—farmers, buyers, transporters, input suppliers and banks. The enterprise typically deducts a 10 percent service charge from the gross proceeds of every marketing transaction facilitated by the platform prior to the disbursement of net funds back to the farmer. In addition, DrumNet collects a fee for managing the credit program on behalf of the bank (Kopicki and Miller 2008). Esoko charges farmers and farmer organizations based on a tiered subscription fee model which range from USD 36 for individual farmers to USD 8000 for farmer groups (David-West 2010).

ICT platform enterprises provide data collection and farmer survey services to clients on a subscription model. Agro-processors, exporters and input suppliers are also charged a subscription fee to advertise their products and services to farmers and to be matched to farmers. Esoko partners with mobile network operators (MNO) on a revenue-share model; the MNOs retain 70 percent-80 percent of the communication fee and Esoko is paid 20–30 percent of the SMS or call center charge. The enterprise plans to integrate an input wallet solution with the platform, and will start to charge input suppliers a commission fee for every input commodity (for example, seeds and fertilizer) sold to farmers on the platform (self-reported). Farmers Online Market charges differential prices based on the customer segments, for instance, farmers are charged Nigerian Naira 1000 (USD 3.17) and agents are charged Nigerian Naira 6000 (USD 19) (Farmers Online Market n.d.). MFarms generates revenue through annual subscription, customization, training, and credits for SMS and IVR messages conveyed through the platform.

Financial Viability

The financial sustainability of the model hinges on multiple factors: using the appropriate technology that enables maximum reach, structuring profitable revenue-share models with mobile network operators to enable enterprises to earn higher margins on communication costs, attracting higher number of paying customers in comparison to non-paying customers, and providing a combination of information and transaction related services for all stakeholders. However, once these elements are in place, recurring costs are limited to upgrades, maintenance and staff salaries, resulting in high margins. As long as the platform is able to build significant traction of paying customers, they remain viable.

Multi-stakeholder ICT platform enterprises need to invest time to understand the support that farmers require in the pre-harvest and post-harvest phases. They also need to continuously maintain the platform by adding and improving both, content and functionality. Enterprises typically leverage donor grants and patient capital to support initial costs until they can interest banks and other investors to finance their growth. As noted above, Esoko spent USD 800,000 as upfront costs to develop the platform, of which USD 200,000 was

donor-funded (World Bank 2011). Initial development costs for Farmforce was supported by the Syngenta Foundation for Sustainable Agriculture, a non-profit organization and co-funded by the State Secretariat for Economic Affairs of Switzerland (World Bank n.d.).

Most enterprises try to create diversified revenue streams to ensure consistent revenue flow. They leverage their knowledge of different customer groups to estimate their ability and willingness to pay for different services. For example, when linking farmers to transport providers to deliver produce to end markets, enterprises examine possible revenue streams such as charging transport providers for information on return loads; the platform could match them with farmers who require commodities from markets on the transporters' return trips.

Most ICT platform enterprises design their marketing and pricing strategies to acquire farmer groups and agribusinesses that work with farmers as opposed to acquiring individual farmers; this helps in reducing the cost of services to each farmer while increasing revenue earning potential for the enterprises. For instance, Esoko charges individual farmers USD 36, while farmer groups with up to 200 members pay USD 250 (translates to USD 1.25 per farmer) (World Bank 2011). With a larger number of farmers on the platform, agribusinesses and other stakeholders including government and NGOs are willing to pay higher prices to be part of the platform. Platforms also increase their participant numbers by offering discounts which they share with vendors who offer the services. This impacts viability of the model; although the strategy increases the topline, it is difficult to encourage clients to transition to paying full prices at a later time.

Most platforms use information and content as the hook to interest subscribers; and content creation needs upfront investments. Data collection and marketing are key costs associated with this model (World Bank 2011). Passive support such as solely providing information does not earn revenues—clients often expect enterprises to offer this for free. The more passive support a platform offers, the less profitable or viable it is likely to be. Successful platform enterprises focus on creating content that customers will be willing to pay for or tag the content to services that directly lead to business and revenues for customers.

For example, Esoko has a dedicated team of enumerators who source and cross-verify market price information prior to disseminating it to farmers and traders registered on the platform. Esoko also provides market access to farmers to sell their produce to agro-processors and export companies. Agrinet sources price information by linking SMS to physical information boards located in markets. In order to cover these costs, it charges a commission fee for each brokered deal based on the information provided by Agrinet (World Bank 2011). Strategic partnerships with reliable information sources such as weather forecasting companies and market price information agencies help enterprises to continue providing trustworthy and value driven information to farmers and other stakeholders, thereby increasing customer stickiness and willingness to pay.

Enterprises incur initial costs in training farmers and other stakeholders on the use of the platform. However, given that training needs to be undertaken only at the point of on-boarding customers, the Return on Investment (ROI) steadily grows over the years. A study by NYU in 2011 compared the cost of Esoko's service with the estimated benefits to farmers. At that point Esoko offered its services to farmers at GHS 24 (USD 6); Esoko's ROI was over 200 percent, after considering cost of the service and cost of training farmers on the use of the platform (Hildebrandt, Nyarko, Romagnoli, and Soldani 2015).

Partnerships

Enterprises establish partnerships with mobile network providers, development organizations and government agencies for data collection, information dissemination and increasing their reach to farmers. Enterprises work with local government bodies to reach remotely located smallholder farmers and build trust in using the platform. In collaboration with government agencies, they also provide training to farmers on internet and mobile use. Strategic partnerships with mobile network operators can be beneficial to enterprises. Sharing revenues earned through SMS and voice service communication between stakeholders on the MNO's networks could serve as an additional source of income for enterprises. They can increase the number of customers on the platform by lowering text package prices. They can also expand network infrastructure to reach remote rural areas thereby increasing target customers (World Bank 2011).

In order to facilitate the traceability of smallholder produce and compliance with the Food and Drug Administration's Food Safety Modernization Act (FSMA), Farmforce in partnership with Mercy Corps used the tool to support the export industry in Guatemala to enable export of smallholder farmer produce to the United States of America. The enterprise also partnered with the European Union on a project related to export of produce from Kenyan smallholder farmers to Europe. Partnering with development foundations with similar agendas in seeking to support smallholder farmers helps in increasing acceptance of multi-stakeholder ICT tools among farmer groups and agribusinesses.

Implementation: Delivering Value to the Poor

Awareness

Enterprises market their platforms to a wide variety of participants across the agriculture value chain. Typically, they conduct training and education programs on the role of internet and mobile technology in partnership with rural government agencies, NGOs and farmer co-operatives. They conduct training sessions for farmers and traders on effective market linkages and mentor traders in undertaking transparent trading without manipulating farmers. They broadcast their services on local radio, newspaper and market price information boards. Most enterprises involve local farmer leaders in spreading awareness about their platforms. Ricult identifies middlemen that farmers are comfortable trading with and train these middlemen in using the technology; the middlemen visit farmers and on-board them to the Ricult platform. Cowsoko markets its platform on Facebook and other social media platforms. It also places advertisements in dairy societies, and publishes blogs in local newspapers. Farmforce interacts with agribusinesses and explains the benefits of using the tool for their out-grower and contract farming management; the enterprise also relies on early adopters to further spread awareness of its platform.

Acceptance

Prior to product design and deployment, enterprises invest time to understand pre-harvest and post-harvest support required by farmers, mobile and internet penetration levels, local languages, and key participants in the agricultural value chain. Farmers are more receptive

to platforms that allow two-way communication. Enterprises, therefore, create open communication platforms. Prior to listing agricultural experts on Cowsoko's platform, the enterprise trains them on basic business and farmer interaction skills. It is also critical for them to offer their tools in local languages. For example, Farmforce works across Latin America, Africa and Asia. The enterprise offers its platform in English, Spanish, French and Portuguese to cater to farmers and agribusiness clients in these regions. WeFarm has a network of volunteer translators for international answers. Farmers from across the globe interact with each other; for example, a Kenyan farmer's reply in English or Swahili is translated to Spanish for a farmer in Peru. The platform also offers French and Haitian Creole as language options.

Accessibility

Ease of accessibility and user interface are critical for stakeholder adoption, particularly for smallholders. Multi-stakeholder platforms leverage mobile and internet technology to connect farmers with other agricultural stakeholders for real-time information and transaction exchange. Farmers are not required to travel to central markets for information on produce planning, market access or certification requirements. Ricult undertakes door step delivery of input commodities to farms; the enterprise also provides on-farm soil testing services (Ricult n.d.). Other value-chain actors can provide information to farmers that enable them to produce commercial export quality crops. These value-chain actors can also interact with each other to assess farmer default risks and plan their activities accordingly. For example, Farmforce enables interaction between contract-farming agribusinesses, input suppliers, certification providers, and financial institutions, and collaborate to provide support to smallholder farmers that they manage. Most enterprises provide multi-media platforms including SMS, Android application, web platform, Interactive Voice Response (IVR) and call center services. Farmers Online Market and Esoko provide call center options for farmers who are less educated and provide interactive mobile and SMS based communication platforms for advanced users.

Affordability

Multi-stakeholder platforms are typically free of cost for farmers. Some enterprises charge nominal rates in terms of SMS communication costs or commission on the sale of farmer's produce to buyers. Ricult offers a 30 percent discount to farmers on input commodities (Ricult n.d.). Services to other stakeholders are also priced competitively in order to attract more customers onto the platform. Stakeholders also have the option to advertise their products and services directly to farmers, which is a more cost-effective alternative for them in comparison to visiting remote locations to undertake marketing activities.

Results and Cost Effectiveness

Multi-stakeholder platforms facilitate inclusion of smallholder farmers in formal value-chains by reducing information asymmetries and enabling knowledge sharing and transaction exchange among different agricultural stakeholders. The use of the model in increasing transparency and traceability in food production and supply-chain processes

enables agribusinesses to source from small-scale farmers and opens doors to global markets for these farmers.

Scale and Reach

Multi-stakeholder platforms move beyond providing piecemeal support to farmers to offering an array of services by bringing together different participants across the value-chain. This, combined with the leverage that the internet offers, enables them to scale up their operations significantly within a few years of operation. The increasing spread of mobile and internet technology in developing countries (estimates show that approximately 70 percent of the bottom fifth of the population in developing countries own a mobile phone; Peru's statistic agency estimates that 85 percent of Peru's households owns at least one mobile phone and 40 percent of the population has access to the Internet) is promoting the uptake of these platforms among small-scale farmers (Schipani 2016). With the increased scrutiny on food safety standards, agribusinesses are keen to adopt tools that allow them to monitor and trace smallholder farmer activity without involving a high-touch on-ground model. Enterprises are able to attract and on-board many customers on their platforms since the platform caters to improving incomes and productivity for a wide variety of stakeholders in the agriculture sector.

Generally, platforms that are free of cost or heavily subsidized to farmers are able to on-board a large number of farmers immediately following the launch of the platform. For example, within just one year, WeFarm on-boarded 69,000 small-scale farmers and 10.1 million interactions have taken place between farmers and other stakeholders listed on the platform (Odera 2016). ITC operates 6,500 internet kiosks across 40,000 Indian villages reaching about 4 million farmers (World Bank 2011). Since the beginning of its operations, Esoko is present in 10 countries in Africa, and serves over 400,000 smallholder farmers and 35 agribusinesses, government agencies and NGOs registered on its platform. Over 9.5 million messages have been sent between stakeholders on the platform, and 1 million prices have been requested (self-reported). Within the first 2 years of its operation, DrumNet had facilitated over 7,000 marketing transactions on behalf of its 647 registered farmers and generated over USD16,700 in gross revenue (Giné 2005). MFarms had over 5,000 farmers and 4 large scale agribusinesses registered on its platform within the first 2 years of operation (USAID 2012). Agrinet has over 300,000 small-scale farmers and 10 buyers registered on its platform (self-reported).

Scale and reach of smallholder farm management tools are dependent on agribusiness clients' network of farmers. Since these platforms typically cater to contract farming companies who export smallholder farmer produce these enterprises are able to reach clients across multiple geographies. For instance, Farmforce works across 25 countries and has reached 150,000 farmers through its smallholder farmer management tool.

Improving Outcomes

Multi-stakeholder ICT platforms support small-scale farmers by providing them a multitude of advisory services and market access linkages: knowledge on quality inputs, linkages to input suppliers to purchase inputs, improved access to credit, linkages to exporters and processors, linkages to certification providers, information on government policies and certification standards, and transparency in supply-chain processes. Electronic receipts and record management lower the chances of discrepancies and errors in transactions between

Table 26. Examples of companies and their reach

Company	*Country of operation*	*Years of operation*	*Number of farmers reached*
Agrinet	Uganda	8	• 300,000 small-scale farmers • 10 buyers
e-Choupal (ITC Limited)	India	16	• 4 million farmers
Esoko	Ghana, Kenya, Malawi, Zimbabwe, Mexico and Pakistan, Benin, Nigeria and South Africa	8	• 400,000 farmers
Farmforce	• *Africa:* Ghana, Ivory Coast, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Zambia • *Asia:* Bangladesh, China, India, Indonesia, Singapore, Thailand, Turkey, Vietnam • *Latin America:* Brazil, Guatemala, Haiti, Honduras, Nicaragua, Peru	4.5	• Over 150,000 farmers
WeFarm	Kenya, Peru	1	• 84,798 users • 142600 questions asked • 207400 answers • 12.9 million pieces of transferred information

smallholder farmers and other stakeholders. These platforms don't stop at only providing one-way communication flows to farmers, instead they connect participants involved across the chain and facilitate backward and forward linkages between them; other stakeholders use the platform to understand farmer needs, interact with farmers in comparison to only pushing information to them and use these insights to design better products and services.

While there is scope for more third party validation and assessment of the impact of multi-stakeholder platforms on farmers, research studies and development organizations have conducted some impact studies on such platforms. Esoko's farmers earned 20–40 percent more incomes after using the platform (World Bank 2011). Esoko farmers were also found to have a 12 percent higher repayment rate in comparison to a control group farmers that had received loans from the same bank, but were not Esoko registered farmers.† In another study of 600 Esoko smallholder farmers in northern Ghana, the French National Institute for National Research (INRA) found that farmers have seen a 10 percent revenue increase since they began receiving and using Esoko SMS market prices (Halewood and Surya 2012).

A study by USAID on farmers in the Kinangop region of Kenya using MFarms for collective selling showed that these farmers were able to receive more than double the price for certain types of produce, such as snow peas and sugar snap peas, than what they were able to receive when selling their produce individually. Feedback from farmers using

† Self-reported by Esoko based on a study conducted by IDinsight and funded by Acumen.

the service has also revealed that access to current market information has given them a transparent bargaining platform to use when selling individually to brokers or agents (USAID 2012). A study conducted in 2009 on DrumNet's platform involving interviews with farmers, input dealers, Equity Bank, rural assemblers, transporters and BIDCO Ltd. revealed that farmers registered on the platform earned 86 percent of the price paid by BIDCO (including the transportation fee of 9 percent of BIDCO's price deducted by BIDCO, and 5 percent DrumNet commission fee charged to farmers) in comparison to non DrumNet farmers who earned only 65 percent of the sale price (Egyir, Al-Hassan, and Abakah 2013). Similarly, in India, research on web-based e-Choupal indicated that there was a transfer of 1 percent to 5 percent margins earned from traders to farmers (Halewood and Surya 2012).

Improved traceability and smallholder farm management helps agribusinesses in facilitating farmers to receive global certifications and tracking compliance with food safety standards, thereby enabling an increase in incomes that farmers can make. For example, between 1991 and 2003, a study in Kenya showed that stricter enforcement of food safety and quality standards resulted in the export value of fresh vegetables increasing from USD 23 million to USD 140 million (Qiang, Kuek, Dymond, and Esselaar 2011). Ricult, a multi-stakeholder platform in Pakistan estimates that by using the platform, farmers are able to earn an additional USD 219 per year (Huppe 2016).

Multi-stakeholder platforms have helped increase the income-generating potential of small-scale farmers. Real-time communication between farmers and other value-chain actors has resulted in farmers gaining relevant information about global markets and in stakeholders being able to integrate these farmers in formal value chains.

Cost Effectiveness

Multi-stakeholder platforms decrease information and market access search costs for farmers. For example, estimates show that farmers in Niger spend USD 0.80 in per-search costs to travel to central markets to gather information, whereas the cost of using mobile technology to obtain this information is USD 0.20 (Goyal and Gonzalez-Velosa 2013). Another study showed that information search costs across the value chain amount to more than 69 percent of total transaction costs for farmers in Sri Lanka (de Silva and Ratnadiwakara 2008). This study suggested that an integrated system using a mobile phone platform that provides information to farmers and other stakeholders from the planting stage to selling stage will significantly reduce information search costs and associated transactioncosts (de Silva and Ratnadiwakara 2008).

Farmers typically trade their produce using supply chains comprising multiple stakeholders such as transport providers, agents, processors, wholesalers, retailers and other intermediaries. The information asymmetries brought about by disaggregated communication amongst all these players results in lower profits for farmers. A platform that integrates participants across the value chain enables transparency in information flow and transaction exchange. Research shows that farmers associated with DrumNet reduced costs in trading their produce through traditional supply-chains; of the total sales value, they saved 9 percent in transporter fees, 23 percent in broker commission fees and 3 percent involved in marketing activities (Egyir, Al-Hassan, and Abakah 2013). Farmers reduce transaction costs by accessing both credit and markets on DrumNet's single platform; they can pay their loans with their farm produce proceeds on the platform as well.

Besides farmers, multi-stakeholder platforms are also cost-effective for other stakeholders. For example, large processors and buyers registered on DrumNet's platform reduce costs involved in managing transaction intensive credit programs (Giné 2005). Government agencies who use such platforms to provide agricultural information directly to farmers benefit from lower costs involved in SMS-based services. In the absence of such platforms, government extension agents would visit remotely located farmers in rural areas Qiang, Kuek, Dymond, and Esselaar 2011). Since these platforms enable two-way information flow, governments can also conduct large scale farmer surveys using mobile and internet technology versus field surveys. Agribusinesses are also able to reduce costs involved in aggregating and monitoring smallholder farmers; instead of sending their agents to visit farmers on a frequent basis, these businesses can now leverage farm management tools to manage outgrower schemes on a real-time basis.

Scaling Up

Challenges

Given that costs involved in development and maintenance of multi-stakeholder ICT platforms are high, enterprises face difficulties in accessing credit to fund these operations. Banks and other financial institutions are risk averse to funding internet and mobile based platforms. However, since the primary target group of customers is smallholder farmers, enterprises are forced to keep prices low. These enterprises cross-subsidize low prices charged to farmers by charging other stakeholders a fee to be on their platform and largely rely on this source of revenue to fund their operations.

Data in most developing countries continues to be expensive and unaffordable for smallholder farmers. As a result, although access to these platforms is free or affordable for farmers, they find it expensive to communicate using SMS or voice services. For example, in South Asia, the total cost for an enterprise to deliver a single agricultural text is estimated to be around USD 0.02. While this seems affordable, research shows that most farmers are highly cost sensitive and reluctant to bear these costs (Qiang, Kuek, Dymond, and Esselaar 2011).

Taking into consideration that reliable information to all stakeholders is the backbone of such platforms, enterprises face difficulties in sourcing consistently dependable and timely data at low costs. Most government related data on weather is not accurate. Enterprises therefore partner with private agencies that use sophisticated satellite imagery to source such information.

Role of Government and Policy

Government processes and regulations related to affordability of mobile communication, and availability of reliable data play a pivotal role in the manner in which enterprises structure their multi-stakeholder ICT platforms.

Governments in some countries, have structured policies that promote healthy competition amongst mobile network providers, and boosted availability of reliable data sources to feed into the ICT platforms. For instance, in Kenya, the open and enabling ICT

regulatory environment has helped to increase competition among mobile network operators and reduce mobile phone tariffs (Qiang, Kuek, Dymond, and Esselaar 2011). Enterprises can leverage low mobile communication costs to attract more farmers to the platform. In Turkey, emanating from a need to strengthen weather data and expand data collection beyond urban areas, a publicly funded project set up 5 small meteorological stations and 14 small reference farms. The establishment of these rural data collection points helped in providing accurate microclimate forecasts to dispersed small-scale farmers (Halewood and Surya 2012). Enterprises can source information from the government, thereby decreasing costs on information acquisition from third party private organizations.

Governments can leverage these platforms to disseminate data on weather, pest management and other farming best practices to a wider network of farmers.

Enhancing telecom infrastructure in rural regions helps multi-stakeholder ICT platforms flourish. Governments can work with mobile network operators to expand their services to remote areas. They can also influence network providers to lower SMS and communication costs. A research study to understand the impact of mobile-phone technology platforms on smallholder farmers in India showed that most farmers could not afford the services. At package prices of approximately USD 1.50 per month, only half of the sampled farmers planned to renew their package despite stating that the services had helped them negotiate better prices, gained better access to quality inputs and increased incomes (Qiang, Kuek, Dymond, and Esselaar 2011). These farmers went back to relying on newspapers, radio or public information boards as sources of information. MNOs earn high margins on SMS messages; however, regulators can frame policies such that SMS rates for transmission of public-good information can be reduced (Qiang, Kuek, Dymond, and Esselaar 2011). This will increase affordability for farmers and encourage them to use these platforms.

Research also indicates the need for governments to strengthen education services in the ICT sector. It is critical for enterprises to hire good talent to develop and maintain multi-stakeholder platforms. However, the lack of talent proves to be a challenge for these enterprises. For example, in Kenya, only 5,000 of the 30,000 university graduates in 2008 were deemed suitable for employment in the ICT industry (Qiang, Kuek, Dymond, and Esselaar 2011).

Conclusion

Multi-stakeholder platforms have the potential to reach a vast number of participants across the agricultural value-chain. The possibility of two-way communication and transaction flow between smallholder farmers and other ecosystem players is an attractive solution to all stakeholders in the chain. However, initial platform development costs, platform customizations to cater to varied segments of players in the chain, and creation of relevant content make this model significantly investment heavy.

Since platform use is typically provided free of cost to farmers, enterprises must structure their parallel sources of revenue charged to other stakeholders in a manner in which communication and data collection costs are covered, at a minimum. In order to secure a robust revenue stream for platforms, it is also important for enterprises to identify the optimal blend of information services along with transaction exchange services that ultimately

result in an economic benefit to all stakeholders. Region-specific policies on ICT and costs involved in service delivery have a direct impact on the uptake of the platform by stakeholders, and thereby the financial sustainability of the model. Partnerships with information sources, governments and mobile network operators influence the model's success.

Table 27. Social enterprises: Multi-stakeholder platforms

Company	*Country*	*Solution description*
Agrinet	Uganda	Agrinet offers market linkages for agribusiness value chain actors including smallholder farmers, traders, large-scale processors and exporters. It provides agricultural market intelligence, transaction security service, product marketing, agro-processing and value addition services. It sources commodities on behalf of its buyers, organizes auctions on behalf of sellers and manages forward contracts for a range of commodities.
Cowsoko	Kenya	Cowsoko facilitates backward and forward information and transaction exchanges between multiple stakeholders. The platform connects farmers with other farmers, buyers, input suppliers and transporters for delivery of produce and input commodities. The platform also hosts agricultural extension providers and trainers for a subscription fee.
DrumNet	Ghana	DrumNet links smallholder farmers, finance providers, large-scale buyers, transporters, and field agents through an integrated marketing and payment system. Farmers can access inputs at local input providers through an established line of credit from DrumNet. During the pre-harvest phase, DrumNet negotiates contractual arrangements between buyers and farmers, and at harvest time coordinates produce aggregation, grading, and transportation through agreements with local field agents and transporters.
e-Choupal	India	e-Choupal is an initiative of ITC Limited's Agri Business Division. Internet enabled e-Choupal telecentre kiosks are established in rural areas and are operated by trained farmers. Farmers can avail information on pre-harvest related topics, can gather market and price information, and linkages to buyers.
Esoko	Ghana, Kenya, Malawi, Zimbabwe, Mexico and Pakistan, Benin, Nigeria and South Africa	Esoko is a mobile based technology platform that enables input suppliers, agro-processors, export companies, farmer co-operatives, finance providers, governments, mobile operators and NGOs to provide critical information to farmers. Agribusinesses can advertise their products and services to farmers. Agro-processors and exporters can manage supply-chain processes. Stakeholders can also request data collection and farmer surveys through the platform.

Table 27. Social enterprises: Multi-stakeholder platforms (continued)

Company	*Country*	*Solution description*
Farmers Online Market	Nigeria	Farmers Online Market is a web and mobile-based platform that connects farmers, buyers, input suppliers, agents, transporters, cooperatives, governments, financial institutions and consultancy service providers. Stakeholders can exchange information with farmers about their products and services such as seeds, fertilizers, farm machinery, input loans, trainings and workshops to farmers. Farmers also receive updates on government policies, programs and subsidies on the platform.
Farmforce	• Africa: 11 countries • Asia: 8 countries • Latin America: 6 countries	Farmforce is a web and mobile-based smallholder farm management and traceability tool. Initially developed by Syngenta Foundation for Sustainable Agriculture, an NGO, Farmforce is currently in the process of transitioning to become a for-profit entity. Clients include agribusinesses that manage out-grower schemes and work with smallholder farmers on a contract basis. Clients can extend their Farmforce licenses to third parties including finance providers, certification assessors and agricultural experts.
MFarms	Ghana, Benin, Burkina Faso, Cote D'Ivoire	MFarms is a web and mobile based communication and management platform connecting farmers to agribusinesses. They communicate with each other and undertake transaction of goods and services. The platform also enables governments to track the distribution of subsidized fertilizers and seeds and adherence of importers to allocated budgets. Agro-dealers are able to track their stock.
Ricult	Pakistan	Ricult is an online marketplace that connects farmers to farm input sellers, farm produce buyers, banks, insurance companies, veterinary services, and farm advisory services. The platform enables information and transaction exchange between farmers and other stakeholders.
WeFarm	Kenya, Peru	WeFarm's mobile based platform enables peer-to-peer (P2P) knowledge sharing between smallholder farmers in rural communities. Farmers can post their questions via SMS short codes and receive answers from other registered users Through its WeFarm Insights and WeFarm Reach modules, stakeholders can interact with farmers and request data on small-scale farmers for a fee.

References

Business Call to Action (BCtA) and United Nations Development Programme (UNDP). 2015. "How can ICT innovations be leveraged to address value chain challenges? Insights from the Kenya Workshop Report." https://www.businesscalltoaction.org/sites/default/files/resources/Technological-Innovation-for-Inclusive-Agribusiness_Workshop-Report.pdf

David-West, Olayinka. 2010. "Esoko Networks: facilitating agriculture through technology." Growing Inclusive Markets, United Nations Development Programme. http://growinginclusivemarkets.com/media/cases/Ghana_Esoko_2010.pdf

Feed the Future/United States Agency for International Development (USAID). 2016. "From Plant to Plate: Kenya's National Horticulture Traceability System." https://www.feedthefuture.gov/article/plant-plate-kenya%E2%80%99s-national-horticulture-traceability-system

de Silva, Harsha and Dimuthu Ratnadiwakara. 2008. "Using ICT to reduce transaction costs in agriculture through better communication: A case-study from Sri Lanka." LIRNEasia. http://www.lirneasia.net/wp-content/uploads/2008/11/transactioncosts.pdf

Egyir, Irene S., Ramatu M. Al-Hassan, and James K. Abakah. 2013. The Effect of ICT-Based Market Information Services on the Performance of Agricultural Markets: Experience from Ghana." *International Journal of ICT Research and Development in Africa* 2(2): 1–13. July–December. http://www.irma-international.org/viewtitle/60387/

Farmers Online Market. n.d. http://farmersonlinemarket.com.ng/ Giné, Xavier. 2005. "The DrumNet Case Study." The World Bank: Washington, D.C. http://siteresources.worldbank.org/DEC/Resources/DrumnetCaseStudy.pdf

Goyal, Aparajita and Carolina Gonzalez-Velosa. 2013. "Improving Agricultural Productivity and Market Efficiency in Latin America and the Caribbean: How ICTs can make a Difference?" LCSSD Occasional Paper Series on Food Prices. The World Bank: Washington, D.C. http://documents.worldbank.org/curated/en/137441468045043608/pdf/682550WP0P1247018B0Final0ICT0report.pdf

Halewood, Naomi J. and Priya Surya. 2012. "Chapter 2: Mobilizing the Agricultural Value Chain." *Information and Communications for Development 2012*. The World Bank:Washington, D.C. http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/IC4D-2012-Chapter-2.pdf

Hildebrandt, Nicole, Yaw Nyarko, Giorgia Romagnoli, and Emilia Soldani. 2015. "Price information, inter-village networks and "bargaining spillovers": Experimental evidence from Ghana." New York University, NYU Abu Dhabi and Center for Technology and Economic Development (CTED).

Huppe, Phil. 2016. "Ricult: Explain Your Idea." https://challenges.openideo.com/challenge/agricultural-innovation/improve/ricult

Kopicki, Ron, and Calvin Miller. 2008. "DrumNet: An Enterprising Third Party Transaction Manager." FAO Policy Learning Program. http://www.fao.org/docs/up/easypol/519/3-4_drumnet_148EN.pdf

Mukerji, Maitrayee. 2013. *ICTs and Development: A Study of Telecentres in Rural India*. Palgrave Macmillan.

Odera, Dennis. 2016. "Information…the cornerstone of Agribusiness." http://wefarm.org/information-the-cornerstone-of-agribusiness/

Qiang, Christine Zhenwei, Siou Chew Kuek, Andrew Dymond, and Steve Esselaar. 2011. "Mobile Applications for Agriculture and Rural Development." ICT Sector Unit World Bank. Washington, D.C. http://siteresources.worldbank.org/INFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/MobileApplications_for_ARD.pdf

Ricult. n.d. http://www.ricult.com/

Roast Magazine. 2016. "UK's WeFarm Proposes Peer-to-Peer Benefit to Coffee Farmers." May. http://dailycoffeenews.com/2016/05/06/uks-wefarm-proposes-peer-to-peer-benefit-to-coffee-farmers/

Schipani, Andres. 2016. "Smallholders turn to message service to share farming advice." *The Financial Times*. February 3. https://www.ft.com/content/993d0576-9e6e-11e5-8ce1-f6219b685d74

United States Agency for International Development (USAID). 2012. "ICT and AG Profile: MFARM." https://agrilinks.org/sites/default/files/resource/files/MFarm_profile_0.pdf

World Bank. n.d. "How do ICT solutions make smallholder business models more cost-effective?" Grow Africa Smallholder Working Group Briefing Paper: Information and Communication Technology. https://www.growafrica.com/sites/default/files/ICT_0.pdf

World Bank. 2011. *ICT in Agriculture: Connecting Smallholders to Knowledge, Networks and Institutions*. The World Bank: Washington, D.C. http://documents.worldbank.org/curated/en/455701468340165132/pdf/646050ESW0P1180lture0e0Sourcebook12.pdf

CASE STUDY

Esoko

Founding year: 2008
HQ: Accra, Ghana
Countries of operation: Ghana, Kenya, Malawi, Zimbabwe, Mexico, Pakistan, Benin, Nigeria, and South Africa

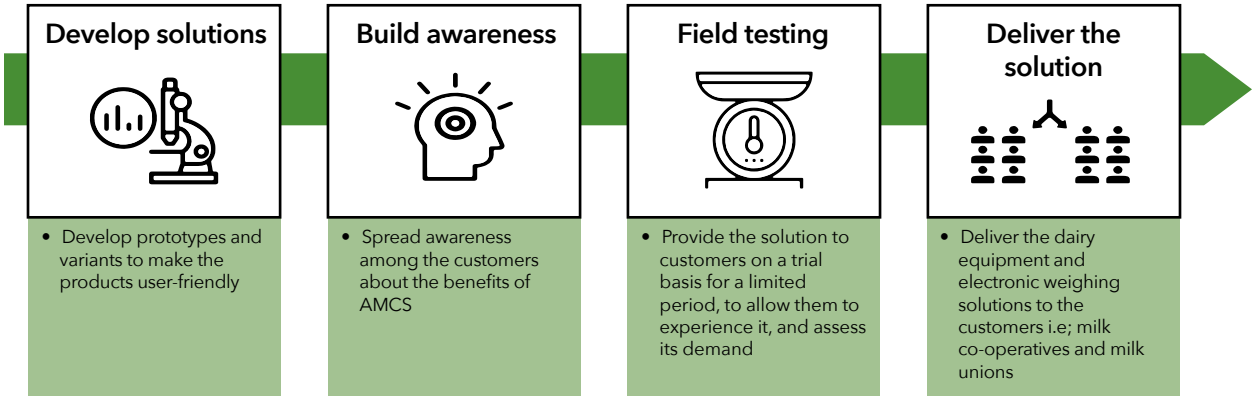
Orientation: For-profit
Employees: 60
Turnover: USD 4 million

Smallholder farmers in Africa lack reliable information on productivity-enhancing practices, timely price and demand information and linkages to formal markets. On the other hand, input dealers, agricultural businesses, finance providers, and policy makers lack reliable data on and connectivity with small-scale farmers, thereby restricting these stakeholders from marketing appropriate inputs, delivering tailored extension services and reaching remotely located farmers to procure their produce and sell in global markets.

Esoko is a market information platform that leverages mobile and web technology to bring together different stakeholders in the agriculture value chain. The services provided on the platform include SMS alerts, extension information messages, farmer survey and SMS polls, marketplace matching, and data collection. The platform provides two-way communication and information flow between farmers and other value-chain actors. This has led to increased farmers' knowledge and access to quality pre-harvest inputs, expanded access to credit, and extended access to formal markets. Esoko operates in 10 countries across Africa and has reached 400,000 farmers till date.

Operating Model

Initially established as a mobile and web-based repository for price information in Ghana, Esoko has transformed over the years to a platform that connects stakeholders across the agricultural value chain. The platform provides information on pre-harvest practices and real-time market prices. In addition, the platform serves as a marketplace for farmers and



buyers to make offers, and for input suppliers to advertise input commodities. The platform also provides data collection, product traceability and logistics tracking services.

The platform enables real-time exchange of information between stakeholders across the value-chain. Esoko's technology platform differs from traditional ICT systems, which are designed to solely push information to farmers, in that it is a platform that enables two-way information flow between farmers and other agricultural stakeholders. This decreases information asymmetries along the chain.

Esoko's customers include farmers, farmer groups, input suppliers, financiers, mobile operators, agro-processors, exporters, farmer co-operatives, government agencies, and non-governmental organizations. Farmers receive real-time SMS feeds on price and demand information, location of seed and fertilizer outlets, weather forecasts, disease prevention tips on their mobile phones. They are also matched to buyers, including traders and processors. Agribusinesses can use the platform to monitor farm activity, market their products to farmers and receive feedback from farmers. Stakeholders can also receive information on crop cycles, and farmer yields. Co-operatives, NGOs and government bodies can use the service to broadcast critical information to farmers using Esoko's bulk text messaging service. Esoko provides data collection services to clients as well. For example, it conducted a poverty assessment study for the Government of Ghana to analyze the impact of social benefits on farmers. For the purpose of such studies, enumerators employed by Esoko visit farms and capture farmer related data on Android apps. The enterprise also caters to mobile operators, for instance, in partnership with Vodafone Farmer Club in Ghana, Esoko provided information to farmers. As part of the club, member farmers can make free calls to other farmers in the network, and are allowed to access Esoko's content at no cost. Financial institutions can leverage farmer profile data to appropriately assess default risk and accordingly provide credit to farmers.

Financial Sustainability

The enterprise invests significant costs in development and maintenance of the platform. The initial upfront investment to set up the platform included USD 600,000 of personal capital and USD 200,000 in donor funds (World Bank 2011). The primary cost components constituted new hardware, staff to operate the hardware and work in the commodity markets to collect price information. Esoko continuously strengthens its multi-stakeholder

platform; it spent USD 700,000 in 2015 on upgrading and maintenance. In pursuit of expanding services delivered on its platform, Esoko is set to launch an input wallet solution in that will allow purchase of input commodities directly on its platform by linking farmers to input suppliers, along with financial institutions playing a role in input finance.

To support its operations, Esoko employs a differentiated revenue model: subscriptions and revenue share. Subscriptions are paid primarily by enterprise customers to use the platform. Revenue share is with the mobile operators; typically mobile operators retain 70–80 percent of the value of the communication (SMS costs or call center charges) and Esoko is paid 20–30 percent of the value of the communication. With the introduction of the input wallet solution, input sales will be based on a commission model. Farmers and farmer groups are charged based on a tiered subscription model.

Table 28 provides an indicative farmer pricing model.*

In addition to these revenue streams, Esoko also pursues public-private partnerships to improve sustainability. Government stakeholders are important in designing interventions appropriate to smallholder farmers (World Bank 2011).

Table 28. Indicative farmer pricing model

Tier	*Services*	*Target customer*	*Annual cost (USD)*
Bronze	Mobile alerts of market prices and offers. Average of 10 SMSs per week	Individual farmer	36
Silver	SMS Push and market sites	Farmer groups with up to 200 members	250
Gold	SMS Push, market sites, scout polling	Farmer groups with 200–2,000 members	1,500
Platinum	SMS Push, market sites, scout polling	Unlimited farmers	8,000

Impact

The consolidated impact on all stakeholders on Esoko's platform is yet to be assessed. However, the service is believed to have increased efficiencies across the value-chain. For instance, an export company registered on Esoko's platform undertook the procurement process in 31 days with 3 employees as opposed to 60 days and 5 employees prior to using Esoko (World Bank 2011). Farmers' self-reported evidence showed an increase of 20 percent-40 percent in revenue (World Bank 2011). A banking study conducted by IDinsight and financed by Acumen indicated that Esoko farmers who were provided loans from an agricultural bank in Kenya had a 12 percent higher repayment rate than farmers who were provided loans from the same bank but not registered on Esoko (self-reported). According to Esoko, the reason for the higher repayment rate could likely be attributed to the customer loyalty engendered by the services provided on the Esoko platform; cus-

* Developed in David-West 2010.

tomers valued the content and were inclined to stay in good standing with the bank, as opposed to only receiving repayment reminders which were more distressing in nature to the farmers (self-reported).

Challenges and Lessons

Esoko's primary challenges are linked to access to finance and working capital. Given the high costs involved with technology development, architecture and maintenance, cash flow is a significant challenge. Another challenge is finding talent at affordable prices—a large part of its business model relies on accessing data and verifying the authenticity prior to disseminating it to stakeholders across the value-chain. Keeping abreast on government regulations is also a key consideration for Esoko; for example, any changes in telecom regulations may affect Esoko's service delivery. The enterprise was recently under pressure by the meteorological department in one of the countries of Esoko's operation to mandatorily get the enterprise's weather feed approved by the meteorological society prior to disseminating it to farmers.

CASE STUDY

Farmforce

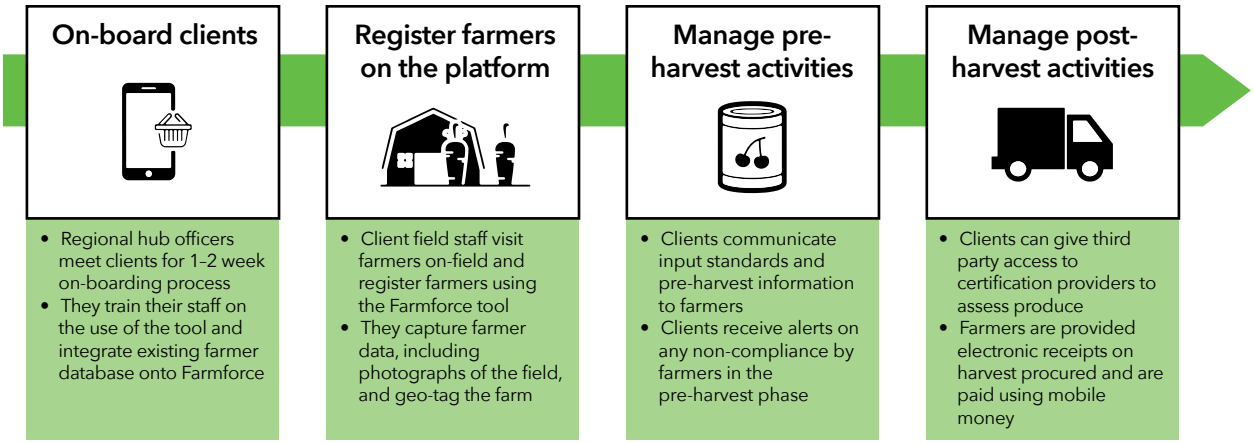
Founding year: 2012
HQ: Guatemala, Kenya, Thailand
Countries of operation: 25 countries across Latin America, Africa, and Asia
Orientation: Currently in the process of converting to for-profit
Employees: 12
Turnover: not disclosed

Smallholder farmers in developing countries face a multitude of challenges right from planting all the way up to selling end produce. Small land holdings, limited knowledge on quality agricultural inputs, and lack of access to finance result in low yields and limited bargaining power. Added to these challenges, information asymmetries linked to price information, government policies, global certification standards, and knowledge on profitable markets make it even more difficult for farmers to move away from subsistence farming and realize higher prices for their produce. Aggregators and export companies, who could potentially provide increased incomes to farmers by helping them surpass middlemen, are reluctant to work with these farmers owing to lack of traceability and quality assurance data across the value-chain.

Farmforce is a cloud-based traceability software application that enables agribusinesses working with smallholder farmers on a contract basis to efficiently manage backward and forward linkages across the agriculture value chain. Stakeholders on the platform include farmers, exporters, processors, certification providers and financiers. The enterprise has reached over 150,000 farmers till date.

Operating Model

Farmforce is a web and mobile based platform solution for agricultural businesses, aggregators, exporters and agricultural processors to manage relationships with smallholder farmers. Farmforce is active in 25 developing countries across Latin America, Africa and



Asia for a variety of crops, such as horticulture, cereals, coffee, cocoa and works with more than 150,000 smallholder farmers.

International markets require compliance with food safety standards and transparency in quality of inputs used in production. Small-scale famers lack the resources or the information to adhere to these strict norms and thereby lose out on the opportunity to sell to global markets. On the other hand, agribusinesses that work with large numbers of smallholder farmers rely on paper records and frequent on-field farmer interaction to manage contract farming operations, making it an expensive and time-intensive process.

The Farmforce platform enables digitizing contract farming and out-grower schemes, thereby increasing efficiencies in smallholder farmer management and expanding opportunities for these farmers to be part of global formal markets. Once the tool is sold to clients, Farmforce representatives from the respective regional hub meet with client staff either in person or over online media. Clients undertake a one-week onboarding training where Farmforce agents assess client requirements, train the client users on the tool's communication and data management features, and integrate the client's existing farmer database on to the Farmforce platform. The enterprise also operates an online support centre to address any client issues via screen sharing and video calls.

Clients use Farmforce to gather data on farmers, and their locations using geo-referencing and Google Maps. In addition, they can record information on type of crops grown, soil fertility, quality of fertilizers and other inputs used. During the pre-harvest phase, farmers can communicate with field agents on the farming protocols. Field agents can verify the inputs used by farmers in line with certification standards, inspect the crops and forecast yields. Farmforce's photo capture and GPS features also enable companies to ensure that their extension officers and field agents are monitoring the farmers on a regular basis (BCtA and UNDP 2015). The tool's finance monitoring feature allows companies to interact with finance providers and manage input loans and cash advances made to farmers. The platform stores information on the farmer's loan history and send SMS reminders to farmers for outstanding loans. In addition, certification bodies on the platform assess the quality of inputs used and compliance to food safety standards prior to awarding certifications such as the Good Agricultural Practices (GAP). The tool's strong association with certification providers

also enables real-time communication to farmers on changes in certification standards or regulatory policy that may impact the production process.

Farmforce offers a transparent harvest procurement mechanism wherein the tool is linked to digital weighing scales and a Bluetooth printer at collection centres. The produce is weighed using these scales and an electronic receipt is printed and given to farmers for their records. The receipts include information on the quantities delivered by farmers, traceability data and produce prices. The tool allows automatic deduction of outstanding input loans from harvest sales. Companies use mobile money platforms or electronic bank transfers to pay individual farmers.

Financial Sustainability

The software-as-a-service was developed by Syngenta Foundation for Sustainable Agriculture, a non-profit organization and was co-funded by the State Secretariat for Economic Affairs of Switzerland (World Bank n.d.). Initially established as a project, Farmforce is currently in the process of being converted to a for-profit enterprise.

Farmforce earns its revenues by sale of licenses to a variety of agricultural stakeholders including exporters, processors, and co-operatives to use its web and mobile platform. Clients can further extend the license to other third party stakeholders such as agronomists, trainers, input providers, certification bodies and financial institutions for a fee paid to Farmforce. Smallholder farmers are not required to pay for the tool. Revenue streams include subscription fees, set up fees and fees for customizations required by the client. Prices may vary based on the features, functionalities and suite of languages desired by the client and the number of devices required by the client. Packages could differ by the modules requested by the client, such as basic farming module, SMS communication, compliance functionalities and other sophisticated tracking features.

The enterprise incurs significant costs in developing and maintaining its software platform. Initial upfront costs involved in designing the technology and user interface represented almost 100 percent of the total costs. Over the 4 years of operation, this cost has been brought down to less than 50 percent of the total costs. Maintenance and continuous development of the platform, salaries paid to local support staff and marketing and business development activities in customer acquisition represent other major operational costs incurred by Farmforce.

The tool is built taking into consideration a large variety of crops thereby creating a generic tool that can be customized for individual client at an additional fee; this helps decrease costs for development of the tool. The tool is also designed for use in different languages - English, Spanish, Portuguese, French, Vietnamese, Chinese, Thai, Turkish, Hindi, Bahasa Indonesia, which helps in increasing sales to companies managing smallholder farmers across different geographies. In order to strengthen financial sustainability, Farmforce is seeking long-term franchisee partners for resale of its tool. It currently partners with a leading supplier of software for the Agricultural Industry in Southern Africa which undertakes marketing and sales of Farmforce tools and pays Farmforce a commission.

Impact

Farmforce's tool has a dual impact on smallholder and marginal farmers: one, by helping agribusinesses in streamlining their smallholder farmer management processes, it indirectly

helps farmers in growing quality produce and reaching formal markets and two, in improving technical support and transparency in harvest procurement. The system enables effective monitoring of adherence to food-safety and sustainability standards, which eventually translate to higher produce prices for the farmers.

The increased use of data allows exporters to estimate yields and advise farmers on production planning and appropriate inputs, and on the other hand enables financiers to provide input loans in accordance to quality assessment of risk. The use of ICT in monitoring field activities allows extension workers to provide more targeted advice to farmers at the right time. The ability to link multiple stakeholders on one platform increases communication flow and traceability at every point of the value-chain. This results in minimizing any leakages between planting and sale of the produce.

Challenges and Lessons

Given the geographies that Farmforce operates in, most clients and target customers have limited experience with using technology in farmer management. Many of these companies are risk-averse to digitizing records and prefer to interact with farmers using a high touch engagement model. Therefore, Farmforce invests significant time in demonstrating the value of the tool in tracking farmer compliance to food-safety certifications and the potential for cost savings in monitoring remotely located dispersed farmers using mobile technology vis-à-vis on-ground management.