ICT USES FOR INCLUSIVE AGRICULTURAL VALUE CHAINS

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2013

RECOMMENDED CITATION
FAO. 2013. *ICT uses for inclusive agricultural value chains*. Rome

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Executive summary

This study documents the various kinds of information and communications technology (ICT) initiative being implemented globally to improve agricultural value chains and agribusinesses. Many of the solutions presented entail improving access to reliable and timely information. Inequity in access to information allows those with information to take advantage of those without it (often farmers), even though much of the information is technically within the public domain. Because of the ever-lower costs and growing ubiquity of ICT, such as mobile phones and the networks needed to connect them, new avenues have been opened, offering critical information to farmers, fishers, small traders and business people. This document provides examples of three types of ICT solution, categorized in terms of the end result for the consumer: ICT for production systems management, ICT for market access services, and ICT for financial inclusion.

ICT FOR PRODUCTION SYSTEMS MANAGEMENT (CHAPTER 2)

Information services provide data that are tied to helping farmers improve their productivity, yields and profitability during the course of their normal business of growing agricultural produce. Information services are one of the most common ICT-related categories for inclusive agricultural value chains. They are broken down into sub-categories of information services that involve short-term and long-term productivity enhancements; those that minimize the negative effects of crisis events, for example, by informing on how to protect crops from freezing weather in the short term; and those that improve field-based risk management, for example, by guiding the implementation of crop rotation to preserve the soil in the long term.

Short-term productivity: Typically, information such as weather updates is readily available at low or no cost (often subsidized by the local government). However, farmers do not have access to these data, or at least not timely access. Short-term productivity and crisis management information services attempt to fill this void, and are typically the easiest and most commonly offered by service providers. Short-term productivity and crisis management services are often offered conjointly, with significant overlap. In the context of this paper, short-term productivity information services entail providing information mainly to end beneficiaries, such as farmers, to help them improve their crop yields in the near to medium term, and they are the most common types of information services available. These productivity services provide information that is generally quick and easy to access and use (information "nuggets"), such as current or forecasted weather information. An example of short-term productivity services is the e-Dairy project in Sri Lanka in which milk yields were improved by informing dairy farmers about the most opportune times for artificial insemination.

Crisis management: Crisis management information services essentially help prevent losses (rather than raising productivity). Often these services serve as an alert system enabling farmers to react quickly before an oncoming event (often weather- or disease-based). For example, the Radio and Internet for the Communication of Hydro-Meteorological Information (RANET) project in Kenya uses FrontlineSMS technology to collect weather data from local farmers and push out warnings to them of potential weather-related risks.

However, two common issues arise from these short-term productivity and crisis management services. The first is that much of the information is simply pushed out to the consumer with little customization or interaction. To improve the success of the short-term type of services, providers could focus on customizing the information more specifically to the end customer's needs, or on allowing the customer to choose which information she/he wants.

The second issue is that while farmers appreciate these services, they often either do not have to pay because the service delivery is subsidized, making the service unviable, or are unwilling to pay because they are used to acquiring information for free, albeit from flawed and slower sources. One option is to

make the offering more valuable, for example by bundling different sources together or offering different levels of service. There could be a free (or "pay-as-you-go") offering of very basic and general information versus a more robust package providing more localized information customized to the customer in terms of information type.

Long-term productivity: Long-term productivity enhancements and risk management ICT services can have a more significant impact on customers' livelihoods, through higher income or lower risk of loss. As with shorter-term services, long-term productivity and risk management services are often offered together and overlap. Long-term productivity information services cover topics that take longer to learn and are often offered with other technologies and channels, such as face-to-face training or extension agent support. Benefits from such services are generally realized at a much later date. Many such services are delivered in conjunction with in-person and continuing training, extension services, demonstrations and field visits. These services are typically education-focused, often with a distance learning aspect, and serve as a way to monitor the progress of beneficiaries.

Risk management: Risk management information services are also long-term in scope, but as with crisis management, they help farmers avoid losses rather than increasing productivity. These types of service differ from crisis management services in that they take a longer time to absorb and implement, and the benefits are realized much later than are those of crisis management. For example, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India created its Virtual Academy to train local women through Internet-based video conferences so they could act as extension agents and help women farmers change their cultivation and harvesting techniques to reduce long-term risks. In one case, the Virtual Academy taught women farmers how to experiment with drought-resistant crops.

For long-term productivity and risk management information services, ICT does not replace extension agents or even offer a new service. Instead it allows the extension agents to offer better services more efficiently. For example, extension agents may be very knowledgeable in their field, but may be trained on the latest techniques only once a year. In the meantime, ICT solutions can provide extension agents with access to virtual libraries and the Internet for researching new ideas and techniques. ICT can also help extension agents be more productive by enabling them to serve more beneficiary farmers at once. This can be done with fewer visits to the field and more interaction with beneficiaries through the ICT platform, such as via distance learning or day-to-day monitoring and advice using personal mobile phones. For example, as far back as 1999, researchers found that livestock mortality in Bangladeshi villages decreased after extension officers provided timely advice through mobile phones (Bayes, von Braun and Akhter, 1999).

While many solutions focus more on short-term information services, there is significant opportunity for improving the longer-term types of information service through ICT. However, this would require higher levels of investment and higher continuing support from often cash-strapped governments and academic institutions. It may be necessary to involve private firms from within the value chain to help raise the investment needed.

ICT FOR MARKET ACCESS (CHAPTER 3)

Market access ICT services comprise any service that provides beneficiaries, especially farmers, with access to information on pricing of agricultural products (inputs and outputs) and on finding and connecting to suppliers, buyers or logistics providers, such as storage facilities and transport companies. Such services include simple pricing services, virtual trading floors (matching services or full commodity exchanges) and holistic trading services. Market access services also cover ICT solutions that help the typically larger upstream and downstream firms, such as processors or exporters, to manage their operations and the quality of their produce better – here called downstream administration.

Pricing: The most common ICT intervention for the agricultural value chain is a *pricing service* in which commodity price information is pushed out to customers on a regular basis. These data are often national or regional in scope, and so may not be entirely relevant for the farmer in the field, depending on his/her proximity to markets. Users (mainly farmers) generally have little interaction with providers, and must digest the information to find and negotiate with buyers. This type of service simply replaces

(or enhances) services that are often provided through print, radio or television. The most common advantages to such services are price transparency and improved negotiating leverage for the often disempowered seller (farmer). For example, the Northwest Agricultural Marketing Association (NAMA) in Cambodia provides farmers with timely pricing data on agricultural produce such as maize, soybeans and cassava and on agricultural inputs such as seed and fertilizer. However, there are some potential shortcomings with pricing services. As with short-term productivity services, customers may not value this service enough to pay for the required return (as the information is generally provided "free" even if late). The provision of pricing services is also a relatively easy market to enter, so these services are often bundled with other services.

Virtual trading floors: Virtual trading floors (VTFs) are electronic market places where buyers and sellers connect through an electronic network (as opposed to pricing services, which mostly only provide static information). The important difference between VTFs and more traditional trading floors is that the buyers and sellers on a VTF do not have to be physically in the same location to make an exchange. There are two basic kinds of VTF: matching services, and commodity exchanges. On matching-service VTFs, sellers and buyers connect directly with one another to conduct the exchange of goods available at that moment (the "spot market" covering today's prices). Sellers register their products and delivery schedules, and buyers register their needs. These records are matched by a machine (or human operators referring to databases), which when requested gives either party a range of options to choose from.

The second type of VTF is a more conventional commodity exchange in which the suppliers and buyers do not necessarily know one another. The exchange acts as the intermediary that matches the buyer to sellers with the right price and quantity without either side of the transaction knowing who the other is. One advantage of commodity exchanges is that not only is there a spot market of current prices but the exchange also generally has enough information to estimate future prices.

Holistic trading services: Holistic trading services essentially provide the same services as pricing information services and VTFs, with additional assistance beyond the simple transactions of purchasing and buying agricultural products. Such assistance can include weather information, technical information on agricultural practices, and long-term education. These holistic service packages can not only link suppliers and buyers but can also connect parties for logistics, transportation, processing and storage needs. Often, holistic trading providers also offer access to financial services (payments, credit, etc.). For example, e-Choupal in India reduces transaction costs by connecting buyers – primarily e-Choupal's parent ITC Ltd – with farmers, using Internet kiosks to procure agricultural and aquaculture products such as soybeans, wheat, coffee and prawns. Through its ICT-kiosk platform, e-Choupal also offers farmers many other value chain development services, such as sharing of best practices to improve productivity, and price benchmarking to increase sales prices.

In theory, holistic trading services are compelling endeavours, as the provider can offer many different services through the same ICT infrastructure and customer interface channel (such as kiosks). Customers can also benefit by only having to visit one place. However, it is already difficult for ICT services to succeed beyond the piloting of one service. Attempts to offer many products and services at once could confuse both staff and clients.

ICT FOR FINANCIAL INCLUSION (CHAPTER 4)

The primary types of financial services offered through ICT solutions for value chains are transfers and payments, credit, savings, insurance and financial derivatives. ICT can help improve rural communities' access primarily by convincing financial institutions to enter potential rural markets through unconventional methods. These methods typically involve a reduced need for high-cost branches, improved productivity of the staff in place, and a cost model that generally emphasizes variable costs by paying agents on the basis of transaction volumes instead of salaries. Informal financial services, such as savings groups, often meet two critical needs of the rural poor: convenience (e.g., door-step service), and flexibility (e.g., ability to save and withdraw small amounts). However, these informal services typically lack another key criterion – security. Security is where formal financial institutions generally excel. So ICT enhancements for financial inclusion services can either entail making informal providers more secure or making formal players more convenient and flexible.

Transfers and payments: In recent years, money transfers through ICT solutions, notably through mobile phones, have become a much-discussed solution. This service is typically called or direct person-to-person (P2P) service. These types of solution are often offered by mobile network operators (MNOs) rather than banks, as they provide a simple cash transfer service, similar to that of Western Union. It is difficult to talk about such solutions without mentioning the highly successful M-PESA in Kenya, which enables urban Kenyans to send money home easily to their families in rural areas. Many providers in Kenya and throughout the world want to replicate M-PESA's success, and M-PESA has expanded significantly into other services, such as savings, and new clients, such as businesses. In recent years, governments have also begun to make transfer payments (government-to-person [G2P] payments) – such as welfare, social security and pensions – to rural beneficiaries through these same electronic platforms. Ideally, this new way of transferring money reduces costs, improves efficiency and, most important, reduces graft and waste.

Payments for products and services may be a more compelling way of helping to develop agricultural value chains. These options entail payments from businesses to people/farmers (B2P) or the reverse – people/farmers to businesses (P2B). B2P ICT payment services typically entail a buyer of agricultural products paying a farmer or group of farmers for her/his/their agricultural products. The buyer does not pay in cash but instead uses electronic payments that are typically transferred to either the farmer's bank account or to his/her mobile (phone) money account to be withdrawn at automated telling machines (ATMs) or cash-in/cash-out points – often local retailers. Such payments are advantageous as it is often a burden for farmers to travel to a buyer, wait for the agroproduct transaction and then carry away a year's worth of cash, risking theft and loss.

P2B ICT payment services involve the farmer paying a business, typically an input provider, for the purchase of inputs such as fertilizers and pesticides. The farmer repays the input supplier at the time of harvest, through the income earned from the sale of the agricultural products. For example, M-PESA's P2P channel has already been used informally for many years to facilitate payments between small traders and farmers, but will likely expand as M-PESA reaches out to corporate customers.[1]

Credit: Large credit programmes through governments have often failed, but in recent decades there has been a significant increase in access to private credit providers, such as input suppliers, lead buyer firms, speciality lenders, microfinance institutions and banks, which all require at least sustainability if not profitability. This trend has encouraged a search for higher efficiency, improved (credit) risk monitoring, and better delivery to farmer and institutional customers – ICT has played a significant part in achieving all three of these aims. For example, DrumNet in Kenya helped link financial institutions, smallholder farmers, retail providers and agricultural product buyers through a cashless microcredit programme. Farmers obtained access to inputs (e.g., seeds, fertilizers, pesticides) at local input providers by using a pre-established line of credit from banks, with collateral from the fixed-purchase-price contracts of a large buyer. DrumNet provided the bank with a credit rating score for each farmer, based on whether or not the farmer had paid her/his loans and delivered the promised agricultural product on time. The farmers benefited from increased access to financial services without the need to visit a distant branch or undergo an extended underwriting and disbursement process.

Savings: More compelling solutions may be found in other financial services, such as savings and insurance, both of which are often ignored in the preference for credit. The rural poor need financial services that are convenient, flexible and secure, especially for their own money, i.e., savings. The most common ways for rural farmers to save are informal, such as in kind and through savings groups, and generally meet the first two criteria – convenience and flexibility – very well. However, the third point, security, is a major constraint of informal mechanisms: money guards may run away with the money; in-kind savings such as stored rice may spoil or diminish in value; and money left under the mattress may be lost in a house fire. By either making informal methods more secure or improving formal financial institutions' convenience and flexibility, ICT can help solve the savings puzzle for rural farmers. For example, the Cooperative for Assistance and Relief Everywhere (CARE) in East Africa is experimenting with

[1] www.safaricom.co.ke/index.php?id=256

connecting its village savings and loan associations (VSLAs) to the formal banking system. Each VSLA will have a single account tied to a bank, which can be tracked and managed via a mobile phone. The advantages of these links and use of ICT are that they provide access to additional products from the bank, reduce the likelihood of theft or loss of the savings, and improve the management and accounting of VSLAs' finances (AllAfrica, 2011).

Insurance: ICT can be a significant contributor to improvements in the adoption and administration of insurance, as policy renewals are historically very poor (potential solution: short message service [SMS] reminders), trust between customers and insurance companies is generally low (potential solution: improved claim processing times), and the level of data for appropriate pricing of policies and monitoring of potential risk events is inadequate (potential solution: put in place remote rainfall sensors connected to a database via a satellite connection). ICT applications can also help in the reduction of basis risk, i.e., the risk that the index proxy used to calculate pay-out events and outcomes is not adequately linked to the actual field outcomes. Often, weather indices of average regional rainfall data are used; some farmers may incur losses and not be paid (discouraging farmer adoption), while others may not incur losses but be paid (discouraging insurance companies from taking on such products). The Index Insurance Innovation Initiative (I4) is exploring the use of satellite micro-rainfall data to see if basis risk can be reduced.

KEYS TO SUCCESS

ICT is not a panacea that will solve all the issues related to value chain development. Practitioners often become so enamoured with the newness of a technology that they often confuse ICT with the actual service provided to end beneficiaries, while ICT is only a means of providing a better service. For example, many farmers still do not have access to mobile phones (or adequate connectivity), so lower-technology solutions such as radio may still be the answer for years to come. ICT-based interventions can only be successful when there is sufficient need for the underlying service and institutional capacity to implement and maintain the enhanced service, as underlined in the following four key success factors:

1. Forget the hype. There is probably too much attention now being paid to ICT in development, especially to mobile banking. First focus on what the need is, then figure out what is needed to satisfy it.
2. Listen to clients (and field staff) and understand where the real problems and needs lie. Try to give customers greater control over the services they choose and over how they use those services (such as checking their mobile balances on their own – they prefer it and it is less costly for the provider).
3. Keep the solution simple – in both the technology and the service offering. Many of the technology solutions described here and in other sources have been around for more than a decade. There is no need to try to choose the most state-of-the-art solution. When a provider chooses simple ICT solutions coupled with more traditional low-technology solutions and communications media, such as radio, the likelihood of success can increase as there should be a smoother customer transition to a new platform and reduced risks that the ICT will be too difficult to use or will be faulty.
4. Plan for the future not the now. There are several interesting and innovative examples profiled in this document, but unfortunately many of them have not emerged from the idea or pilot stage. DrumNet, mentioned in the credit section, showed promise with a successful test involving more than 4 000 farmers, with a large buyer and a bank as partners. However, DrumNet's ICT infrastructure was not created to scale up quickly and had limited financial backing. In most ICT innovations for value chains, the practitioner must create alliances for – among many other issues – constructing and putting in place an adequate customer service team and distribution channel; convincing farmers to use and pay for the application; and enabling the application to be offered on existing communication networks.

Criteria for selecting ICT solutions for agricultural value chains: When considering ICT solutions to improve agricultural value chains, the following questions should all be answered in the affirmative:

- Is there a compelling and large enough customer need or problem area?
- Has the technology already been tested and proved in other applications? There is no need to purchase state-of-the-art equipment and software.

- Does the provider have the capacity to implement the solution on its own? If not, what potential partners are there? Ideally partners will have the requisite experience of implementation and the resources for implementation and continuing support.
- Ultimately, the most important question is: Is this solution scalable and viable in the long term? Many ICT solutions can achieve break-even or better only when they achieve significant client outreach. First, the ICT solution must be ready to service a significantly large population. Second, the solution must be appropriate and fulfil a need for the target client group. Third, the target client base must be significantly large, and ideally expanding. This is why the provider may want to consider adopting a for-profit strategy from the beginning, or find a partner with intentions of benefiting economically from the endeavour rather than earning credit for a corporate social responsibility exercise.

Acknowledgements

The authors would like to thank those who generously shared their insights on innovations of ICT. Special thanks are due to the Indian Society of Agribusiness Professionals of India for their work on the cases and examples in the document.

A special recognition is given to Prasun Das for his diligent support of the effort and to FAO colleagues, Milica Petruljeskov and Giang Duong for their work on the tables and the document. It is also important to recognize the document review and useful insights of Heiko Bamman, Eva Gálvez-Nogales, Pilar Santacoloma and Nomathemba Mhlanga, the copy editing by Jane Shaw, the desktop publishing by Monica Umena, the proof-reading by Francesca Cabré-Aguilar. Finally, the support of Larissa D'Aquilio and Simone Morini who coordinated production is highly appreciated.

Acronyms

ACDI/VOCA	Agricultural Cooperative Development International Volunteers in Overseas Cooperative Assistance
AGRISNET	Agriculture Resources Information System Network (India)
ATM	automated telling machine
B2B	business-to-business
B2P	business-to-person
BCNM	business correspondent network manager
CARE	Cooperative for Assistance and Relief Everywhere
CEPES	*Centro Peruano de Estudios Sociale* (Peru)
CGAP	Consultative Group to Assist the Poor
EU	European Union
FINO	Financial Inclusion Network and Operations (India)
G2P	government-to-person
GIS	Geographic Information System(s)
GPRS	General Packet Radio Service
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	information and communications technology
ICT4D	information and communication technologies for development
ICTA	Information and Communication Technology Agency (Sri Lanka)
IFMR	Institute for Financial Management and Research (India)
IIIT	International Institute of Information Technology (India)
IVR	interactive voice response
KACE	Kenya Agricultural Commodity Exchange
KCC	Kisan Call Center (India)
MFI	microfinance institution
MFS	mobile financial service(s)
MIS	management information system(s)
MNO	mobile network operator
NAMA	Northwest Agricultural Marketing Association (Cambodia)
NGO	non-governmental organization
OLPC	One Laptop Per Child
P2B	person-to-business
P2P	person-to-person
PDA	personal digital assistant
PIN	personal identification number
POS	point-of-sale
RANET	Radio and Internet for the Communication of Hydro-Meteorological Information (Zambia)
RFID	radio-frequency identification device
RITS	Relationship Information Tracking System
RML	Reuters Market Light
SMS	short message service

UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USSD	Unstructured Supplementary Service Data
VAS	value-added service(s)
VSAT	very small aperture terminal
VSLA	village savings and loan association
VTF	virtual trading floor

Chapter 1
Introduction

In many agriculturally based local economies, the low availability of timely and needed information is skewed in favour of more "networked" individuals or organizations which often force disadvantaged farmers to sell their harvests below fair value. The uneven spread of infrastructure – market, finance, administrative (e.g., government services) and physical (roads, etc.) – is equally problematic in developed and developing nations, leading to significant differences in the ability to leverage individual and regional strengths. Insufficient extension services and poor access to information widen the gap in the adoption of new technologies and can lead to lower long-term productivity.

Most farmers have access to a variety of information sources that they consult for regular agricultural information, even though these may not be the most up-to-date, accurate or beneficial sources. Many farmers do not have a single channel that serves as a comprehensive source for all their information needs. The most common sources are still TV, radio, newspapers, other farmers, government agricultural extension services, traders, input dealers, seed companies and relatives. However, the quality and relevance of the information provided by these sources can be highly variable. Some sources of information may even be biased against the farmer, such as the intermediary/trader who also serves as a moneylender. Most farmers in developing countries therefore lack access to consistent, reliable information for many of their needs and often rely on a combination of these varied but inconsistent sources, plus traditional knowledge, experience and estimates, when making decisions. Another constraint is that even when correct and timely market price information is available, farmers are often unable to exploit any potential pricing benefits that exist between markets because of their inability to transport their produce to the markets with higher prices.

Encouragingly, different information and communications technology (ICT) solutions have emerged – notably low-cost but well-connected mobile phones, which are increasingly available in even the remotest locations – to help overcome these information gaps and improve the business of agriculture proactively. This document outlines many of these solutions to help practitioners consider and devise potential ICT solutions of their own (or improve existing ones) so they in turn can help the value chain players they work with to grow and prosper.

DOCUMENT SCOPE

This document describes the different kinds of ICT solution available around the globe to help improve the effectiveness and efficiency of agri-food value chains and agricultural activities, and to demonstrate how ICT can mitigate the inherent risks in these chains and activities. While the parties implementing the ICT solutions described in the examples are widely varied – such as governments, non-governmental organizations (NGOs) and private companies – the use and value of the different ICT solutions are portrayed from the farmer's or producer group's perspective, with examples from typically larger upstream or downstream players' perspectives, such as banks, cooperatives or processors. Many, if not most, of the examples presented are meant to be simple representations of the different types of ICT intervention and not necessarily examples of successful ICT projects. The topic of ICT in value chain development is so new that many of the cases presented are still in the pilot stage and have not been rolled out in a robust way (and have not yet achieved critical success factors such as adoption, scale and viability). As many of these cases are simple and small pilots that were sourced from public records and private conversations, there are likely to be data gaps in the typical statistics relating to these projects: number of clients, transaction volumes, etc.

For each type of ICT intervention, some common types of technology used are presented, but in no way do these examples represent a definitive list of the technology involved in all such projects. The authors are sure that many strong examples have been left out, as there were too many examples to choose from in putting each chapter together. In addition, the descriptions of the technology are mostly from the user's perspective, in terms of how the technology functions for the user and

why it is helpful (i.e., the value), rather than providing the technical details of how the technology functions and communicates in the background. The descriptions of technology interventions are also mostly from a front-end user perspective, rather than covering the back-end infrastructure needed, such as mobile phone networks, satellites or Internet cables. The challenges and opportunities of each type of ICT intervention are given at the end of each chapter. Suggested key success factors and decision-making criteria are presented at the end of the document, along with resources that readers can refer to for more information on ICT in general and ICT for agricultural/value chain development in particular.

This document is not meant to catalogue every intervention available, every stakeholder's perspective or all the ways in which stakeholders can be involved; additional potential areas of study on this compelling topic include:

- how policy, laws and additional infrastructure support from governments, multilateral agencies and large donors can improve the availability and success of ICT implementation for agricultural value chains;
- more in-depth and technical studies/descriptions of the technologies being used (or developed), how they interact with various types of management information system (MIS) and communications system, and how these connections can be improved;
- how ICT can become a more direct tool for development through enhancing livelihood opportunities, for example, by setting up entrepreneurial e-Choupal kiosks in India (Chapter 3);
- more in-depth evaluation, including key performance metrics, of the few interventions that have reached significant scale and some level of viability, to identify how they have succeeded and where the missteps have been.

BASIC TERMINOLOGY AND DOCUMENT STRUCTURE

ICT encompasses the use of existing technology: hardware, software and telecommunication options, including the Internet and telephony (mobile and landline) systems. ICT solutions for agribusinesses and value chains typically fall under a relatively new topic called information and communication technologies for development (ICT4D), which can also entail other types of development interventions in health and education, for example. This document covers primarily a subset of ICT4D, usually called ICT for agriculture.

The ICT examples in this document are divided into three main categories based on experience, observations and research. These categories are used to help present the concepts and are not an attempt to create new taxonomies or terminology. Each of the three categories has subtopics that the different examples fall under. Some examples may seem to be misplaced, and there may seem to be missing categories, as there is significant overlap of solutions (ICT solution providers often offer myriad different services that cut across categories):

- ***Category 1:*** *ICT for production systems management* comprises information that is linked to helping farmers improve their productivity, yields and profitability (and minimize their risks) during the course of their normal business of growing agricultural produce. This chapter covers ICT applications for production systems that involve short- and long-term productivity enhancement, minimize the negative effects of crisis events, and improve field-based risk management (Chapter 2).
- ***Category 2:*** *ICT for market access services* comprises any service that facilitates beneficiaries' (especially farmers') access to information on pricing of agricultural products (inputs and outputs), and connections to and knowledge of suppliers, buyers or logistics providers, such as storage facilities and transport companies. These services also include ICT solutions that help the typically larger upstream and downstream firms, such as processors or exporters, to manage their operations and the quality of the produce better (Chapter 3).
- ***Category 3:*** *ICT for financial inclusion* entails ICT solutions that allow formal and semi-formal financial institutions and direct value chain players (e.g., those using trade credit) to provide financial services in a more convenient, secure, flexible and low-cost manner (Chapter 4).

RECENT HISTORY OF ADOPTION OF ICT IN DEVELOPING COUNTRIES

The information economy represents not only a current digital divide, but also a digital opportunity for the developing world. Very few communities in the developing world understand the full potential that ICT can offer in the short and medium terms, providing people with opportuni-

ties in the information economy, regardless of their class, gender or location. Difference in the pace of ICT adoption are based mainly on:

a) availability of infrastructure, and hence access to the service;
b) assessment of value of the service, and hence keenness to adopt it;
c) disposable income levels and pricing of the service.

Leapfrogging technology – the mobile phone[2]

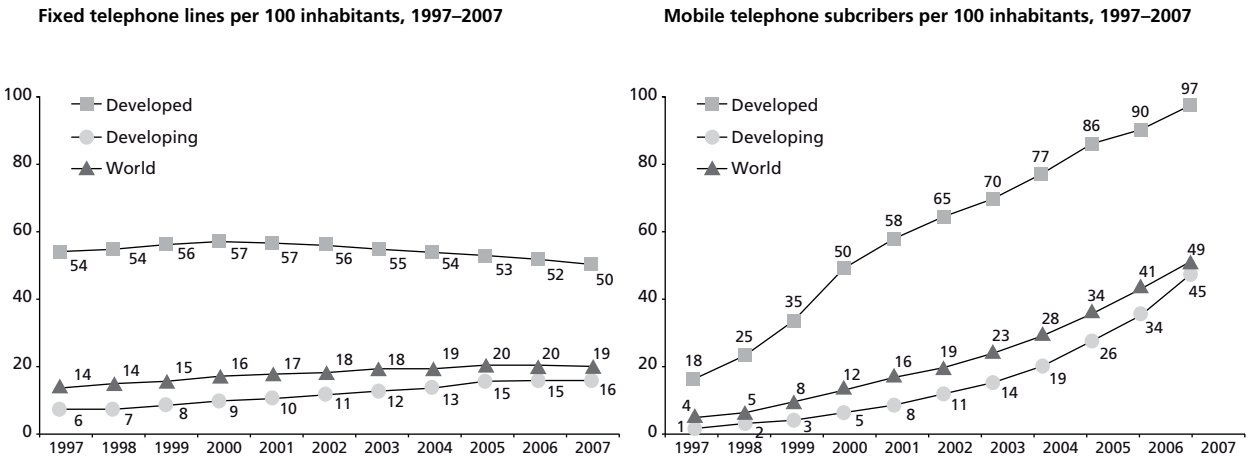
Since the late 1990s, the use of Internet, mobile communications and computing power has grown exponentially throughout the world. For example, developing countries and their citizens have been able to skip the step of having landline phones (Figure 1 shows the flat and declining trend lines for landlines) and move straight to mobile phones (Figure 1 shows the significant growth curve for mobile phones – especially in developing countries). The same is predicted to happen for the Internet in the near future, with the developing world likely to skip the stage of accessing the Web through typical desktop and laptop computing (using Internet service providers such as cable or phone lines) and move straight to access from their mobile phones. (However, this is likely to be a few years away – see Table 1.)

As shown in Figure 1, the rate of mobile phone adoption has been significant in all parts of the world, especially the developing world, and is making access to information much easier. This is by virtue of the rapidly declining cost of both airtime and handsets, combined with the rapid increase in services made available on handsets and the rapid build-up of mobile phone networks by mobile network operators (MNOs).

The rise of mobile phones is only one of the ICT solutions with significant potential to serve developing markets, especially rural ones. For example, recently, many Internet-provided services have begun to shift away from written language towards the use of audio and video services, lessening the need for consumers to be able to read and write. These services are available from both government agencies and private players. Depending on the quality and frequency of information available, the services are often paid for by farmers/traders who need information that is not locally available. Box 1 provides another innovative example based on the creation of tablet/laptop computers at prices that are much more affordable in the developing world (US$100 or less).

Poverty and inadequate education have not proved to be significant barriers to acceptance of new technologies or services, such as the mobile

FIGURE 1
Growth in landline and mobile phone subscriptions



Source: http://www.itu.int/ITU-D/ict/statistics/ict/index.html

[2] The terms "cell phone" and "mobile phone" are used interchangeably throughout this report.

TABLE 1
Expected ICT technology adoption in rural areas of developing countries

Period	Access gateway at rural telecentres/ households	Examples of services
Current	Mobile voice and SMS	SMS-based information delivery; voice-/SMS-based trading floors
Next 5 years	Internet access at up to 56 kbps	Streaming of audio, radio, e-mail, Web sites, social networking services, instant messaging
Next 10 years	Broadband access up to 2 Mbps	Streaming of video, Internet TV, real-time online auctions and settlements

Source: Adapted by authors from Indian Society for Agribusiness Professionals. www.isapindia.org

phone or even, for example, rural Indians' ingenious way of using automated telling machines (ATMs) as an unintended safe remittance system (Pandey and Shukla, 2009). The perceived value of the service is paramount to the adoption rate of a technology/service. Irrespective of education level, people in all countries have adopted technologies that provide a visible direct link to better incomes and better access to important markets, services or opportunities.

ICT AND ITS RAMIFICATIONS FOR RURAL ECONOMIES

From making a simple call to a contact for information, to gaining access to new markets and buyers, or obtaining expert advice from distant experts, ICT – particularly the mobile phone – has made obtaining the right information on demand achievable for many people, despite their remoteness. The impact on productivity can be measured in terms of increased returns to farmers, through changes in cropping patterns, yield increases and better prices for inputs and output. Non-price factors, such as information on the availability of inputs, seed quality and the adoption of modern techniques, are also critical to raising productivity.

Prior to the 1990s, ICT in agriculture entailed mainly the use of radio and TV, especially radio in Africa and some parts of Asia, to pass on information to farmers in a static and standard format. Now, however, many countries, including India, Indonesia, Thailand and Viet Nam, have simple short message services (SMS) through cellular telephones for market prices of agricultural commodities. These cater to a range of clients from farmers to market intermediaries. Applications for sharing even more types of timely and relevant information in ways that are tailored to individual needs are only a few steps away, and many new solutions are already being tested – as described in this report. For example, the linkage of radio and TV stations to cellular telephony technology has not yet been fully exploited, and there are many more potential solutions.

BOX 1
Ever-lower-cost computer hardware and software

Amid the publicity surrounding the launch and success of Apple Inc.'s iPad, a high-end hand-held tablet computer typically costing US$500 or more, there have been numerous, more discreet launches of low-cost tablets/laptops based on open-source technologies where no proprietary operating systems and software are used. For example, in 2012, Nicholas Negroponte – co-founder of the United States of America-based Massachusetts Institute of Technology's Media Lab – launched the children's laptop, One Laptop Per Child (OLPC), in the developing world, at the goal cost of US$100 per device (*Economic Times of India*, 2012).

Many of India's engineers have also been researching the development of a low-cost computer. The Indian Government turned to students and professors at India's elite technical universities to develop the US$35 tablet after receiving a "lukewarm" response from private sector players. After delays in development and manufacturing, the laptop was finally launched as *Aakash*, meaning "sky", at a cost of US$50 (subsidized down to US$35 for schools and sold to private individuals for US$60) (Datawind, 2011).

Potential impact

Throughout this document, examples are presented to illustrate the different ways of applying ICT to increase the cost-effectiveness of public and private interventions that aim to develop inclusive agricultural value chains. A growing amount of literature estimates the impact of such interventions. One example is a research study conducted with fishers in Kerala, India during 2007. This study researched the impacts of fishers' use of mobile phones on how they conducted business and, ultimately, on their incomes. The study found that the introduction of mobile phones decreased price dispersion and spoilage of the catch (typically 5 to 8 percent prior to mobile phone use) by facilitating the dissemination of information about which ports had the greatest need for fish, and hence the highest prices. The mobile phones allowed the fishers to call in just before they docked their boats, to obtain timely price information and decide on the best place to land and sell their daily catch. Fishers' prices rose by some 8 percent, while prices to consumers actually fell by 4 percent (*Economist*, 2007). The most compelling aspect of this example is that an outside entity such as an NGO or government agency did not step in to encourage it, and no pricing service was created. The fishers simply began to adopt mobile phones once the mobile network coverage reached over the ocean, and made calls to potential buyers on their own accord. Other examples include the case in Bangladesh where agricultural extension agents' use of mobile phones reduced livestock mortality rates (Bayes, von Braun and Akhter, 1999); the Internet kiosks established by the public sector in India to provide information on market prices and cropping techniques were shown to reduce regional market price fluctuations and increase average yields (Goyal, 2010). In general, the evidence suggests that the main effects of ICT use in rural and agricultural markets relate to greater efficiency in the arbitrage of prices and less concentration of market power within segments of the value chain. This in turn can result in greater supply from producer groups to growing markets, reduced dependence on transportation for market transactions, and lower price variability (Jensen, 2010).

Chapter 2
ICT for production systems management

All ICT interventions in agricultural value chains involve the transmission and use of information. For the purposes of this report, however, information services cover information that is tied to helping farmers improve their productivity, yields and profitability during the course of their normal agricultural and animal husbandry production cycles.[3] Information services to facilitate production systems management are the most prevalent category of ICT service for inclusive agricultural value chains. This report covers information services that involve four categories: i) short-term productivity, such as weather information to help farmers decide when to plant or harvest; ii) long-term productivity, such as training on proper fertilizer usage; iii) minimizing the negative effects

BOX 2
Farmer call centres

Farmer call centres are advantageous as they can help overcome many constraints that other productivity improvement services, such as typical extension services, cannot: access, literacy, language, tailored (and well-informed) responses, scale, and timeliness. Call centres are also useful in being able to collate data and identify trends. Farmer call centres are mainly "pull services", with the farmers calling when they have specific queries and the call centre experts either answering immediately or providing a response after research.

India's Kisan Call Center (KCC) in the State of Madhya Pradesh was established in 2008. The 30-seat centre has a system of telecommunication infrastructure, computer support and human resources organized to manage the queries raised by farmers effectively, efficiently, instantly and in the desired local language. KCC's objective is to resolve farmers' queries and problems related to agricultural topics such as agronomy, horticulture, plant pathology, soil sciences, animal husbandry, entomology, agricultural economics, farm management, plant breeding and genetics. Within the first year of operation, it had resolved more than 200 000 farmers' queries from 50 districts of Madhya Pradesh. The centre can be used to provide short-term productivity and crisis management information, as well as information for longer-term activities through weekly conference calls with topical experts. For example, KCC is implementing an early warning system to inform farmers about impending natural disasters (floods, drought or cyclone). The call centre has already provided the state government with critical support in handling a disaster and serves as an important link between the farmers and policy-makers.

KCC has benefited the state by:

1. generating a state-wide farmer database;
2. publicizing government schemes;
3. monitoring the implementation of various schemes;
4. providing direct feedback from farmers on ground-level situations.

The main disadvantages of the system are the high cost of implementation and the reliance on a qualified workforce, which is scarce and expensive. KCC estimates that its costs vary according to the quantity and level of service desired; the average call costs US$1–2 (Rs 40–80) depending on the complexity of the query.

Source: www.manage.gov.in/kcc.htm

[3] Chapters 3 (market access) and 4 (financial inclusion) provide summaries of information interventions and services that go beyond the conducting of normal agricultural practices.

of crisis events, such as information on how to protect crops from oncoming freezing weather; and iv) improving field-based risk management, such as information on the implementation of crop rotation to preserve the soil. Many of these services are government-sponsored, but there are also privately run services and public–private partnerships, such as the Kisan Call Center example in Box 2.

TYPES OF ICT INFORMATION SERVICE

ICT applications for production systems management can include the provision of data on the following topics (but this is not a comprehensive list). All of these techniques aim to improve data collection, processing and reporting through simple and affordable means that help farmers to make decisions that will improve (or protect) their incomes. As already stated, information services through ICT typically serve four main purposes: productivity enhancement for short- and long-term effects, crisis management in the short term, and field risk management in the long term.

Short-term productivity information services

In the context of this document, short-term productivity information services entail providing information mainly to end beneficiaries, such as farmers, to help them improve their crop yields in the near-to-medium term, and are the most common types of information service available. These productivity services provide information that is generally quick and easy to access and use (information "nuggets"), such as current or forecasted weather information, and is frequently pushed out by the information provider to subscribers without much interaction between the provider and the consumer. These services are especially important to farmers who already know and understand a great deal about their crops and farming techniques but who occasionally need timely information to improve their productivity. This kind of information, such as the exact timing of the oncoming monsoon season, is often difficult to access in remote rural areas, and without timely, technical information, farmers are forced to make decisions based on rules of thumb, past experience, local rumours and instinct. The following and Box 3 provide examples of interventions for helping to improve crop and dairy yields:

- *Crop advice from experts using digital photos:* Project e-Sagu of the International Institute of Information Technology (IIIT) in Hyderabad, India enables farmers to receive advice on planting, monitoring and harvesting crops and on pesticide and fertilizer usage based on digital photos taken by the farmers themselves.[4]
- *Ensuring high milk production from dairy cattle:* In Sri Lanka, Web and mobile technologies have been introduced to help dairy farmers achieve self-sufficiency in milk production. The e-Dairy project is part of the effort of the country's Information and Communication Technology Agency (ICTA) to improve the livelihoods of the rural community, which accounts for 70 percent of Sri Lanka's population. The government discovered that 53 percent of the country's milking-cows were yielding milk because they were not pregnant. The low pregnancy rates were because timely artificial insemination and breeding services were not available, owing to the lack of communication between farmers and public sector service providers. ICTA attempted to bridge these gaps through mobile phone-based SMS messages and touch-button computers installed at the milk collection centres where farmers gather every morning to sell their milk. The system offers a number of "just-in-time" services, including access to artificial insemination agents, to help induce pregnancy. ICTA believes that if cows are artificially inseminated within the required time frame (after the first signs of being on heat), milk production could be increased by 30 percent (ICTA, 2009).

Crisis management information services

Crisis management information services essentially help prevent losses, rather than raising productivity. These services often serve as an alert system enabling farmers to react quickly before an oncoming event (often weather- or disease-based) reaches them. The following and Box 4 provide examples of interventions around warning farmers about potential weather and pest disasters:

- *Weather and pest information for farmers:* In Turkey, the agricultural department established five weather sites to monitor the need for pest control and frost prevention, and now provides this information to farmers

[4] http://web2py.iiit.ac.in/research_centres/default/view_area/11

BOX 3
FrontlineSMS and organic farmers

FrontlineSMS[5] builds and distributes free and open-source software to "lower barriers to driving transformative social change using mobile technologies". Frontline does not carry out field activities, such as storing medical information for a health clinic, but helps such initiatives use simple and cost-effective ICT tools (mainly cell phones and low-cost laptops) to manage their activities better and improve communication.[6] It covers five key areas: credit, learning, legal, medical and radio. This chapter outlines a few of the more than 20 FrontlineSMS applications that are currently being used in information services for agricultural and value chain development across Africa, Latin America and Asia.

The Organic Farmer-Kenya (Oyenuga, 2011a; Banks, 2011): John Cheburet created the Organic Farmer radio programme in 2008 to support the parallel *Organic Farmer* magazine. The radio programme is broadcast weekly (pre-recorded) on two national radio stations at night, when farmers are at home. Topics vary from soil fertility management, to the number of female goats that one male can comfortably mate.

The choice of using a magazine, radio and mobile phone texting revolves mainly around access and simplicity. It is estimated that more than 60 percent of Kenyans own a cell phone and more than 90 percent own a radio (versus only 20 percent with a TV, and fewer with electricity). The Organic Farmer radio programme uses FrontlineSMS to receive and manage the text messages (about 20) received each week from listeners and to send SMS reminders about the radio show's time. The Organic Farmer responds to each enquiry individually, but takes note of common issues that are then brought up on the show. For example, with help from listeners, the radio show uncovered an industry secret involving goat breeds. Many listeners complained of a supposedly "high-quality dairy goat" that cost more than regular goats but did not yield the promised amounts of milk. With the help of the show, the community discovered that suppliers had falsified records about the goats.

Cheburet believes that both radio and SMS are necessary, because SMS messages have limits, such as the amount of information that can be shared, and radio is very one-dimensional. He believes that to make radio interesting, especially for farming, "there has to be a two-way communication".

via their cell phones. The service gathers information about when pests are likely to be prevalent by placing pest traps and observing temperature levels. Using the information, the farmers have been able to reduce their use of pesticides by 50 percent – lowering expenses and improving crop productivity. The tracking of temperatures also helps farmers to prevent losses from frost by monitoring temperatures hourly and sending text messages to the farmers, who can then take crisis management measures, such as burning dead leaves near their fields (Kumar, 2011).

- *Sea conditions for fish farmers:* The Chilean Aquaculture Project provides daily information about the sea surface temperature, the clarity of the seawater and the amount of chlorophyll in the water. Information on chlorophyll content enables fish farmers to take action when harmful algal blooms multiply to a level where they threaten farmed fish.[7]

Long-term productivity information services

Long-term productivity information services cover topics that take longer to learn, and are often offered with other technologies and channels, such as face-to-face training or one-to-one support from local extension agents. Many such services are delivered in conjunction with long-term training, extension services, demonstrations and field visits. Benefits from these services are generally realized months or even years later. As far back as 1999, researchers found that livestock mortality in villages decreased after extension officers began to provide more timely advice through mobile phones (Bayes, von Braun and Akhter, 1999).

[5] www.frontlinesms.com
[6] www.frontlinesms.com/press/press-kit/frontlinesms-mission/
[7] www.hatfieldgroup.com/sectors/aquaculture/cap.aspx

BOX 4

Alerting farmers about impending extreme weather: FrontlineSMS and RANET in Zambia

Extreme weather events such as drought or floods can cause not only loss of life but also loss of livelihood for many Zambian farmers. Well-documented and timely warnings can help these farmers reduce the risk of loss and harm to their families, animals and incomes. To counter the risks, the Zambian Government's Meteorological Department has created the Radio and Internet for the Communication of Hydro-Meteorological Information (RANET) project,[8] which helps farmers avoid the disastrous outcomes of weather events.

RANET's success depends on interactions between RANET and the beneficiary farmers. More than 3 000 farmers have been given rain gauges to measure rainfall data, which are fed back to RANET's local weather stations via the farmers' mobile phones. For motivation, RANET recharges these farmers' phones for free from time to time. RANET is now testing FrontlineSMS's tools to reduce service costs even further – perhaps even offering them to farmers free of charge. For farmers without access to a mobile phone, communities are provided with a solar radio, of which 3 000 have been distributed so far. In return for the information sent by farmers, RANET pushes the aggregated and analysed data back to the farmers through SMS weather alerts, more than ten local community radio stations, and local extension agents. Through these three channels, farmers learn how and when to adjust their crop production methods to changing seasonal patterns.

Source: Mumbi and Ghazi, 2011.

These services typically focus on education, often with a distance learning aspect.[9] They can also serve as tools for obtaining follow-up on services provided in the short term, as in the examples described in the following and in Box 5:

- *Training farmers in the use of agricultural information – the Community Network in Chancay-Huaral, Peru (long-term productivity enhancement)* (Galperin and Mariscal, 2007): The land surrounding the Chancay-Hural River in Peru should provide adequate resources for local farmers to do well: healthy soil, adequate water, and proximity to Lima and the north. However, residents lack access to communications and public services. *Centro Peruano de Estudios Sociale* (CEPES)[10], a local NGO, believed that there was likely a correlation between the lack of access to services and communication and the fact that farmers often planted the same crops year after year, despite market prices. CEPES also remarked that there was a strong need to improve water management by the local cooperative board. To counter these two main issues, CEPES created an agricultural information and communication system for the region, offering long-term training to improve farmers' decision-making, and timely communications among the local water irrigation commissions that manage the water cooperative. To overcome the lack of telecommunications infrastructure, CEPES put in place a Wi-Fi network connecting 12 villages and providing them with Internet access to the outside world.

Risk management information services

Risk management information services are also long-term in scope and, as with crisis management services, they help farmers to avoid losses rather than increasing productivity. These types of service differ from crisis management services in that they take longer to absorb and implement, and the benefits are realized much later than with crisis management. The following is an example of an intervention that helps women farmers in India to avert many of the common effects of drought:

- *Distance learning to help women in India overcome drought and pests:* In 2004, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) created a Virtual Academy that trains local women who then, with the help of remote scientists, provide critical information to farmers in 21 villages. These women meet ICRISAT

[8] http://nctr.pmel.noaa.gov/education/IOTWS/RANET/Activity_Overview_RANET.pdf

[9] A way of educating students, often through information technology, while the teacher/professor/content provider is in another location.

[10] www.cepes.org.pe/portal

BOX 5

SMS for ensuring training effectiveness for Tanzanian coffee farmers: Technoserve, FrontlineSMS and monitoring and evaluation

Technoserve[11] provides Tanzanian coffee farmers with training to improve the quality of their coffee beans, thus helping them to secure higher prices on international markets. Trainers conduct multiple sessions to ensure retention and to cover many topics from equipment usage to appropriate fertilizer amounts. Technoserve reports having trained more than 12 000 farmers, with 60 farmer trainers running between 15 and 20 sessions at a time.

One of the key issues in training is trainee retention – usage of the new knowledge and behavioural change after the training. With training reaching thousands of farmers, it is difficult to keep track of all the follow-up data generated by the trained farmers. Technoserve uses FrontlineSMS's data collection tool to address this issue by administering surveys that were once paper-based to farmers (through the farmer trainers). Now all post-training evaluations are carried out via SMS. Each farmer trainee is given a unique identification number, which is used in the post-training survey. The trainer asks each trainee a series of questions based on behaviour change, enters the data into her/his mobile phone, and sends the responses back to the head office. This helps Technoserve determine the level of impact that the training has had in helping farmers improve their farming techniques. It helps reduce the time for data collection, collation and analysis, and reduces errors. Another application is the weighing and tracking of improved yields (or their absence) among a sample of trained farmers' coffee crops through SMS messages. Technoserve compares the new yield with previous years' yields to estimate how much of a difference the training has had.

Source: Oyenuga, 2011b.

scientists via audio and video conferences and exchange key information about droughts, planting practices, pest control, soil fertility, etc. For example, Rameswaramma, a 38-year-old villager from Nijalapur village underwent computer and agricultural technical training from the Virtual Academy (and won an award for her efforts). She now helps local farmers experiment with drought-resistant crops, such as castor, and shares other agricultural practices, market prices and weather information with the help of the remote scientist experts (Paul-Bossuet, 2011).

COMMON ICT PLATFORMS FOR INFORMATION SERVICES

Collection and analysis

Data collection can be quite complicated and expensive in the chain of providing information services, especially when collecting comprehensive and timely data on weather, pests, etc. throughout an entire country. Because of this constraint, governments and multilateral agencies such as the United Nations often undertake the data collection and analysis steps. Commonly used platforms include the creation and updating of Geographic Information Systems (GIS), satellite mapping and environmental maps. However, a form of "crowd-sourcing" is under way, often using simple and inexpensive mobile devices, such as mobile phones, through which local extension agents or even beneficiaries report back certain data (e.g., the RANET project in Zambia, described in Box 4).

GIS in particular is already being used in many developing countries, such as Bangladesh, Cambodia, Colombia and Malawi. GIS helps monitor agriculture-related issues or identify viable new opportunities in agriculture.[12] For example, GIS tools can help monitor changes in crop coverage in

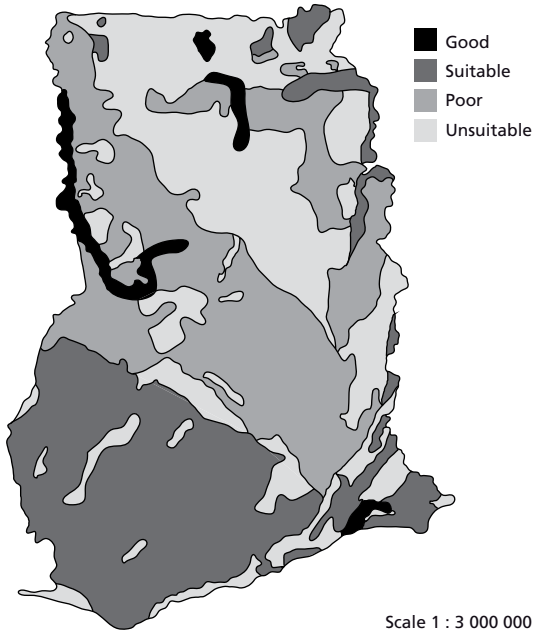
[11] Technoserve supports farmers, cooperatives and suppliers and assists in developing sustainable rural industries across the world (www.technoserve.org).

[12] GIS is defined as "a computer system for capturing, storing, checking, integrating, manipulating, analysing and displaying data related to positions on the Earth's surface. Typically, a Geographical Information System (or Spatial Information System) is used for handling maps of one kind or another. … In aquaculture, it has been used to assess the suitability of geographical sectors, and also to investigate the suitability of a species to an area." (www.fao.org/fi/glossary/aquaculture/spec-term-n.asp?id_glo=16466&id_lang=terms_e&lang=en).

agricultural areas, detect and map relevant chemical and mineral substances within soils in a region, and identify appropriate fishing sites (showing the intensity of fishing) (Figure 2).[13]

"The software is not costly," said José Aguilar-Manjarrez of the Food and Agriculture Organization of the United Nations (FAO). "There are many GIS and remote sensing software packages at low cost, plus the new trend is open source [free] software" (Fog, 2011). However, creating the infrastructure, training personnel, and collecting, processing and maintaining data are expensive activities. For this reason, FAO has developed GISFish, an Internet Web site of GIS-based resources for aquaculture and inland fisheries in developing countries. The mission of the project is to "solve problems in inland fisheries and aquaculture using GIS, remote sensing and mapping". Satellite, airborne, ground and undersea sensors acquire many of the related data, especially on temperature, wave current velocity and height, chlorophyll concentration and land and water use. The data are then analysed, aggregated, formatted and uploaded for public use on the GISFish website.[14]

FIGURE 2
Example of a GIS map indicating soil suitability for aquaculture development in Ghana



Source: FAO, 1991.

Delivery

Since the arrival and proliferation of the mobile phone, the delivery of information services has become much easier and less expensive, and is often provided by private players. The mobile phone's advantages are its simple format (often text-based messages), ubiquitous (or near ubiquitous) ownership and low cost. Many MNOs or mobile application providers provide these services as add-ons to normal mobile services, often called "value-added services" (VAS). Another common delivery platform is the use of landline telephone numbers (which are being phased out, generally by cell phones), often staffed by experts such as veterinarians or scientists who provide advice. Prior to the proliferation of these phone-based systems, radio and even television were (and still are) used to push out information to farmers. The constraint of radio and television is that they can provide only very general and standard information to everyone, whereas phone-based systems can be somewhat tailored to farmers' specific questions. Data provision directly through the Internet is far less used in rural areas of developing countries. The Internet can provide much more data and in a more easily digestible and visual format than a phone can, but many rural areas do not have access to the Internet, which is also often cost-prohibitive. Information provision over the Internet often uses information centres or kiosks operated by an entrepreneur or service agent who helps farmers to navigate the different sources:

- *Internet/Web portal:* The Agriculture Resources Information System Network (AGRISNET) is a project created by the Tamil Nadu Department of Agriculture in southern India and the Government of India to provide a complete Web-based portal for sharing needed information with farmers. Information is gathered and disseminated by 385 local agricultural extension centres, which all have Internet access. AGRISNET provides information on weather forecasts, market trends, quality requirements, policies and eligibility for benefits, among other topics. In the past year, 8 million farmers in Tamil Nadu have used the service – 33 per-

[13] Example of an aquaculture map from Ghana (available at www.fao.org/fi/glossary/aquaculture/showImage.asp?id_image=3473&lang=en&id_lang=terms_e).
[14] www.fao.org/fishery/gisfish/index.jsp

cent of all the farmers in the state (Government of India, no date).[15]

- *Combined radio and phone:* In a study carried out in 2010, Freedom Fone used a combination of radio and cell phone platforms (and other back-end technology beyond the scope of this report) to deliver relevant audio files to farmers in rural Ghana. (The files were often of radio broadcasts the farmers had missed.) Radio stations became the focal point for collecting and recording relevant data on audio files that farmers could listen to when they were interested in the topic. Farmers could also leave voicemail messages to provide feedback on the service. While there were issues of take-up owing to the cost and to farmers not grasping the service's value, the farmers who used the service frequently found it a useful source of pricing trends and agricultural information (Sullivan, no date).
- *Phone-based voice messages:* The Local Language Speech Technology Initiative's National Farmers' Information Service project provides Kenyan farmers in remote rural areas with information on crops, livestock, market prices, inputs, disease outbreaks, weather reports and which crops are most suitable for a specific area, even though many of the farmers lack access to the Internet or extension services and are illiterate. Essentially, text-based information is converted to audio, in either English or Swahili, and provided over a landline or cell phone. Farmers call with queries, and staff of the service read the relevant information back to them (Sullivan, no date).
- *Adapted call centres:* A version of the Web sites that are popular in developed countries, where users ask questions to experts online, Question Box uses simple technology such as phone boxes in remote villages of India and Uganda, which farmers use to contact trained agents with the relevant language skills to answer their questions; staff typically have access to the Internet. In India, the dairy operator Arohana provides its dairy farmers with a connection to veterinary specialists at the local university. The project in Uganda also has a staff member at the origination point, who makes the calls for service users with enquiries (Tatalović, 2010).

ISSUES AND CHALLENGES FOR ICT INFORMATION SERVICES

Non-tailored service provision: Many of these services are "push-based" in that once the service is subscribed to, the service provider sends the information, often by SMS, at times determined by the service provider. Such services are also one-directional in that the recipient cannot receive clarifications or answers to his/her specific queries. This challenge can be overcome by allowing the subscriber to choose which information she/he wants first, or by providing staffed services, as KCC does (Box 2) – although this can be difficult and expensive.

Illiteracy: Illiteracy is a challenge for services based on mobile phone text messages or the Internet. Farmers typically find a "work-around" solution by asking a literate friend or relative to help, but the text-to-speech example described in the previous section, and emerging interactive voice response (IVR) technology will eventually allow users to use only their voices for enquiring and listening.

Sustainability: From a more global perspective on these services, the main issues revolve around sustainability and scale. Most, if not all, of the examples mentioned in this and other publications are essentially pilots subsidized by governments or multilateral institutions. While these players may have to continue providing data collection services, private players' move into the delivery of information (e.g., VAS with mobile phones) can encourage sustainability and greater reach. Two common business models are being explored around the globe: i) subscription models; and ii) pay-as-you go models based on usage. There is still the issue of whether end beneficiaries will pay for such services, as farmers are often highly price-sensitive and prefer carrying out their business as they have always done. Mobile phones present an additional issue as the VAS provider may charge a fee to the user, and the user has to pay for data and/or phone time charges. The poor often use ingenious tactics to minimize their talk-time usage as much as possible, such as by calling and quickly hanging up before being answered, signalling that the person called should call back.

[15] AGRISNET has been set up in more than 20 states of India. Tamil Nadu AGRISNET Web site http://tnagrisnet.tn.gov.in/website/index.php

Upstream, for-profit firms such as processors and dairies (and even downstream suppliers) may have an incentive to provide these services for free or at a subsidized rate in the long term as the services could help improve the quality and quantity of the end product.

Cost of collection: As already mentioned, the cost of collecting the data used for short-term productivity services is typically high because of the implementation and maintenance needs of these services. This requires that a public player provide short-term productivity services, as finding a sustainable pricing model for consuming the data could be difficult (very similar to how highways function in transportation systems). Setting up such a system takes a great deal of political will, resources and time.

Customer adoption: No model can be successful if the end users do not grasp real value from the services. Many of these projects have problems with customer adoption because they are not able to convince potential users to try (and use frequently) such services. Kenya's M-PESA (mobile phone money transfers – the most oft-cited, successful ICT-based service for the poor) has been able to evolve from a small pilot of a large MNO to a successful and viable business, by listening to end users' needs, conveying the fulfilment of these needs in a simple and compelling message ("send money home"), and executing a consistent and easy to understand service.[16] Few other bodies working in financial inclusion or other development services such as value chain development have been able to match this level of success in using ICT services because they have missed at least one (and often all) of the three necessary steps: understand the need, convey a compelling value message, and execute well. Providers should take care to parse out exactly what information is important to farmers and provide it in ways that make it easy to digest and act on, avoiding "data dumps" of information.

Seasonality: Another issue affecting the sustainability of short-term productivity ICT services is that farmers request them only at the time of need. As agriculture is inherently seasonal, with several dormant months a year, the question of sustainability for these types of service arises. If they are a small part of a larger portfolio of services, this is less of an issue, such as for an MNO. However, a dedicated service provider would likely need to offer other services (likely for other target markets) to remain viable during the interim periods.

ADVANTAGES OF AND OPPORTUNITIES FOR ICT INFORMATION SERVICES

Ease of use: The most compelling aspect of these services is that they can provide relevant and timely information in a way that can be absorbed and acted on immediately, for example, "I should plant in a week and not today". The services are also generally simple to understand and easy to subscribe to and use, making them a compelling entry point for additional information services, and perhaps also the services addressed in the next chapter, such as education and long-term extension services. ICT information services can also serve as excellent entry points for farmers who have not previously had access to unbiased and timely information.

There is also a dimension of creativity in the delivery of these services, to meet the needs of end beneficiaries, such as the use of voice messages and voice boxes in the examples. However, basic text SMS continues to be the most popular method owing to its simplicity and low cost (see next point).

Cost of delivery: Data collection may be expensive for short-term productivity services, and typically requires public support (even the United States Government must step in to provide weather data for the National Weather Service, and oceanic data for the National Oceanic and Atmospheric Administration, for example). However, the delivery of such services has become much easier and less expensive with the arrival and proliferation of mobile phones, especially in the developing world. Simple software can be embedded in the phone or downloaded, although many providers choose the even easier and less costly route of providing text messages.

Provider sustainability: Most short-term productivity services are leveraged on existing infrastructure, such as radio stations or mobile phone networks. As these service providers have already expensed the major cost in their businesses' fixed costs, any additional service entails essentially added value with relatively low incremental costs. The providers therefore have an incentive to

[16] www.safaricom.co.ke/index.php?id=256

BOX 6

Telecentres providing distance education for rural youth and farmers in Sri Lanka

In 2003, the Sri Lankan Government and the World Bank launched the e-Srilanka service with plans to create more than 600 telecentres in rural areas. "Youth managers" at the centres were to provide the populace with Internet access, ICT-based services and access to information from the government and other sources. However, the economic viability of the telecentres came into question because of their poor performance. Fusion, a subsidiary of Sarvodaya – a large Sri Lankan NGO – explored the issues and helped create viable telecentres.[17] It held a workshop for 25 youth managers to understand their processes and issues. Through this exercise, Fusion was able to identify the key target groups (youth and farmers), their needs and how best to serve them. Fusion runs 200 village information centres and has served more than 200 000 individuals.

Fusion and the University of Mortuwa created a distance education model that brought high-quality courses through the Internet to all rural telecentres, through interactions with professors over Skype, a common syllabus and textbook and a common examination conducted by a certified government agency. This model gives students throughout the country access to quality education with certification, providing a better scope of topical choices and greater employability. It also allows the youth managers of telecentres to be economically independent and to introduce many more services.

For farmers, the telecentres provide basic information on pests and diseases and market prices, but also offer more long-term services through special "agriclinics". Fusion collates updated research from local and international resources and distributes this information through the telecentres. Agriclinics also distribute the information through telecentres, "using both electronic and traditional communication mediums such as leaflets to support farmers' decision-making over pest and disease problems" (Sarvodaya Fusion, 2009).

add services as long as there is a strong enough demand and willingness to pay. In addition, as most providers are pre-existing businesses, they are not entirely dependent on this one stream of revenue to continue operating (especially in the early periods).

Tailored services: Apart from a few of the services mentioned, such as radio, different types of information can easily be added on to or removed from information services – especially for phone-based interventions – depending on the demand from users. This can maximize the benefits for farmers of different crops/animals and in different regions (with different weather patterns), for example. The e-Srilanka example in Box 6 illustrates how such services can be modified after listening to the end beneficiaries.

[17] www.fusion.lk, www.sarvodaya.org and www.seeds.lk

Chapter 3
ICT for market access

In this document, market access ICT services entail any service that gives beneficiaries, especially farmers, access to information on the pricing of agricultural products (inputs and outputs), and connections to and knowledge of suppliers, buyers and logistics providers, such as storage facilities and transport companies. These services also cover ICT solutions that help the typically larger upstream and downstream firms, such as processors or exporters, manage their operations and the quality of the produce better. Most examples, if not all, have a pricing information component and provide information on or links to at least one of the players mentioned: suppliers, buyers or logistics providers (the most common from the farmers' perspective being buyers).

TYPES OF MARKET ACCESS ICT SERVICE

Market access ICT services are somewhat simpler, less varied and newer than the production systems management ICT services described in Chapter 2. The following are some of the market access service types provided. The most common services provide current market pricing for relevant agricultural products. As many of these services are new (and in pilot stages), there will likely be much evolution in final service provision and probably new services and ways of delivery:

- pricing services;
- virtual trading floors (VTFs);
- holistic trading services;
- downstream administration/management.

Pricing services

Simple pricing services generally entail a provider pushing out current market data on one or more agricultural products. Often these data are national or regional in scope, and so may not be entirely relevant for the farmer in the field, depending on his/her proximity to markets. Users (mainly farmers) generally have little interaction with the providers, and must digest the information to find and negotiate with buyers. This service is typically the most common type of market access ICT service provided and simply replaces (or enhances) services that are often provided through print, radio or television. The most common advantages to these services are price transparency and improved negotiating leverage for often-disempowered sellers (farmers). FrontlineSMS[18] in particular has helped provide several pricing services to farmers throughout the world, as described in Box 7.

Virtual trading floors

VTFs, such as the FarmerNet example in Box 8, are electronic market places where buyers and sellers connect over an electronic network (as opposed to providing only static information, as pricing services do). The important difference between VTFs and more traditional trading floors is that the buyers and sellers do not have to be physically in the same location to make an exchange on a VTF.

Matching services: In matching-service VTFs, sellers and buyers connect directly with one another to conduct the exchange of goods available at that moment (the spot market covering today's prices). Sellers register their products and delivery schedules, and buyers register their needs. These records are matched by a machine (or human operators referring to databases), which when requested gives either party a range of options to choose from. There are several matching-service VTFs in various parts of the world although the platform has not taken off as desired. In Bangladesh, the e-Purjee system was established jointly by the Prime Minister's Access to Information programme and the United Nations Development Programme (UNDP) in December 2010. e-Purjee uses SMS to issue growers with permits and billing information for sales of sugar cane to the 15 State-owned sugar mills. Some 2.5 million growers across the country obtain fair prices and no longer have to depend on potentially corrupt intermediaries to sell their sugar cane to the mills. On 13 January 2012, e-Purjee reported on its Web site that it had facilitated almost 500 000 permits for the processing of 826 000 tonnes of sugar

[18] See Chapter 2, particularly Box 3, for background information on FrontlineSMS.

BOX 7
FrontlineSMS – pricing service examples

Many of the more than 20 applications in the area of agricultural development facilitated by the FrontlineSMS software provide pricing information to farmers throughout Africa, Asia and Latin America. The following are just a few examples of these services. As in previously mentioned examples, the advantage of FrontlineSMS is its use of simple, free and open-source software and ubiquitous cell-phone and laptop hardware technology.

Providing cashew farmers in Côte d'Ivoire with timely pricing information: RONGEAD,[19] a non-profit organization, helps small cashew nut producers in five regions of Côte d'Ivoire to gain better access to markets through transmitting market information via SMS. RONGEAD sends 3 000 SMS messages (in addition to an e-newsletter and a local radio show) on prevailing market prices tailored to the five regions. Two sector specialists analyse the pricing data and include their summaries with the general pricing information to help producers make better-informed decisions on when and where to sell. RONGEAD has complemented this with training of producers on how to interpret the data and trends and how to make better decisions. RONGEAD underscores that understanding the information is just as important as receiving it on time (Gonnet, 2011).

Getting price information to fishers in Banda Aceh-Indonesia: FAO-Indonesia is implementing the Fish Marketing Information System[20] project in Bandeh Aceh using FrontlineSMS technology. The objective is to "support the development of conducive and fair trade practices for economically competitive fish products from Aceh in the local, national, regional and international markets". Fish product information is sent to all players in the chain, including fishers, farmers, traders, processors and government agencies, through several types of complementary media: SMS, radio, Web site and newspapers. Data are sent to the system via SMS from local collectors using handsets and FAO's Enumerator software. The goal is to replicate this system in all districts of Indonesia, and the low cost and simplicity of the software mean that increasing the scale may not be a significant issue (Syaputra, 2009).

Sending price information (and more) to remote, rural farmers in Cambodia: In 2009, a team from the University of Canberra-Australia[21] helped put in place the Northwest Agricultural Marketing Association (NAMA)[22] information service in Pailin, Cambodia. The service provides price information (maize, soybeans and cassava), buyer contacts, weather information and farmer communications (e.g., meeting reminders) through FrontlineSMS software. The NAMA service goes as far as rating good suppliers and buyers and providing information on seed and fertilizer costs. The team is now addressing the community's needs in a more holistic way through such services as providing basic health information to rural areas (e.g., health alerts and communications, and health-related information) and information to field extension agents (e.g., weather alerts and meeting alerts) through SMS messages (Fitzgerald, 2009).

BOX 8
FarmerNet – Sri Lanka[23]

FarmerNet by Fusion[24] is a Sri Lankan ICT-based trading platform in the pilot stage. The system enables farmers and traders to send information by SMS regarding the availability of/requirement for a particular commodity, including quantity required, price quoted and location for delivery. The user enters the database and is matched with a corresponding party. The pilot is being carried out for fresh vegetables in Nuwara Eliya in the country's Central Region. The system's robustness and interconnectivity with mobile operators is being studied. About 100 farmers and traders are currently using it.

[19] www.rongead.org
[20] www.infofi sh.org
[21] mathetic.info
[22] http://nama01.businesscatalyst.com/index.htm

[23] www.farmer.lk and http://farmernet.wordpress.com
[24] See Chapter 2, particularly Box 6, for background information on Fusion.

BOX 9

Holistic trading services and *Soko Hewani* – the supermarket on air

The Kenya Agricultural Commodity Exchange (KACE), a for-profit entity established in 1997, developed the radio programme *Soko Hewani* ("the supermarket on air" in Swahili) to help users to sell and buy agricultural commodities (and to sell, buy and lease equipment). KACE reports that it can facilitate the provision of services for 13 traditional agricultural products, six types of livestock, dairy products such as eggs and milk, inputs such as fertilizer and seeds, and even fish and honey. The matching involves not only purchasing of these products but also processing, packaging, transport of commodities, storage, grading, quality testing and finance.

While the initial front-end delivery of the information is "low-tech" (via radio), there is a significant technology back-end to help the matching process. Agents of the KACE Market Call Centre use sophisticated ICT hardware and software to take in, process and respond to requests made around the clock. (Calls made after normal business hours are recorded and addressed the following day.) Each client buyer or seller pays a flat fee of K Sh 100 (about US$1.10) for each call made, no matter how long the call lasts; market clearing and other services entail additional fees.

The process is as follows:

- Using a mobile phone, a client seller calls the Market Call Centre to place an offer to sell or offer lease an agricultural or other commodity, property or service.
- A client buyer on the other side of such a transaction seeking information on offers of services calls in via a mobile phone, uses the Web site through a subscription plan, or visits a KACE Market Resource Centre. Buyers can also make bids to buy or rent an agricultural commodity, property of service.
- Each call is answered by a KACE agent, who registers the information, which is entered into the main database where it can remain for up to 14 days until fulfilled. (Eventually, KACE plans to enable such enquiries to be made via SMS and not just live calls.)
- KACE selects a small number of verified offers and bids for the *Soko Hewani* radio programme, which is broadcast through several local radio stations across the country. The broadcast lasts for 15 minutes each day.
- Interested parties call KACE back to accept or negotiate the broadcasted offer.

KACE reports the main benefits for stakeholders as:

- achieving a better price for services;
- saving on search costs;
- reaching a wider audience of potential buyers/sellers;
- avoiding exploitive intermediaries.

Source: Mukhebi, 2011.

cane to produce 47 000 tonnes of sugar.[25] *Soko Hewani* and the Kenya Agricultural Commodity Exchange Ltd (Box 9) is another example of this type of VTF.

Commodity exchanges: More conventional commodity exchanges differ from the one described in Box 9 in that they act as intermediaries to match buyers and sellers at the right price and quantity without either side of the transaction knowing who the other is. This type of exchange is similar to the commodity exchanges found in the developed world (other than in size and sophistication), such as the Chicago Mercantile Exchange in the United States of America. An advantage of commodity exchanges is that not only is there a spot market of current prices, but the exchange also generally has enough information to estimate future prices and even to provide risk management services through forward contracts or more complex derivatives for buyers and sellers, to mitigate potential losses from price fluctuations in the future (and ideally to smooth out income expectations). However, these types of commodity exchange are generally more difficult and capital-intensive than a match-

[25] www.epurjee.info/en_index.php

BOX 10

DrumNet – facilitating an entire sunflower oil value chain through ICT

DrumNet, founded by Pride Africa in 2007, intervened in the French bean, passion fruit, baby maize and sunflower markets in Kenya.[26] DrumNet is a holistic trading model that brought together many different stakeholders in agricultural value chains – suppliers, buyers, input suppliers and financiers – to facilitate stakeholder relationships and put in place processes and mechanisms that help the parties to complete transactions.[27] In particular, DrumNet: i) organized farmers into marketing groups to increase market leverage; ii) offered information services, such as weather information and more intensive extension services; iii) provided pricing and VTF services; and iv) facilitated access to credit. DrumNet used local entrepreneurs to provide the services in the field and charged a fee per activity – often of 10 percent of the gross transaction value – for its brokerage, administrative and transactional services, to remain viable (FAO, 2008). DrumNet's low-cost open-source ICT infrastructure was compatible with different channels, including the Internet, mobile phones and other wireless devices, providing SMS scouting, data mapping and tailored reporting on market trends, weather and prospective partners, produce aggregation and post-transaction payment processing. Most communication among the different players was through simple and inexpensive mobile phones and SMS messages.

DrumNet operated in the sunflower market from 2007 to 2009, serving smallholder sunflower producers who were connected to Equity Bank and input suppliers. One of the largest successes of DrumNet was contracting Bidco Oil Refineries Ltd, the largest manufacturer of vegetable oils in East Africa.[28] DrumNet tracked and facilitated each process in the value chain, from input purchasing and credit through to the sale of produce to a buyer (and the repayment of credit). DrumNet first organized sunflower producers into groups, and created subcontracts between producers or groups of producers and Bidco, defining their respective obligations. At harvest, contracted produce was aggregated and graded at designated collection points, then sold to Bidco.

DrumNet facilitated much of the information flow up and down the supply chain via the use of SMS and mobile phones to enhance more than transactions and financing. For example, Bidco was able to track what and how much was planted, enabling it to create product plans. It was also able to monitor crop progress and pass on important extension information to producers. Input retailers could obtain information about which products to stock and when, and producers were informed of produce collection dates and locations.

DrumNet's robust ICT system provided the internal controls (and trust in the system) to track and report on compliance throughout the process.[29] By the end of the initial pilot, DrumNet had intervened in five provinces with two large buyers, a commercial bank and more than 4 000 farmers. Farmers had improved produce sales by an average of 20 percent, and the institutional buyers lowered their costs by 10 percent for higher-quality produce. DrumNet operations broke even in many of the regions and proved the possible business case for commercializing and scaling up the concept (Rausch, 2010).

Despite the success of the initial pilot, however, DrumNet was unable to scale up for the following reasons:

- The partners' diverging interests created misunderstanding of roles and diverted the model away from its core purpose.
- Farmers lacked familiarity of using SMS, and mobile phones had relatively low penetration.
- Although innovative, the software back-end was not robust enough to support a higher volume of business (Rausch, 2010). DrumNet tried to create a new system to address this issue, but had troubles with individual developers. Eventually the funds were depleted before the software was finished.

To avoid such issues in the future, DrumNet recommends that other support organizations should choose partners carefully and define expectations clearly; utilize software that is readily available; and place the model's integrity above all else (Rausch 2010).

Source: Pride Africa, 2009.

[26] www.prideafrica.com

[27] More on the financing component of DrumNet is covered in Chapter 4, particularly Box 15.

[28] www.bidco-oil.com/common/index.aspx

[29] DrumNet learned the hard way to focus on local consumption markets. In a parallel study on the export market, DrumNet farmers were more likely to export than other farmers, but they did not enjoy an increase in incomes or receive European Union (EU) certification. The exporter dropped the farmers because of the lack of certification, and the farmers' crops were left to rot in the fields (Karlan, 2009).

ing service, such as the VTFs mentioned in the previous subsection.

Both trading floors and exchanges are difficult to set up because of the capital required. It is also difficult to achieve success because the "network effect" has a significant impact on the numbers of buyers and sellers involved (and the product volumes). With exchanges such as these, the higher the volumes and numbers of players, the better the information and the exchange's value. So it is difficult to achieve break-even in the early years, as players decide whether or not they want to be part of the exchange. Another potential issue for commodity exchanges is that they are a volume business, and small producers may not have large enough product allotments to participate, or may be priced out by high or flat fees.

Although VTFs have had only limited success, they are an important step in using ICT to reduce the distance between the producer and the buyer. In many traditional value chains, it is common to have three to four intermediaries between the producer and the final consumer, making the producers' revenue share in the value chain much lower than is often warranted. Reducing the number of intermediaries by even only one or two through VTFs can boost the producers' return if carried out efficiently.

Holistic trading services – virtual trading floors

Holistic trading services essentially provide the same services as do pricing information services and VTFs but they offer additional assistance beyond the simple economics of purchasing and buying agricultural products. This assistance can entail services such as weather information, technical information on agricultural practices, and long-term education. These holistic service packages can link not only suppliers and buyers but also parties involved in logistics, transportation, processing and storage (such as the KACE example in Box 9). Often, holistic ICT providers also offer access to financial services (payments, credit, etc.), such as DrumNet's facilitation of bank credit described in Box 10.

These holistic types of service can be advantageous for many rural farmers in developing countries, who often have more than one problem or gap. Rural farmers often have many impediments that prevent them from maximizing their agricultural product yields and incomes, such as low productivity resulting from poor use of fertilizer, and lower income because of not knowing prevailing market rates. Packages of holistic services can serve farmers' critical needs more efficiently and from a trusted source. Holistic services can also put more of a "face" to the service package than can offering a simple pricing service, for example, which sends out only static information. Farmers often have follow-up needs and extensive customer service/extension service needs well beyond simple information.

The drawbacks to these holistic services are essentially the same as those for VTFs: i) large capital outlays; and ii) the need for a large network to reach the necessary scale for sustainability – this need is likely to be more pronounced for holistic services than for VTFs. Many of the services added on to pricing and trading also require extensive human interaction with the consumers. As there is an almost infinite number of potential add-on services (or VAS), practitioners should take care in planning how many types of service to offer and which services to roll out in the initial stages. Service providers may want to focus on only a few additional services at a time, to ensure that these are highly needed services and to avoid overwhelming the system and staff. Although relatively successful, the famous e-Choupal kiosk system has run into such issues with its *sanchalak* kiosk entrepreneurs becoming overwhelmed by the product offering, as described in Box 11.

Downstream (and upstream) administration

In the context of this document, downstream administration essentially entails any ICT solution that helps direct value chain players beyond farmer producers – such as input suppliers, cooperatives, bulk/lead-firm buyers, exporters, processors and transport companies – to manage their businesses more efficiently. There are too many types of solution to list here. Examples include:

- accounting systems for cooperatives, to improve financial management and reduce fraud and errors;
- systems that monitor the level of moisture or temperature for products stored in a warehouse, to avoid spoilage;
- satellite tracking of trucks moving produce from the cooperative to the processor's plant;
- equipment that tests the quality and fat content of dairy products, updating a system for calculating payment amounts;
- databases of input suppliers for farmer customer management, such as Kickstart, Kenya's use of FrontlineSMS to reach potential farmer customers (Kilo, 2009);

BOX 11

Farmer kiosks – e-Choupal in India

ITC is one of the largest multinational conglomerates in India and is traditionally known as the main player in the local tobacco and cigarette markets.[30] Over the last few decades, ITC has diversified into new areas, including branded prepared foods and snacks, and basic food ingredients such as flour and oil. This diversification pushed ITC into setting up a standard system for procuring ingredients in specific quantities, leading to the creation of the ITC e-Choupal service.[31]

In 2000, ITC's solution was a network of e-Choupal kiosks, each equipped with a simple desktop computer and printer, powerful battery back-up (uninterruptable power supply), solar panels (if needed) and a very small aperture terminal (VSAT) array for connection to the Internet.[32] In rural areas, village Internet-enabled kiosks are provided and managed by entrepreneur *sanchalaks*, who are often farmers. These *sanchalaks* provide access (and translation) to many different types of information and service, such as weather and market prices. It is estimated that an e-Choupal kiosk costs between US$3 000 and US$6 000 to set up, and about US$100 per year to maintain. Farmers are not charged for using e-Choupal's services, but the *sanchalak* incurs operating costs. *Sanchalaks* have exclusive rights to serve about ten villages in a given area and receive a commission on each transaction (about 0.5 percent of the value of the trade). ITC reports that it takes one year to recover set-up costs from an e-Choupal kiosk and that the venture as a whole is profitable. There are now more than 6 500 e-Choupal kiosks covering more than 40 000 villages across 16 states of India. In the decade following their creation, e-Choupal kiosks helped an estimated 4 million farmers.

e-Choupal connects buyers with farmers to procure agricultural/aquaculture products such as soybeans, wheat, coffee and prawns, to reduce transaction costs. At harvest time, ITC buys crops directly from any farmer at the previous day's price; the farmer transports her/his crop to a processing centre for weighing and quality assessment. The farmer is then paid for the crops (at a higher rate if deemed of high quality) plus a transport fee. e-Choupal also offers farmers many other value chain development services through its ICT-kiosk platform, such as sharing of best practices to improve productivity, and price benchmarking to increase sales prices.

e-Choupal reports that farmers earn an average of US$6/tonne more because of more accurate weighing and better pricing information. ITC has benefited through lower procurement costs (about 2.5 percent less) owing to lower intermediary fees and transport costs, and more direct control over produce quality. Through direct action with farmers, the system feeds information to ITC on conditions on the ground, improving planning, reinforcing relationships and ultimately improving supply security.

However, following the introduction of a large variety of products and services at the kiosks, including consumer products, many *sanchalaks* have become overwhelmed and may not have the requisite expertise to explain or provide the service adequately. To add to the confusion, e-Choupal has invoked significant product churn. One of the larger questions is kiosk sustainability – many kiosks have yet to attain long-term viability. The issue is not costs but rather the adequacy of revenues, as most farmers use the market access services only once or twice a year and are not heavy users of the other services. Although the market access services have been a relative success, as a purveyor of information services, e-Choupal has achieved only weak to moderate success. Nevertheless, ITC plans to expand into the remaining Indian states and to offer services for even more agricultural products, as well as financial services such as insurance and microcredit, and health and education services.

Source: Annamalai and Rao, 2003.

[30] Formerly known as the India Tobacco Company, the company is now called just ITC as it offers many more products and services. www.itcportal.com and www.itcportal.com/itc-business/agri-business/agri-commodities-and-rural-services.aspx

[31] www.itcportal.com/itc-business/agri-business/e-choupal.aspx and www.echoupal.com/

[32] A VSAT connection typically entails a small outdoor transceiver to communicate with satellites for the connection, and an indoor interface device connected to the computer. These devices are ideal in areas (often rural) where typical Internet connections through phone, cable and/or Internet service providers are not available. http://searchmobilecomputing.techtarget.com/definition/VSAT

- export traceability solutions that track produce through the entire value chain, from farmer to end consumer (see following explanation and examples).

Traceability systems: Traceability is often but not exclusively applied to export markets and entails a system of record keeping and documentation by value chain players that enables tracking of the movement of a product or ingredient throughout the agricultural value chain. Traceability systems should aim to enhance the continuity of information through the food supply chain, making them eminently suitable users of ICT. By establishing a food traceability system, governments and companies can win the confidence of consumers and address documentation requirements stipulated under export trade agreements.

However, traceability requirements can impose a significant burden on players in the value chain, so the hope is that ICT can make data input more efficient and reliable, thereby lowering the cost of compliance with traceability standards. The additional data should also help value chain players improve their businesses in the long run. To minimize complexity and costs, organizations tend to combine high-technology solutions with low technology, such as the simple segregation of sourced products in different containers, warehouse compartments, etc.

Most developing countries have to start with the basics of traceability and overcome many coordination issues resulting from the frequent fragmentation of players within the value chain; many smallholder farmers, governmental agricultural departments, formal and informal processors, testing laboratories, transport companies, warehousing facilities and exporting companies are involved. To establish a secure traceability system for the food chain, it is necessary to ensure consistent standards not only *within* individual organizations, but also *between* food business operators along the supply chain, from upstream to downstream. When establishing traceability systems for an entire industry, it is also desirable to ensure consistency *among* food business operators who are at the same stage of the food value chain, such as processors or packers.

Critical parameters to be met for a successful traceability project include:

a. systems-orientation, in which no documents are issued without interaction with the software;
b. ability to review all the previous steps completed, to track the movement of documentation and products;
c. inbuilt checks and balances in the software ensuring that the succeeding step can be carried out only when the preceding steps have been successfully completed.

Examples of traceability systems from around the globe include the following:

- *The Agricultural Produce Export Development Agency of the Government of India* has installed the integrated monitoring software TraceNet to cover all the produce stakeholders in the supply chain with a centralized database. TraceNet is an Internet-based traceability software system, which goes up to the farm level and includes components for monitoring pesticide residue, achieving product standardization and facilitating product tracing back from retail shelves to the farm, using various techniques of sampling, testing, certification and packing. This solution has been successfully used by grape farmers and there are plans to include pomegranates, mangoes and other key fresh produce (Logicsoft, no date).
- *The Livestock Identification Trace-back System project of the Government of Botswana* uses radio-frequency identification devices (RFIDs) to capture data on individual cattle, which are transmitted directly and error-free to a central database. RFID tags are located in the stomachs of more than 135 000 cattle, which can be individually identified and traced throughout their lives. The database helped Botswana's meat export industry obtain EU certification for exports, and is a critical information source for livestock farmers, State veterinary services and health authorities (Burger, 2004).
- *The Jamaica Broilers' Group* (private) installed a US$500 000 (J$40 million) computer-based inventory management system that allows it to track its products in real-time from pre-delivery, before the chickens reach the warehouses as raw material, to the distribution of the finished products for customer consumption. The system, called Mobile Enterprise Mobility solutions and created by Motorola, uses barcoding and scanning technologies to increase the speed of processing and to reduce human error in the tracking inventory (Motorola, 2008).

- *Sustainable Harvest and the United States Agency for International Development (USAID)* (mostly private) have collaborated in the United Republic of Tanzania and Peru to create the Relationship Information Tracking System (RITS) for coffee traceability. Farmer cooperatives use RITS to track deliveries and define the variety and quality of different coffee bean lots. Roaster customers can also access videos, photos, quality and lot information from the supplier cooperatives. RITS can be used through any Internet connection or smart phone, but primarily uses Apple iPads and iPhones because of their user-friendly interface (Sustainable Harvest, no date).

COMMON ICT PLATFORMS FOR MARKET ACCESS ICT SERVICES[33]

Pricing services: For simple pricing service initiatives, the requisite ICT front-end and back-end infrastructure is minimal. Many initiatives use the existing mobile phone infrastructure to deliver services through a specially developed simple software application that is housed on a user's phone or through even simpler (and cheaper) SMS messages. However, these services are often delivered in parallel via many low-technology channels, such radio, TV and newspaper.

Virtual trading floors: VTFs also often use mobile phones as a delivery mechanism, but need a more sophisticated back-end infrastructure (which is more expensive to set up and maintain) because of the needs for two-way communication and for safeguards to ensure timeliness and security. These systems often require more human resources to serve the users directly and to trouble-shoot.

To eliminate mistakes, these services have installed robust call-centre software and hardware. Although still not perfect or ready for scale-up, some providers are now experimenting with voice-enabled systems or IVR in which the user moves through the service with the help of the ICT system (which uses the local language), rather than having a human operator. Such systems can also help reduce human error, enable those who are illiterate to use the service, and even offer a higher level of security owing to the uniqueness of each individual's voice.

Holistic trading services: Because of the diversity of holistic trading services offered, the ICT needs also vary. However, to support many products and services on one platform, the systems for these services need to be far more robust than those for pricing services and basic trading floors. Some may even need to implement an expensive enterprise resource planning system to ensure coordination and communication across the different platforms used. If data needs are high, connectivity and information delivery are critical in the field, where existing infrastructure (even mobile phones) cannot suffice. The provider may therefore need to create infrastructure, such as ITC has done with its e-Choupal kiosks using VSAT connections (Box 11). These services also depend on strong relationships with and customer service for their users, which cannot all be automated. Holistic trading services therefore require well-informed and always available human resources.

ISSUES AND CHALLENGES FOR MARKET ACCESS ICT SERVICES

Up-front investment: Other than simple pricing services and other mono-focused VAS applications delivered over mobile phones, market access services in general require high levels of investment of capital and human resources. Such services are often non-existent or have no infrastructure to build on, necessitating significant capital outlays for development and for acquiring equipment and software. The volumes required for profitability and the security required for gaining user trust also demand significant capital outlays. Providers can overcome these challenges by partnering existing parallel providers, such as MNOs, and using their networks, especially for delivery.

Scalability and viability: Scale determines the viability of market access services. Very few examples of highly successful and profitable market access ICT services at significant scale were found. Many of the examples in this chapter are at the pilot stage and are still being subsidized to some extent. Even the oft-cited e-Choupal has not realized a clear and proven business model. However, while there is no typical business model for information services, there is one for market access services, which generally facilitate transactions and services that farmers already pay for, meaning that customers have a clearer idea of the cost and value of the services.

[33] There are many possible solutions for downstream administration improvements through ICT across all industries. This section includes only a selection of the possible hardware and software solutions available.

Farmers and other value chain providers have been using the old, low-technology intermediary system for market access for ages. Convincing them to change will take time and require the establishment of a clear value proposition that can be trusted. The intermediaries will fight back to protect their businesses, and the providers of market access ICT service might want to consider developing a transitional solution, such as e-Choupal's use of intermediaries as *samyojaks*. If market access ICT service providers can find a way of securing sufficient numbers of farmer and buyer customers, their incremental revenues should eventually exceed the mainly fixed costs commonly involved in such ICT offerings. Once such a service is set-up, expanding into new regions or new products (such as rice versus wheat) will not require much additional capital, as the main system is already in place.

Trying to be all things: While holistic trading ICT services are an intriguing idea as efficient and valued "one-stop shops", especially for farmers, there are risks involved in this model. One of the primary issues is that new services tend to take on too many initiatives at once – often adding two or three (or more) new services before the first has yet proved successful and viable. Field agents and call centre representatives may also become confused by wide-ranging offerings, or be inadequately trained on them. Another risk area is customers' perceptions of the overall service (i.e., the brand). Customers may become confused by the variety of services being offered, or prefer specialists for the services that are most critical to them. Many holistic service providers are likely trying to offer several services at once to cover the significant fixed costs of creating an entirely new channel and ICT infrastructure. However, rather than pursuing economies of scope by offering many products before the system and brand are proven, providers may consider focusing on economies of scale by taking on the one or two services that are the most important/critical for the most farmers.

ADVANTAGES OF AND OPPORTUNITIES FOR MARKET ACCESS ICT SERVICES

Time and cost efficiencies: One of the clearest advantages of using an ICT solution to provide market access services is the empowerment of the poor and their potential gains in income from better sales prices and reduced transaction and transport costs. Such services should also reduce the time it takes for all players to conduct transactions, allowing them to spend more time in more productive or personally preferred activities.

Improving the overall value chain: Not only can market access ICT services help improve cost and time efficiencies throughout the value chain, they can also help realize other less tangible but equally important advantages, such as improving the way business is done. These ICT services can help improve trust among players by providing transparency of prices, transaction histories/reputations and other information. Knowing the person on the other side of the transaction also helps to reduce defaults on trade credit through proper screening and the desire of each player to continue functioning in the market in the long term. Such gains in trust should also help to improve the overall success of transactions in general – delivery, storage, etc.

Smart technology: One of the more encouraging aspects of the examples profiled in this chapter is the use of smart technology. This term is not used in the same way as it is in "smart phones", which can do seemingly smart things, instead it refers to the appropriateness of ICT for delivering the needed value chain services. The market access services provided through ICT are rarely entirely new – price information provision and buyer-seller brokerage have always existed. So rather than throwing out the low-technology solutions altogether, many of the examples, such as *Soko Hewani* in Kenya, use ICT to complement and strengthen other channels such as radio and newspapers. Not only does this allow markets to transition more smoothly into technology adoption, it also allows time for the technology to improve and yield reductions in implementation and maintenance costs (early adopters often obtain inferior technology that costs more than it would have done if they had waited for a year or two). The examples have also demonstrated that the technology is not the product or service itself (the "what"), but rather the means for end users to obtain that product or service (the "how"). The ultimate goal is therefore not to purchase the best and most expensive ICT solution, but rather to supply services in the most convenient and cost-effective way, regardless of how.

Chapter 4
ICT for financial inclusion[34]

ICT applications for improving financial inclusion within agricultural value chains have long been pursued but have been elusive, especially when scaling up their use. Other than limited use of personal digital assistants (PDAs – the pre-cursor to smart phones) (CGAP, 2004) in the late 1990s and early 2000s, much of the ICT used for financial inclusion in the past was "back-office", focusing on helping financial institutions manage and track the data created from serving thousands of small customers at once.[35] ICT is now sufficiently evolved (and has become less costly) to be more widely used for direct customer interactions.

Many studies have shown that farmers in the developing world can and do use financial services extensively, such as savings groups or local moneylenders, even if no formal or semi-formal financial institutions are available. With the help of ICT, formal (i.e., banks) and semi-formal institutions (such as NGO microfinance institutions [MFIs]) can extend their reach if they provide their services in ways that satisfy the primary needs of the rural poor: i) convenience, such as short distances, appropriate opening hours and low documentation needs; ii) security, such as a strong brand, good systems and ethical field staff; iii) flexibility, such as few withdrawal/deposit restrictions and appropriate products that match agricultural cycles; and iv) of course, low cost (Rutherford, 1999). ICT can help satisfy each of these customer criteria by:

1. helping financial service providers extend their reach into remote areas, through eliminating the need for full service branches, which also reduces costs;
2. improving access to financial services, by putting more direct control over how such services are used into the hands of local operators/agents or the customers themselves.

TYPES OF FINANCIAL INCLUSION ICT SERVICE

The primary types of financial services offered through ICT solutions for value chains are:

- transfers and payments;
- credit;
- savings;
- insurance;
- financial derivatives.

Transfers and payments

Transfers: The most recognized and successful solutions in the provision of financial services to rural areas are those offering payments and transfers. The most widely known example, M-PESA in Kenya, mentioned in previous chapters, began as a service enabling people living in cities to send money back home (money transfers) to their families in rural villages in an easy, trustworthy and low-cost way. The individuals at each end of these transactions typically use their own mobile phone for processing the transfers and visit the local shop for depositing and withdrawing the cash. This service type, such as the two examples from the Philippines described in Box 12, does not help improve agricultural value chains directly but facilitates the provision of supplemental income for when the agricultural cycle does not permit income generation, and therefore creates a safety net for rural farmers and their families. The service is typically called a direct person-to-person (P2P) service. These types of solution are often offered by MNOs rather than banks, as the service is a simple cash transfer, similar to that offered by Western Union. (However, many banks are catching up or partnering MNOs.)

In recent years, governments have also begun to make transfer payments – government-to-person (G2P) payments – such as welfare, social security and pension transfers to beneficiaries, through these same electronic platforms. Ideally, this new way of transferring monetary benefits reduces costs, improves efficiency and, most important, reduces graft and waste. GCASH, described in Box 12, and the Brazilian model profiled in Box

[34] This chapter does not cover traditional microfinance/microcredit in general but rather focuses on financial service support for players within agricultural value chains.

[35] As back-end ICT solutions have been widely available for many years, and are therefore generally understood, this report does not cover the available solutions and requirements.

BOX 12
Mobile financial services in the Philippines

Two of the main mobile financial service (MFS)[36] providers in the Philippines are SMART Money and GCASH. While both have expanded the services they offer, their main service remains money transfers from family members living abroad (international remittances) and those living in Philippine cities sending money home to rural villages (domestic remittances). SMART Money and GCASH both focus mainly on domestic remittances, airtime purchase and bill payments (although most rural users do not use the bill payment service) (BFA, 2010). GCASH has started a money transfer pilot with the Philippine Government in its conditional cash transfer programme of benefits to the poorest – often rural – Filipinos (G2P) (Bold, 2011).

Introduced in 2001, SMART Money is run by *Banco de Oro* Universal Bank in partnership with SMART Telecom. The product is a prepaid card, which enables access to cash using an ATM (9 000 to date),[37] a credit card terminal or a mobile phone (with 4 000 cash-in/-out points). GCASH was introduced in 2004 by Globe Telecom.[38] GCASH's money transfers primarily occur through using a mobile phone and visiting a local GCASH agent at one of the more than 18 000 points (Bold, 2011). In October 2010, CGAP reported that SMART had 1.3 million previously unbanked, active customers and GCASH 247 500 (McKay and Pickens, 2010). A majority of GCASH customers tend to send money within and between more urban settings, as more than 60 percent of Filipinos live in urban areas. About half of SMART Money's users are in rural areas (BFA, 2010).

GCASH and SMART Money, both well known in the MFS sector, have evolved and improved their services over the years. However, there are still issues related to trust, lack of awareness and lack of available cash points, especially across such a vast country as the Philippines with several thousand islands (BFA, 2010).

16 both provide these types of G2P payments to rural families.

Payments: While the P2P and G2P transfers mentioned in the previous subsection have been more widespread and successful as supplemental sources of indirect support to agricultural value chain players, ICT-based payment services provide perhaps an even more compelling way of improving agricultural value chains directly. These options entail business-to-person (B2P) and person-to-business (P2B) models, with payments from businesses to people/farmers (B2P) or the reverse, from people/farmers to businesses (P2B).

B2P ICT payment services typically entail a buyer of agricultural products paying a farmer (or group of farmers) for his/her agricultural products. The buyer does not pay in cash but rather through electronic payments that are typically transferred to either the farmer's bank account or to his/her mobile (phone) money account to be withdrawn at ATMs or cash-in/cash-out points – often local retailers. The advantage of such a service is that the buyer does not have to worry about keeping large amounts of cash on hand of about all the related administrative issues and human resources required. Farmers are typically paid much faster, do not have to travel several miles to be paid, and do not have to carry the entire cash amount for a harvest on their person, risking theft, loss or overspending. Box 13 describes how farmers and buyers have used M-PESA, which is generally a P2P system, and effectively turned it into a P2B payment system, without having to create an entirely new infrastructure/system.

P2B ICT payment services involve the farmer paying a business, typically an input provider, for the purchase of inputs such as fertilizers and pesticides. There are often two transactions in this process in which the trade or input supplier extends credit (credit is described in greater detail in the following section) to the farmer to obtain

[36] In this report, the term "mobile financial services" (MFS) refers to the use of mobile phones or any mobile device for financial services such as mobile banking (or m-banking), cell-phone/cellular banking and mobile money. Electronic banking or e-banking encompasses a wider spectrum of ICT solutions for financial services, including m-banking, but also desktop computing and typical Internet banking, which are not mobile. Branchless banking typically entails an m- or e-banking solution, but here the mobility refers more to the location (e.g., roaming agent or fixed retail shop) and human resources (e.g., agents instead of staff) than to the services provided.

[37] www1.smart.com.ph/money/what/

[38] http://gcash.globe.com.ph/

BOX 13
Highest bidders paying farmers via M-PESA Kenya

In Ng'arua, 350 km northwest of the Kenyan capital, Nairobi, farmers are able to circumvent intermediaries and sell their maize directly to the highest bidder through *Sokopepe*, an online commodity marketing platform created by the Arid Lands Information Network, an NGO operating in three East African countries.[39]

Farmers must first be members of the local *Maarifa* (knowledge) centre, where they can learn about weather patterns and farming techniques, among other topics. The *Maarifa* field officer moves around the village entering the amount of produce each farmer has into a Windows-based mobile phone that is directly linked to the *Maarifa* ICT network and the *Sokopepe* Web portal. Registered buyers then log on via the Internet – buyers are often larger and urban-based so have access – to see what is available and what price they should pay. When the buyer makes a bid, the bid is sent back to the Maarifa centre. The buyer then retrieves the maize and often pays farmer members via M-PESA.

Source: Wararu, 2011.

the inputs; at the time of harvest, the farmer repays the input supplier using the income earned from the sale of agricultural products (and perhaps obtained through B2P payments). The agricultural product buyer may even coordinate with the input seller/trader so that the input seller/trader is paid before the remaining amount of the payment is sent to the farmer. Such solutions are often completely cashless, meaning that payments are often sent between the buyer's bank account and the input supplier's bank account, using traditional computer terminals and the Internet to conduct the transaction and monitor the many different sales of inputs and related trade credit (i.e., this type of P2B is often really business-to-business [B2B]). The primary advantage of using ICT for P2B payments is the reduced administrative and human resources costs it requires to track and process such payments, which are often relatively small and numerous. Using B2B payments also reduces the chance of default on trade credit.

Agricultural credit[40]

For many decades, the use of agricultural credit has been a common response for facilitating rural development. Large credit programmes through governments have often failed, but in recent decades, there has been a significant increase in access to credit from private credit providers, such as input suppliers, lead buyer firms, specialty lenders, MFIs and banks, which all require at least sustainability if not profitability. This trend has encouraged a search for higher efficiency, improved (credit) risk monitoring, and better delivery to farmer and institutional customers; ICT has played a significant part in achieving all three of these aims.

Efficiency: One of the main reasons that financial institutions do not extend their services to remote rural areas is the issue of cost. Running a branch in a rural area and running one in an urban area require (more or less) the same amount of "bricks and mortar", information technology, security and human resources. Many of these costs are fixed in nature. However, the amount of business that can be generated in a rural branch is significantly less, with fewer customers, who often have much smaller transaction needs. This means that (up to a point) it takes the same amount of resources to service 1 000 as 2 000 clients, and the same amount of time to underwrite and administer a single loan of US$100 as one of US$1 000.

ICT can often serve as a way to reduce the effect of these fixed costs even when there are fewer clients, who have small financial needs. First, ICT can increase the number of customers one staff member can serve in the credit underwriting, disbursement and servicing processes by reducing the required paperwork, eliminating entire (unnecessary) steps altogether (such as the need to talk to more than one staff member), and reducing duplication of data entries (e.g., by only having to

[39] www.sokopepe.co.ke and www.alin.net

[40] This report does not describe all the different kinds of agricultural finance application for ICT. Many opportunities for ICT can be linked to value chain finance. For more information, see Miller and Jones, 2010, or visit FAO's Rural Finance Learning Centre Web site: www.ruralfinance.org/library/service-provision/value-chain-finance/en/?no_cache=1

BOX 14

Keeping it simple through basic ICT – ACDI/VOCA and access to agricultural credit in Honduras

Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance's (ACDI/VOCA's) activities for improving access to agricultural credit in Honduras provided credit management ICT tools (and training) to improve credit disbursement and administration for retail input suppliers. The technology used was simple off-the-shelf accounting software packages (QuickBooks) and tools that ACDI/VOCA had modified from other microcredit programmes, including an Excel-based cash flow analysis tool and an Access-based loan portfolio management tool. These tools were not only inexpensive to implement and use but also improved the lending and collections process and reduced delinquencies through improved monitoring. This also helped improve the funding coordination and communication processes of the larger input distributors providing the financing (which often received the funding from banks), while the retailers acted as intermediaries in providing credit directly to farmers and monitoring. With the improved administration, the retailers began to negotiate better terms from the distributors, including for wholesale credit funds.

Sources: AZMJ, 2011; Grace, 2011.

provide the customer's name once even when there are several "forms" to be filled in). By increasing staff productivity, this can help increase top-line revenue. Second, ICT can reduce costs. Instead of increasing revenue by having more productive staff, the lender can cut back on the staff needed. Other fixed costs can also be reduced, especially regarding the physical infrastructure required. A simple example is that less space is needed for the processing, filing and storage of documents. The IT infrastructure needed can be sophisticated and expensive, such as banks' proprietary solutions with whole IT staff teams and rooms full of secure servers, or simpler (and cheaper) solutions can be used, such as cloud-computing (data storage on the Web) or "off-the-shelf" software, much as in the example from Honduras described in Box 14.

Credit risk management: In addition to the efficiencies that ICT can generate for credit, technology can also help to improve financial risk management systems that are already in place. The primary risk that lenders face is credit risk, or the risk of default by borrowers. Technology allows lenders to enter data during the underwriting process, using software that can predict the likelihood of default in a short time (e.g., by checking external credit bureaux or using the lender's own credit scoring methodology), while individual humans could not possibly do the same without spending significant analysis and data review time. ICT can also enable lenders to know how exposed they are to sub-industries or regions, helping them to avoid overreliance on one group of customers. By completing the menial analysis, ICT also permits lenders' staff to spend more time on the more value-added due diligence activities that technology cannot do, such as reference checks and visual examination of places of business. Post-disbursement, ICT also allows lenders to aggregate and analyse transaction data for monitoring credit repayment trends for the entire portfolio at once and for identifying any individual credit red-flag issues or clustering red flags, including mass defaults in a certain region or within a certain sub-industry such as dairy farmers. A mass default situation can be mitigated by the speed of data transmission. ICT can assist in this by connecting branches/outlets to the central office in real time/on the same day, rather than having each branch send in monthly paper-based reports, for example. Such data transmission can be done through sophisticated dedicated line transmission or simpler, less costly transmission over the Internet or through mobile phone networks.

Delivery: Efficiency gains and risk management improvements benefit primarily the lending organization, but the end customers can also benefit from their lender's use of ICT. The primary benefit is access to credit that many farmers may not otherwise have, or access to better credit terms from a well-reputed institution (versus depending solely on local moneylenders or potentially exploitive trader credit). Farmers can also benefit from the use of ICT through improvements in delivery, such as door-step delivery (versus having to visit the bank branch) and reduced transaction

BOX 15

Making agricultural credit more accessible and easy for farmers – DrumNet and Equity Bank in Kenya

DrumNet[41] helped link financial institutions, smallholder farmers, retail providers and agricultural product buyers through a cashless microcredit programme. Farmers obtained inputs (e.g., seeds, fertilizers and pesticides) at local input providers using a pre-established line of credit from banks, particularly Equity Bank, via DrumNet.[42] DrumNet's facilitation of fixed purchase price contracts and a transaction insurance fund provided adequate collateral and comfort for the bank partners to lend to farmers. DrumNet also facilitated farmer customers' access to banking information, such as account balances and loan payment histories, through their mobile phones. It provided credit/credibility ratings of the farmers for the banks, based on who had paid their loans on time and delivered promised product on time, in the right amounts and of the required quality.

For example, contractual agreements between farmer producers and Bidco, a large sunflower seed oil producer, for the purchase of sunflower seeds post-harvest allowed producers to obtain credit and to purchase farming inputs from certified input retailers, through in-kind loans and a cashless payment procedure. Farmers applied for and received credit from Equity Bank, which then notified the input retailer to provide the inputs. DrumNet facilitated and tracked payments for each seller, and credit was automatically repaid to Equity Bank when the produce was sold.

The farmers obtained access to lower-cost finance from Kenya's largest bank by number of customers. They also benefited by not having to visit a distant branch or undergo an extended underwriting and disbursement process, taking them away from important activities in their fields. Bundling of the farmers into larger groups, improved risk assessment (credit scoring) and strong collateral (Bidco contracts) enabled Equity Bank to administer some K Sh 4 million (about US$46 000) in loans to more than 4 000 previously unreachable farmers.

One significant challenge was restrictive laws, which delayed the clearing of certain transactions. (Unwillingness of the bank to modify its systems was another challenge.) For example, SMS messages were not considered legal documents, leading to payment delays.

Sources: Pride Africa, 2009 and Web site.[43]

times (meaning more time in the fields). Farmers can have more control over their finances through ICT such as mobile phones, by being able to check their credit balances and confirming that lenders' staff have registered their repayments, as described in the DrumNet example in Box 15.

Savings for agricultural needs[44]

For farmers, savings can serve two purposes in supporting the agricultural value chain. The first is that accumulated savings can help the farmer to purchase larger ticket items, such as a year's worth of fertilizer or an ox for ploughing. Savings are often insufficient to cover the entire price of the expensive item, but they reduce the need for taking on credit. The second main purpose is as a safety net – a type of self-insurance – for emergencies, such as a sick family member or livestock or floods that wipe out an entire crop and homestead. Savings are often either set aside when the annual harvest payment is received or generated from supplemental income-generating activities that often take place during the off-season for the main agricultural crop, such as daily labour, vegetable/fruit gardening, dairy milking or even small retail activities.

As described in the introduction of this chapter, the rural poor need financial services to be convenient, flexible and secure. These three key needs are even more pronounced when it comes to the rural poor's own money (and not someone else's money obtained through credit). The most common ways that rural farmers save – informal

[41] See Chapter 3, particularly Box 10, for more information on the DrumNet project.
[42] www.equitybank.co.ke
[43] www.prideafrica.com/ourwork.php#tab1
[44] As with the credit section in this chapter, this section does not describe all the various forms or channels for savings in rural areas and/or for agricultural purposes. For farmers, typical saving mechanisms are saving at home, in-kind savings (e.g., livestock or jewellery), money guards (friends, family, neighbours or local merchants), savings groups, and their local cooperative banks, if they have access to these (described in the Brazil example in Box 16).

ways such as in-kind savings and through savings groups – generally meet the first two criteria very well: convenience, through providing the service at or near the home; and flexibility, such as by allowing small and frequent amounts of deposits/withdrawals. However, the third point, security, is a major constraint in informal mechanisms: money guards may run away with the money; in-kind savings, such as stored rice, may spoil or diminish in value; and money left under the mattress may be lost in a house fire.

By either making informal methods more secure, or improving formal financial institutions' convenience and flexibility, ICT can help solve the savings puzzle for rural farmers. In Ghana, for example, traditional *susu* (savings) collectors visit their clients in urban and rural areas daily to collect small savings amounts, returning at the end of the month to hand the entire saved amount back to the client (less one day's savings as the collector's fee). The collectors go directly to the customers, and the customers can choose to save any amount they want (in general). However, customers often do not keep track of how much they have saved and do not have formal proof (or recourse) of the saved amounts. As *susu* collectors are not tied to institutions (or regulations generally), they can easily disappear with the money or lose the savings through robbery. In 2006, Barclay's Bank in Ghana (a bank based in the United Kingdom of Great Britain and Northern Ireland) pioneered connecting susu collectors to the formal banking system; local financial institutions, Fidelity Bank and First Capital Plus (a non-banking financial institution) have reported plans to do the same, while enhancing such interventions by arming the *susu* collectors with mobile phones connected to the financial institutions' MIS for better tracking of funds and transactions and lowered risk of fraud and mismanagement. The *susu* customers will also be able to check their balances on their mobile phones (Ghana Co-operative Susu Collectors Association, 2011; Dowuona, 2011).

The Cooperative for Assistance and Relief Everywhere (CARE) in East Africa is experimenting with connecting its village savings and loans associations (VSLAs) to the formal banking system. Each VSLA will have a single group account tied to a bank, which can be tracked and managed via mobile phone. Individual VSLA members will be able to send in their savings transaction through a phone. The advantages of these links and use of ICT are that they provide access to additional products from the bank, while the bank aggregates small customers rather than dealing with each individual; reduce the likelihood of theft or loss of savings, which were previously kept in a lock-box; and improve the management and accounting of the VSLA's finances, while reducing the potential for fraud and error (AllAfrica, 2011).

Instead of making the informal sector more secure, the other option is for formal banks to create their own channels for reaching more of the rural poor in remote areas to provide savings options and other products. This is often called "down-scaling", and can include other products such as credit. The most typical solution is for the bank to use a local person, such as a shopkeeper or post office worker, to act as its legal representative for customer acquisition and service and for conducting transactions that generally involve either cash-in or cash-out from customers' bank accounts. The key to success is often in minimizing the paperwork and the time that the agent must spend going to and from the local bank branch (to deposit or withdraw money).

To do this, most banks employ simple technology, such as point-of-sale (POS) terminals[45] or mobile phones, so that transactions are either instantaneously updated in the bank's core banking system (or a special, parallel system) or uploaded in batches at the end of the day. Transactions are often initiated through the customer's own phone and completed with the agent's phone. This allows the customer to have more control and oversight over his/her account. It also minimizes accounting errors and any temptation the agent may have to use the money she/he has in hand until he/she visits a bank branch. The two most prominent agent-based bank-led models are in Brazil and India, with many other developing countries, such as Mexico, Pakistan and South Africa, experimenting in such down-scaling activities. The Brazil correspondent banking model, probably one of the oldest agent banking models in existence, and its use of technology to reach remote areas in the Amazon are described in Box 16.

Insurance

Within financial inclusion, insurance, especially agriculture-based, is significantly underrepresented. This is because of multiple issues that are com-

[45] A small device that can often be held in the hand. Typically used in restaurants, retail shops and grocers for debit and credit card transactions.

BOX 16
The Brazilian correspondent banking model[46]

The Consultative Group to Assist the Poor (CGAP) reports that in 2008, Brazil had more than 160 000 correspondent banking agents helping to manage more than 10 million simplified bank accounts throughout the country (just more than half of the accounts are considered active). While most small municipalities in Brazil (often rural towns) do not have a bank branch, almost all have a banking agent. Agents conducted 2.8 billion transactions in Brazil in 2009 (just less than 6 percent of total banking transactions). Of these agent transactions, 75 percent were bill payments (commonly utility bills), with withdrawals and deposits to/from savings and demand accounts representing 12.6 percent. Rural agents conduct more withdrawals and deposits, at 38 percent of transactions, which suggests that access to savings and demand accounts through agents is more important in rural areas. The third most popular type of payment is government transfers (7.3 percent of agent transactions), mostly tied to the popular Bolsa Familia programme to help poor, rural families with children (and also providing pensions and salaries to employees such as teachers) (CGAP, 2010b).

In the Brazilian correspondent banking model, most banks install POS machines on the premises of the retail businesses contracted as correspondents, with customers using cards that are swiped at the POS terminal. However, banking correspondent retailers can also use a personal computer with other equipment, such as barcode scanners and ATMs, depending on the level of service. These terminals are usually connected to the servers of the bank that has hired the correspondent, via dial-up or broadband Internet connection, General Packet Radio Service (GPRS, a data transmission technology for use in cell phones), or even satellite connections. Data can be transmitted in real time, or in batch processing at set times during the day, depending on the complexity of the services and the infrastructure available at each correspondent's premises. The technology enabling communication between banks and retailers is usually managed by a third-party network manager. These specialized managers also set up the equipment at the retail point and manage the training of the retail employees and maintenance of the whole operating process of data transfer from the terminal to the bank systems.

Effects of banking access on the remote town of Autazes deep in the heart of the Amazon: Autazes has about around 15 000 inhabitants, with many more in smaller, surrounding communities, and is more than 2 500 km from São Paolo and Rio de Janeiro. The town is situated deep in the Amazon forest with the main method of travel being by boat on the Amazon River to Manaus, the nearest large city (more than 100 km away). In the past, to conduct banking, retailers (for deposits and some withdrawals for buying merchandise) and pensioners (for withdrawals) often had to take a 12-hour boat ride (each way) that cost about US$40 return. Some – often pensioners who were too old to make the trip – would give their ATM cards and personal identification numbers (PINs) to specialists who made the trip and the transactions for them. However, these funds were frequently lost or stolen. Many retailers carried bags of cash with them on the boat ride, risking unwanted attention and robbery.

Now that agents are present, individuals have seen a significant decrease in the time spent on financial needs, and reductions in the risk of losing some or all of their money. An additional benefit is that the presence of agents has helped spur the local economy (but this is confirmed only anecdotally, and a road has also been built). With fewer trips to the large city needed for banking, customers instead spend their money in Autazes. Before there were fewer than ten retail stores, now there are 36, offering many types of product. Some leaders in the community claim that Autazes has become the region's banking centre in its own right, with people from surrounding communities visiting the town for their banking needs, and making follow-on transactions at local shops (McKay, 2010a).

One of the first agent managers in rural Autazes relayed the following story to CGAP:

"At first, the same guys who made a business going to the city to manage cash tried to keep their business here and came in with many debit cards. However, we refused to serve them and soon the people themselves came in. The old people especially were overjoyed to feel they had control over their own finances for the first time in many years. Many were surprised to learn the actual amount of retirement benefits they received. They brought us gifts of fish and chickens since they were so grateful" (McKay, 2010b).

[46] Known as "agent banking" in many other parts of the globe, and "business correspondent banking" in India (Box 19).

BOX 17

Tracking animal health through ICT to improve livestock insurance – IFMR, India

India's Institute for Financial Management and Research (IFMR), with its insurance company partner HDFC Ergo,[47] uses RFID tag technology to verify the location and ownership of each animal being insured (a dairy cow is shown in the photo). Field officers and veterinarians then scan the tag each time the animal is visited, using hand-held scanners connected to netbooks. This triggers a requirement for the staff member to enter data on the visit into the management database. Compulsory veterinarian visits help reduce the likelihood of disease or fraud. IFMR's management information system (connected via VSAT at each branch) is also connected to its insurance company partner's information system (World Bank, 2011).

GUPTA, 2010

There are still issues with this solution, primarily regarding ongoing risk of fraud (it is easy to remove/switch RFID tags). Customer adoption (and retention) continues to be lower than hoped owing to mistrust of insurance companies, which have reputations for denying legitimate claims, and confusion with the other insurance policies available (personal accident) (World Bank, 2011). Nevertheless, despite the costs of infrastructure and monitoring, this use of technology to reduce administrative resources and risk has helped reduce the cost of premiums by almost 3 percent, the number of claims (compared with peer programmes) and the mortality rate of the animals insured (Gupta, 2011).

mon to offering insurance in the developing world: frequent and severe weather-related events; lack of reliable historical data; low customer understanding, adoption and renewal; fraudulent claims; and high cost of delivery in remote locations. ICT can help solve many of these issues, especially those of delivery costs, using simple mobile phones and local labour, and customer renewal, through SMS reminders for example. While the timing and magnitude of the risk events cannot usually be reduced, ICT can assist insurance companies in collecting reliable data to help the pricing of policies and monitoring of typical risk events (usually weather- or disease-related), which at least minimizes damage. ICT use in agricultural insurance (often called microinsurance, depending on the size of the beneficiary) can be important in two areas: i) data collection for actuarial and claim verification needs; and 2) delivery of initial and subsequent enrolments, claims processing and other communications with customers, typically covering crop yields, weather, and livestock health insurance.

ICT applications can also help the reduction of basis risk, i.e., the risk that the index proxy used to calculate pay-out events and outcomes is not adequately linked to the actual field outcomes. Often, weather indices of average regional rainfall data are used, instead of more precise microclimate data, for example. Some farmers may incur losses and not be paid (discouraging farmer adoption), while others may not incur losses but be paid (discouraging insurance companies from taking on such products). The Index Insurance Innovation

[47] www.ifmr.co.in and www.hdfcergo.com

BOX 18

Processing of weather insurance claims through mobile phones in Kenya

In 2009, the Syngenta Foundation piloted *Kilimo Salam*a (Swahili for "safe agriculture") with its partner UAP Insurance in Kenya, to provide weather insurance that guarantees at least a partial recapture of the capital investment made if certain weather conditions occur.[48] The farmer has the option of being automatically enrolled in the insurance programme when she/he purchases inputs from one of the *Kilimo Salama* partners who sell seeds, fertilizer, etc., as the stockist scans the barcodes of the products with a simple camera phone. The farmer must also be registered with one of the programme's solar-powered weather stations.

To determine who should receive claims payments, when and of how much, *Kilimo Salama* has set up 30 automated solar-powered weather stations throughout Kenya, to collect weather data. Farmers no longer have to file claims or fight with insurance agents about whether or not their crops have failed. As soon as one of the weather stations records too much or too little rainfall, a claim and payment is automatically triggered for each affected farmer in a radius of 15–20 km. Each affected farmer receives an SMS message through his/her mobile phone, informing him/her of the claim and pay-out. The programme distributes insurance payments to farmers using M-PESA (mentioned in this chapter's subsection on transfers).

Instead of the farmer having to open a bank account or travel to a bank branch to cash a cheque, the payment is instantly transferred (versus the common processing times of typical insurance policies, which take weeks or months) and can be cashed by the farmer at a local M-PESA agent shopkeeper location. The use of technology also allows a relatively low-cost premium, of approximately 5 percent of the input values (seeds, fertilizers, pesticides, etc.), and pay-out amounts of up to 80 percent of the farmer's (input) investment in the crop. In March 2010, 9 500 farmers were using the weather insurance, and the goal was to reach more than 50 000 farmers within a few years.

Kilimo Salama was still in the pilot phase in 2011, and it is unclear whether it is scalable and viable in the long term for the insurance partner, and whether it will be fully embraced by Kenya's farmers. However, with low costs, fast processing and growing trust in the system, farmers are slowly adopting this new type of insurance and distribution mechanism.

Source: Ogodo, 2010.

Initiative (I4) of USAID and the University of California is exploring the use of satellite micro-rainfall data to see if basis risk can be reduced.[49]

For data collection, insurance companies need historical data both to help underwrite and correctly price insurance policies for agricultural needs and to monitor current patterns such as rainfall, disease, etc. to prepare for or mitigate a risk event in certain regions. Data are often collected through satellite monitoring or local weather stations, typically run by local governments, which are linked via the Internet or mobile phone networks to pass information back to a central database. Insurance companies monitor and use these data for underwriting and processing claims. ICT can also be used in other innovative ways, such as for improving access to livestock (health) insurance by reducing the costs and risk of fraud through regular visits and data collection, as described in Box 17.

The advantages of ICT's ubiquity (especially mobile phones) and relative improvements in efficiencies and costs are being used to improve access to insurance and make premiums more affordable. In such examples, the servicing of the customer can often be done at his/her doorstep (i.e., there is no need to travel to an agent's distant office), and the processing of enrolments and claims can be reduced to a fraction of the time usually taken by insurance companies, as in the example from Kenya in Box 18. Mobile phones often reduce (but do not eliminate) the need for an agent, especially in the claims process, as customers can make the necessary enquiries and post the required information themselves. The use of technology enhances the information available to the insurance companies (reducing risk), helps pool many small customers together to improve

[48] www.syngentafoundation.org/index.cfm?pageID=562, http://kilimosalama.wordpress.com and www.uapkenya.com

[49] http://i4.ucdavis.edu/about/

the overall risk pool profile (and reduce costs), and reduces human resource needs. Each of these improvements for the insurance companies can translate into price reductions passed on to the end customers, making insurance more affordable. Technology can also help tackle one of the most pervasive problems of insurance in rural areas: renewal of policies. Technology allows the insurance company to stay in touch with the customer throughout the insurance period (often a year) and remind her/him when the time for policy renewal approaches. More important, ICT can facilitate the payment of policy renewals by using accessible technology, such as mobile phones, through a payment system or banking platform, rather than requiring farmers to visit an office and pay in cash.

It is necessary to be creative with insurance products and features, as well as for their adoption. For example, in South Africa, anyone can enrol in funeral insurance for just one month (rather than the typical one year) by simply purchasing a card that is similar to mobile phone airtime card at a retail store. This product has reduced the main inconveniences that poor rural customers usually experience with complicated products such as insurance, by avoiding the need to pay a large, annual lump sum, which is too much to pay – poor customers prefer small, regular payments; reducing the processing; and being available for purchase anywhere (the poor's time is precious as they often work on an hourly basis) (CGAP, 2010a).

Financial derivatives for financial risk management[50]

Financial institutions and commodity markets have the capacity to provide more than just the simpler form of one-to-one forward contracts described in the market access section in Chapter 3. These players can provide derivative-type products, such as futures, options and swaps, to reduce the risk entailed in price fluctuations (or even weather fluctuations), and do not have to be directly involved in the agricultural value chain. No physical products have to be exchanged at the end of the derivative's time period, whereas forward contracts typically involve the buyers and sellers of products and the actual delivery of products at the end. Farmers could benefit from access to such instruments (with much caution however, as described later in this section) through improved price transparency, a more liquid market (i.e., more buyers) and typically better pricing than what a forward contract can offer. Derivatives also permit flexibility in terms of amount, timing, etc. For example, a farmer does not have to hedge her/his entire crop, but often perhaps only 40 percent of it.

The largest agricultural commodity exchanges are based in the United States of America and China, but many developing countries now have growing and substantial exchanges, such as Brazil, Kenya, India and Indonesia. Many of these exchanges have shifted to an entirely computerized operation with little human intermediation. Derivatives trading is a prime example of the need for using ICT, as the exchanges are typically based hundreds or thousands of miles from most rural areas and maintain a trading volume that requires the ability to conduct significantly large transactions within fractions of seconds with an almost zero margin of error.

As with insurance, providing such complicated and expensive solutions could be achieved through the use of ICT for value chain development. However, these solutions would be difficult to implement because of their complexity and the need for infrastructure, as well as sufficient size and number of direct transactions involving smallholder farmers. Derivatives can also be extremely dangerous when not fully explained to the users or when used as a way to "beat" the market instead of for risk management. A compelling solution might be to bundle needs through cooperatives, single financial institutions or large lead buyer organizations, creating larger, aggregated transactions, and to use seasoned derivative providers on existing exchanges/platforms rather than creating new platforms.

MCX, the sixth largest commodity exchange in the world, has done something similar for large and small farmers in India (*Economic Times of India*, 2010). Through its *Gramin Suvidha Kendra* programme, MCX provides information for farmers at more than 500 (and growing) post office locations in five states, and provides SMS messages directly to inform farmers and traders of commodity spot and futures price movements.[51]

[50] This section does not cover financial products for reducing commodity price risk, such as these derivatives, in great detail because of the lack of examples from the development context and the complexity of the products. For basic information on agricultural derivatives, see www.cmegroup.com/education/index.html

[51] India has more than 150 000 post office locations (www.indiapost.gov.in/our_network.aspx).

Some of these locations install self-service Internet kiosks to provide the information, and at most locations the local post office worker posts daily prices on a simple black-board (some prices are posted on the electronic notice boards at train stations as well).[52] Farmers benefit from better price information and increased access to finance (using product as collateral) and risk management techniques such as locking in prices on the futures market (FAO, MCX and UNCTAD, 2007).

COMMON ICT PLATFORMS FOR FINANCIAL INCLUSION SERVICES[53]

ATMs: The most widely known type of customer-facing technology is the ATM. ATMs have long been tested and used throughout the world, including in developing countries. However, most ATMs are concentrated in urban areas as there are common issues with installing ATMs in rural areas in developing countries: i) although ATMs are less costly than branches, the low volume of business often does not warrant the cost of purchase, installation and maintenance;[54] ii) it is difficult to send people to repair and replenish the ATMs; iii) many ATMs in rural areas are vulnerable to theft and damage; and iv) ATMs require a high level of dedicated, strong connectivity to the ATM network, which many rural areas cannot offer. Encouraging innovations include requiring customers to use only a PIN or their mobile phones to access the ATM, such as Nedbank and M-PESA in South Africa, which avoids the need for a card or even a bank account for remittances/loan disbursements;[55] making ATMs smaller, and hence less costly, such as the mini-ATM launched by Financial Inclusion Network and Operations (FINO) and NCR in India (Artha Platform, 2010); and using a hybrid machine-and-human model in which the administrative side of the transaction takes place at the ATM machine and the cash disbursement/deposit takes place at the counter of the shop where the ATM is housed, which diminishes the need for cash management in the machine and makes it less expensive. The potential problem with smaller ATMs is that they can be easier targets for theft. Putting ATMs into retail shops could increase customer volumes for shopkeepers but also make them a more visible target for robbery. ATMs will likely always be part of the solution for improving financial inclusion in rural areas (they also add a physical branding presence), but ultimately they will not be able to replace human interaction needs for customer service.

Computers (desktops, laptops, netbooks and tablets): Computers are often used to extend financial reach into rural areas as they have higher functionality and data retrieval than POS or mobile phones and have generally become less and less expensive over time. Contracted agents often use computers connected to peripheral devices, such as printers and card readers. Computers also allow agents to offer other services, such as bill payments and ticket purchases (bus, train, etc.), as the connection is often through the Internet. Banks have been testing mini-branches or "one-person" branches with a small, one-room office or kiosk available for conducting transactions using computers. Laptops and netbooks are portable, which can allow agents to visit customers at their homes or places of business. The primary issue with computers is that they generally need to be connected through phone lines or traditional Internet providers, which many rural areas do not have. Although prices have diminished over time, computers can still be expensive, especially for agents. Computers also do not allow significant customer interaction.

Point-of-sale (or point-of-transaction) devices: POS devices are among the most commonly used devices for agent banking across the developing world, as the technology for credit and debit card transactions has been implemented in a stable manner for many years. POS devices are also generally much cheaper than ATMs and computers. Most POS devices allow the keying in of basic alpha-numeric data and the swiping of an ATM or smart card for customer authentication. POS devices are also more flexible in their connections to the financial institution's central system, which can be through the Internet, phone lines, cable, VSAT and, more important, mobile phone net-

[52] http://gsk.mcxindia.com/aboutgsk.htm, http://gsk.mcxindia.com/service.htm and http://gsk.mcxindia.com/arcmediacoverage.htm

[53] This section focuses on the common customer-facing technology typically used in the field rather than on back-end infrastructure and data storage. The section does not cover every type of technology available (or iteration).

[54] Some countries, such as India, have done away with ATM fees altogether to improve financial inclusion. However, this can disincentivize banks from expanding their ATM networks into rural areas.

[55] www.nedbank.co.za/website/content/m-pesa/pdfs/withdraw.pdf

works (which are more ubiquitous, often through GPRS).[56] Many POS terminals are very portable and allow agents to roam if needed. However, functionality can be limited by the small screen size. Peripheral devices such as biometric authenticators and printers can be connected to the POS with cables or through wireless Bluetooth/near field communication functionality.

Mobile phones: Mobile phones are increasingly becoming the device of choice for improving financial access in remote areas because of the almost ubiquitous mobile phone networks, even in developing countries, and the low cost of mobile phone devices (many of which can be bought for less than US$30). Mobile phones allow customers more direct control over and interaction with the financial service offered and a way of monitoring their balances and activity outside normal visits to agent locations. Often, even when the customer does not have her/his own phone, he/she will have access to a phone within the household. Mobile phones also allow financial institutions to use agents who may not be able to afford the US$100–200 needed to purchase a POS device.

The major constraints to mobile phone use are limited functionality and user interface, as a mobile phone can display (and store) only so much data. To date, the need has been for solutions that can be provided through low-cost devices (i.e., not smart phones) that do not need to be connected to the Internet to download large data files and applications. This need has led to a higher use of SMS text messaging and Unstructured Supplementary Service Data (USSD) technology, which allows an actual connection between two parties.[57] In general, these methods work because many rural individuals are used to texting, loading phone minutes and using other basic phone capabilities. However, USSD can be somewhat problematic for customers (many of whom are illiterate), who often have to memorize menu choices and/or strings.

A promising technology for overcoming both security issues (remote customer authentication) and illiteracy issues is the use of IVR, as described in Box 19. IVR can allow any customer to speak (and listen) in her/his language of choice and to move easily through the choices and the transaction process through voice prompts and verbal menus (even if he/she is illiterate). The system typically requires registration of the person who will access the services, and the user's accent and diction are recorded. Thereafter, when the user accesses the system, user identification is based on speech alone and no PIN numbers are required. In fact, IVR decouples the need for customers to own a phone altogether, as they can use any phone with little risk of divulging too much information or losing security features. IVR is a potentially scalable model as once the infrastructure is in place, updates occur at only the central server, with no significant hardware requirements in the field (not even for peripheral devices) and no software to download. IVR is not yet completely free of issues, as it can have problems dealing with ambient noise, often misunderstands accents and certain words, and cannot resolve unusual customer service needs. It also requires significant investment at the beginning to implement and tailor the service and language needs. However, it is a compelling idea that should be closely watched.

WWW.FINO.CO.IN

A POS device used by FINO in India

ISSUES AND CHALLENGES FOR ICT FINANCIAL INCLUSION SERVICES

Overemphasis on technology: The technology is not the financial product; it merely provides access to the needed financial services. In recent years, innovations in finance and access to finance through technology have caused quite a stir. However, publicizing the technology often overshadows the real purpose, which is just to offer what has always been available in a better way –

[56] Used on Global System for Mobile communication networks (http://searchmobilecomputing.techtarget.com/definition/gsm).

[57] http://searchnetworking.techtarget.com/definition/ussd

BOX 19

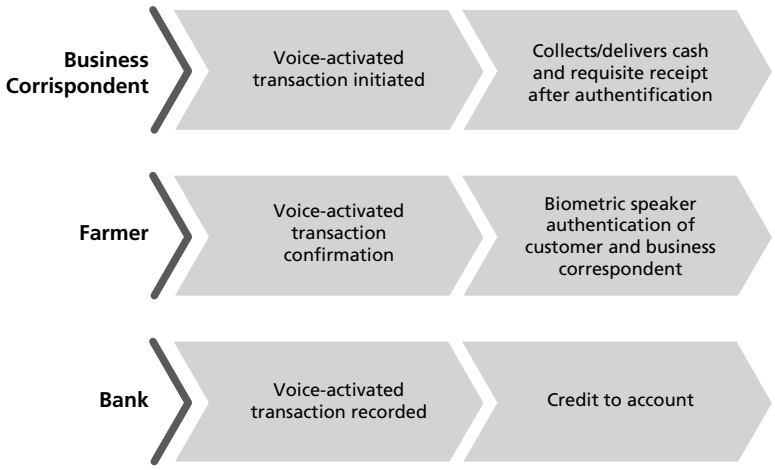
BASIX Sub-K – business correspondent banking model using IVR technology in India

BASIX Sub-K iTransaction Limited (Sub-K)[58] is a subsidiary company of BASIX, one of the largest and oldest MFI parent companies in India. Sub-K acts as a business correspondent network manager (BCNM) for banks. Sub-K, meaning less than 1 000, was envisaged to provide primarily the rural poor with access to financial services within a radius of 1 000 m (1 km) of their homes or businesses, for transaction values of less than Rs 1 000 (about US$20), incurring transaction fees of less than 1 000 *paise* (Rs 10 or US$0.20) from outlets serving about 1 000 customers in a locality. (Sub-K and BASIX focus on rural areas, hence the 1 000 customers condition; BASIX reports that 90 percent of customers are rural.) Sub-K provides access to bank accounts for deposits and withdrawals, payments of utilities and top-ups for prepaid mobile service plans. In August 2011, Sub-K reported that it had a network of 522 agents serving more than 75 000 customers across four states.

Sub-K uses VoiceNet, developed by Uniphore Software Systems,[59] to implement an IVR customer interface that improves the security of the transactions, allows anyone to use the system regardless of their education level, and enables Sub-K to scale up operations very quickly. The system that Sub-K implements can handle up to 90 transactions per minute; within a year of implementation it was being utilized for about 30 transactions per minute.

The customer interaction occurs as shown in the following figure:

1. The customer approaches a business correspondent agent in his/her neighbourhood to deposit/withdraw money into/from her/his bank account.
2. The agent uses a hand-held device to contact the system in the language desired, and the user and account details are verified using voice/speech identification techniques.
3. The desired transaction is recorded at the bank and verified with the BCNM.
4. The agent takes the deposit/makes the payment.



Source: Author, adapted from BASIX Sub-K

[58] www.basixindia.com and http://subk.co.in/about-sub-k/basix-group

[59] www.uniphore.com

more convenient, more flexible and more secure. There is a risk in overemphasizing the technology, which can create a bubble effect of too many players focusing on seemingly "easy" routes, such as remittances through mobile phones. While M-PESA has made great strides in improving rural Kenyans' situations and in innovative financial inclusion in general, it has in some ways done a disservice to the rest of the world. Many players now want simply to replicate the same solution. However, the most common issues in improving access to finance in rural areas have very little to do with technology. Mobile financial services technology has been around for well over a decade.

The key solutions are more to do with solving customers' real needs and executing the services – both of which are more human-related than ICT-related. First, many institutions now trying to implement technology solutions for finance in rural areas do not really understand what customers need or where their problem areas are in trying to use financial services. For example, mobile financial services are currently receiving significant attention for extending access to finance in rural areas. While mobile phone availability, cost and connectivity have improved greatly over the years, the use of mobile phones is still often a very expensive proposition for rural inhabitants who use their mobile phones sparingly for important needs. (Often they use a "dropped call" technique to have the other person call them back rather than use even one minute of their talk-time.) Therefore, solutions that require the customer to call in for several minutes, send data files over the network, surf the Internet or download feature-rich applications will simply not be appropriate in many rural settings.

The other human issue relates to execution, which typically has to do with the customer-facing staff member or agent of the financial institution. These staff members or agents are often too poorly trained, too undercompensated and too short of central office support to be able to serve customers adequately. A focus on customer value and execution would therefore increase the success rate far more rapidly than would worrying about whether the most robust, most secure (e.g., the current overemphasis of biometrics) and up-to-date software is in place.

Lack of scale: As mentioned previously, technology generally involves high fixed costs at the beginning with relatively low maintenance costs thereafter. To serve rural areas with customers whose transactions are for small amounts, the primary way to achieve sustainability is through scale, i.e., having many customers or – ideally – many customers who use the service frequently. Unfortunately, many examples from this chapter, except for M-PESA, are no more than pilots or demonstrations.

Expensive implementation: Despite improvements in technology and the falling costs, implementing the solutions is still an expensive endeavour. When financial institutions implement the latest, most robust ICT solutions available they incur two risks: i) not generating enough revenue to cover the more expensive costs of implementation; and ii) depending on technology that is not 100 percent reliable – new technology is often unreliable and must be constantly modified. Financial institutions operating in rural areas would still likely do better by focusing on inexpensive, simple ICT solutions that have proved to be reliable.

ADVANTAGES OF AND OPPORTUNITIES FOR ICT FINANCIAL INCLUSION SERVICES

Lower-cost technology: For the past few decades, technology for financial institutions as a whole has improved dramatically and dropped in cost significantly. Even small Western banks and credit unions can easily operate robust customer data systems, ATM network connectivity, etc. at very low relative cost. With the rise of new technology, such as the Internet and mobile phones, this trend has improved, pushing these innovations within the grasp of not only commercial banks in the developing world but also semi-informal institutions, such as credit unions and MFIs.

Efficiency and innovation gains through higher productivity and lower costs: The benefits of technology for financial institutions include true efficiency gains, particularly for financial institutions operating in rural areas. With the spread of mobile phone networks and other communication infrastructure (e.g., satellites), many financial institutions can communicate with and provide operations in very remote areas. Technology also allows financial institutions to avoid having to place expensive fixed-cost infrastructure – for example, by using connected agents – in rural areas where the potential transaction and customer volumes cannot cover high infrastructure and human resource costs. Financial institutions are now able to monitor rural operations effectively to reduce risks, and can also increasingly use the same data to help create new products and tailor

old ones to rural needs. Another compelling feature for rural finance is that financial institutions do not necessarily have to provide their services to only one segment of the community, but can serve all community members, regardless of whether or not they are involved in the agricultural value chain. This provides financial institutions with an opportunity to achieve a break-even point and higher revenues more quickly.

Increasing flexibility and control for the customer: Technology in rural financial services has certainly helped the end customers greatly, simply by improving access (e.g., convincing banks to engage even without a branch presence). Equally important, technology has reduced major costs for the end customers, such as by requiring less time for travelling, waiting in lines and processing unnecessary paperwork and by reducing the risky holding of too much cash on hand. However, financial institutions could improve the customer experience by looking beyond lowering costs towards improving access; making solutions more flexible to customers' needs, such as by allowing small, frequent transaction amounts and using an easy-to-use customer interface; and placing more control in the hands of customers. For example, M-PESA did not become an instant success. Early on, most transactions were balance enquiries because customers did not yet trust the system. Once M-PESA had proved that customers' money was safe, the level of enquiries declined, and customers began to use the service more for its intended purpose. This provision of control to customers helped M-PESA gain customers' trust and ultimate adoption.

Chapter 5
Conclusions and next steps for ICT in inclusive agricultural value chains

This chapter presents the main conclusions that can be derived from the analysis presented in this document. These conclusions aim to provide policy-makers in governments, international public organizations, NGOs and private organizations with criteria for deciding when and how to support interventions that increase the outreach of ICT in rural and agricultural markets. This is deemed relevant, as the public sector, in collaboration with private actors, is best positioned to create an enabling framework that can trigger the spread of ICT uses in ways that favour socio-economic development.

Throughout this document, four key actions have emerged that are relevant for public and private organizations interested in developing inclusive agricultural value chains through ICT applications.

1) Forget the hype about ICT – especially mobile phones: When starting to implement an ICT solution for value chains, a good first step is to remember that the technology is not the end goal. ICT can only help make an existing service more efficient, much as trains did for the carrying of agricultural goods. Many ICT providers create a solution without identifying or fully understanding where the problems are and why these problems exist (the proverbial "hammer looking for a nail"). In many cases, the issue is not too few technology options but too many. For example, according to a popular joke, it is impossible to throw a stone in Bangalore, India without hitting a software company that has an m-banking solution. So, first identify the problem and its causes; then look for possible ICT assistance.

2) Listen to customers and field staff: Related to the first point, talking to end users (e.g., farmers) and field staff is important in not only identifying problems but also understanding possible solutions. While customers and field staff may not be technologically sophisticated, they have likely come up with several ingenious ways of working around the problem that is to be solved. These insights can help build the ultimate solution, and increase the likelihood of customer adoption by mirroring familiar existing solutions. End customers, such as farmers, are used to having no control over how they receive information or technical assistance, such as the information services, market access and financial inclusion outlined in this document. If the implementing party can empower the end customers so that they control and direct parts of the interventions that they have access to – including the ways in which applications are presented – the likelihood of customer adoption and usage can be much higher.

The last point related to listening is that ICT implementers need to realize that technology roll-outs are only about 25 percent technology-related, and the bulk of efforts and resources have to be dedicated to human elements. Too often ICT implementers have a "if you build it, they will come" mentality and do not fully grasp that the users must be properly trained, incentivized and serviced (including through direct human contacts) to use the technology. Continuous monitoring, evaluation and improvement of the technology must also be an integral part of the strategy, to ensure that the project remains relevant to the community it is serving.

3) Keep it simple: Many of the examples in this document use simple ICT solutions and/or low-technology solutions, such as radio and face-to-face interaction with customers. Low technology is not a poor choice if it fulfils the needs of the end customers. For example, ACDI/VOCA in Chapter 4 (Box 14) used simple Excel spread-sheet models and off-the-shelf accounting software to help improve the administration of input credit programmes. The Organic Farmer in Chapter 2 (Box 3) did not do away with old ways of communicating with farmer listeners, such as radio, newspapers and magazines, but rather had SMS mobile phone technology complement these media to help listeners feel more engaged and to improve the content of the radio programme. Keeping this customer-oriented vision is an important

criterion for selecting the best ICT to apply in agricultural value chain dynamics for ensuring significant outreach in rural areas, with little marginal investment. This vision usually implies that interventions should be compatible with existing technology infrastructure, such as cell phones, radio or Internet coverage, and require effective partnerships between communication companies and service providers (e.g., finance or agricultural input providers).

The other aspect of keeping it simple is in the service offering. The examples of holistic VTFs in Chapter 3 are compelling in that the same agents on the ground can deliver multiple products to farmers, such as pricing and weather information, extension services and consumer goods, while the farmers can save time by going to only one place to obtain all of these services. However, not many of these models have proved to be fully scalable, much less viable in their own right. Staff on the ground can become confused by the different offerings and give poor advice because of data overload. Customers too can become confused and miss out on the core activity or two with which they really need help. Practitioners may want to scale back their vision of one-stop shops and offer only the one or two services for which farmers have the greatest need and that have the highest potential for scale. If multiple solutions are desired, practitioners may want to roll out each solution gradually over several years rather than providing all at once, to establish the brand and trust before expanding the range of services offered. Instead of providing all potential solutions themselves, service providers with ICT technology could link up with other complementary service providers, such as those offering m-health expertise, which could use the ICT technology infrastructure and field channel platforms to offer their services in addition to those of the ICT service providers. This can help reduce potential confusion among staff and customers and allows each party to focus on its core strengths, and – most important – its customers' main needs. Confusion can be avoided by carefully analysing customer needs, to distinguish between services that are truly useful and those that are not.

4) Plan for the future not the now: Several interesting and innovative examples are profiled in this paper but, unfortunately, many of them have not emerged from the idea or pilot stages. For example, e-Sagu (mentioned in Chapter 2) was an innovative idea for providing farmers with advice remotely, using expert diagnosis from the review of digital photos. Although e-Sagu was recognized for several awards and was sponsored by a well-known academic institution, there is little indication that the solution has moved beyond a classroom experiment. DrumNet (profiled in Chapters 3 and 4, particularly Boxes 10 and 15) had even more promise, with a successful test involving more than 4 000 farmers, with a large buyer and a bank as partners. However, DrumNet's ICT infrastructure was not created for rapid scale-up and had limited financial backing, so the idea has not been scaled up since the end of the project in 2010.

It is relatively easy to create a software platform for sharing weather and pricing information with farmers through mobile phone applications. However, execution and full-scale roll-out are difficult. In most ICT innovations for value chains, among many other issues, the ICT provider must create an ICT platform that is robust enough to support high-volume data transfer; put in place an adequate customer service team and distribution channel (i.e., human teams); convince farmers to use (and pay for) the application; and negotiate with the MNO (or other partners) for offering the application on its network.

An example of a successful ICT platform is M-PESA, the mobile money transfer platform in Kenya. M-PESA was not an instant success, and many mistakes were made. However, the MNO sponsor Vodafone and its Kenyan subsidiary Safaricom contributed to several critical aspects (adapted from Morawczynski, 2009):

- planning for eventual scale-up if the product proved profitable, including the human resources and technology needed for full roll-out;
- providing support, including financial resources; Nick Jones and Susie Lonie from Vodafone, and Michael Joseph, Chief Executive Officer of Safaricom at the time, chose to become primary sponsors of the idea, helping to plan and execute the roll-out and forging the necessary partnerships;
- establishing and maintaining key partnerships; Vodafone and Safaricom had the brand name and mobile network in place, but did not have the expertise or resources to ensure that M-PESA could succeed on its own; the United Kingdom of Great Britain and Northern Ireland's Department for International Development provided key pilot and start-up financial and technical

assistance support; Sagentia and IBM were the key players in developing and maintaining the software and back-end technology; Safaricom partnered several organizations to help market and deliver its services, such as MFIs, the post office and banks; and – most important, M-PESA worked closely with Top Image to reach out to communities and recruit and manage M-PESA's agents;

- providing a service that rural communities wanted and that was simple to use; the pilot discovered many issues, particularly that the original product – providing credit over mobile phones – was not a significant need; Safaricom adjusted the service platform to provide a more needed money transfer service; the tagline, "Send Money Home", clearly registered with customers in an understandable and compelling way.

Some may believe that these lessons from M-PESA's success are difficult to replicate because the sponsors had significant resources to make the service work. While this may be true to a point, any ICT practitioner in agricultural value chains must plan for and fully support an eventual roll-out, forge critical partnerships and provide a service that is needed by and understandable to the end consumer. Many of these learning points are similar to the success criteria profiled in the following section.

CRITERIA FOR SELECTING ICT FOR AGRICULTURAL VALUE CHAINS

One criterion concerns the need for an overall enabling framework for the development of ICT technology in any given country. This macro condition refers to the need to put in place a regulatory framework that enables the establishment of ICT infrastructure. The more effective this framework, the less the effort required to tailor strategies that lead to increased application of ICT in agricultural value chains. This is because a proper regulatory framework increases the chances of having basic expertise and infrastructure to build on.

Other than the basic need to evaluate ICT in terms of both set-up and ongoing costs, the following criteria should be considered when planning to use ICT for enhancing agricultural value chains.

Does the solution address a priority need/customer value proposition? There are many potential uses of technology for improving the agricultural value chain, but not all can be applied. Too much technology can complicate the process and confuse the various players (and become cost-prohibitive). The ICT implementing party should first complete the second action in the previous section, by listening to the end users and prioritizing the issues to be resolved (and selecting those to discard). The people for whom the ICT is intended must be empowered to express their requirements and take a leading role in technology development. Without end-user involvement, well-intentioned outsiders will make mistakes, perhaps even dooming the project from the start.

Technology is often meant to relieve the problem areas that users encounter in existing services. The key is to find the correct combination of users' common/frequent and serious problem areas. For example, in terms of financial inclusion, the most common and serious problem areas are loss of time and risk of losing cash (Yamini *et al.*, 2010).

Is the ICT solution already functional and stable? As there are so many areas for improvement in traditional value chains, it is often more appropriate to use ICT solutions that have already been proven in other, perhaps more advanced, industries. There is rarely a need for the value chain to use the most state-of-the-art technology, which often has many bugs and other problems to be resolved. (This does not mean that the ICT solution should be of low quality, however.)

A follow-on question could be: Does the ICT solution leverage on existing technologies and infrastructure? Building communications structures from the ground up is a very complex and expensive endeavour; if the solution can be built using infrastructure that is already there, there is more likelihood of success. Examples of existing infrastructure include weather stations, mobile phone networks and satellite networks. Infrastructure that is in place for one purpose can often be used to serve an additional purpose/industry, such as GPS technology, which was originally only for military purposes. However, the ICT implementing agency must be careful with assumptions regarding the growth or improvement of infrastructure, whether by government providers or private players in the area. Projects must distinguish between investments that can be fully controlled by the institution and those that depend on support from others. Many of the new solutions require significant increases in bandwidth and computing power for example;

BOX 20

Can ICT4D solutions for agriculture be viable?[60]

The answer to this question is "probably", because ICT has been viable in other areas, such as manufacturing, formal financial institutions and Western farmers. However, there are few examples of large-scale interventions that have broken even financially in ICT4D agricultural projects. One for-profit entity that believes the answer to the question is "yes" is Reuters Market Light (RML), which is a mobile phone-based, personalized information service for farmers, which disseminates timely, accurate and personalized information, such as crop advice, weather forecasts and local market price information.

Thomson Reuters, the parent company, is a US$13.4 billion revenue, for-profit company, answerable to stockholders on expected returns (Accenture, 2010). Reuters has significant experience in setting up efficient data and communications networks and providing the resulting information to end customers in a compelling and digestible way. The parent also has experience in marketing and explaining difficult concepts, such as finance, to end customer markets.

Needless to say, Thomson Reuters did not launch RML only to earn public relations credit with the Indian Government or the general public. More than US$2 million was invested in the early period to create and implement the concept for RML. Thomson Reuters plans to make RML a profitable division through:

- *reaching scale:* RML has served more than 2 million farmers from more than 15 000 villages throughout India;
- *strong distribution:* RML operates in 13 states in India and collects data from more than 1 400 markets and 2 800 weather locations with the help of its 300+ employees (One Acre Fund, 2011); RML sells subscriptions through partnerships with the retailers of IDEA cellular and Nokia and with input suppliers, NGOs, banks and other entities (Thomas, 2011);
- *having a compelling customer proposition:* Reuters reports that by using its services, farmers can earn between Rs 500 and Rs 200 000 (US$10.6 to US$4 000) of additional profits, and save costs of almost Rs 400 000 (US$8 000) (Accenture, 2010);
- *a paid model from the beginning:* farmers pay Rs 260 (US$5) per quarter (Thomas, 2011);
- *creating content – a broad product offering:* RML provides information on 440 crops in several local languages, and plans to add more;
- *significant opportunity:* RML believes that some US$4–5 billion could be saved through interventions similar to its own.

In 2010, RML earned Rs 60 million (US$1.3 million) in revenue (Accenture, 2010). Despite the resources put into it and the scale and revenues already achieved, in February 2011, it believed that it needed another 18 to 24 months to break even because of high development and distribution costs. In 2012, RML reached its five-year anniversary (having started in late 2007), but on 20 June 2011, it was reported that it still was not sustainable (One Acre Fund, 2011).

however, the rural poor may not be able to use such services because networks are inadequate or too expensive to use regularly.

Value chains are particularly complex ecosystems with many different players, often fragmented among many small players in one category (e.g., input supply retailers or smallholder farmers). The simpler the ICT solution is to implement and use, the less cost and the higher the likelihood of adoption (related to action 2 in the previous section).

Does the implementing (or beneficiary) agency have the capacity to implement and maintain the new ICT solution? It is necessary to think about not only the implementation phase of an ICT solution, but also how the solution will be maintained, especially if the implementing agency, such as an NGO, will not be present in the long term. It will often be necessary to bring on technical expert partners (preferably based locally), hard-

[60] www.reutersmarketlight.com/aboutus.php

ware and software vendors and, possibly, systems integrators to help ensure that the solution is implemented and maintained well. Those with few resources might do well to partner larger, private companies, such as MNOs, to take advantage of not only their technology infrastructure but also their expertise and general support.

Is the ICT solution scalable (or replicable) and viable? Successful ICT projects are generally successful when the fixed costs can be spread across wide usage of the technology, e.g., there are many users, frequent usage and, perhaps, different types of usage. Ideally, a solution initially tested and used in one type of geographical area should be easily implemented in another, with relatively low incremental costs.

The issue of scale feeds directly into the issue of viability. Self-sustaining models with a clear revenue generation plan and/or financing model have a greater chance of success than those based solely on donors. If the solution does not generate revenue directly, clear and monitored cost and efficiency gains should be stipulated and tracked.

As mentioned in the introduction, very few examples of ICT4D in agriculture can be described as successes in terms of scale and viability (Box 20). After examining 400 mobile phone-based businesses, the Monitor Group reported to the *Economist* "that too many are dependent on donor money. Social entrepreneurship often muddles demand and need … [just because] an African smallholder needs prices for his crops on his mobile does not mean he will pay for them" (*Economist*, 2011). Practitioners may do well to begin their endeavours with a clear for-profit and scaling strategy in mind – or even with a for-profit partner that views the endeavour as a true business opportunity and not just a corporate social responsibility exercise.

FUTURE OF ICT IN AGRICULTURAL VALUE CHAINS[61]

The use of ICT to improve agricultural economies is still in its early stages, and its full potential has yet to be realized. Many of the examples outlined in this document are in the pilot phase and have still to be fully tested or adopted. For future success, the following may be some of the more promising technologies, based on the criteria in the previous section.[62]

Solutions for end user needs

Information services: For information services, much effort has concentrated on short-term productivity enhancements or crisis management (e.g., information on impending inclement weather, etc.). However, ICT could considerably enhance and improve more long-term productivity solutions, which are often delivered through extension agents in developing countries. Arming extension agents with best practices and resources that are difficult to obtain could greatly enhance the information relayed to farmer users, using a mix of delivery through technology and face-to-face encounters. One potential issue for extension services is the question of viability, and such services may need to be supported on a regular basis by local governments or downstream players, such as lead buyer firms, which clearly benefit from long-term productivity improvements in farmers' yields.

Market access services: Many of the current ICT solutions for market access focus on simple price discovery or matching individual sellers to individual buyers. Throughout the developing world, most transactions still take place off-line, with farmers having very few options for seeking potential buyers. However, to affect real change in price transparency and improve potential income gains for farmers, setting up robust virtual markets with many buyers and sellers and high transaction volumes may be more sustainable and have the most impact in effecting change (and is sustained by the transaction fees paid by both sides). This solution would generally entail significant infrastructure creation; however, partnering existing exchanges that serve a different industry or demographic group should make the cost of implementation more manageable.

Financial inclusion: Waiting for timely cash payments and carrying/holding cash are both significant problem areas for farmers. There has been much emphasis on transfers, both P2P and G2P;

[61] As mentioned in the Introduction, policy and laws are not discussed in this document. However, improved or new government policies are often critical for successful ICT implementation.

[62] This list is not an attempt to pick winning technologies or solutions to needs, and it does not cover all of the compelling solutions in existence or under development.

for value chains, these same solutions could be leveraged to facilitate more P2B (e.g., farmer-to-input supplier) and B2P (buyer-to-farmer) payments, both of which would have a more direct positive effect on various agricultural value chains.

A second but more long-term option in financial inclusion is insurance. Many of the risks in agriculture cannot be mitigated by best practices and improved knowledge: weather, climate change, disease and world commodity price fluctuations are just a few examples. There is compelling need for solutions in this area, especially given the vulnerability that many smallholder farmers experience from season to season. However, implementation and adoption have been very difficult for three main reasons: lack of credible, historical data; lack of trust on the part of both parties (farmers and insurance companies); and lack of appropriate pay-out trigger mechanisms that avoid moral hazard but reflect adequate compensation for true losses. The potential for ICT is most compelling for credible data collection that helps insurance companies price risk correctly and provides the insurers with clear and objective data showing whether or not a risk event warrants a claim pay-out. ICT can also improve trust on both sides by allowing insurers to process registration, renewals and claims much faster than before (a common complaint among the insured). ICT can be used to identify customers and events that truly warrant claims – helping reduce fraud for insurers. It can also assist insurers with the issue of adoption (and understanding) by opening up regular communication between the insurer and the insured, especially near the time for policy renewal. Renewals are often challenging without ICT because it is very difficult to locate remote customers who may not have fixed addresses.

Promising technology platforms for end user needs

Interactive voice response: IVR may not become the panacea solution many of its creators promise, but it has three compelling features that can be examined and applied for future ICT solutions. The first is that anyone can use IVR: the user does not have to be able to read or memorize strings, can use his/her mother tongue, and does not even need to own any type of device (mobile phone or otherwise) to use IVR technology. Second, IVR is inherently scalable – once the basic voice recognition software has been tested and the needed languages, technical terms and menus are recorded, there is very little need to undertake additional fixed costs. Calls can be made from anywhere in the world, if need be. Third, IVR is a much simpler and less costly way of using biometrics to ensure security; again, there is no need to purchase expensive equipment that scans eyes or fingerprints (and scans are often smudged and result in false negative responses in the field).

Value-added services through applications: It will likely be a few years before much of the developing world has access to smart phones through affordable prices and can access the Internet. In the meantime, the creation of applications by various players has exploded in recent years, based on existing software and mobile phone platforms. The creators of such applications do not have to be organized institutions; even individuals can create smart and compelling applications in a matter of days. In India, for example, some predict that the mobile applications market could be as large as US$4 billion within a few years (Vaidyanathan, 2012). With the level of creativity in India and a need to meet the needs of several hundred million Indians in rural areas, some applications will focus on improving agricultural value chains in the country. For example, one company in India is testing a simple technique for turning water pumps on and off in the fields via a missed call through a mobile phone (Mangal, 2012), which helps farmers avoid travel time every day. The missed call feature allows farmers to avoid spending precious talk-time minutes. Again, mobile phones and applications may not be the end solution for helping value chains to develop, but the compelling message from this growing sector is that simple services can easily be implemented and deployed on existing infrastructure at significant speed and low cost.

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Pride Africa: Our Work http://www.prideafrica.com/ourwork.php
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Reuters Market Light: www.reutersmarketlight.com/aboutus.php

RESOURCES FOR FURTHER LEARNING

ICT for agriculture

Asian Development Bank ICT agriculture: http://beta.adb.org/sectors/ict/ict-in-key-sectors/agriculture
European Federation for Information Technology in Agriculture, Food and the Environment: www.efita.net
- ICT in agriculture: perspectives on technological innovation: http://departments.agri.huji.ac.il/economics/gelb-main.html

FAO Rural Infrastructure and Agro-Industries Division, Rural Finance Learning Center: www.ruralfinance.org/library/service-provision/technology-and-outreach/en/?no_cache=1
Global Alliance for ICT and Development (GAID): www.un-gaid.org
- E-Agriculture community of expertise: www.un-gaid.org/tabid/937/default.aspx
- Publications: www.un-gaid.org/ictddirectory/tabid/868/default.aspx

GSMA mAgri: www.gsma.com/magri
- Resources: www.gsma.com/mobilefordevelopment/programmes/magri/resources/

- Agri VAS Market Entry Toolkit: www.gsma.com/documents/agricultural-value-added-services-agri-vas-market-entry-toolkit/19441
- mFarmer Initiative: www.gsma.com/mobilefordevelopment/programmes/magri/mfarmer-initiative/
- African Agriculture and ICT, an overview: www.gsma.com/documents/african-agriculture-and-ict-an-overview/19488
- Inventory of Innovative Farmer Advisory Services using ICTs: www.gsma.com/documents/inventory-of-innovative-farmer-advisory-services-using-icts/21423
- Strengthening rural livelihoods: the impact of information and communication technologies in Asia: www.gsma.com/documents/strengthening-rural-livelihoods-the-impact-of-information-and-communication-technologies-in-asia/21425

UNDP Asia Pacific Development Information Programme: www.apdip.net
- Case studies: http://www.apdip.net/case/
- Country profiles: www.apdip.net/projects/dig-rev/info/

USAID
- Microlinks technology-based solutions: http://microlinks.kdid.org/topics/financial-services/technology-based-solutions
- ICT and AG Community: https://communities.usaidallnet.gov/ictforag/home

World Bank Agriculture and Rural Development Department: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTARD/0,,contentMDK:20549935~menuPK:7288332~pagePK:210058~piPK:210062~theSitePK:336682,00.html
- ICT in agriculture: www.ictinagriculture.org/ictinag/
- Sourcebook: www.ictinagriculture.org/ictinag/content/ict-agriculture-sourcebook

ICT agriculture resource documents

Heeks, R. 2008. ICT4D 2.0: the next phase of applying ICT for international development. *IEEE Computer,* 41(6): 26–33 (available at www.computer.org/csdl/mags/co/2008/06/mco2008060026-abs.html).

Singh, S. 2006. *Selected success stories on agricultural information systems.* Bangkok, APAARI (available at www.apaari.org/publications/selected-success-stories-on-agricultural-information-system.html).

Talyarkhan, S. 2004. *Connecting the first mile: a framework for best practice in ICT projects for knowledge sharing in development*. ITDG (available at http://practicalaction.org/docs/icts/ict_best_practice_framework.pdf).

Vodafone/Accenture. 2011. *Connected agriculture – the role of mobile in driving efficiency and sustainability in the food and agriculture value chain* (available at www.vodafone.com/content/dam/vodafone/about/sustainability/2011/pdf/connected_agriculture.pdf).

Social networks/communities for connecting with ICT4D professionals

E-Agriculture: www.e-agriculture.org

ICT4D Learning Network (mostly Washington, DC-based): www.meetup.com/intlrel-76

ICT for Development Network (MDG 1 – poverty and hunger): www.comminit.com/ict-4-development/

ICT Works: www.ictworks.org

Zunia Knowledge Exchange (Development Gateway): http://zunia.org
- Agriculture knowledge and information systems and ICT: http://zunia.org/post/agriculture-knowledge-and-information-systems-akis/?no_cache=1&rank=d&cHash=f5d5d284c7fc1333a1b8192b8a4b8a06

General ICT4D information

CGAP Microfinance Gateway technology hot topic (primarily for financial inclusion): www.microfinancegateway.org/p/site/m/template.rc/1.11.48240/

Digital Opportunity Channel (news on ICT4D projects): www.digitalopportunity.org

Ethnos Project (information and database on ICT4D projects): www.ethnosproject.org/site/?page_id=2

ICT Dev: www.ictdev.org

ICT Update: http://ictupdate.cta.int

IDRC (information and communication theme page): www.idrc.ca/en/themes/information_and_communication/pages/default.aspx

ILO (UN Microinsurance Facility Technology): http://www.microinsurancefacility.org/en/thematic-pages/technology

Kiwanja.net (news source on mobile technology deployments for ICT4D, including FrontlineSMS): www.kiwanja.net

Mobile Active.org (directory of major mobile phone deployments for development): www.mobileactive.org/directory

UNCTAD ICT Programme: http://r0.unctad.org/ecommerce/

- Publications: http://r0.unctad.org/ecommerce/docs_en.htm

Annex

Examples of ICT innovations in agricultural value chains

This document is a supplement to the report on ICT uses for inclusive agricultural value chains. The following table provides basic information on just a few examples of each of the ICT categories profiled in the main document. It does not attempt to profile every existing example under each category (please see the reference section of the main document for additional resources). As explained in the main document, there is some overlap among examples and categories, especially between the short-term productivity and pricing service examples, as many projects provide several services at once. As the use of ICT in developing agricultural value chains is relatively new, many of the examples profiled are only in the pilot stage and cannot be labelled as successes. The primary purpose of this annex is therefore to generate ideas and highlight the need to investigate potential solutions further.

Information services: short-term productivity

Project name (**)	Project description		Services provided
Freedom Fone* *Other links:* The Kubatana Trust of Zimbabwe Farm Radio International Voltastar Radio Voltastar and Freedom Fone: The use of radio and Interactive Voice Response to reach farmers with agricultural information	Country: Ghana Ownership: NGO/ private	Year started: 2008 ICT used: Free open-source IVR menus and mobile phones, desktop computers, VoiceblueLite Global System for Mobile Communications (GSM) gateway modems	Freedom Fone's IVR system can be used in a variety of ways. In this example, a local radio station uses Freedom Fone to enable farmers to call into the radio station to listen to broadcasts they have missed, request agricultural product pricing, and leave voicemail messages for call-back – all in two local languages.
Question Box* *Other links:* Question Box brings world of information to villagers	Countries: India and Uganda Ownership: NGO	Year started: 2009 ICT used: Telephone intercom boxes, hotline call centres with desktop computers, landlines and Internet, Open Question software for managing calls	Question Box is an initiative for reaching people in remote areas who might otherwise lack access to the agricultural information they need because of language or technology barriers. It uses simple technology, such as a phone box in a village where a trained operator with Internet access takes calls and answers people's questions (in the local language).
Maharashtra Agriculture Department SMS Service *Other links:* Now, SMS service for grape, pomegranate farmers	Country: India Ownership: public	Year started: 2009 ICT used: SMS messages via mobile phones	This service uses SMS messages to provide grape, pomegranate, cotton and soybean farmers with weather forecasts, government contacts, and information on recommended chemicals and pests.

Information services: short-term productivity *(Continued)*

Project name (**)	Project description		Services provided
Rajasthan Sahakar Kisan Sanchar Yojana *Other links:* Rajasthan State Cooperative Department Farming Tips on Mobile	Country: India Ownership: public	Year started: 2008 ICT used: SMS messages via mobile phones	The cooperative department provides a Kisan SIM Card for farmers' mobile phones. The farmers receive free information on weather, livestock rearing and crop infection through SMS and voice messages. Subscribers also receive updates on the department's policies and schemes and can make local calls at less than 1 rupee per minute.
Nokia Life Tools *Other links:* First services to focus on email, agriculture and education	Country: India Ownership: private	Year started: 2009 ICT used: Downloadable mobile applications	Nokia Life Tools provides agricultural information – e.g., market and input prices, weather and agricultural techniques – and education value-added services, which are downloaded and icon-based but delivered through SMS to ensure connectivity.
e-Sagu*	Country: India Ownership: Academic	Year started: 2004 ICT used: N/A	e-Sagu provides advice to farmers on the planting, monitoring and harvesting of 50 different types of crop and on pesticide and fertilizer usage, based on digital photos taken by the farmers themselves.
Kisan Call Center (KCC)* *Other links:* ISAP Department of Agriculture & Cooperation	Country: India Ownership: public	Year started: 2004 ICT used: Local Area Network (LAN), Call Centre, high bandwidth telephone line desktop computers, Internet connectivity, printers, Uninterrupted Power Supply (UPS) and air-conditioning	KCC has a system of telecommunication infrastructure, computer support and human resources organized to manage farmers' queries in the desired local language. Its objective is to resolve farmers' queries and problems related to agricultural topics such as agronomy, horticulture, plant pathology, soil sciences, animal husbandry, entomology, agricultural economics, farm management, plant breeding and genetics.
National Farmers' Information Service (NAFIS)* *Other links:* Text to speech service supporting farmers in Kenya Local Language Speech Technology Initiative (LLSTI)-UK	Country: Kenya Ownership: public	Year started: 2008 ICT used: Voice recording/ mobile phones	NAFIS converts text into audio in English or Swahili. Farmers use landlines or mobile phones to place requests for voice-based information. The system provides information on disease outbreaks, weather reports and which crops are most suitable for a specific area.
Pinoy Farmers' Internet *Other links:* Open Academy for Philippine Agriculture (OPAPA)	Country: Philippines Ownership: public	Year started: 2003 ICT used: Internet based multi-agency SMS and multi-media messaging (MMS)	This is an extension support system to help farmers in the Phillipines. It provides online courses and SMS messaging on several crops and weather. The Farmer's Text Service allows farmers to send data on their crops to obtain assistance and advice through SMS, photos and videos, for example, on diseased rice crops.
Nutrient Manager for Rice Mobile (NMRiceMobile) *Other links:* International Rice Research Institute (IRRI)	Country: Philippines Ownership: public	Year started: 2010 ICT used: IVR and SMS applications/mobile phones	NMRiceMobile assists farmers and extension workers in providing site-specific nutrient management (SSNM) for rice. It helps determine the best applications of fertilizer for particular fields or areas. The farmer or extension worker calls the toll-free number and enters site-specific data using the number keypad. NMRiceMobile then sends a text message with its fertilizer recommendation.

Information services: short-term productivity *(Continued)*

Project name (**)	Project description		Services provided
e-Dairy* *Other links:* Information and Communication Technology Agency, "ICTA initiates e-dairy project to increase milk production"	Country: Sri Lanka Ownership: public	Year started: 2009 ICT used: Mobile phones with SMS messaging and touch-button computers at milk collection centres	In Sri Lanka, Web and mobile technologies have been introduced to help dairy farmers improve and increase milk production. ICTA bridges information gaps through mobile phone-based SMS messages and touch-button computers installed at the milk collection centres where farmers gather every morning to sell their milk. The system offers a number of "just-in-time" services, including access to artificial insemination agents to help induce pregnancy in dairy cows.
FrontlineSMS* (also pricing services) *Other links:* Kiwanja.net	Countries: United Kingdom of Great Britain and Northern Ireland/ worldwide Ownership: NGO	Year started: 2005 ICT used: SMS text messages via mobile phones using open-source software and laptop computers	FrontlineSMS builds and distributes free and open-source software to "lower barriers to driving transformative social change using mobile technologies". It does not carry out field activities such as storing medical information for a health clinic but helps institutions to use simple and cost-effective ICT tools to manage their activities and improve communications. Frontline has five categories : Credit, Learn, Legal, Medic and Radio. Most agricultural development applications fall under the Learn, Radio and Credit categories. Most of the 20+ applications of the FrontlineSMS software in the area of agricultural development provide information services, including pricing information, to farmers throughout Africa, Asia and Latin America.
Philippines Aquarium Fish Project *Other links:* AED/FHI 360 Marine Aquarium Council PDAs and Beyond: Innovative Technologies and Applications Accelerate Development	Country: Philippines Ownership: NGO	Year started: N/A ICT used: PDAs	Through the use of PDAs, fishers have been trained and certified to use new environmentally and ethically sound fishing methods. The PDAs use a picture-based technology for people who are not literate, indicating how many fish to capture (based on orders from international aquariums all over the world). Previously, the fishers captured as many fish as possible, and unwanted fish were usually left to die.

* Denotes a project that is described in the main document.
** Denotes a link that was valid when last visited on Monday, 10 December 2012.

Information services: short-term crisis management

Project name	Project description		Services provided
Chilean Aquaculture Project (CAP)* *Other links:* CERMAQ/ Mainstream Fish farms need monitoring technologies	Country: Chile Ownership: multi-lateral/private	Year started: 2002 ICT used: GIS, Web portal	CAP provides fishers/farmers with daily information about sea-surface temperature, clarity of seawater and amount of chlorophyll in the water. For example, information on chlorophyll enables fish farmers to take action when harmful algal blooms multiply to a level where they threaten farmed fish.
Virtual Academy* *Other links:* International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Climate Conversations - Women take on drought and pests with virtual science academy	Country: India Ownership: public/ multilateral	Year started: 2007 ICT used: Video conferencing via satellite and audio conferencing	Designated women from villages meet ICRISAT scientists via audio and video conferences to exchange information about droughts, cropping practices, pest control, soil fertility, etc.
Pest control and frost prevention* *Other links:* Agricultural Directorate Using Cell Phones to Reduce Harvest Losses	Country: Turkey Ownership: public	Year started: N/A ICT used: Weather data collection at meteorological stations and dissemination via text messages on mobile phones	The project gathers information about pest control and frost prevention from weather stations placed throughout the country and sends this information to farmers via cell phones, for example to alert farmers ahead of peak pest seasons to help them choose the best time for pesticide application.

* Denotes a project that is described in the main document.

Information services: long-term productivity

Project name	Project description		Services provided
AGRECOL *Other links:* ICT for the Exchange of Farmer Experiences in Ecological Agriculture - Bolivia	Country: Plurinational State of Bolivia Ownership: NGO	Year started: 2003 ICT used: Cameras for capturing digital photographs, audio and video laptop computers, PowerPoint software, projectors, Web site/ database	AGRECOL staff use cameras to capture best practices and testimonials from local farmers on ecological agriculture and the sustainable use of natural resources. The data collected are used in presentations as videos, photos or audio recordings during training workshops, meetings with individual farmers and through the Web site.
The Talking Book *Other links:* Literacy Bridge	Country: Ghana Ownership: NGO	Year started: 2009 ICT used: Hand-held audio computers	The Talking Book is a hand-held audio computer that records locally produced agricultural and literacy information for Ghanaian farmers to play back in their own language. Farmers interact by pressing any of ten buttons; for example, pressing the right and left arrows navigates through categories such as livestock, fish farming and health.
Digital Green Project of Microsoft	Country: India Ownership: private	Year started: 2008 ICT used: Digital video recordings and a distribution video database called COCO Internet	Digital Green supports agricultural extension through technology. Village-level mediators use locally produced videos to motivate and train small-scale farmers, increasing the adoption of sustainable agricultural practices and technologies. Digital Green helps create and disseminate agricultural information for small and marginal farmers in India through digital videos.
e-Arik	Country: India Ownership: public	Year started: 2007 ICT used: Internet at village kiosks/centres – desktop computers and Internet access Web portal	e-Arik disseminates information from farm publications, multi-media CDs and newspapers at local village knowledge centres and through training.
Lampung Fishery and Forestry Counseling Coordination Agency (Lampung BKPPK) *Other links:* Lampung farmers surf the Internet	Country: Indonesia Ownership: public	Year started: 2009 ICT used: Internet at village kiosks/centres, desktop computers	BKPPK's "cyber-extension" programme provides guidance and counselling to farmers via the Internet. This permits extension agents to support more farmers. The topics covered are crop information, horticulture, livestock, fishery and forestry.
Agrarian Information System (SIA)* *Other links:* Centro Peruano de Estudios Sociale (CEPES) Digital poverty: Latin American and Caribbean perspectives Huaral Valley farmers marry ICT to traditional agriculture	Country: Peru Ownership: NGO	Year started: 2004 ICT used: Wi-Fi networks, VSAT link, Agricultural Information Database, Internet access through telecentres	CEPES created an agricultural information and communication system for the region offering long-term training to improve farmers' decision-making and timely communications among the local water irrigation commissions that manage the water cooperative. To overcome the lack of telecommunications infrastructure, CEPES put in place a Wi-Fi network connecting 12 villages and providing them with Internet access to the outside world.
The Interactive System for Agricultural Exchange and Electronic Learning (i-ExEL) *Other links:* Agricultural Training Institute (ATI) ICT in Agriculture Sourcebook	Country: Philippines Ownership: public	Year started: 2007 ICT used: Internet/online courses delivered through local e-learning offices	i-ExEL was designed to help agricultural extension workers improve their assistance to farmers and fishers. ATI offers online certificate courses on agricultural technology and best practices for several agricultural crops. The courses are delivered through a combination of online learning and face-to-face interaction with experts. Farmers can also interact in discussions and access other resources online.

Information services: long-term productivity *(Continued)*

Project name	Project description		Services provided
Africa Soil Information Service (AfSIS) Web Map Service Global Soil Map.net *Other links:* Digital Map of Africa's Depleted Soils to Offer Insights Critical for Boosting Food Production	Countries: countries in Africa Ownership: multilateral	Year started: 2009 ICT used: Multivaried information collection techniques, e.g., near-infrared spectroscopy (NIR), spectral diagnostics, satellite imagery	"A digital soil map is a spatial database of soil properties that is based on a statistical sample of landscapes or regions and that permits functional interpretation, spatial prediction and mapping of soil properties relevant to soil management and policy decisions." The objective is to provide recommendations based on the soil, climatic and socio-economic conditions for fertilizer application rates, soil organic matter management, use of legumes, and tillage operations in cropping systems. Ultimately, the maps should help farmers and agricultural experts identify the best options for sustainably improving crop production through better soil management. Extension agents are trained in interpreting and using the data to provide recommendations to local farmers. The goal is to provide a comprehensive soil map for each of the 42 African countries.
e-Srilanka* *Other links:* Information and Communication Technology Agency Fusion /Sarvodaya/ SEEDS Sharing Fusion's lessons at CABI Global Summit, London	Country: Sri Lanka Ownership: NGO/ public	Year started: 2003 ICT used: Telecentres with desktop computers and Internet access	About 600 telecentres in rural areas provide local citizens with Internet access, ICT-based services and access to information from the government and other sources. Most telecentres are run by "youth managers". Fusion and the University of Mortuwa have created a long-distance education model to provide courses via the Internet to all rural telecentres through interactions with professors over Skype, a common syllabus and textbook, and a common examination conducted by a certified government agency. The telecentres provide farmers with basic pest, disease and market price information as well as offering more long-term services through "agri-clinics". Fusion collates updated research from local and international sources and distributes this information through the telecentres. Agri-clinics also distribute the information through telecentres, using both electronic and traditional communication media such as leaflets to support farmers' decision-making regarding pest and disease problems.

* Denotes a project that is described in the main document.

Market access: pricing services

Project name	Project description		Services provided
Bhutan Telecom/ B-mobile *Other links:* Market info system for farmers	Country: Bhutan Ownership: public/private	Year started: 2010 ICT used: SMS messaging via mobile phones and IVR	B-Mobile plans to offer farmers throughout Bhutan access to vegetable prices in three local languages and English, and is available 24 hours a day and 7 days a week. Average, high and low prices are provided for each commodity in the farmer's region each day.
DatAgro *Other links:* Foundation for Agrarian Innovation Datadyne.org	Country: Chile Ownership: NGO	Year started: 2009 ICT used: SMS messaging via mobile phones using its Mobile Information Platform (MIP) data compression/ decompression to transmit and receive enhanced SMS	Cooperative farmers using DatAgro can request information about supply and product prices in local and international markets, weather and news.
Reuters Market Light (RML)* *Other links:* Masters of rural markets: The Hallmarks of High Performance Can ICT increase the impact of agriculture development?	Country: India Ownership: private	Year started: 2007 ICT used: Mobile phone SMS messaging	RML is a mobile phone-based, personalized information service for farmers that disseminates timely, accurate and personalized information, such as crop advice, weather forecasts and local market price information. RML has served more than 2 million farmers from more than 15 000 villages in 13 states throughout India. It collects data from more than 1 400 markets and 2 800 weather locations with the help of its 300+ employees. RML sells subscriptions through partnerships with IDEA cellular and Nokia retailers, input suppliers, NGOs, banks and other entities. Farmers pay INR 260 (US$5) per quarter (three months). RML provides information on 440 crops in several local languages, and plans to add more.
Livestock Information Network and Knowledge System (LINKS) National Livestock Marketing Information System (NLMIS) *Other links:* Global Livestock CRSP USAID Texas A&M University	Countries: Kenya and Ethiopia Ownership: public/ multilateral	Year started: 2007 ICT used: Global Positioning System (GPS), mobile phones, SMS messaging, pricing database, Web platform, WorldSpace Radio, laptops, solar panels, portable printers, satellites radio receivers	LINKS/NLMIS collates data on livestock sales and prices from a network of district livestock marketing officers for dissemination through SMS messages.
M-Farm *Other links:* Think Innovation: M-Farm Profile	Country: Kenya Ownership: private	Year started: 2010 ICT used: Mobile phones and SMS messages	M-Farm is a non-subscription mobile phone service that gives farmers information about market prices across the country through text messages. Farmers send an SMS to the number 3535 to obtain access to product prices, buy inputs and find buyers. M-Farm was created by Strathmore University students to make the market more transparent to farmers. Its target group is small-scale farmers in rural areas who lack access to information.

Market access: pricing services *(Continued)*

Project name	Project description		Services provided
Fish price alert system *Other links:* Co-op Africa-ILO Department for International Development (DFID)	Country: Kenya Ownership: multilateral/public	Year started: 2009 ICT used: Mobile phones and SMS messaging	This alert system gives fishers access to information on buyers and current selling prices on their mobile phones. Fishers can send texts to one another to help avoid certain buyers or find the best prices.
M-Kulima* *Other links:* Mobile app developers tackle Africa's biggest problems	Country: Kenya Ownership: private	Year started: 2009 ICT used: Mobile phones, SMS messaging, Java ME application	Dairy farmers send their questions via SMS messages. The software matches key words from the questions with a database on local markets and provides answers in a Twitter-like format of no more than 140 characters.

* Denotes a project that is described in the main document.

Market access: virtual trading floors

Project name	Project description		Services provided
E-purjee* *Other links:* Access to Information programme (A2I) UNDP	Country: Bangladesh Ownership: public	Year started: 2009 ICT used: Mobile phones, SMS messaging and Web site	E-Purjee uses SMS to issue permits and billing information to sugar cane growers to support sales to the 15 State-owned sugar mills. On 13 January 2012, e-Purjee reported on its Web site that it had facilitated almost 500 000 permits, for processing 826 000 tonnes of sugar cane and producing 47 000 tonnes of sugar.
Cell Bazaar* *Other links:* CellBazaar, Bangladesh's Burgeoning Mobile Marketplace Grameen Phone	Country: Bangladesh Ownership: private/NGO	Year started: 2006 ICT used: Mobile phone-based: SMS messaging, WAP applications, Internet and IVR	Cell Bazaar is a simple matching service based primarily on person-to-person (P2P) commerce selling used or unwanted consumer goods – all through the mobile phone. It features more than 20 agricultural products for exchange among subscribers.
Tradenet *Other links:* Dialog Tradenet – GGS Partnership set to Revolutionise Agri Market Access Dialog	Country: Sri Lanka Ownership: private/public	Year started: 2009 ICT used: Mobile phones via SMS, Unstructured Supplementary Service Data (USSD), IVR and Web	Dialog Tradenet, provided by Dialog, one of Sri Lanka's largest mobile network operators, is available to 6 million subscribers in three languages. The platform is mostly used by consumers (P2P) to trade used or unwanted consumer goods or to purchase goods and services from businesses (B2C). Tradenet also provides access to spot and forward prices for agricultural products from three dedicated economic centres.
Krushiseva.com *Other links:* SumanaBh	Country: India Ownership: private	Year started: 2002 ICT used: Internet portal	Krushiseva links farmers, agri-input traders and manufacturers and vegetable vendors for pricing and ordering. For example, KrushiSeva Kendra (shopkeepers) sell agri-related products to farmers directly after registering their requirements.
Soko Hewani-KACE* *Other links:*	Country: Kenya Ownership: private	Year started: 2003 ICT used: Direct Internet access or through market resource centres, mobile phones via SMS or IVR, and radio programmes	KACE/Soko Hewani matches subscribing buyers and sellers of agricultural products. It reports that it can facilitate the provision of services for 13 traditional agricultural products, 6 types of livestock, dairy products such as eggs and milk, inputs such as fertilizer and seeds, and even fish and honey. Matching involves not only the purchasing of these products but also processing, packaging, transport, storage, grading, quality testing and finance. Transmission is via radio, mobile phone and the Internet, with a significant call centre to facilitate transactions.
FarmerNet* *Other links:* FarmerNet Blog Fusion	Country: Sri Lanka Ownership: NGO	Year started: 2009 ICT used: Mobile phones and SMS messaging, or the Internet	FarmerNet by Fusion is a Sri Lankan ICT-based trading platform that enables farmers and traders to send information by SMS regarding the availability of or requirements for a particular commodity, including the quantity required, quoted price, delivery location, etc. The user enters the database and is matched with a corresponding party.
Mobiashara *Other links:* How SlimTrader's Service Works for Notore SlimTrader Slim Trader Blog	Country: Nigeria Ownership: private	Year started: 2010 ICT used: Mobile phones and SMS messaging, IVR or mobile Web	MoBiashara uses village promoters (retailers) to help their farmer clients use mobile phones to order and purchase agri-inputs such as fertilizer from Notore, an agro-input supplier. (Users can also purchase many consumer goods and services such as bus tickets.) Payments are made through a mobile money partner such as M-PESA, Airtel or MTN. The system has an in-built fertilizer inventory system.

* Denotes a project that is described in the main document.

Market access: holistic trading

Project name	Project description		Services provided
E-Choupal* *Other links:* Indian Tobacco Company (ITC) What Works: ITC's e-Choupal and Profitable Rural Transformation	Country: India Ownership: private	Year started: 2000 ICT used: Internet kiosks with desktop computers and printers, battery back-up, solar panels (if needed), and V-SAT arrays for Internet connection	Choupal means "village meeting place" and e-Choupal provides a virtual market place where farmers can transact directly with buyers to realize better prices for their produce. E-Choupal also transmits information (e.g., on weather, prices and news) and transfers knowledge (farm management, risk management). Village Internet-enabled kiosks are provided and managed by entrepreneur sanchalaks, who are often farmers. More than 6 500 e-Choupal kiosks cover 40 000+ villages across 16 states of India, helping more than 4 million rural villagers since their inception.
Sokopepe **(Arid Lands Information Network-ALIN)*** *Other links:* An ALIN approach to learning	Countries: Kenya, Uganda and United Republic of Tanzania Ownership: NGO	Year started: 2010 ICT used: Mobile phones through SMS and WAP, e-mail and Web and Internet through Maarifa centres	Farmers are able to circumvent intermediaries and sell their maize directly to the highest bidder through Sokopepe, an online commodity marketing platform created by the Arid Lands Information Network (ALIN), an NGO operating in three East African countries. Farmers must first be members of the local Maarifa (knowledge) centre, where they can learn about weather patterns and farming techniques, among other topics. Sokopepe gives rural farming communities in remote areas access to market information and knowledge sharing; they learn new farming techniques and the use of computers and the Internet, and obtain access to information on weather and climate change.
DrumNet* *Other links:* PRIDE and Bidco Experience in Kenya's Sunflower Sector DrumNet: An Enterprising Third Party Transaction Manager	Country: Kenya Ownership: NGO	Year started: 2004 ICT used: Internet, mobile phones (SMS) and wireless devices	DrumNet is operated by Pride Africa, an international NGO operating in Kenya in the French bean, passion fruit, baby maize and sunflower markets. DrumNet is a hybrid model that brings together many different stakeholders in agricultural value chains: suppliers, buyers, input suppliers and financiers. Its role is to facilitate relationships among farmers, banks, input retailers and buyers and to put in place processes and mechanisms that help the parties to complete transactions. DrumNet uses a comprehensive finance, production, delivery and payment process with clearly defined roles, rights and responsibilities for all value chain partners. DrumNet uses local entrepreneurs to provide services in the field and, to remain viable, charges a per-activity fee for its brokerage, administrative and transactional services. DrumNet enables the provision of information services, such as weather information and more intensive extension services, often via the buyer entity. Farmers undergo a four-week orientation course covering financing and marketing processes as well as advanced agricultural practices (but much of this is not based on ICT). DrumNet provides marketing groups with information through mobile phones, alerting representatives about current market prices, available contracts, harvest and pickup schedules, and payment status. Individuals have access to information on their own personal pricing and marketing histories.

* Denotes a project that is described in the main document.

Market access: downstream administration

Project name	Project description		Services provided
Livestock Identification Trace-back System (LITS)* *Other links:* LITS: tracking Botswana's livestock using radio waves Omong Wa Dikgomo FAQs	Country: Botswana Ownership: public	Year started: 2003 ICT used: RFID tags and scanners, livestock inventory database	LITS uses radio-frequency identification (RFID) technology to capture data on individual cattle, and transmits this information directly, and error-free, to a central database. RFID tags are located in the stomachs of more than 135 000 cattle, which can be individually identified and traced throughout their lives. The database helped Botswana's meat export industry obtain EU certification for exports, and is a critical information source for livestock farmers, state veterinary services and health authorities.
Jamaica Pest Control and Traceability Project* *Other links:* Traceability: Tracking food from farm to fork	Country: Jamaica Ownership: public	Year started: N/A ICT used: GPS, Internet	This traceability project is part of a nationwide response to address the gall midge pest problem that affects hot pepper exports from Jamaica to the United States of Amercia. A monitoring and surveillance system has been developed to discover infected peppers at ports, before they enter the United States, and to trace their sources back to farms. GPS technology is used to map farm locations, and exporters are responsible for labelling loads from farmers, using an individual registered code for each farmer. (The system is now fully available on the Internet.) Use of the system has led to a better understanding of the behaviour and biology of the gall midge pest and to effective prevention through identifying the source of infested peppers. The administrators also hope to identify pest-free seasons, hot spots and pest-free zones. The original database has been enhanced to include other export agricultural products to facilitate the opening of new markets, the sourcing of produce and access to data for stakeholders.
Apple Service Project *Other links:* Shri Jagdamba Samiti The Apple Project Apple Service Project India	Country: India Ownership: NGO	Year started: 2007 ICT used: SMS messaging, database	The Apple Project maintains a database of information on apple farmers, such as details on their landholdings, numbers of trees and estimated production of apples. It has four decentralized apple collection centres that operate as cooperative-type processing agribusinesses.
AKASHGANGA	Country: India Ownership: private	Year started: 1997 ICT used: Mobile phones (GPRS, SMS), smart cards, solar-powered collection systems	Akashganga designs, develops and produces automatic milk collection systems and connects all players to information on milk collection, storage, processing and payments, for data monitoring. Data are collected and shared among collection points, chilling centres, dairy plants, etc. SMS messages are sent to milk-producing farmers, to confirm that their milk has been deposited, and smart cards are used to confirm and process transactions. Recently, Akashganga has created a milk analyser to measure the fat and protein content of the milk for quality assurance and pricing.

Market access: downstream administration *(Continued)*

Project name	Project description		Services provided
TraceNet* *Other links:* APEDA (Agricultural Produce Export Development Agency -Government of India) Traceability Solutions for Fresh Produce – Case Studies	Country: India Ownership: public	Year started: 2009 ICT used: Internet-based	APEDA has created TraceNet, a centralized monitoring system on the Internet for all produce stakeholders in the supply chain, to ensure traceability and quality assurance. TraceNet can monitor pesticide residue, achieve product standardization and facilitate product tracing back from retail shelves to the farm. The ultimate goal is to facilitate certification for the export of organic products from India that comply with importer standards.
Virtual City	Country: Kenya Ownership: private	Year started: 2000 ICT used: PDA, mobile phone applications, portable printers, virtual private networks (VPNs), and a Bluetooth-enabled electronic scale	AgriManagr, a product of Virtual City, was designed for buyer firms and their field agents who buy directly from farms. With a PDA device and the AgriManagr app, an agent can record how much the farmer has to sell, the weight (through an electronic scale), quality and any payments due. AgriManagr can also produce customized reports and receipts for an accurate, printed record of farmers' transactions, for use in trading, requesting credit and tracking productivity. Where there is a network connection, the app sends data to the agent's main office through a secure VPN. Using the collected data, the office updates warehouses, transporters and buyers with details of where to collect the produce and how much to expect. Each person or business connected to the supply chain therefore has a much clearer idea of what goods are available, in what quantities, and where. Virtual City also has solutions called Distributr, Tracr (product tracking) and Warehousr.
Relationship Information Tracking Systems (RITS)* *Other links:* Sustainable Harvest USAID Sustainable Harvest's Relationship Information Tracking System (RITS)	Countries: Peru and United Republic of Tanzania Ownership: private/ multilateral	Year started: 2010 ICT used: Internet, smart phone applications	Sustainable Harvest has created RITS for coffee traceability in the United Republic of Tanzania and Peru. Farmer cooperatives use RITS to track deliveries and ascertain the variety and quality of different coffee bean lots. Roaster customers also have access to videos, photos, quality and lot information from the supplier cooperatives. RITS can be used through any Internet connection or smart phone (but primarily uses Apple iPads and iPhones "because of their user-friendly interface").

* Denotes a project that is described in the main document.

Financial inclusion: transfers and payments

Project name	Project description		Services provided
GCASH and Smart Money* *Other links:* Demand Study of Domestic Payments in the Philippines Globe Telecom's GCASH REMIT in support of the Philippine Government's Poverty Alleviation Program	Country: Philippines Ownership: private	Year started: 2003/2004 ICT used: Mobile phones, ATM, POS, smart cards	Smart Money (Smart Telecom) and GCASH (Globe Telecom) (both of which are mobile network operators) mainly provide money transfers from family members living abroad (international remittances) or in Philippine cities with relations in rural villages (domestic remittances). Smart Money and GCASH focus on domestic remittances, airtime purchase and bill payments (although few rural users use the bill payment service). GCASH has also begun a money transfer pilot with the Philippines Government, as part of its Conditional Cash Transfer Programme of benefits to the poorest – often rural – Filipinos (G2P). Smart's product is a pre-paid card that provides access to cash using an ATM, a credit card terminal or mobile phone (at one of 4 000 cash-in/-out points). GCASH's money transfers occur mainly through mobile phones (and visits to local GCASH agents at more than 18 000 locations). Most of GCASH's customers are urban, while about half of Smart Money's customers are rural.

* Denotes a project that is described in the main document.

Financial inclusion: credit

Project name	Project description		Services provided
La Coordinadora de Integración de Organizaciones Económicas Campesinas, Indígenas y Originarias de Bolivia (CIOEC-BOLIVIA) *Other links:* Information System for Access to Public Funding by Small Producers in Agriculture - Bolivia	Country: Plurinational State of Bolivia Ownership: NGO	Year started: 2003 ICT used: Internet access and database software	CIOEC, the apex organization for economic farmers' organizations (OECAs) in the Plurinational State of Bolivia, facilitates farmers' access to public investment. CIOEC has a database and e-mail system for communication with remote OECAs to inform them about available opportunities and how to submit applications and follow up on requests.
Wokai	Country: China Ownership: NGO	Year started: 2007 ICT used: Internet	Wokai allows people with an Internet connection to provide loan capital to MFIs that operate solely for rural villagers in China.
Acceso a Crédito para Agricultores (ACA)/MCA* *Other links:* ACDI/VOCA Financing the Value Chain through Input dealers	Country: Honduras Ownership: NGO/ private	Year started: 2007 ICT used: Quickbooks, Excel and Access databases	ACDI/VOCA's work with ACA in Honduras provides credit management ICT tools (and training) to improve credit disbursement and administration for retail input suppliers. The technology is simple off-the-shelf accounting software packages (QuickBooks) and tools that ACDI/VOCA has modified from other microcredit programs, including an Excel-based cash flow analysis tool and an Access-based loan portfolio management tool. These tools are not only inexpensive to implement and use but have also improved the lending and collections process and reduced delinquencies through better monitoring. This has helped improve the funding coordination and communication processes of the larger input distributors providing financing (which often receive funding from banks), while retailers act as intermediaries in providing and monitoring credit provided directly to farmers.

* Denotes a project that is described in the main document.

Financial inclusion: savings

Project name	Project description		Services provided
Banking Correspondents* *Other links:* Technology Program Country Note: Brazil	Country: Brazil Ownership: private	Year started: 2000 ICT used: Typically POS terminals and smart cards, desktop computers, scanners, and connections to banks via telephone, cable GPRS (mobile phone) or VSAT	CGAP reports that Brazil had more than 160 000 correspondent banking agents in 2008, helping to manage more than 10 million simplified bank accounts throughout the country (although just over half of the accounts are considered active). While most small municipalities in Brazil do not have a bank branch (particularly in rural towns), almost all have a bank agent. Agents conducted 2.8 billion transactions in 2009 (just less than 6% of total banking transactions). 75% of all agent transactions were bill payments (mainly utility bills), with withdrawals from and deposits into savings and demand accounts representing 12.6% of transactions. However, rural agents conducted more withdrawals and deposits, accounting for 38% of their transactions, suggesting that access to savings and demand accounts through agents is more important in rural than urban areas. The third most popular type of payment is government transfers (7.3% of agent transactions in 2009), mostly tied to the popular Bolsa Familia programme to help poor, rural families with children (but also including pensions and salaries to employees such as teachers). The technology for enabling communication between banks and retailers is usually managed by a third-party network manager. These managers also set up the necessary equipment at the retail point and manage the training of retail employees and the maintenance of the data transfer process from the terminal to the bank system.
BASIX Sub-K* *Other links:* BASIX	Country: India Ownership: private	Year started: 2010 ICT used: Mobile phones, IVR	Sub-K acts as a business correspondent network manager (BCNM) for banks. Sub-K, meaning less than 1 000, was envisaged to provide primarily the rural poor with access to financial services within a radius of 1 000 m (1 km) of their homes or businesses, for transactions of up to Rs 1 000 (about US$20), incurring transaction fees of less than 1 000 paise (Rs 10 or US$0.20) and using an outlet serving about 1 000 local customers. Sub-K provides access to bank accounts for deposits and withdrawals, payment of utilities and top-ups for prepaid mobile service plans.
East Africa Voluntary Savings and Loans Associations (VSLAs)* *Other links:* CARE MTN Rwanda Rwanda: Rural Savings Groups to Be Linked to Mobile Banking	Country: Rwanda Ownership: NGO	Year started: 2011 ICT used: Mobile phones and SMS messaging	CARE in East Africa is experimenting with connecting its voluntary savings and loans associations (VSLAs) to the formal banking system. Each VSLA has a single group account tied to a bank, which can be tracked and managed via mobile phones. Each individual member can send in his/her savings transaction through a phone. These links and use of ICT provide access to additional products from the bank (which benefits from aggregating small customers rather than dealing with each individual), reduce the likelihood of theft or loss of the savings (previously savings were kept in lock-boxes), and improve the management and accounting of VSLA finances (reducing the potential for fraud and error).

* Denotes a project that is described in the main document.

Financial inclusion: insurance

Project name	Project description		Services provided
IFMR/KGFS* *Other links:* HDFC Ergo ICT to improve livestock insurance Making Risk Management Hassle-free and Affordable for Small Dairy Farmers in India	Country: India Ownership: private/NGO	Year started: 2010 ICT used: RFID tags and scanners, netbooks, VSAT connection	IFMR and its insurance company partner, HDFC Ergo, use RFID tag technology to verify the location and ownership of each animal insured. Using hand-held scanners connected to netbooks, field officers and veterinarians scan the tag each time the animal is visited. This triggers a requirement for the staff member to enter data on the visit into the management database. Obligatory veterinarian visits help reduce the likelihood of disease and fraud. IFMR's management information system (connected via VSAT at each branch) is connected to its insurance company partner's information system.
Kilimo Salama* *Other links:* Syngenta Foundation UAP Insurance Safaricom/ M-PESA Kenyan farmers get micro-insurance	Country: Kenya Ownership: private/NGO	Year started: 2008 ICT used: Solar-powered weather stations, mobile phones and SMS messaging, camera phones and barcode software	The Syngenta Foundation piloted *Kilimo Salama* (Swahili for "safe agriculture") with its insurance partner, UAP Insurance, to provide weather insurance that guarantees at least partial recapture of capital investments if certain weather conditions occur. The farmer has the option of being automatically enrolled in the insurance programme when she/he purchases inputs from *Kilimo Salama* partners selling seeds, fertilizer, etc., as the stockist scans the barcodes of the product with a simple camera phone. To determine who should receive claim payments, when and of how much, *Kilimo Salama* has emplaced 30 automated solar-powered weather stations throughout Kenya to collect weather data. As soon as one of the weather stations records too much or too little rainfall, a claim and payment is automatically triggered for each affected farmer within a 15 to 20 km radius. Each affected farmer receives an SMS message through his/her mobile phone, informing him/her of the claim and pay-out. The programme distributes insurance payments to farmers using M-PESA.

* Denotes a project that is described in the main document.

Financial inclusion: financial derivatives

Project name	Project description		Services provided
Gramin Suvidha Kendra (GSK)* *Other links:* MCX Agri Revolution: Financing the Agricultural Value Chain – Conference Summary Report	Country: India Ownership: private	Year started: 2007 ICT Used: Mobile phones and SMS messaging, Internet kiosks	Through its GSK programme, MCX provides farmers with information at more than 500 post office locations in five states, and sends SMS messages directly to inform farmers and traders of commodity spot and futures price movements. Some of the locations have installed self-service Internet kiosks that provide the information; most of the local post office managers post daily prices on a simple blackboard (some prices are also posted on the electronic notice boards at train stations). The farmers benefit from better price information, access to finance (using product as collateral) and risk management techniques such as locking in prices on the futures market.

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ICT USES FOR INCLUSIVE AGRICULTURAL VALUE CHAINS

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