Chapter 2

Mobilizing the Agricultural Value Chain

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In many developing countries the agricultural sector plays a significant role in the national economy. The sector employs about 40 percent of the total labor force in countries with annual per capita incomes ranging from $400 to $1,800 (World Bank 2008). Developing countries will continue to rely heavily on the agricultural sector to ensure employment for the rural poor and food security for growing populations as well as to meet challenges brought on by climate change and spikes in global food prices.

Improving efficiencies in the agricultural value chain is central to addressing these challenges. Increasing productivity in agriculture is also critical to reducing poverty. Greater productivity can boost farmers' income, especially for smallholder farmers and fishers, who have limited resources to leverage in growing and marketing their produce. Creating a more efficient value chain also requires engaging many stakeholders, from farmers growing crops and raising cattle to input suppliers to distributors.

The potential benefits of using mobile phones to connect these diverse stakeholders along the agricultural value chain speak for themselves. For rural populations, geographically dispersed and isolated from knowledge centers, the information and communication capabilities of the mobile phone can be even more valuable. Close to 6 billion phones are in use today and are accessible to the 70 percent or so of the world's poor whose main source of income and employment comes from the agricultural sector (World Bank 2012).

The mobile revolution in agriculture is not driven by mobile phones alone. Other mobile devices such as smartphones and tablets have already begun to have an impact as information delivery channels. These devices can carry applications that are much more sophisticated than those available in the basic mobile phone. As the cost of these devices declines, they will increasingly be adopted in developing contexts.

This chapter examines how services provided on mobile phones and other mobile devices have begun to change the way stakeholders across the agricultural value chain make decisions regarding inputs, production, marketing, processing, and distribution—decisions that can potentially lead to greater efficiencies, reduced transaction costs, and increased incomes. The chapter also examines the key challenges mobile service providers are facing in scaling up their operations to reach critical mass and to ensure sustainability for the development of a whole ecosystem of different stakeholders. Based on this analysis, the chapter concludes by drawing key policy considerations.

Making information mobile

Among the numerous technological developments in the information and communication technology (ICT) sector, mobile phones have had the most pronounced impact in developing countries. As detailed in chapter 1, adoption has

been driven by improved accessibility and affordability made possible through the expansion of mobile networks that are cheaper to deploy than fiber-optic cable infrastructure. The capacity or bandwidth available on mobile networks continues to increase as the technology evolves, enabling more data-intensive services to be delivered through sophisticated devices such as smartphones and tablets.

The most common device in developing countries is still the basic mobile phone, and hence most of the examples cited in this chapter are for mobile services provided through the text-based SMS (short message service) (see table 1.1). An SMS of up to 160 characters can be sent from one phone to another. SMS messages can be used to communicate, inform, and share knowledge on various aspects of agricultural and rural life. The SMS function is generally bundled into the price of a subscription or prepaid package; in many, but not all, developing countries, SMS costs a small fraction of the price of a voice call and can be sent asynchronously, that is, without the caller and the called party having to be online at the same time. Messages sent using USSD (Unstructured Supplementary Service Data) have a functionality similar to instant messaging and can be used when both parties are online, for instance, to access information from a database; USSD messages are sometimes cheaper than SMS messages.

As prices continue to decline, data-enabled devices such as feature phones, smartphones, and tablet computers are expected to become more accessible to more people. These devices include an operating system, which means they have computing capabilities and can carry software applications, referred to as mobile applications. In the past year tablet computers have started to revolutionize various entertainment and knowledge-based industries such as music, videos, books, newspapers, and magazines. Combining the operational potential of a computer, the communications capabilities of a phone, and the versatility of a notepad, companies have already started selling no-frills tablets for less than the cost of some mobile phones ($50–$150).

These data-enabled devices, along with their increasing affordability, can have a range of implications for the development of mobile applications, including ease of use, richer multimedia that can transform agricultural extension services, and the ability to access relevant information on demand in local languages. While cost may still be a barrier for smallholder farmers,[1] community knowledge workers, and local entrepreneurs, users are increasingly able to afford these mobile devices, incorporating them in their work to collect and disseminate information. Devices targeted for this market increasingly use offline technology such as USB (universal serial bus) media to overcome connectivity issues.[2]

Mobile and remote wireless sensors and identification technologies also have an important role to play in gathering data and information relevant to agricultural production, such as temperature, soil composition, and water levels. Illustrative examples of emerging uses of these non-cellular technologies in developing countries are given throughout this chapter.

Increasingly, specialized mobile services targeted to specific agricultural functions are becoming more available (table 2.1). The basic functions of a mobile phone—sending and receiving voice calls and text messages—are invaluable in increasing efficiency in smallholder agriculture by improving the flow of information along and between

Table 2.1 Mobile-enabled solutions for food and agriculture

Improving access to financial services*	Mobile payment platform Micro-insurance system Microlending platform	Increasing access and affordability of financial services tailored for agricultural purposes
Provision of agricultural information	Mobile information platform Farmer helpline	Delivering information relevant to farmers, such as agricultural techniques, commodity prices, and weather forecasts
Improving data visibility for supply-chain efficiency	Smart logistics Traceability and tracking system Mobile management of supplier networks Mobile management of distribution networks	Optimizing supply-chain management across the sector, and delivering efficiency improvements for transportation logistics
Enhancing access to markets	Agricultural trading platform Agricultural tendering platform Agricultural bartering platform	Enhancing the link between commodity exchanges traders, buyers, and sellers of agricultural produce

Source: Vodafone 2011.

* The role of mobiles in finance is discussed in chapter 4.

various stakeholders in the value chain from producer to processor to wholesaler to retailer to consumer. Furthermore, mobile phones also enable smallholder farmers to close the feedback loop by sending information *to* markets, not just consuming information *from* markets.

Improved access to agricultural information

The expansion of mobile networks provides a unique and unparalleled opportunity to give rural smallholders access to information that could transform their livelihoods. This section explores the role of mobile applications in mitigating some of the informational costs that producers in developing countries face in obtaining better yields, increasing their income, and managing uncertainty. The most common uses of SMS and USSD in the context of agriculture include access to price information, disease and meteorological information, and information on growing and marketing practices (extension services).

Price information

The prevailing market price signals the aggregated demand and value on any given day and fluctuates over time. Before the expansion of mobile networks, agricultural producers were often unaware of these prices and had to rely on information from traders and agents to determine whether, when, where, or for how much to sell their crops. Delays in obtaining this data or misinterpretation of second-hand pricing information has serious consequences for agricultural producers, who may end up underselling their products, delivering too little or too much of the product, or having their products wither away. Further, reliance on traders or agents creates rent-seeking opportunities, adding to the agricultural workers' cost of business.

This "information asymmetry" often results in price dispersion—drastically different prices for the same products in markets only short distances apart—and thus lost income for some farmers and higher prices for consumers. Numerous studies have shown the benefits of ICT in promoting access to price information, including increases of up to 24 percent in incomes for farmers and up to 57 percent for traders and price reductions of around 4 percent for consumers depending on the crop, country, and year of study (table 2.2).

A study (Aker 2010) conducted in Niger from 2001 to 2006 found that the introduction of mobile phones had reduced grain price dispersion by 6.4 percent and reduced price variation by 12 percent over the course of one year. Further, the study notes that the impact (or benefits) of mobile phones tends to be greater in markets that are more remote. Pricing for the agricultural sector requires village-level information and generating relevant localized information can be costly and time-consuming. To address this challenge, and to improve local livelihoods, Grameen AppLab in Uganda and Reuters Market Light in India (box 2.1) have collaborated with the government agencies and nongovernmental organizations (NGOs) to employ farmers and extension service providers to collect information.

Feature-enabled phones with camera and GPS (global positioning system), and smartphones have already begun to emerge in rural areas, where they are being used by field workers responsible for collecting data. At volume, the cost of data can be much cheaper than SMS in some countries. For example, through the Grameen Foundation's partnership with a telecommunications operator in Uganda, data is dramatically less expensive than SMS for the volumes their Community Knowledge Workers use. A worker can earn $20 a month from disseminating and collecting information and another $20–$30 from charging farmers' phones from their solar charger.

Disease and meteorological information

Disease and meteorological information is also required by farmers on a frequent basis. Without such information, farmers may be unable to use timely measures to stem losses from climate shocks and poor yields caused by crop diseases. Mobile phones can serve as the backbone for early warning systems to mitigate these risks and safeguard incomes.

For example, a publicly funded pilot project in Turkey provides locally relevant information to farmers in Kastamonu province, where producers maintain orchards susceptible to frost and pests (Donovan 2011). Initially, nationally aggregated weather data collected in urban areas was used but proved to be inaccurate and of limited use to farmers in the provinces, because of differing microclimates from farm to farm in temperature, humidity, precipitation, and soil fertility. Five small meteorological stations and 14 small reference farms were then established to collect data on these variables, enabling accurate pest monitoring. Given the wide use of mobile phones with SMS capability,

Table 2.2 Impact of ICT on farmers, traders, and consumers

Location, product, medium (study authors)	Farmer income (%)	Trader income (%)	Consumer savings (%)	Comments
Uganda, maize, radio (Svensson and Yanagizawa 2009)	+15			Increase in price paid to farmers attributed to farmers' improved bargaining power
Peru, range of enterprises, public phones (Chong, Galdo, and Torero 2005)	+13			Farm incomes increased, but incomes for nonfarm enterprises increased more
India (West Bengal), potatoes, SMS (M. Torero, IFPRI, pers. comm.)	+19			Yet to be published, but both information through SMS and price ticker boards in markets shown to be important
Philippines, range of crops, mobile phones (Labonne and Chase 2009)	+11–17			Commercial farmers, but not subsistence farmers, showed income gains; perceived increase in producers' trust of traders was also reported
India (Madhya Pradesh), soybeans, web-based e-Choupal (Goyal 2008)	+1–5 (average: 1.6)			Transfer of margin from traders to farmers, effect seen shortly after e-Choupal established
Sri Lanka, vegetables, SMS (Lokanathan and de Silva, pers. comm.)	+23.4			Appreciable price advantage over control group over time, plus benefits such as increased interaction with traders and exploring alternative crop options
India (Maharashtra), range of products, SMS (Fafchamps and Minten n.d.)	No significant effect			In this one-year study, quantitative analysis did not show any overall price benefit, but auction sales in state were thought to affect this finding; price benefits of 9 percent were observed at farm gate sales and among younger farmers
Morocco, range of crops, mobile phone (Ilahiane 2007)	+21			Small sample showed usual behavioral changes; higher-value enterprises took a more proactive approach to marketing via mobile
India (Kerala), fisheries, mobile phones (Jensen 2007)	+8		–4	Outlier in the sense that fish catches are highly variable and fishermen have their own boat transport
Uganda, range of crops, SMS and radio (Ferris, Engoru, and Kaganzi 2008)	Bananas +36; beans +16.5; maize +17; coffee +19			Awareness of market conditions and prices offers more active farmers opportunities for economic gain
Niger, grains, mobile phones (Aker 2008)		+29	–3 to –4.5	Traders increased margin by securing higher prices through greater capacity to search out better opportunities
Ghana, traders, mobile phones (Egyir, Al-Hassan, and Abakah 2010)		+36		Traders using mobile phones tended to sell at higher prices but also tended to be larger-scale traders than nonusers
Kenya, wholesale traders, mobile phones (Okello 2010)		+ 7		Improved trader margin through combination of cheaper buying prices and higher sale price
Ghana, maize, groundnut, and cassava, SMS (Subervie 2011)	+10			Half of those surveyed receiving market prices via SMS saw increase in incomes

Source: Updated from Dixie and Jayaraman 2011.

the project supplies timely information so that producers can apply pesticides as and when needed, resulting in lower production costs and improved crop yields. Savings amounted to about $2 a tree, with overall savings estimated to be as much as $1 million a year. Considering the cost required to set up this service (around $40,000), this project may be viewed as a success.

Information on growing and marketing practices

Information shortfalls exist in many areas throughout the agricultural production cycle. Whether for growing crops, fishing, or raising livestock, the producer must make decisions on cultivating certain crops or livestock, crop inputs, pest management, harvest, postharvest, marketing, and sale.

Box 2.1 How Reuters Market Light generates hyperlocalized information

An international news giant launched Reuters Market Light (RML) in 2007 to provide market prices and weather and crop advisory services to farmers in India. Invented by a Reuters employee, this service offers highly customizable market information to farmers through text messages delivered to mobile phones.

To subscribe, farmers call a toll-free number to activate the service in the local language and specify the crops and markets in which they have an interest. Farmers receive four to five SMS alerts with relevant information each day. Initial studies show that farmers who receive the service typically gain 5–10 percent more income.

RML is one of India's largest market information services, serving 250,000 customers across tens of thousands of villages. It delivers customized information to India's farming sector covering over 250 crops, 1,000 markets, and 3,000 weather locations across 13 Indian states in 8 local languages.

The company employs over 300 office staff in eight states to process localized agricultural information. The teams, organized according to content type, scour media sources for agricultural news (including market prices, pest and disease reports, government programs, weather reports, and local news). This information is sorted by geography and sent to the appropriate subscribers. RML's growth shows that embracing a wide network of people—including, in this case, price collectors, agricultural institutes, and other information providers—is a vital success factor for mobile applications ecosystems.

Such detailed processing can involve large sunk costs with relatively high monthly operating costs of $4 a customer. There is a trade-off between the provision of local information and scalability. Local teams are needed to collect data, and expansion into new areas may involve additional content provision costs, limiting economies of scale. Costs therefore climb in parallel with new subscribers. Because it relies solely on income from this single service, RML's market remains relatively small and is not yet profitable.

RML has sought to reach as many customers as possible through a number of strategies, including sales offices in postal offices, local shops, input suppliers, and banks. Customers obtain RML through basic SMS using prepaid scratch cards that give access to the service for a given amount of time.

RML competes with traditional information services (radio, market intermediaries, newspapers) and other services that use mobile phones. IFFCO Kisan Sanchar Limited (IKSL) offers similar market information for rural farmers but uses voice messages so illiterate farmers can use the service. Achieving economies of scale is essential for profitability. In 2009 RML reportedly crossed the $1 million sales mark.

Sources: Adapted from Donovan 2011 and Qiang et al. 2012.

Farming organizations and cooperatives provide farmers with a broad range of information, as well as institutional links to large-scale suppliers and distributors. These organizations give farmers a collective voice and more visibility in the agricultural value chain. Many of these organizations started out by providing information and services through leaflets, radio, and internet sites, but they are increasingly using the mobile platform to provide tailored information to farmers (box 2.2). These organizations are being used to supplement and support existing face-to-face trainings for farmers and livestock owners.

Smallholder farms are often disadvantaged compared with larger enterprises because of their inability to leverage economies of scale in procuring inputs, marketing their goods, and sharing machinery and knowledge. Successful agricultural cooperatives and farmer groups have solved this problem by enabling small farmers to pool their resources and improve their bargaining power vis-à-vis

large producers and traders. Cooperatives can also be ideal networks to launch and manage mobile information services, because they can provide highly relevant and localized information, and drive farmer adoption through existing social networks. Coopeumo, a Chilean farming cooperative with fewer than 400 members, uses text messages to help small-scale farmers increase productivity. Through the Mobile Information Project (MIP), nearly 200 farmers receive daily messages including market prices and weather forecasts directly from the internet to their mobile phones. The MIP provides two different services—DatAgro and Yo Agricultor. DatAgro provides targeted weather updates that are particularly useful to farmers at critical points such as planting and harvest. Yo Agricultor is a sophisticated web portal for farmers supported by the Chilean government that uses MIP to send messages to further its outreach to groups that have more limited internet access. The MIP software works on the basic phones (costing around $15–$20) that farmers tend to use and is effective over slow networks.

While many farmer groups have seen success in forming long-standing cooperatives in Latin America, such cooperatives are less prevalent in Sub-Saharan Africa. Organizations serving them, and companies operating in the value chain, thus face different needs and opportunities. In areas where farmers are less networked, the interventions may need to be more robust—building up social networks to reach the poorest—and to ensure the information is relevant and actionable in order to drive farmer adoption of new technology services.

A recent addition to the kind of information available to farmers is digital images of agricultural land. The Seeing Is Believing West Africa (SIBWA) project—started by scientists at the ICRISAT (International Crops Research Institute for the Semi-Arid Tropics)—involves local extension service providers and farmers in Burkina Faso, Ghana, Mali, and Niger, who interpret information from very high resolution imagery (VHRI) taken from satellites. The images are used to gauge the relative fertility of the soil (through light reflectivity) and to measure the size and shape of fields. Many farmers may not know the precise size of their land, so the SIBWA team works with the farmers to determine the optimal amounts of fertilizer, pesticide, and seeds needed to cover their land evenly. Knowing the size and shape of fields can help rural communities plan for future developments, including investments in irrigation, for example. The SIBWA team also worked with local NGOs with expertise in specialized technologies and extension services to complement their efforts (Deloitte 2012).

Box 2.2 A pregnant pause for Sri Lanka's cows

The Information and Communication Technology Agency (ICTA) of Sri Lanka discovered that between 2003 and 2008, more than half of the country's 560,000 milk cows were not in fact pregnant at any given time, resulting in a loss of 30–35 days' worth of milk. Low pregnancy rates resulted from a lack of timely access to artificial insemination and breeding services. The eDairy program was introduced in 2009 to enable farmers to request veterinary and extension services (related to issues such as animal health, artificial insemination, milk prices, and construction of dairy stalls) through a simple SMS interface or on touchscreen tablets. Farmers type in their personal identification code and the code of the service they need. The request is then sent to all registered suppliers, so they can contact the farmers directly. Farmers usually obtain feedback within a few hours. So far, 300 farmers have registered for the service. According to Sri Lanka's Department of Dairy Foods, milk production could be increased by 30 percent if artificial insemination services were requested and supplied in a timely manner. Moreover, the ICTA estimates that farmers could earn an additional $262 per calf each year.

Source: Adapted from Qiang et al. 2012.

Improving data visibility for value-chain efficiency

In addition to improved information services for producers, mobile services can also enable better access to markets and other value-chain stakeholders such as traders, input suppliers, and end users. Mobiles can help agribusiness companies and wholesale buyers connect with geographically dispersed producers. This section explores how mobiles and mobile applications create value in the value chain by linking producers to distributors and retailers through better record-keeping and traceability.

Improving logistics

Transporting produce requires coordination between producers, truckers, and, at times, warehouse owners and aggregate traders. Many producers, especially in remote and rural areas, must carry their produce themselves, often by foot, to the nearest collection point. Coordinating transportation is also key to larger traders who aggregate produce for sale in urban areas or for export. Studies show that so far traders are using their websites to relay information on transport and logistics. Some of these services, however, could also be provided on a mobile phone.

The Zambia National Farmers Union operates an SMS-based information service that provides information on commodity prices to farmers. To complement the service, the union has also launched an electronic transport system that allows registered transporters to publicize the arrival and delivery times of loads or cargo.[3] They have three main services, one through which producers can publicize the size of their load and where it is located for pickup, the second for transporters on the way back from the market with an empty truck that could potentially be used to haul products from the market to the village, and the third a directory of transporters that allows producers to contact a transporter directly. This service is being provided through a website in Zambia, but in Morocco, a similar service is using mobile phones. Through the use of voice and SMS, farmers coordinated with local truckers to improve product transport and identify where to deliver their products. Some farmers developed a two-way trade, bringing products back from the market to sell in their own rural communities (Dixie and Jayaraman 2011).

Another example is M-Farm Ltd,[4] an agribusiness company established by a group of women developers, that emerged from the IPO48 competition, a 48-hour boot-camp event aimed at giving mobile and web developers a platform to launch their applications. Besides the staple text-based service for obtaining price information, M-Farm enables suppliers to publicize information on special offers to farmers. This format follows a global trend in deal-of-the-day websites that feature discounted offers at local retailers, such as the Groupon service in the United States.

Tracing products from farm gate to market

The growing globalized and interdependent nature of food production and distribution, combined with raised awareness of food-borne diseases, has shed light on the need to ensure food safety in the global food supply chain.[5] These trends have catalyzed effective technological innovation to trace the food supply from point of origin to the consumer (Karippacheril, Rios, and Srivastava 2011)

The International Organization for Standardization (ISO) defines traceability as the ability to trace the history or location of the item or product under consideration. Traceability is therefore a common element of both public and private systems for monitoring compliance (with regulations on quality environmental, or other product or process attributes related to food). Traceability is becoming increasingly relevant to developing countries that want to gain or expand into new export markets. Smallholder farms, which often lack resources to keep up with strict and changing food safety standards on their own, are now increasingly turning to cooperatives and aggregators who are leveraging ICTs to improve traceability. By opening up new specialized market opportunities, the use of ICTs has led to improved consumer protection and food safety on the one hand, and better livelihood outcomes for farmers on the other (box 2.3).

For this challenge, radio frequency identification (RFID) chips are emerging as a solution for traceability. Placed on a crate of apples or in the ear of a cow, the chip can collect data such as motion, temperature, spoilage, density, light, and other environmental variables though an interface with wireless sensor networks. Traceability systems for bulk products have been implemented in developing countries, even among small farmers.

Representing more than 500,000 small farmers, the National Coffee Growers association in Colombia has leveraged RFID technology to improve traceability and recordkeeping on coffee quality standards. At a cost of

Box 2.3 Tracking specialty coffee

Lack of traceability during the growing and procurement process is a major constraint for producers growing for high-value export markets, such as specialty coffee. For the cooperatives and companies that manage the exports, emerging mobile technology—smartphones and tablets—can play a major role in capturing, tracking, and accessing valuable information from growing practices to crop quality.

Sustainable Harvest is a coffee importer that works with 200,000 farmers in Latin America and East Africa. Extending its relationship-based procurement model to the digital platform, the organization and its farmer training offices have introduced a new coffee traceability program—called the Relationship Information Tracking System, or RITS—to help coffee growers become more efficient, reliable, and quality-focused through a new mobile or tablet-based information tracking system.

RITS provides farmer cooperatives with the ability to trace each step of the value chain. Using a cloud-based application, the cooperative managers can record deliveries of coffee from each member including details of coffee varieties and quality scores for each lot of coffee received. The application also tracks the certification status of each delivery, processes farmer payment, and generates reports on farmer productivity, payments, and samples.

Roaster clients can access videos, photos, quality, and lot information from their supplier cooperatives. The application has been designed for Apple's iPad and iPhone, but it can be used in any smartphone through the web browser. Devices with large touchscreens allow for easier input of a large variety of information. The application can record information offline, and then upload to the online database when connectivity is restored.

In 2011 Sustainable Harvest also launched RITS Ed, an iPad app that delivers agricultural training videos on organic coffee production and quality control that co-op managers can use to assist their members. Sustainable Harvest also plans to expedite the application process for third-party certification (organic, for example) through the launch of a new module, RITS Metrics, that will enable more robust, and customizable reports.

RITS is currently testing the program with two cooperatives in Peru with 500 members and one cooperative in East Africa with 1,840 members.

Sources: USAID 2011; http://www.sustainableharvest.com/; Annerose 2010.

$0.25 a tag, encased wear-resistant tags with unique farm identification numbers are distributed to farmers. These tags are read at each step to market, thus helping to maintain the stringent standards required for this high-value specialty coffee.[6]

RFID chips are also commonly used to trace animal movements, enabling the monitoring of animals from cradle to grave. The Namibian Livestock Identification and Traceability System (NamLITS) (Collins 2004), implemented in 2005, focuses on nurturing livestock production for export markets. More than 85 percent of agricultural land in Namibia is used to raise livestock, and beef production constitutes 87 percent of agricultural revenue. The objective of NamLITS is to implement a traceability system to help in the control, risk management, and eradication of bovine diseases such as foot-and-mouth disease. The use of RFIDs to replace traditional paper-based recording, has increased the accuracy of the data and the speed with which it is disseminated. It has also contributed to a more vigorous market: the Namibian livestock market increased approximately $83 million in 2010 (Deloitte 2012).

Mali is a landlocked country with 80 percent of employment in subsistence agriculture and fishing. In the 1990s the government identified mangoes as having potential for diversifying the country's exports. It faced a number of challenges, however, including meeting increasingly stringent criteria regarding the origin of products, the way they are grown, the fertilizers and pesticides used, and how they are

packed. With the support of donors and NGOs, Fruit et Legumes du Mali (Fruilema), an association representing 790 small producers and five exporting companies, launched a web- and mobile-enabled platform through which potential buyers can track and monitor their mangoes (Annerose 2010). The consumer can type the number shown on a tag attached to the fruit into a website to get the exact details of where the mango came from, its producer, and the methods used to cultivate the mango. To leverage the mobile phone platform, Fruilema partnered with a Senegalese mobile operator, Manobi, to pay farmers an additional 9 cents a pound when they entered data on their produce on the Manobi website. One of the key challenges Fruilema faces is to make sure farmers send in all the necessary information to meet the criteria for exporting (Deloitte 2012).

Enhancing access to markets

Mobile phones, although owned and used by individuals, can nevertheless have an important impact in linking markets and key stages of the value chain. A recent study of farmers conducted in Bangladesh, China, India, and Vietnam found that 80 percent of farmers in these countries owned a mobile phone and used them to connect with agents and traders to estimate market demand and the selling price (Minten, Reardon, and Chen n.d.). More than 50 percent of these farmers would make arrangements for sale over the phone. Another study (Muto and Yamano 2009) found that as remote communities in Uganda were provided with access to a mobile network, the share of bananas sold rose from 50 to 69 percent of the crop. This effect, however, was not observed for maize, which is a less perishable crop.

Improved understanding of real-time market dynamics can help farmers deal with external demand, such as switching to high-demand but riskier (perishable) products (Sen and Choudhary 2011). Risky products include crops that are easily ruined if the rainy season arrives too early, for example. The growing sophistication and knowledge of value chains also means that farmers can work directly with larger intermediaries, capturing more of the product's value. Farmers are able to expand their networks and establish contacts directly with other buyers in other areas (Shaffril et al. 2009). Aside from the overall impact of mobile phones on marketing and market linkages, certain mobile applications can help aggregate information between buyers and sellers (box 2.4).

As mobile service and applications providers in agriculture become more knowledgeable about the needs of the farmers as well as their behavior, they are developing increasingly sophisticated applications. In 2000 ITC (Indian Tobacco Company), a large conglomerate in India, broke new ground by establishing e-Choupal—kiosks with computers—in rural villages, where farmers are able to access price, planting, and weather information. Since then, the company has been working to provide its services over mobile phones. ITC has been piloting a new virtual

Box 2.4 DrumNet, the value chain on your mobile phone

More than two-thirds of Africans rely on agriculture for a living, yet because of the lack of complete information, high transaction costs, and inefficient value chains, farmers, intermediaries, and buyers are unable to effectively collaborate in the fragmented market. Pride Africa's DrumNet project is an integrated platform that uses various ICTs, including mobile phones, to provide producers, traders, and financial service providers with an end-to-end solution to procuring inputs, linking to buyers, and finalizing credit and payments.

Starting with fast-growing horticulture and oilseed industries in Kenya, DrumNet ran a series of pilots that delivered services to agro-buyers, banks, farm input retailers, and farmers. The pilots were implemented in five different Kenyan provinces and are reported to have involved over 4,000 small-scale farmers.

Before farmers plant crops, DrumNet's network of entrepreneurs negotiates contractual arrangements between buyers and farmers. These agreements allow farmers to access credit

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Box 2.4 *(continued)*

from partner institutions such as Equity Bank and to purchase inputs from certified retailers. At harvest, DrumNet franchise representatives coordinate produce aggregation, grading, and transportation through agreements with local field agents and transporters. DrumNet tracks and facilitates the entire process through the use of complimentary manual and SMS applications.

Benefits to the stakeholders include:

- Farmers reduce transaction costs by accessing both credit and markets through DrumNet and are able to pay off their loans with their farm produce proceeds. Farmer income is reported to have risen by an average of 32 percent.
- Large-scale buyers are freed from the requirement of managing cumbersome transactions to ensure reliable supplies of produce from multiple smallholders.
- Input sellers can access new customers without having to sell products on credit.
- Banks and microfinancial institutions are able to tap into a currently inaccessible market for savings and credit while avoiding high transaction costs.

The process creates an enabling environment for agricultural finance in a number of ways:

- Banks are assured at the time of lending that farmers have a market for their produce and the means to adequately serve that market, which indicates a healthy revenue stream.
- Banks offer in-kind credit to farmers for inputs.
- Cashless payment transfers reduce strategic default, since farmers cannot obtain revenue until their outstanding loans are fully paid.

The DrumNet project employs tested value-chain approaches to promote agricultural lending. Its operating cost of about $6.80 a user is high, and DrumNet is facing difficulties because it has not yet reached a critical mass that would allow it to stand alone without donor funding. Farmers' inability to attain sufficient crop yields, because of irregular and insufficient rain and other factors, has also threatened the success of the project.

Sources: Adapted from Deloitte 2012, Qiang et al. 2012; and http://www.prideafrica.com.

commodity exchange, Tradersnet, that enables the direct purchase and sale of coffee by producers and wholesale purchasers over an internet-based trading platform. SMS messages are sent to users' mobile phones every morning with the offers and grades available for purchase on that day. At the end of the day, users receive a text message with details of what actually took place (Vodafone 2009).

In Ghana, TradeNet established Esoko to serve as a central repository of price information to be run by a centralized agency such as the government. The people who set up Esoko soon realized that the agricultural sector consists of many decentralized markets where a single price cannot suffice. Therefore, Esoko became a mobile and web-enabled repository of current market prices and a platform to enable buyers and sellers to make offers and connect to one another. Using a bronze/silver/gold/platinum subscription model, Esoko has also been able to offer differentiated service to a diverse customer base. In a recent study of 600 smallholder farmers in northern Ghana, the French National Institute for National Research (INRA) found that farmers have seen a 10 percent revenue increase since they began receiving and using Esoko SMS market prices (Egyir, al-Hassan, and Abakah 2010).[7]

Policy considerations

The examples provided in this chapter demonstrate that food producers and intermediaries are already able to do more with their mobile phones to raise farm incomes and the efficiency of the value chain. Governments have a role to play in ensuring that innovation in this area continues. An enabling environment for mobile services, applications, and other devices, such as RFIDs and remote sensors, includes three support pillars:

- *Business models.* Many of the services described in this chapter rely on public funding and are in pilot stages. DrumNet and RML, while they provide robust business models, are still figuring out how to address high per-user costs, by either scaling up or adding new services to increase the number of subscribers. Public funding, applied through pull mechanisms and results-based financial incentives such as challenge funds, can provide grants and soft loans to innovators who are experimenting with new technologies and business models until they can become financially viable. The public sector can also innovate in its own agricultural programs to create more client-oriented information and knowledge services that leverage mobile technology. Finally, governments can play a catalytic role in facilitating collaboration and dialogue between various private sector players, public sector service providers, and academia and knowledge centers.
- *ICT skills.* Information needs in developing countries are highly localized; therefore, nurturing a domestic ICT skills base in the workforce is crucial to the development of mobile applications and services in the agricultural space. Several of the examples cited in this chapter are from India and Kenya, where the strong presence of skilled software professionals and entrepreneurs has significantly helped these countries lead in producing relevant and high-quality development-focused application services. Governments have a critical role to play in ensuring that the education curricula at the secondary, tertiary, and vocational levels properly reflect the needs of the emerging digital economy. In addition to the pull-based mechanisms and challenge funds described above, technology hubs and technology incubation programs can have a crucial role in encouraging entrepreneurship and emergence of an industry in this space.
- *Supporting infrastructure.* To make the more powerful mobile devices, such as smartphones and tablets, more accessible and affordable, governments will need to ensure that the private sector is capable of offering mobile broadband services at affordable prices. That requires an enabling environment where competition between telecommunications providers is robust.

In addition to supporting the emergence and growth of the mobile services industry, governments could also benefit from the data generated through mobile phone networks and remote sensors. For example, information on price, weather, and diseases could potentially be aggregated so that research institutions and relevant government agencies can analyze and monitor trends. The highly relevant and up-to-date information generated from this type of analysis can inform higher-level policy dialogue on topics such as commodity pricing, subsidy effectiveness, climate change, and trade. Further, by disclosing the aggregated data and analysis to the public, people who initially provided the data, such as farmers, input suppliers, and distributors, would benefit from the analysis—an important component of the Open Data Initiative that many developing countries are implementing.

Conclusions

As information becomes more accessible through the use of mobile devices for stakeholders throughout the agriculture value chain, people are gradually moving toward more efficient ways of producing agricultural products, increasing incomes, and capturing more value by linking fragmented markets. Key benefits include increases in productivity and income for farmers and efficiency improvements in aggregating and transporting products. Although elements of the mobile agriculture platform are emerging in developing countries, the full potential has yet to be realized. The mobile services cited here are simply tools, and without the proper supporting pillars such as those described above, the key challenges that hamper their sustainability will be difficult to overcome.

Looking forward, governments will need to examine their role in creating an enabling environment for innovators seeking ways to meet the needs of this information-intensive sector. Specific ICT strategies for the agriculture sector would help guide both the public and private sector in creating this

enabling environment. These policies should take into account the need for new business models in specific country contexts and facilitate inputs such as the supporting infrastructure (broadband services) and the IT industry (IT skills). Technologists, governments, NGOs, private businesses, and donor agencies are just starting to work together to leverage mobile technologies for greater inclusion of rural and poor communities into their spheres of activity.

Notes

1. The definition of smallholder varies across countries and regions but generally refers to farmers with limited volumes of yield and low or uncertain income. According to the Food and Agriculture Organization (FAO 2004), smallholder farmers often cultivate less than one hectare of land in favorable areas, whereas they may cultivate 10 hectares or more in semi-arid areas, or manage 10 head of livestock.
2. Examples are the new tablets from the Canadian firm Datawind, which have been much in demand in emerging markets such as India, Turkey, and Thailand. http://www.bbc.co.uk/news/technology-17218655.
3. http://www.znfu.org.zm/index.php?option=com_wrapper&view=wrapper&Itemid=89.
4. http://afrinnovator.com/blog/2010/11/02/video-pitch-of-ipo48-winner-m-farm.
5. The main source for this section is Karippacheril, Rios, and Srivastava 2011.
6. Colombia Coffee: "Finalists Unveiled for the Fourth Annual RFID Journal Awards," *RFID Journal,* March 18, 2010, http://www.rfidjournal.com/article/view/7467.
7. http://www.esoko.com/about/news.htm.

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