

## NOTES

## Improving Agricultural Productivity and Markets: The Role of Information and Communication Technologies

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### STRENGTHENING THE INFORMATION ECONOMY OF SMALLHOLDER AGRICULTURE

Raising the productivity of smallholders is a necessary condition for increasing incomes and improving livelihoods among the rural poor in most developing countries. This increased productivity is essential to both household food security and to agriculture-based growth and poverty reduction in the larger economy. Smallholder productivity is limited by a variety of constraints including poor soils, unpredictable rainfall, and imperfect markets, as well as lack of access to productive resources, financial services, or infrastructure. It is also critically limited, for example, by lack of information about market prices, available crop varieties, production techniques, and methods of disease management—information that pertains specifically to local conditions. Smallholders also lack timely information sources such

as news reports or early warning communications about weather, pest outbreaks, and other seasonal risks, and about services that could help address them.

The smallholder agricultural economy is in crucial ways an *information and service economy*. The physical isolation of smallholders imposes high information costs that compound the high transport and transaction costs of obtaining inputs and marketing outputs. Improving the information, communication, transaction, and networking resources available to farmers—and to the markets, organizations, and institutions they interact with—is essential to making smallholder agriculture more productive. The appropriate deployment and use of information and communication technologies (ICT) is central to this improvement.

Information and communication technologies are also vitally important to commercial and large-scale agriculture, and to agriculture-related services and infrastructure such as weather monitoring and irrigation. This note focuses on the sometimes less-obvious importance of ICT in improving the information, communication, transaction, and networking elements of smallholder agriculture in developing countries.

### IMPROVING INFORMATION AND COMMUNICATION FOR SMALLHOLDER AGRICULTURE

Improving smallholder agriculture is an information- and communication-intensive process throughout the value chain from farm to market and beyond. Smallholders face higher information costs, both as producers and sellers, as a result of their typically greater isolation and the poor state of rural information and communication infrastructure. They require information to make informed decisions at each stage of the production cycle, from crop selection, to planting, to harvesting, to selling. Timely information about prices and consumer preferences not only informs production decisions about crop mix and the need for inputs, but enables farmers to balance their investment of family labor in farm and non-farm activities during the growing season.



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Crop quality and yield also depend heavily on producers' access to information and networks. Given the diverse agro-ecology of smallholder agriculture (particularly in Africa) and the growing diversity of national and global food product markets, the information and advice that farmers need is increasingly diverse and context-specific.

At harvest, this same knowledge helps farmers negotiate a better price from traders and other middlemen, and even to access a wider variety of markets, middlemen, and transport opportunities for their products. The ability to pool output and increase negotiating leverage through cooperatives and producer associations, for example, can also help farmers earn higher incomes.

The costs of searching for information can represent a substantial proportion of farmers' total costs, and a substantial majority of their transaction-related costs. In Sri Lanka, for instance, de Silva and Ratnadiwakara (2008) documented evidence that these information costs can represent 11 percent of farmers' total costs, and up to 70 percent of their transaction costs. Because the cost of information does not vary with the size of a farmer's crop, smaller farmers are particularly burdened by high information costs.

This information will increasingly come not only from traditional sources such as national agricultural research systems and agricultural advisory services, but from fellow farmers, the private sector, and other local sources. As agricultural innovation systems adapt to meet more diverse information needs, ICT can play a key role in strengthening the more complex and time-urgent pathways of information and knowledge-sharing on which this new form of agricultural innovation depends.

*Mobile phones, rural ICT kiosks, and ICT-equipped intermediary organizations can all serve as pathways for this information exchange and collective action.* In particular, mobile phones have recently enjoyed increasing attention as a result of their availability, affordability, and versatility, as platforms for a broad range of information and transaction services.

## **STRENGTHENING THE SERVICE ECONOMY OF DEVELOPING COUNTRY AGRICULTURE**

Many cooperatives, producer and trader organizations, extension agencies, and other intermediaries and service providers are subject to the same impediments as the farmers they serve. Improving their ability to aggregate and share information and knowledge, and to connect people and foster collective action will increase their effectiveness in serving members and communities. Recognizing the importance of these intermediaries, donors such as the Gates and Rockefeller Foundations are increasing efforts to expand and support networks of rural agro-dealers. Providing appropriate ICT tools and connectivity to these networks, and building their capacity to use ICT should be an important element in developing vital links in the rural service economy.

ICT can extend the reach of financial services in rural areas in two ways. It can help traditional financial institutions reduce the costs and inefficiencies of reaching, assessing, and servicing rural clients. In Ghana, for example, ICT has helped an extensive network of independent rural banks, to both increase their efficiency and extend their services to a wider population. ICT can also facilitate new business models for providing financial services to the poor, helping them to afford higher-quality inputs and to secure prompt payment for their outputs.

ICT can serve a similar function in strengthening public services for the rural poor, from land registration, extension, and advisory services to health and social services, and public support payments. Yet the poor often have very limited information about those services, or about their own eligibility to access them. Even among those who are aware, accessing public services often entails considerable time and money to travel to towns where the responsible institutions are located. Local government services are, moreover, often prone to corruption.

ICT can increase information about government services, and facilitate collective action to increase effective demand

### **The Impact of Improved Communication Services: Evidence from the Field**

In Kerala, Robert Jensen demonstrated that the rollout of mobile phone service had a pronounced impact on the sardine fisheries along the coast. While still off shore, fishers phone a number of landing points to learn about current prices at different locations. Based on this information, and factoring in the transport costs of travelling to each location, they decide where to "land" their catch of the day. The effects were dramatic. Price volatility and variation dropped dramatically; average price paid to fishermen rose by 8 percent; consumer prices dropped an average of 5 percent; and wastage was eliminated.

In Niger, Jenny Aker has studied the impact of the mobile phone rollout on grain markets, and has shown that mobile phone service has reduced grain price dispersion across markets by a minimum of 6.4 percent and reduced intra-annual price variation by 10 percent, primarily by reducing search costs for traders.

## The Promise and Limits of Mobile Phones

Mobile phone service has become widely affordable and now covers between 80 and 90 percent of the population in many developing countries. Private sector innovators—such as TradeNet—are developing adaptable and affordable software solutions for mobile phone-based price information and market transaction systems for cooperatives and individual farmers. More broadly, the widespread use of SMS text messaging services in developing countries is leading to an explosion of SMS-based information and transaction services, ranging from market information and extension services to mobile banking.

The affordability and flexibility of mobile phones makes them a promising platform for innovation in rural service delivery, and they are likely to be an important focus of pro-poor ICT innovation in the coming years. Yet it will be some time before they reach the poorest and most isolated farmers, who will probably see greater impact from ICT-enabled improvements in the performance and transparency of the institutions and markets with which they interact, and from better communication access by key intermediaries such as cooperatives and traders. The measure of the value of mobile phones to the rural poor is how well they improve the lives and livelihoods of those who do not have them as well those who do.

for them. It can make services and the institutions that provide them more efficient and transparent, and decrease opportunities for corruption. A trailblazing example took place during the Bhoomi project in Karnataka, India. The project involved the computerization of several million land records which were documented and made publicly available through a network of rural ICT-linked kiosks. This process reduced opportunities for corruption, eased farmers' access to documentation needed for land transactions and loans, and demonstrated that farmers are willing to pay higher use fees for quicker, more reliable access.

### LINKING FARMERS TO CHANGING URBAN AND GLOBAL MARKETS

Consumption patterns among urban populations are changing and generally diversifying. Demand for meat, fish, dairy, horticultural, and processed products in particular is increasing. Here too, ICT can play an important role in enabling smallholders to produce high-value commodities and to capitalize on opportunities to participate in these markets. Supply chains leading to these urban and global markets are highly integrated, and require timely information and impose exacting quality standards. ICT can be instrumental in improving smallholders' access to information about these markets and what is required to produce for them. It can also greatly facilitate networking among smallholders, and provide new ways to communicate with institutions that are involved in carrying out transactions in these markets.

### MAKING ICT WORK FOR AGRICULTURE

Extending affordable access to ICT will depend on innovation in technological and business models, including

a variety of shared-use models that have already shown great promise. Perhaps the best-known shared-use model is the Village Phone model first launched in Bangladesh, wherein micro-loans enable women in poor villages to purchase a mobile phone and re-sell phone service at per-call rates to their neighbors. The increasing affordability of mobile handsets and pre-paid service, combined with innovations such as multi-account mobile phones, are permitting greater local innovation in sharing phone service among those who cannot afford their own phone. Technical innovations such as cell phone signal amplifiers are extending the range of mobile services, and many telecommunication providers are extending communications infrastructure further into rural areas to respond to new market opportunities.

The competitive markets needed to stimulate this innovation and expanded access will require effective legal, policy, and regulatory frameworks. Government policies, regulations, and (where appropriate) public investments, can create incentives for private investment in adapting ICT tools, infrastructure, and service models to those in low-income, isolated, and often-rugged environments. Governments and donors can play a vital role in encouraging innovations appropriate for local conditions, among other things by improving the investment climate for new businesses. In addition to their role as facilitators of extended information and communication networks, governments also use these networks to improve and extend public services. These "supply side" initiatives need to be complemented by measures to stimulate demand for ICT among farmers and the organizations and institutions that serve them. Part of this "demand side" work entails raising awareness of the ICT services and resources that are available, and showing how they can be used to improve farmers' livelihoods and the operations of local organizations.

## Thinking about the Gender Dimensions of ICT Interventions

Women have a substantial role in smallholder farming throughout the developing world, and constitute the majority of farmers in Sub-Saharan Africa. Yet the ability of women to access and use resources such as ICT, and the innovations they enable, is often hampered by household gender relations, asset endowments, and cultural constraints. Given the key role of women both in household food security and in improving agricultural productivity, ICT-for-agriculture interventions should include explicit strategies for assuring access by women, and for strengthening the information, communication, and networking resources of women. Organizations such as the Women of Uganda Network ([www.wougn.net](http://www.wougn.net)) and the Self-Employed Women's Organization in India ([www.sewa.org](http://www.sewa.org)) have been leaders in developing strategies to use ICT to empower women economically and socially, both by promoting better information access for women and by using ICT to help women and women's groups engage more effectively in policy advocacy and joint action.

It is important to distinguish between *access to ICT* and *access to the services, resources, networks, and capacities that ICT enables*. In many cases, the most sustainable and transformative impact of ICT in rural areas will come from *its effect on the markets and institutions with which the poor interact*. Improving the capacity of these institutions to use a broad range of technologies, including Web-based technologies, will increase their effectiveness as sources of local service delivery. At the same time, increasing rural access to newer ICT should not obscure the continued value of more established communication tools such as radio. Some of the most creative and sustainable innovations for information, communication and transaction services in rural areas will come from integrated mixes of technologies that are adapted for local contexts. The Developing Countries Farm Radio

Network ([www.farmradio.org](http://www.farmradio.org)), a pioneer in using radio to support farmers, is now exploring how content can be distributed creatively through a variety of technologies ranging from radio and mobile phones to portable audio players.

The specific character of local demand for ICT, and the local economic, social and physical context, will determine the mix of technologies and services that are most appropriate and most likely to be sustainable. Detailed assessment of this demand and context, and of any factors that might be impinging on the local agricultural information economy is, therefore, an early priority in the design of ICT interventions. In general, ICT-for-agriculture interventions should be embedded in, and subordinate to, locally-appropriate strategies for improving the agricultural information economy more broadly.

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