



## SELECTING MOBILE ICT DEVICES FOR AGRICULTURE SERVICES & APPLICATIONS IN SUB-SAHARAN AFRICA

### INTRODUCTION

This is one in a series of briefing papers to help USAID missions and their implementing partners use information and communications technologies (ICT)<sup>1</sup> more successfully and with greater scale to improve the impact of their agriculture development projects in sub-Saharan Africa (SSA).

This paper compares ICT-enabled devices of value to access information and use ICT-enabled applications. The focus of analysis is on devices that are the most applicable, affordable, useable, and understandable to the greatest number of end-users—especially poor smallholder farmers.

Valid technologies, such as Internet-enabled desktop computers, are not considered here, since poor farmers typically cannot afford to use them. (Farmer groups, input providers, and large buyers can, and indeed do, use these and other higher end devices.)

Given how quickly device options and prices change, this paper can only give a snapshot in time of current devices, but it also offers insights regarding how to analyze new devices as they become available.

### THE PROBLEM

Rural communities in SSA are typically the most financially constrained and least developed in already poor countries. Successful agricultural production increases economic well-being, generating additional benefits, such as:

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<sup>1</sup> ICT: information and communications technology includes cell phone and Internet services, radio, and a range of digital devices and related tools, including cameras, GIS, and a wide range of hand-held computing devices.

keeping young people in the community, improved health, and better education. To increase agricultural productivity, farmers and agricultural workers have many needs—information about and access to financial services; knowledge on best farming methods and techniques; and information on potential selling opportunities, agricultural inputs (e.g., seeds and fertilizer), weather, transport, storage options, and more.

Farmers use a variety of channels to receive information and knowledge, including talking to fellow farmers and agri-dealers, learning from farm extension agent visits, trainings, posters, and listening to the radio, among others. ICT enabled devices are a valuable additional delivery channel.

### THE OPPORTUNITY

ICT, especially mobile devices, offers opportunities to complement communications channels, improving farmers' access to valuable information.

Mobile telecommunications are rising throughout sub-Saharan Africa, although mobile penetration rates vary widely by country. In 2010, for example, penetration was 62 percent in Kenya and 55 percent in Nigeria, but only 39 percent in Liberia, 33 percent in Rwanda, and 17 percent in Democratic Republic of Congo.<sup>2</sup>

Given that phones are often shared within a family, across households, or through commercial services, most people in SSA have access—even among the poor—so that it is an available platform by which to share information.

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<sup>2</sup>International Telecommunications Union (ITU), [2010 mobile phone subscriptions per 100 inhabitants](#).

Penetration statistics are bolstered by steadily dropping communications costs. Usage rates per minute are declining. A new basic cell phone costs as low as \$20, with SIM cards as little as \$1 to \$3.

Smartphones follow this trend as well. They are the fastest growing mobile category, with annual rates projected to double over 2010–15.<sup>3</sup>One pan-African company is planning an Android style smart device, available for \$60.

### CHALLENGES & LIMITATIONS FOR USE IN DEVELOPMENT

Mobile ICT devices are appealing in agricultural projects—perhaps too appealing. Development projects can be lured into seeking uses for high-end devices. Projects may even receive donations for such high-end devices, but then find that the usage is not scalable because the price of additional devices is prohibitively high.

Before any devices are selected, challenges and any features that deter widespread use need to be considered in project planning so that the equipment used is affordable and sustainable without on-going donor support. Factors include: need for on-going donor support; resiliency under usage (e.g., sun, rain, dust); availability for purchase; local repair options (if needed); and ease of use for target users.

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<sup>3</sup>IHS iSuppli, [Mobile Handset Market Tracker report](#).

Given a focus on agriculture and that there are tens of millions of farmers in SSA with varying needs, it is critical to consider the target population that will use the technology. Factors to consider include:

1. Power: Electricity might be unreliable or non-existent. Consider how much power a device consumes, how long a battery lasts, and “re-chargeability.” There are ways to charge batteries “off the grid” using solar power and shared batteries and even successful micro-enterprise models for providing this service<sup>4</sup>, but this constraint—or solutions to it—must be understood up front.
2. Signal access and reliability: Cellular infrastructure has reached most cities, but not all rural regions and is not always reliable. Projects need to ask: will the service reach the target farming population? Is the service reliable enough or, more likely, is it designed to accommodate periods of unreliability? If needed, can the signal be strengthened with investment from the country’s telecommunications universal service fund or signal amplifiers?<sup>5</sup>
3. Target users: Is the initiative intended for use directly by smallholder farmers? Or, is it better as a “mediated” service on behalf of end users (e.g., farm extension worker, trained community worker or volunteer). This defines structural and programmatic dimensions.
4. Literacy rates and languages: In communities with low literacy rates, text-based devices and applications may be less useful than voice-based services. For voice services, what languages will be needed?
5. Pricing service and devices: The ‘fully loaded’ cost of technology needs to be factored in any assessment. Costs include: the device itself, SIM cards, paying for minutes (or other services), repair,

peripheral devices, and power. Consumer pricing may vary by technology. Will some or all target users have to pay fees for connection to a proposed service? Is the device affordable for the majority of the target population? Is financing available, if needed?

For example, radio is free for end users, supported by advertising sales. In some networks, receiving mobile calls is free, but calls made are charged, while data exchanges (such as GPRS) are generally cheaper than text exchanges (such as SMS). For the same cost of one SMS, one could probably send the equivalent data 3,000 times using GPRS.<sup>6</sup>

6. Prevalence: Not all devices are available or understood in all communities. For low market penetration, devices must first be acquired. Successful applications usually use already-prevalent devices or are flexible with multiple devices.

## MOBILE ICT DEVICES DEFINED

A number of devices have promise for use in agriculture service delivery. Defined briefly, they include:

1. Radio: especially community radio, which can also be augmented with feedback via by phone or email.
2. Basic cell phone: including shared phones, with simple voice and text capability (e.g., the basic Nokia).
3. Smartphone: typically equipped with voice, text, email, and web browsing.
4. Global Positioning System (GPS): a satellite-enabled location device, sometimes built into another device.
5. Talking book: a basic computing device with no cellular or satellite connectivity nor screen.<sup>7</sup>
6. Handheld video/digital camera: with recording and play-back ability (e.g., a digital camera) sometimes with a

separate playback option (e.g., projector).

7. Tablet: handheld screen with touch functions and many key features of a full-size personal computer.<sup>8</sup>
8. Cloud phone: multiple people can share one phone. Individuals can use any phone to access their own account in ‘the cloud’.

Technologies can also be combined (e.g., GPS built into a phone or radio with mobile phone text messaging to provide feedback from listeners). For evaluation purposes, they are kept separate. The table below summarizes devices now used in rural development, as well as promising emerging options, comparing basic qualities.

Device	Unit Cost	Penetration	Energy Consumption
Radio	Low	High	Low
Cell phone	Low	Varies (12–50% 2010)	Medium
Smart phone	Med	Low (3.6% 2010)	High
GPS	High	Low	High
Talking book	High	Low	Low
Video device	High	Medium	Medium
Tablet	High	Low	Medium
Cloud phone	Low	Low	Medium

## TRADE-OFFS

Given many devices are available, features, advantages, and disadvantages are important to understand. Choosing the right device for a development purpose is not always clear-cut. For example, smartphones have robust technology (computer-like capability), and are small (just bigger than a basic phone). However, unit cost, service expense, and higher energy usage may make them untenable. Drawbacks may be minimized if farmers share a device or already have one.

<sup>4</sup>Banks, Ken. “[Mobile Telephony and the Entrepreneur: An African Perspective.](#)” *Microfinance Insights* (Sept/Oct 2008).

<sup>5</sup> For more information on universal service and access funds, please refer to [the GBI Portal’s USAF page](#).

<sup>6</sup> SMS is charged per “packet”; GPRS data transmission is charged per megabyte. SMS may cost as little as 2.5 cents (as in Uganda), while a megabyte of data in Uganda on MTN costs 40 cents. Pricing varies by country.

<sup>7</sup>[Talking Book, created by Literacy Bridge.](#)

<sup>8</sup> See [Sustainable Harvest’s use of RITS Ed](#), an iPad app that delivers agricultural training videos on organic production and quality control to coffee cooperatives.

The following table details features, pros/cons and suggests areas for the application of mobile ICT devices.

Device	Pros	Cons	Best uses / Impact
<b>Radio</b>	Inexpensive Low-tech, radio waves travel far Low energy need Target audience may already own and use	One-way communication (but can be augmented with feedback via phone) <sup>9</sup> Static programs at set times (but some radios can record programs for later listening) <sup>10</sup>	Disseminate verbal info from a central location Local stations tailor programming to local needs Radios can be combined with other formats, like text messaging to give feedback on programming or ask questions to on-air experts
<b>Basic cellular phone</b>	Relatively inexpensive Widely used Offer real-time communication Relatively long battery life Off-grid charging possible	May have limited range Depending on country and competition, talk time costs may be high Of little value when out of range of service	Specific or tailored info dissemination Gathering of feedback
<b>Smart phone</b>	Advanced applications Vast chance for connectivity GPRS data transmit may be cheaper than bulk SMS messages Smartphones nearly as cheap as high-end feature phones <sup>11</sup>	Expensive (up-front plus service fees) High power consumption Data speeds may be slow	Combination of features for most robust applications May be best for mediated services because training for providers can be concentrated and fewer devices are needed to reach scale
<b>GPS</b>	Have promise for development applications particularly in mapping, charting, and tracking	Low prevalence Lack of knowledge in the marketplace	Best to be built into another device or shared across an organization or by an extension/field worker
<b>Talking book</b>	A simple, durable tool Has promise for development applications to provide tool for illiterate populations, off-grid, and out of range communities	New technology, little end user demand so far Lack of knowledge in the marketplace Relative high cost	An interesting new technology for sharing information about agriculture, health, and education in local languages and dialects
<b>Camera /camcorder</b>	Wireless communication and subscriptions not necessary Inexpensive low-end models Immediate recording Visual and audio presentation	Need training to make compelling videos Avoid distributing over telecom network by using flash drives	Visual communications and messages Training To share intricate detail and hands-on examples
<b>Tablet</b>	Can be used for two-way communication Comprehensive features similar to a computer No keyboard needed Touch screen more intuitive for illiterate users	Relatively expensive for ICT devices (but not computers) High power consumption	Content can be delivered in a variety of formats (i.e., text, video and audio) and local languages
<b>Cloud phone</b>	High scalability, flexibility, and mobility Cost of use less than buying own phone	GSM only for now; Limited availability at present <sup>12</sup>	Good for low-income individuals wanting access to a phone without buying own handset or SIM card

<sup>9</sup> For examples of 'participatory radio' approaches including incorporating other technologies, see <http://www.farmradio.org/english/donors/home3.asp> and <http://www.farmradio.org/pubs/farmradio-prcreport2011.pdf>

<sup>10</sup>One example is the [Lifeplayer](#) by Lifeline Energy.

<sup>11</sup>[Keynote Presentation by Peggy Johnson, Qualcomm](#) at the Wireless EdTech Conference 2011 on October 20, 2011.

<sup>12</sup>For example, [Movirtu](#) is rolling out a cloud-based, login account to enable anyone with access to a GSM phone to share, accessing their own account & number.

## SAMPLE ICT DEVICES FOR AGRICULTURE

There are many applications developed recently utilizing ICT to serve farmers. The following are a selection of illustrative examples using several of the ICT devices highlighted in this paper.<sup>13</sup>

### The Basic Cell Phone: Workhorse



*Capability:* Calling, SMS texting.  
*Users:* Nokia 1100 alone has 50 mil in Africa,<sup>14</sup> 250 mil worldwide,<sup>15</sup> most popular in world.  
*Energy Consumption:* Low (can go several days without charging).

*Ease of use:* Medium. Simple and straight forward; harder to text, relatively heavy.  
*Durability:* High.

*Impact:* Simple texting enables sending/receiving payments, and a variety of services, including market information sharing and payments, through programs.<sup>16</sup>

**Sample technology use: Farmer's Friend.**<sup>17</sup> Created in Uganda, this application (app) provides replies to individual agricultural queries via SMS text for no additional charge other than text message fees.

It received 2.5 million queries in its first 3 months in service. Nearly instant replies provide insights on crop, livestock, pest/disease control, planting/harvesting tips, and weather forecasts.

Information is obtained from partner organizations, like a local NGO for farming techniques, and the government's Department of Meteorology for weather.

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<sup>13</sup> See [other papers](#) in this series for descriptions of commonly used ICT-enabled agriculture services and profiles of promising services.

<sup>14</sup>[The Economist: More Intelligent Life.](#)

<sup>15</sup>[Gizmodo.](#)

<sup>16</sup>Example ICT efforts: [M-Pesa](#) & [Esoko.](#)

<sup>17</sup>[Farmer's Friend.](#)

### Radio: Adding Two-Way Communication

*Capability:* Largely listening-only, public broadcasts on multiple channels.

*Users:* 59% of population in sub-Saharan Africa.<sup>18</sup>

*Energy Consumption:* Low.

*Ease of Use:* High.

*Durability:* Depends on specific product, but relatively high.

*Impact:* High, ubiquitous technology in use now. New features allow users to record and replay content.

**Sample technology use: Farmer Voice Radio.**<sup>19</sup> This program, created in Kenya, educates and connects farmers. It identifies and disseminates techniques at a local level. Farmers set a local 'agriculture agenda' for the program. Producers then develop content.

Extension officers record farmer interviews and send them to the station, where they are highlighted and disseminated. Farmers provide feedback on content, creating two-way communication. Farmer Voice Radio is available to farmers at no cost. It has three years of funding beginning in 2009 from the Gates Foundation.

### Video: Power in the Visual Image

*Capability:* Visual images overcome low literacy and improve communications.

*Users:* High receptivity/currently low availability.

*Energy Consumption:* Medium.

*Ease of Use:* Medium.

*Durability:* Depends on specific product, but generally medium.

*Impact:* High. Immediate response from people seeing images and hearing explanations, particularly of people and places they know. Quality of content should be a major consideration. Not all video is created equal.

**Sample technology use: Digital Green**<sup>20</sup> uses low priced (off-the-shelf) video recorders coupled with small pico projectors to educate farmers at the local level. In India, there are already

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<sup>18</sup> English, C. "Radio the Chief Medium for News in Sub-Saharan Africa." *Gallup.* (June 23, 2008)

<sup>19</sup>[Farmer Voice Radio.](#)

<sup>20</sup>[Digital Green.](#)

numerous hubs: 2,000+ videos have been produced, and more than 68,000 farmers reached. Digital Green offers the service free to farmers.

Local farmers are trained and motivated by recorded experiences of local peers and extension staff. Videos are recorded by trained community members using pocket video cameras and edited using free software (Windows MovieMaker). Completed videos are uploaded onto YouTube at the district level. Content is also loaded onto microSD memory cards for distribution to participating villages.

Videos are shared with groups of 10–20 farmers. These viewing sessions become informal training schools. It is a potentially scalable method, in that it is a medium people 'get'.

### Smartphone: High-Potential Device in the Long Run?

*Capability:* Computer-like capability, camera, video, email, FM radio, Bluetooth, calling, and texting.

*Users:* 15% penetration rate in Africa expected by 2015.<sup>21</sup>

*Energy Consumption:* High. Average battery lasts a few hours of talk time.

*Ease of Use:* Moderate.

*Durability:* Moderate.

*Impact:* Vast possibilities for app development, including development apps that will work even without mobile-network coverage.

**Sample technology use: Community Knowledge Worker.**<sup>22</sup> Grameen Foundation's AppLab has been in partnership with MTN-Uganda to identify and train community members as Community Knowledge Workers (CKWs). CKWs are equipped with Android phones to disseminate and collect agriculture-related information.

They are set up with what Grameen refers to as 'business in a box', offering phone service on a charge-by-minute basis. This is based upon the Bangladesh 'phone lady' model. The technology includes an off-grid charging solution and marketing material so that it is an entrepreneurial venture.

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<sup>21</sup>Afrographique, [Mobile phones in Africa.](#)

<sup>22</sup>[Grameen Foundation AppLab.](#)

## LOOKING FORWARD

There is great potential for ICT application in agriculture for meaningful development. Key areas include:

**Opportunity abounds.** In the next three years in Nigeria alone, there will be a projected fifty million new mobile phone users. Sharing and borrowing phones can overcome lack of prevalence, at a fraction of the cost for each user.

### **Technology marches forward.**

Devices continue to become more powerful, have new features, are smaller, and are less expensive. Device applicability and utilization for development purposes continually increases. Priority need-to-have functionality should be considered first, then nice-to-have features.

**Simple is better.** Use the right tool for the job. Africa is harsh on electronics. Things wear and break. Basic technology and simple applications may be more viable than technologically involved solutions. People with technical savvy can sway opinion in favor of a device with less utility in the field.

## RESOURCES

Toyama, K. "[Comparative Laboratory Study of 12 Devices for Agriculture Extension](#)" (D-Rev, 2011)

World Bank. "[ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions.](#)" (November 2011)

GSMA and A.T. Kearney. "[African Mobile Observatory 2011: Driving Economic and Social Development through Mobile Services.](#)" (2011)

Accenture and Vodafone. "[Connected Agriculture: The role of mobile in driving efficiency and sustainability in the food and agriculture value chain.](#)" (2011)

Sullivan, B. "[The new age of radio: How ICTs are changing rural radio in Africa.](#)" (Farm Radio International, 2011)

Huggins-Rao, S. "[Marketing on the airwaves: Marketing information service \(MIS\) and radio.](#)" (Farm Radio International 2011)

Schmidt, C., Gorman, T.J., Gary, M.S., & Bayor, A.A. "[Impact of Low-Cost, On-Demand, Information Access in a Remote Ghanaian Village.](#)" *ICTD2010*. (2010)

[Gizmodo](#) provides information and reviews on many devices.

Mobiledia offers a [Global Phone Comparison](#)

## DISCLAIMER

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