LESSONS FOR SUSTAINABILITY

Failing to scale ICT4Ag-enabled services

"

ICTs have undoubted potential to boost agricultural production and value chains in ACP countries. But many efforts to introduce ICTs for this purpose have not been sustainable. What can we learn from their experiences? The stories in this booklet stress the importance of understanding the intended users, ensuring economic viability, fully promoting the service, and making sure the technology offered is the right solution to the problem."

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Learning from experience

Whilst everyone would like to share their success stories, very few have the confidence to share their failures. There should be no shame in experimenting and failing, especially with new communication technologies. As Microsoft founder, Bill Gates, has been quoted as saying: "It's fine to celebrate success but it is more important to heed the lessons of failure." With this in mind, CTA launched a call for papers on failed ICT4Ag projects/initiatives – projects that showed early promise and received third-party support (from governments, donor agencies or private sector investors) but did not reach fruition.

The potential for ICTs in agricultural development is almost endless and numerous applications are being developed

Around 30 proposals were received, of which nine were chosen for further study, covering cases in Côte d'Ivoire, the Democratic Republic of Congo (DRC), Ghana, Trinidad and Tobago, Uganda, Zambia, and three cases from Kenya. These nine covered projects had planned to address perceived weaknesses in agricultural development, including a lack of extension, poor knowledge of markets, and insufficient understanding of inputs. This publication draws mainly from those case studies but also makes use of other sources, such as the World Bank's *ICT in Agriculture Sourcebook*, as well as some of the unsuccessful proposals submitted to CTA.

The potential for ICTs in agricultural development is almost endless and numerous applications are being developed. ICTs can be used to carry out soil tests; to apply fertiliser; to receive extension advice and weather forecasts; to monitor pests and diseases; to make marketing decisions; to decide when to harvest; to weigh produce in the field; to send and receive payments, including credit; to monitor produce during transport and storage; to improve transport, wholesale and retail logistics; and to generally upgrade management efficiency.

The case studies reviewed here mainly discuss ICTs that seem most relevant to ACP smallholders, i.e. those that planned to offer extension and marketing information. 'Relevance' is here defined both in terms of the information to be provided and of the capacity of smallholders to use and pay for the ICTs. While some other services may indeed have considerable potential value for small-scale farmers, both their ability to pay for them and the ability of governments to offer them as a 'public good' must, despite some acknowledged successes, often be questionable.

A local extension agent conducts a survey using a tablet. Mbuzi Village, Tanzania.

ICTs for agriculture:
Nine issues to address from day one

Based both on research carried out for CTA and on other sources, the following lessons highlight the main issues that should be taken into account when designing, introducing and scaling-up ICT4Ag projects.

1. Involve all the potential users when assessing demand

Too often, developers look at whether an information and communication technology (ICT) application is suitable for agricultural use without first assessing the demand. No project design should begin without detailed consultations with the intended users, such as farmers, traders and extension workers. Consultations should first aim to identify their agricultural needs and, only after this has been done, should project developers consider whether these needs could be met successfully by ICTs. Further, both demand and impact need to be assessed on an ongoing basis through rigorous monitoring and evaluation.

Providing services in languages understood by most people is essential

2. Keep it simple

There is often a tendency to want to provide all the information and assistance that farmers could possibly need. This can lead to complex, costly, unworkable and unsustainable designs. For example, projects aiming to supply extension information sometimes run into difficulties in sourcing appropriate content. A better approach is to start by providing limited information to address a core problem, with the intention to upgrade and scale-up services if the pilot is successful.

3. Do not pre-commit to any particular ICT solution

The need for the relatively new ICTs (such as mobile phones, the web, etc.) should not be assumed as, in some cases, they may not represent the best solution to farmers' problems. To address some problems, more traditional ICTs, such as radios, may be the answer. In yet other cases, a mixture of new and traditional ICTs may be the best approach. Whichever solution is proposed, it is essential that this is based on cost-effectiveness and sustainability and not just on the fact that it is desirable and technically possible.

4. Address literacy, gender and social issues from the outset

The use of mobile phones and the internet often runs up against problems of both illiteracy and the ability of the target beneficiaries to use the technology. Providing services in languages understood by most people is essential. Beware that women are sometimes denied access to technology, even though they are frequently able to make better use of the information provided than men. Communities may have strong traditional information and knowledge-sharing approaches, as well as trust-based marketing relationships with traders, and ICT4Ags should promote the continuation of such traditional practices.

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Extension officer Sia Minja is collecting baseline data in Lushoto, Tanzania, to build up a picture of the kind of soils farmers have.

5. Consider the project cost

Externally funded projects are invariably too costly to be supported by governments once donor funds have run out. Donors need to rigorously examine the capacity of the hosting organisation to continue implementing activities after the project. They should design projects with sustainability in mind rather than because they have a certain budget to spend. Governments need to say no to donor support if they feel they cannot guarantee sustainability. Exit strategies must also address who will replace consulting firms that may have done much of the initial work in implementing a project.

6. Work with existing service providers

It is essential that extension staff do not feel threatened by ICT introduction. Increased availability of information requires qualified staff able to help farmers to use it. ICTs for extension purposes should not be designed to replace traditional extension methods but to supplement them and help the extension service staff in both the field and headquarters to function more effectively.

Beware that women are sometimes denied access to technology, even though they are frequently able to make better use of the information provided than men

7. Develop a viable 'business model'

Technology specialists who decide to develop ICT4Ag applications are often not very business-minded. They may need to seek specialist advice that can assess the profit potential of their ICTs before too much money

is invested. How ICT services expect to generate revenue; whether or not the beneficiaries will be prepared to pay for information and how much they will be prepared to pay; the opportunities for external contributions; and how to control costs so that they are in line with the revenue must all be addressed. Similarly, government and donor projects also need a business model in order to assess the potential for sustainability.

8. Do not ignore training, promotion and information requirements

Project budgets invariably underestimate or ignore the training requirements needed for an ICT service to work. Training is required at all levels, from those supervising the service to the farmer receiving the information, and this can involve considerable costs, including travel costs. Similarly, promotion of a service is essential for people to know that it is available, but promotion is also sometimes unbudgeted.

Communities may have strong traditional information and knowledge-sharing approaches, as well as trust-based marketing relationships with traders, and ICT4Ags should promote the continuation of such traditional practices

9. Resolve responsibilities to implement the service

Project developers sometimes design a system while paying little heed to who will actually be required to implement it. It is essential that all management and operational issues are resolved from the outset and that a new service is both confident of the competence of the planned implementers and has the full support of management. The explosion in mobile phone usage in African, Caribbean and Pacific (ACP) countries has come about, in large part, because governments have liberalised the telecommunications sector, thereby allowing private companies to compete to supply phones and networks that people find affordable. This emphasises the importance of the enabling environment for development. Governments need to be aware that other existing or new regulations may also affect the business environment and constrain further growth of the ICT sector by, for example, inhibiting innovation or limiting network expansion. On the specific topic of ICT4Ag, national and local governments, once they have endorsed a new project, need to provide consistent support to its implementation.

Women and children from Mugeyo, Rwanda, take part in a survey aimed at understanding the links between agriculture and nutrition and determine the specific causes of stunting in children under two.
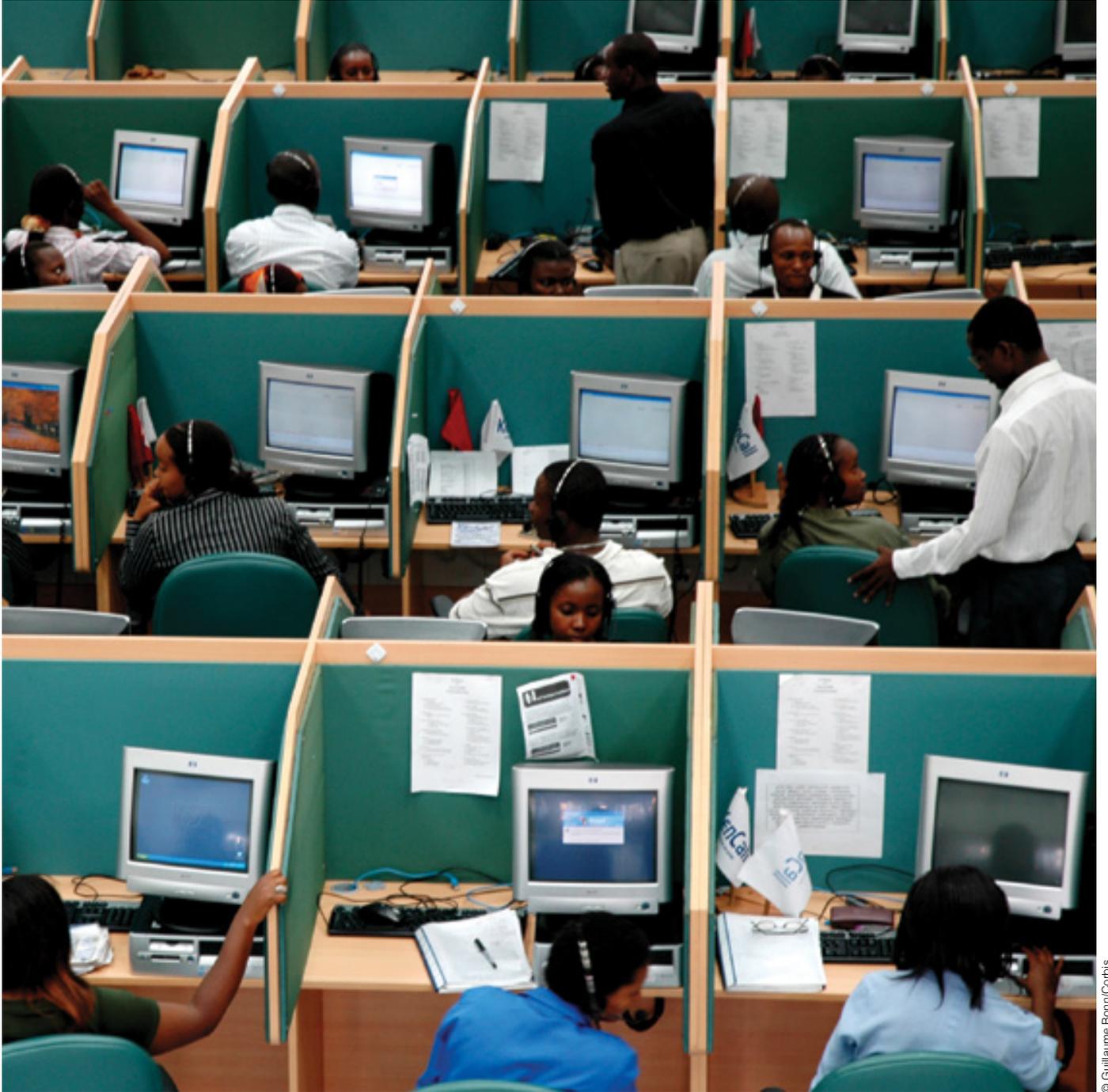
Kencall, the first Kenyan based call centre is situated in the industrial area of Nairobi, the capital city.

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Assessing demand from users for services to be provided through ICTs

A common mistake has been to concentrate on the technology rather than on the problem that technology is meant to solve. ICT4Ag projects have often assumed that they know what problems farmers and others face but have frequently failed to actually ask them.

ICT4Ag projects all start with sound objectives. One from Uganda (see Case 9) aimed to increase agricultural efficiency and effectiveness in order to improve livelihoods, food security and sustainability. Many of the other failed projects had similar objectives. But, despite such aims, developing the projects rarely involved talking to farmers, traders and extension officers. An almost universal feature was that developers, perhaps encouraged by the success of ICTs for other uses in rural areas, such as mobile money, tended to put all their emphasis on the ICT. In some cases this led them to design applications or systems that the users may not really have needed or that they did need but could not afford. Several designed 'sledgehammers to crack nuts'; solutions that tried to do much more than was really required. Others designed technologically sound systems, but these assumed the availability of content that was not necessarily available, such as information needed to provide extension advice.

ICT4Ag projects should emerge from detailed research into problems facing the intended beneficiaries. Where background research was conducted for the cases studied it was usually to assess the technical capacity to use the ICT (e.g. percentage of farmers with mobile phones and smartphones; network coverage; internet connectivity) rather than the benefits that the technology could achieve or the ability of the target beneficiaries to use the technology. Some quotes from the case studies illustrate the point:

"None of us have any real background in agriculture but at that time we saw an opening for greater ICT involvement in the industry"; "We were trying to be too ambitious from the start"; "We did not understand the needs of farmers and did not associate them in development of the application".

Two projects in Ghana (Case 2) planned to use ICTs to help farmers with access to credit and markets, collective marketing training, business planning, record keeping, pest control, and farm management, as well as fertiliser application, planting and spacing. A project in Kenya, not covered by the case studies, aimed to develop a system to help youth and farmers access information on a wide range of topics related to agricultural technology and link them with technology providers, to help farmers access markets, interact with policymakers and create employment. Given the weaknesses that many

national extension services face, it was perhaps realistic to feel that farmers faced problems in getting information on agricultural topics. However, the breadth of coverage proposed caused many complications and involved significant costs.

An important factor to emerge from the studies was that for some types of information, particularly for agricultural extension, farmers were more comfortable in talking to people they knew, such as input dealers or extension workers, than in obtaining information anonymously by phone or text. Case 1, presented in this chapter, gives an example of this from Kenya, where a service aimed to provide advice by mobile phone on appropriate maize varieties but farmers preferred alternative information sources. In addition, farmers were unsure why the service was being offered in the first place. They considered that seed recommendations changed so rarely that it was not needed.

The assumption that seed dealers were only interested in selling slow-moving seed lines, not in helping farmers, was one of the reasons for the establishment of the Kenyan seed ICT. Similarly, other projects seem to have started from the standpoint that farmers were exploited by traders (the so-called 'middlemen'). This assumed exploitation is common in many types of development projects, but is not generally supported by independent research. The assumption that traditional trading relationships are exploitative[1] led several projects to seek ways of 'by-passing the middleman' electronically, by enabling farmers or farmer groups to identify new buyers or to announce products for sale online.

While much agricultural trading around the world is conducted electronically, this is generally done in a very structured way. Electronic trading requires a common understanding between the buyer and seller about the product description. While most ACP countries do have grades and standards, they are not yet commonly used at the level of the small-scale farmer. Further, both parties must be confident that the transaction will be conducted honestly. Commodity exchanges can provide this but are not suitable for individual small-scale farmers.

Small traders who purchase directly from farmers often work in a limited area, where they have developed long-term trading relationships. They are unlikely to consider purchasing by using ICTs unless they can be sure that agreements made online or over the phone will be honoured. Similarly, knowledge of higher prices in a location not usually supplied by the farmer has little value because of the cost or risk involved in supplying that location[2]. Not having adequately researched the situation in advance, several projects eventually found that trust relationships were perhaps more important to farmers than always being able to get the best possible price. Farmers preferred to go to market to get prices and sell to existing clients. The projects also found limited interest on the part of traders to promote their businesses through ICTs.

In conclusion, it is important that developers of ICT applications and systems should carry out a detailed assessment of the need for the planned service. This need should not just be assumed but should be verified after detailed consultations with the intended beneficiaries. How do farmers and others get information now? Are they happy with their information sources? What do they think of the idea of supplying information and advice using ICTs? Which ICTs do they feel would best meet their needs? ■

CASE 1   Maize Seed SMS information services

Country:	Kenya
Implementing party:	Kenya Seed Company (KSC)
Type of service:	SMS
Project duration:	2008 – present
Source:	Wamweya, Jacqueline W. and Mary W. Mutiga: *Government ICTs for Agriculture: Lessons from the failed Maize Seed SMS Information Services in Kenya.*

The Kenya Seed Company (KSC) is a government parastatal that researches, develops and markets high-yielding seeds for a variety of crops. Prior to setting up the Maize Seed SMS service it was already embracing use of ICTs; providing a toll-free line for customer enquiries, giving extension advice over FM radio stations and allowing farmers to pay for seeds through Kenya's M-Pesa mobile money transfer service.

The SMS service was established to help farmers decide which maize variety was the right one for their agro-climatic zone. It was felt that farmers were confused by seed company promotion that was generic rather than location-specific and, as a result, they planted the wrong varieties for their area. ICTs had already been used by others to provide advice on seed varieties in Kenya, including websites, radio programmes and videos. A supplier of cotton seeds had used mobile phones to help farmers choose the right variety and calculate how much seed to use.

The decision to use SMS was made because Kenya has a high level of mobile phone usage and network coverage in almost all of the country.

The system required farmers to send a text message specifying their division (an administrative unit). Information about appropriate varieties had already been preloaded and the system would automatically search the database and then send a reply. Additional information, such as the seeding rate and the KSC price, was also provided.

Take-up of the service was disappointing. In 2013 only 2,000 enquiries were received, compared to the break-even number of 24,000. Interviews suggested that farmers did not understand how to use the system and illiteracy was also a problem. Moreover, the system used English rather than local languages. Promotion of the service had been top-down and carried out by KSC's Head Office rather than by its own extension staff and government extension officers, who felt no ownership. Finally, farmers noted that maize recommendations rarely changed and that they could, anyway, get the required information from KSC depots and extension staff. There would have been more interest in the service if it had covered a variety of crop seeds.

In Benin, regular power cuts require the purchase of voltage regulators for any electronic device.

Considering technical difficulties with the development and use of ICT solutions

When it comes to software development, existing software that is tried and tested is often ignored in favour of 'starting from scratch'. Other technical problems faced by developers have included equipment provision, network coverage, poor phone lines and poor access to electricity.

Several case studies report on technical difficulties experienced during software development. In the case of one, from Trinidad and Tobago (Case 3), the proposed service never went 'live' because the problems, while not insurmountable, could not be resolved with the available time and money. Other projects, including Case 2 presented in this chapter, experienced difficulties with cross-platform compatibility, meaning that the services had problems in being read on mobile phones. Finally, one of the case studies (Case 4) reported difficult relationships with the telecommunications company, with frequent breakdowns in the service.

An ICT project designed to improve monitoring and evaluation of agricultural projects in Kenya (Case 6) only became aware of its unsuitability for use by extension officers after considerable work and expenditure. A similar problem reported from Zambia (Case 8), when a platform that worked well during the testing phase proved unsuitable during the pilot stage and was thus not scaled up.

In general, projects found that failing to get the system right from the start led to numerous modifications and additional costs. Redesigning a system may also necessitate additional training.

A common feature of the case studies is that developers set out to be innovative in their software design, as opposed to building on existing platforms. While ICT4Ag platforms that have a proven track record may initially appear costly to governments and donors, they have already addressed some of the problems. As a result, they may turn out less expensive and more functional than the alternative of 'reinventing the wheel'.

Equipment problems faced included damage to a server due to failure to install a power stabiliser, and the purchase by a ministry of computers that were inferior to the software designer's recommendations. Equipment provision envisaged at the stage of project design was sometimes not carried through, leaving field staff with insufficient tools for implementation. Sometimes, insufficient machines were provided, leaving no backup when one broke down. Even where adequate equipment is supplied (often by donors) there can be problems because of inadequate funds to meet operating costs. For example, government offices sometimes have

shiny new computers but no money to pay internet provider fees, or brand new printers but no money to pay for toner (ink) or paper.

Developers need to be fully aware of the capacity of the intended users to utilise their software and of the suitability of available hardware and communications systems to implement what is proposed

Although network coverage is expanding rapidly, some of the case studies reported that many rural areas in Africa remain poorly served. In countries where there are several service providers, one may have good coverage of a particular area and others poor coverage. If farmers make cross-network calls they have to pay higher fees; but if the ICT4Ag makes the service available on all networks it incurs extra expenses.

Traditional land lines are also often of poor quality and this has an impact on the speed of internet connection. The problem can be overcome by linking computers to mobile phone networks, but this may be difficult and costly for governments, resulting in problems for services aiming to support extension officers through web-based applications.

A problem faced by farmers is that of recharging their phones, as electricity is often not available. Entrepreneurs offer recharging services, using car batteries or solar panels, but such services are often remote from farms. Farmers may leave their phones switched off until they want to make a call, which could present problems for services that aim to 'push' voice calls. A relatively recent development may overcome some of these problems. Spark Africa has taken advantage of the widespread use of bicycles in Kenya to develop a low-cost charger that can be attached to the cycle's dynamo[3].

In conclusion, while agricultural ICTs clearly need to foster innovation, developers do need to be aware of other similar solutions that could be built on. Further, developers need to be fully aware of the capacity of the intended users to utilise their software and of the suitability of available hardware and communications systems to implement what is proposed.■

CASE 2   e-extension platform development

Country:	Ghana
Implementing parties:	Ministry of Food and Agriculture (MoFA); Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ); World Bank
Type of service:	Web sites; call centres (planned); SMS and interactive voice response (IVR) (planned)
Project duration:	2012 – present
Source:	Allavi, Solomon E.: *e-Extension Platform Development in Ghana: Dwarfed from Inception.*

Two e-extension platforms were developed in Ghana over the same period during 2012-13. One was supported by the German technical assistance agency, GIZ, as part of a broader agricultural development project in Ghana, while the other was funded by the World Bank under a West African regional project. Software development was carried out by two separate private companies in the capital, Accra.

Despite the fact that both projects envisaged platforms to be implemented by the Directorate of Agricultural Extension Services (DAES) of the Ministry of Food and Agriculture, they were remarkably similar in their conception. However, http://www.e-extensionmofa.com/home placed its main emphasis on servicing field officers, whereas http://agricextension.gov.gh was more oriented to the farmer. Both sites were planned to be mobile phone enabled.

Plans for both of the sites were very ambitious. They were intended to offer up-to-date information on crop, livestock and fisheries production as well as weather forecasts and market prices. They also planned to offer hotlines where farmers could call

for additional information; newsletters, extension brochures and posters; a good search function; videos; two-way SMS; interactive voice response (IVR); an online forum, and contact information for extension staff. Additionally, it was hoped that the platforms could be used by DAES staff to carry out bulk mailing of SMS extension messages.

Although both sites were still online at the beginning of 2015, neither contained much usable information and it was clear that DAES had not been able to upload the content envisaged during the planning stage. Moreover, neither project had succeeded in developing a cross-platform capacity so that mobile phones could be used to access the sites. Various reasons were given for these problems, including the fact that donor funds had run out, poor planning and consultation with the intended users, and a lack of advance consideration of how information would be developed and maintained on the site and who would be responsible for this.

Building up appropriate content for delivery through simple technologies

Delivering information to farmers through ICTs requires a database of information that can be easily accessed. Moreover, it needs to be in languages that farmers can understand. Content development can represent a major cost that is often overlooked.

The projects that planned to use ICTs to supply agricultural extension information all recognised that they needed a database of information that could be the basis for a website, text messages, interactive voice messaging, or call centre operations. There was a tendency to assume that the content would be easy to obtain, but this was often not the case. Either the information was not available or it was only in English or French.

Content development was particularly difficult for those projects where staff lacked any agricultural background. Indeed, as reported in Case 3, one ICT team found that it became a victim of the problem it was trying to solve, i.e. a lack of information. Almost all projects discovered that building up relevant information resources required significant time and money and that content of direct relevance to the country was not easily available from the internet. For some that realisation was effectively the end of the project. Others still have websites on line but they contain little useful content. In addition to supplying extension information, several case study projects also intended to repackage existing resources to provide information on the weather and on market prices. However, few succeeded in achieving this, with problems related to cost and the user interface of the applications.

In conclusion, the GSM Association[4] recommends the following points for developing content in mobile agricultural services. Content should be: i) actionable – farmers should be able to act on the information and advice delivered, within the capacity and constraints of their operating environment; ii) timely – information and advisory services must be available when farmers need them; iii) relevant – information and advisory services must be applicable to the farmer's situation with regards to location, agro-climactic zone, crop cycle, farming activity and language, amongst others; iv) accurate and high quality – there should be a high level of quality and accuracy of information, and advisory services must be available at all times to build trust of farmers in the service. ■

CASE 3 Carib Cultivate: an online repository of agricultural data

Country:	Trinidad and Tobago
Implementing party:	AgriWorks4u
Type of service:	Mobile phone app
Project duration:	2011 – present
Source:	Bascombe, Keron: *Issues in Mobile App Creation for Agriculture in Trinidad and Tobago.*

Carib Cultivate was designed to provide farmers in Trinidad and Tobago with information on the production of a range of crops, covering topics such as germination and growth periods, common diseases and pathogens, pests and pesticides, and fertilisers. Unfortunately, despite the idea having won two competitive grants, the service has yet to be made available to the farming community.

The five software developers, who were all working towards advanced degrees in Computer Science, planned to develop an online repository of agricultural data. Taking advantage of the inexpensive availability of 3G and 4G networks in the country, and the widespread use of smartphones, they set out to develop an app that could be used on both Android and iOS (iPhone) devices. They also planned for the app to allow for caching so that farmers could access previously viewed pages if they were out of range of a network signal.

In trying to take the software to a stage where it could be launched the developers faced three major problems. First, they were victims of the problem they were trying to solve. In attempting to build up content on agricultural topics they had trouble identifying information relevant to the Caribbean. Not being agriculturalists they ended up hiring an agricultural consultant to do this work but, even then, there were clear information deficits. Second, the designers faced a number of technical difficulties in getting the user interface to work. Further delays were encountered, in part, as a result of the developers wanting to aim for perfection. As time progressed they found that some features they had wanted to include had to be dropped, such as a GPS capacity. Finally, with all the difficulties experienced, Carib Cultivate had to be put on the back burner as the time of the developers was taken up with other work.

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Farmers in Trinidad and Tobago are trained to use ICTs in support of their farming enterprise.

Strengthening the capacity of small-scale farmers to use ICTs

Most case studies highlight the difficulties faced by farmers in using ICTs. These can be summarised as both language and ICT-literacy constraints, combined with cultural and other sensitivities.

The average age of farmers is increasing everywhere. While farmers can often rely on their children or on more literate neighbours to help them to decipher text or web messages, there may be a cultural reluctance to admit to illiteracy. Moreover, someone who is literate may not be available when the farmer really needs to read a message[5]. A further problem concerns the language used. For example, there are 42 languages in Kenya and most people do not speak either Kiswahili or English, the languages generally used by ICT services.

As younger farmers replace their parents and grandparents there should be a gradual increase in average farmer literacy. However, it will be some decades before illiteracy is no longer a major problem in rural areas. Until then, ICT4Ag will need to engage in a complicated juggling act: to identify ways of reaching as many illiterate farmers as possible while, at the same time, to ensure that costs are controlled and revenue is maximised. For example, one response to illiteracy has been to identify literate farmer leaders who can seek information or receive messages on behalf of a group of farmers. In terms of information dissemination this can work well, but supplying information to groups rather than individuals can reduce revenue-earning opportunities, particularly if the recipient organisations have limited resources.

Voice messages do, of course, overcome illiteracy and Case 4 in this chapter reports that farmers, when contacted, showed a strong initial preference for receiving voice information. However, the farmer recipient of voice messages does have to remember the message. He or she cannot refer to an SMS text as a reminder. When messages are fairly complex, for example, concerning seeding rates, relying on a voice message could be dangerous. Voice is also more expensive than SMS and, while voice messages may be suitable to replace brief text messages, they may not be suitable as a replacement for lengthy web-based extension messages that can be downloaded by a smartphone. In the long run, services may have to be multi-channel, offering both SMS and voice messages and eventually providing a call centre, as farmers will want to call back for clarification and additional information, particularly when facing an urgent problem[6].

The general ageing of farmers is also a problem in regard to their ability to use mobile phones. Although there has been an explosion in phone use recently, evidence suggests that they are still mainly being used by farmers to make traditional voice calls. Children are now familiar with smartphones and relatively inexpensive smartphones are available, but young people are not farmers. Some of the studies reported that

Communities have strong existing knowledge-sharing approaches and these can be built on by developing their ICT4Ag capacity.

farmers had difficulties in using the ICTs, particularly where interactive services, smartphones or websites were involved. One study highlighted the problems faced by farmers in remembering the number to call to access a service: shorter numbers that were easier to remember could have been purchased from the telecommunications company, but the cost was too high. Close liaison with the mobile network operators to explain the purpose of the request may overcome this and similar problems.

One study reported that farmers considered the internet as having mystical or spiritual aspects and were thus reluctant to use it. A more pragmatic reason given for farmers refusing to register for one site was that they feared that the information would be shared with the tax man and other government officials.

As the use of ICT4Ag often encounters problems of both illiteracy and the ability of beneficiaries to use the technology, creative approaches to resolving these problems are required. Providing services in multiple languages is essential. Communities and community organisations may have strong existing knowledge-sharing approaches and these can be built on by developing their ICT4Ag capacity. ■

CASE 4 — Interactive Voice Response (IVR) and Radio for Market Information

Country:	Côte d'Ivoire
Implementing parties:	N'KALÔ; RONGEAD (NGO)
Type of service:	IVR; SMS; radio
Project duration:	2011 – present
Source:	Kedja, Serge: *L'information sur les marchés agricoles via le serveur vocal interactif N'KALÔ et les radios de proximité – les limites d'une approche innovante (Côte d'Ivoire).*

N'KALÔ was established to provide market information to 23,000 cashew producers in Côte d'Ivoire. It was developed by an NGO, RONGEAD, and has employed a range of dissemination methods, including weekly newsletters sent by email and on paper; a weekly SMS message; field staff available to be consulted by 'phone; a website (www.nkalo.com), which provides information on several crops in addition to cashew; 'spots' on 37 local FM radio stations; and an IVR service for mobile phone users. From amongst these, N'KALÔ became convinced that radio and IVR were the most effective for farmers, who preferred to receive messages by voice rather than text. In addition to literacy issues, SMS messages were considered too short to convey the information required. However, neither of the voice services is functioning as originally planned.

The IVR service offered a choice of using French or the local language Dioula. Callers were then given a choice of five locations about which to receive targeted messages, at a cost of around €0.40 for a two-minute call. However, problems were experienced, including technical breakdowns; the high cost of obtaining a simple number for farmers to remember; the fact that only one mobile network was used (due in part to the lack of compatibility between the systems used by the various companies and the cost of developing a specific IVR for each system); and the difficult relationship with the service provider that complicated message uploading and made obtaining use statistics difficult. Moreover, a survey found that farmers actually preferred to receive information from the people they knew. Consequently, the IVR service was closed down and replaced by a much-appreciated service that, over eight weeks, automatically called about 500 farmer leaders to deliver recorded messages. The cost of this was €4,600 but, to date, RONGEAD has been unable to generate resources to scale-up.

N'KALÔ, which means "I am informed" in Dioula, had started by using radio stations but had trouble generating revenue. It has now changed to using radio primarily to advertise paid services, particularly a weekly SMS. In special situations, e.g. where there is abnormal weather or an unstable market, radio continues to be used to reach the largest possible number of producers.

A customer conducts a mobile money transfer inside the Safaricom mobile phone care centre in Nairobi, Kenya.

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Considering costs for sustainability

Many development projects, and not just those concerning ICT4Ag, appear initially successful when the donor is actively involved, but have problems in continuing after the project has ended. In particular, services provided free of charge to farmers are often difficult to continue after donors have departed. Consideration of sustainability is essential right from the beginning of any project.

Most of the case studies were donor-funded projects. In some cases the funds allocated were considerable. For example, the study of a call centre implemented in Kenya (Case 5) estimated that it had cost donors around €1.5 million, including salaries for 25 experts available to answer questions online.

Donors tend to allocate funds in one go at the beginning of a project or, at best, in two or three chunks. Donor administrations are not usually equipped to handle projects that allocate resources on the basis of lessons learned and provide the time needed for the activities to become sustainable. There is rarely a possibility to start on a small-scale with limited objectives and expand as the project shows success. Donors may absorb costs at the beginning of a project with little attention to how those costs will be met at the end, other than through optimistic assertions that the service will be profitable by then. Staff and operating costs are met, with few realistic guarantees that the agency implementing the project will be able to subsequently cover those costs. Equipment is provided with little consideration of how it will be replaced.

A common experience was that government agencies or, in one case, a private company, either did not have the resources to continue implementing the service once donor funds were exhausted or did not consider the activity a priority. Although ICT4Ag projects are often designed to address problems caused by resource constraints, such as inadequate extension services, ICTs may not overcome existing funding weaknesses. If anything, projects may increase costs in the long-term.

The studies also suggested that insufficient attention was paid to the ancillary activities necessary for the core activities to work. This included lack of funds for extension workers to both be trained and do training and inadequate resources to generate the content necessary for the planned service, as discussed in Chapter 3.

The willingness of farmers to use ICT services depends on how much they must pay. An SMS message to request information can cost €0.15 in Zambia, while a call to an IVR service in Côte d'Ivoire costs more than twice that. This may not seem much, but measured against the daily income of many farmers in developing countries it is significant and farmers will need a lot of convincing that it is justified. Where ICT4Ag projects choose initially to provide information free of charge to farmers the problem is compounded when the project comes
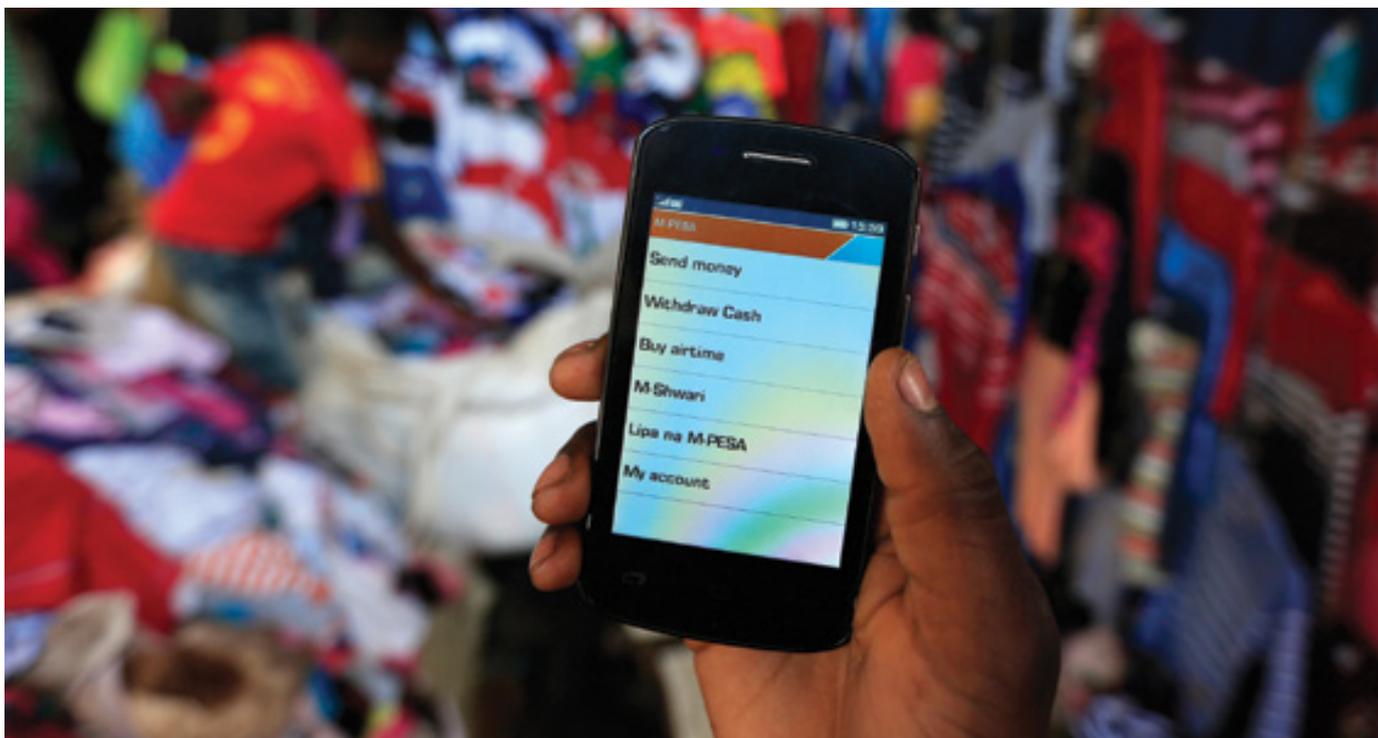
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A man holds up his mobile phone showing a M-Pesa mobile money transaction page at an open air market in Kibera, Kenya.

to an end and farmers are suddenly faced with meeting the true costs of the service.

Donor administrations are not usually equipped to handle projects that allocate resources on the basis of lessons learned and provide the time needed for the activities to become sustainable

The lesson from these experiences is perhaps that the best approach is to limit the number of activities implemented and the amount of content that is initially handled, leaving open the possibility of expanding if the initial application is successful and the beneficiaries exhibit a willingness to pay for the information. Donors need to identify how implementation will be continued after the project has been completed. ICT4Ag developers need to become more business-minded or seek specialist advice on how to make their ideas profitable. ∎

CASE 5   M-Kilimo: A farmer help line

Country:	Kenya
Implementing parties:	KenCall; Rockefeller Foundation; GSMA mAgri
Type of service:	Call centre
Project duration:	2009 – 2011
Source:	Odhiambo, Michael D. and Tabitha A. Omoga: *Failing to scale up in ICT for agriculture projects: learning the lessons from the field – A case of M-Kilimo a farmer help line set in Kenya.*

M-Kilimo has made valuable strides in identifying rural farmers' information needs and explored some ways of structuring a business to deliver them. Having successfully launched the service, going forward focus will tighten on its sustainability and scalability, improving value for all. (GSMA, 2011)

M-Kilimo[7, 8], a Kenyan farmer help line, was launched in 2009 by KenCall, an international call centre service provider based in Kenya, with funding by the Rockefeller Foundation through the GSM Association, for an 18-month pilot. KenCall recruited a team of 15 agricultural experts to provide this service, which was available to farmers between 07:00 and 23:00 every day. These experts, who responded directly to farmers' calls, were required to have a minimum of a Bachelor's degree in Agriculture (while some of them had Master level or a PhD), with at least two years of field experience. The service was provided in a number of local languages and covered all areas of agricultural expertise, including horticulture, agricultural engineering, livestock and environmental and soil advice.

The system aimed to address weaknesses in the availability of extension services in Kenya and it was available across all three mobile networks and charged at a standard network rate. Callers were asked to provide information on their location, the farm size, the number of animals reared, crops and varieties planted, soil types, water sources and inputs used, in order to improve the quality of help that could be given and to build up a database of farmer information.

Despite initial constraints, especially expensive marketing and distribution for a third-party service provider, M-Kilimo was initially very successful, and reached over 20,000 users by 2010. However, four years after its establishment, M-Kilimo was no longer functioning. The high cost of operation meant that it could not be sustained once donor funding had run out. While there were possibilities to generate revenue by linking farmers with relevant businesses, such as fertiliser suppliers, this revenue was never fully explored. As KenCal lacks a capacity of a value-added service (VAS) provider and can't provide or bill for SMS, IVR or any other automated channels, the prospects of recovering helpline costs were very low.

Working with traditional extension service providers

Traditional extension services still have much to offer. A frequent observation from the case studies was that farmers still prefer to receive information through personal contact. Resources therefore need to be allocated so that extension staff can utilise available ICT4Ag services to the full.

It is essential that extension staff do not feel threatened by the introduction of ICTs. Increased availability of information requires qualified staff able to help farmers to use it. ICTs for extension purposes should not be designed to replace traditional extension methods but to supplement them and help them to function more effectively. Integrating ICTs into existing extension approaches will help minimise the illiteracy challenges associated with other approaches that by-pass extension agents.

It is also important to ensure that extension officers both buy-in to an ICT4Ag project and are given the resources to enable them to implement it. If field officers lack computers and have poor internet connections, a service designed to provide more information to them, no matter how well-designed and implemented at headquarters level, will have limited impact in the field. Although not directly aimed at supporting farmers, the project to strengthen monitoring and evaluation of extension projects (Case 6), illustrates some of the difficulties that can be experienced.

Some of the case studies reported that farmers were reluctant to use information conveyed over the phone by an anonymous voice. This applied, in particular, to services designed to link farmers with markets or even just to provide market information, but farmers were also wary of receiving extension information in this way. These studies suggested that they much preferred to obtain information from face-to-face contact or by a phone call to people they already knew. In one case farmers were reportedly hostile to a phone-based market-linkage service, which they considered was designed to cheat them. Some of these difficulties may be overcome by encouraging farmer organisations to become ICT4Ag service providers. In this case the voices used should be those of farmer organisation leaders who would already be well known to the farmers.■

CASE 6   Monitoring and evaluation of a development project in Kenya

Country:	Kenya
Implementing parties:	National Agriculture and Livestock Extension Programme (NALEP); Swedish International Development Cooperation Agency (SIDA)
Type of service:	Computers and software
Project duration:	2000 – 2012
Source:	Thiga, Moses M.: *Failing to scale up in ICT for agriculture projects: A Case Study of the NALEP Monitoring and Evaluation System, Kenya.*

Large-scale development projects require extensive monitoring and evaluation (M&E) so that the donor and the recipient agency can be sure all is going according to plan. ICTs can play an important role in facilitating efficient M&E.

Phase 1 of the National Agriculture and Livestock Extension Programme (NALEP) began in Kenya in 2000. It adopted a community mobilisation approach that identified priority crops and livestock and then established common interest groups and extension groups to ensure that adequate training was provided. This phase covered around half of the country. Phase 2, beginning in 2006, was extended to cover all of the then 70 districts in Kenya. Phase 1 had been criticised for the lack of suitable monitoring and for Phase 2 it was therefore decided to introduce an ICT-based M&E system.

The planned M&E arrangements required completion of reports by hand at divisional level for all common interest groups. This information was then loaded onto computers at the 70 district headquarters in the country and transferred by CD to one of the eight provincial headquarters for further processing.

The system rapidly became unmanageable. The vast amount of information required became impossible for extension staff to handle. They saw it as a burden rather than as a tool to improve their work. They were rarely fully computer literate and training was inadequate to address this weakness. Training unfortunately coincided with a widespread redeployment of Ministry of Agriculture staff in 2006. Computers were only available at district level with none in the divisions, and transport constraints meant that staff had trouble getting to district offices to key-in the data. District offices had an insufficient number of computers for NALEP, and those available did not meet the software designers' specifications. Further, the constant redesign of the data-entry screens led to a mismatch between the data entry requirements and the data actually collected in the field. These and other logistical problems meant that timely M&E reports were not being generated at national level. Finally, by 2012 the number of districts in the country had expanded from 70 to 256; further complicating data collection, entry and transmission.

Traders checking the price of beans in Ethiopia.

© Georgina Smith/CIAT

Ensuring viable business models from the start

Technology specialists are often not very business-minded. They may need to seek specialist advice before too much money is invested. How to generate revenue; how and how much to charge the beneficiaries; the opportunities for external contributions; and how to keep costs in line with revenue must all be addressed.

While, given the difficulty experienced by small farmers in paying for them, ICT-based services may well require continued donor and government support, it is important to generate some revenue. Where they are developed by the private sector it is, of course, essential that they have an income, even if donors are prepared to meet some of the cost. Covering costs is sometimes not considered from the outset, or is based on wishful thinking. Case 7 from DRC gives a good example of this. Where budget projections are made these tend to assume optimistic usage and are frequently made without any consultation of potential users. As one case study quoted project developers:

"We did not have a business model. Who would pay? How much should they be charged? How would they pay? We eventually realised that farmers could not pay."

Young ICT app developers in ACP countries need support in developing business models to enable them to market their ICT4Ag services, yet these are often not easy to access. One private service indicated that it had been unable to identify any source of business advice and suggested that ACP countries should be promoting business incubator services to mentor young developers and provide them with business advice.

Several projects had plans to attract advertisements but advertisers are only interested when a significant audience can be guaranteed. Recognising the inability of many small farmers to pay for information, some services decided on a two-tier approach whereby simple information would be provided free of charge and more detailed information would be subject to a fee. But they found the number of subscribers to the fee-paying service to be very limited.

Early Market Information Services (MIS), which initially disseminated price information to farmers through newspapers, encountered problems of illiteracy and poor newspaper distribution. Subsequently, MIS began to use the radio but national radio stations were unsuitable for providing information on a wide range of products in many locations. The rapidly expanding number of FM stations often proved too expensive as the stations usually insisted on being paid to broadcast prices rather than regarding them as a public service. Attempts to generate revenue by organising sponsorship of price broadcasts were rarely successful.
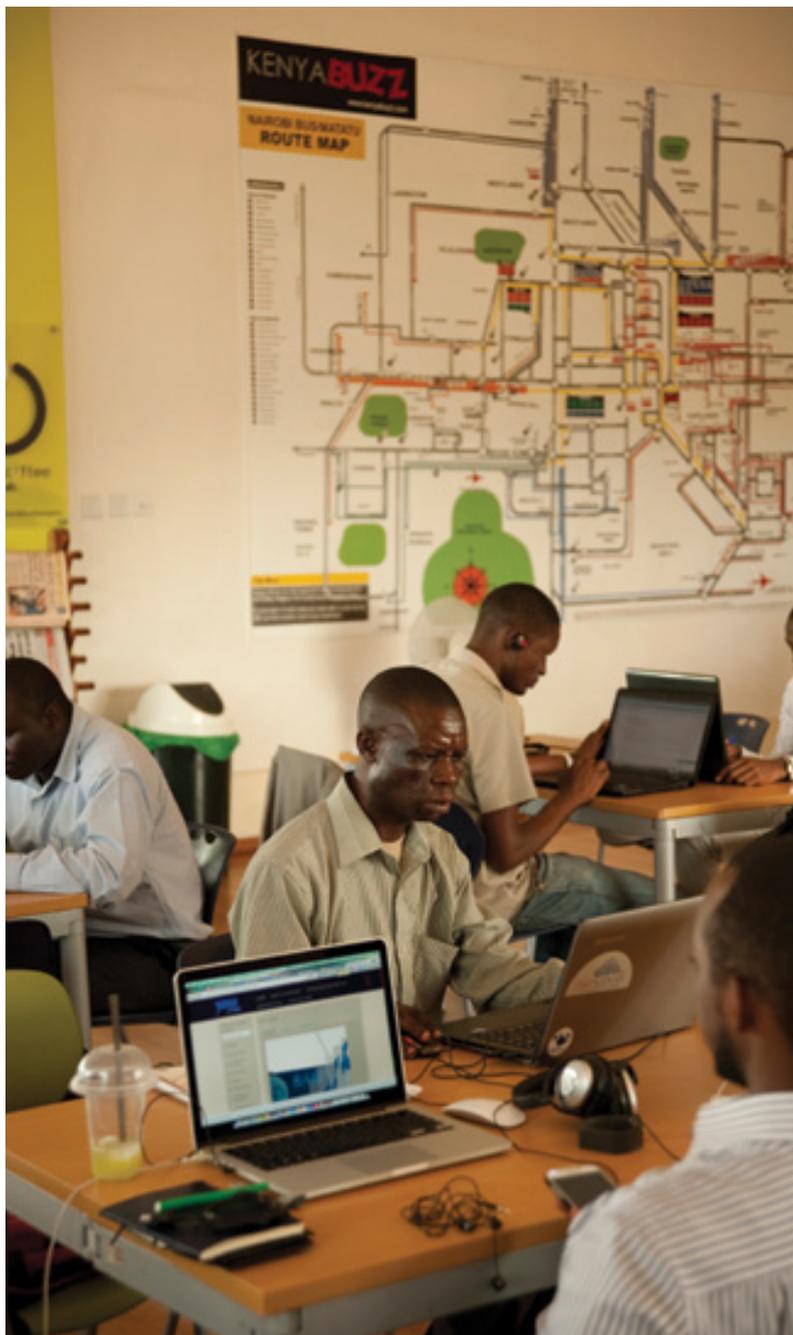
iHub Nairobi's Innovation Hub is a tech community facility with a focus on young entrepreneurs, web and mobile phone programmers, designers and researchers.

Thus the arrival of mobile phones with text capability was quickly seized on by MIS as a way of disseminating information. This speeded up data transmission and allowed it to be targeted to those who really need it, but problems still remained. A business model that would enable MIS to cover their costs from fees charged to farmers for the text or voice messages or from advertisements has yet to emerge.

With widespread access to mobile phones, farmers now have the capacity to call traders or other buyers in order to find out the prevailing price. These calls also offer the opportunity to discuss matters such as collection/delivery and payment arrangements, enabling the farmer to decide who to sell to on the basis of several variables, including price. Thus it may be no surprise that some recent research suggests poor impact of SMS-based services[9]. None of the case studies used for this report looked at a traditional MIS approach. The closest was N'KALÔ in Côte d'Ivoire (Case 4), which provided a text message service to the country's cashew growers but found that the maximum of 160 characters in a text was insufficient to convey both prices and explanations for price trends. As a result it changed over to using voice messages targeted at a more restricted farmer organisation audience. ■

CASE 7 Mobile Agribiz: Online support to farmers

Country:	Democratic Republic of Congo (DRC)
Implementing party:	Private initiative
Type of service:	Web
Project duration:	2010 – present
Source:	Mbunzama, Narcisse: *L'analyse de la problématique de l'échec de l'adoption de TIC pour l'agriculture, cas de la première version de Mobile Agrobusiness en République Démocratique du Congo.*

Mobile Agribiz was an online support service for farmers in DRC. It was established by a team of developers in 2010. After its introduction the developers quickly realised that what they were offering was inappropriate for smallholders in the country. Drawing on the lessons learned they redesigned the service and relaunched it in 2012, with some success.

The first version of Mobile Agribiz was a web application that aimed to help farmers decide when to plant crops and to identify crops and varieties to plant in a particular agro-climatic zone. It also intended to connect farmers to buyers. However, only a small number of farmers used the service, representing about one percent of the farmers in the pilot region of 50,000 farmers. Reasons identified for this included the existence of only one internet café in the region, the high cost of using computers where they were available, and the illiteracy of many farmers. Requiring farmers to establish an online account also raised suspicions amongst the farmers that information provided would reach the hands of the authorities. Developing content in the local language for those able to read and write was complicated by the fact that most material available was only available in French or English. The plan to link farmers to buyers also attracted very little interest from traders.

The developers admitted that they should have initially consulted farmers to identify their needs. Further, they had no business model, with no clear idea of who they would charge, how they would charge them or how much they should charge. They had no plans for marketing the service. They noted that DRC had no business incubators to provide advice and that it was only after they received support from an external business training organisation that they had a clearer idea of what needed to be done.

Providing training, promotion and awareness of the tools

Developers cannot expect to introduce an ICT4Ag service and find that the planned beneficiaries all immediately start using it. First, the farmers need to know that it exists. Second, they need to know how to use it, as do those meant to advise them.

Project budgets sometime underestimate or ignore the training requirements needed for an ICT service to work. Training is required at all levels, from those supervising the service, to field-level staff and the farmers benefitting from it. This training can involve considerable cost, including the cost of travel necessary for extension staff to reach rural areas to train farmers.

Several projects experienced problems with computer literacy of those responsible for implementation. This mainly involved extension staff in rural areas being unable to use computers to retrieve extension advice for farmers. In Kenya (Case 1), a 2013 survey conducted among 81 small-scale farmers in Kakamega district five years later, revealed that 84 percent of them were unaware of the availability of the service and as a result had never used it; officials from KSC were aware of the application but had to refer to brochures for information; and agricultural extension officers were aware of the service but were not conversant with the short codes and did not have brochures or materials to refer to. With the Zambian case (Case 8), headquarter staff who were supposed to respond to SMS questions from farmers also experienced difficulties in using ICTs.

It is also vital for ICT4Ag services to be well promoted but this was rarely budgeted for in most of the cases reported. Extension workers can play an important promotional role and training on this can be carried out at the same time as training on implementation of the ICT. Promotion can also be carried out through farmer organisations and by using radio advertisements, although these can be expensive. More imaginative approaches that can combine promotion and training include setting up stalls in rural centres on market days or having a stall at an agricultural fair. ■

CASE 8   SMS for agricultural extension

Country:	Zambia
Implementing parties:	National Agricultural Information Services (NAIS); International Institute for Communication and Development (IICD)
Type of service:	SMS
Project duration:	2011 – present
Source:	Tembo, Stephen and Jonathan Mwamba: *Challenges of scaling up the National Agriculture Information Service (NAIS) Short Messaging System (SMS) platform in Kasama district, Northern Province, Zambia.*

Taking advantage of the rapid rise in mobile phone use in Zambia, the National Agricultural Information Services (NAIS), a unit of the Ministry of Agriculture and Livestock developed a service that would allow farmers to keep in touch with subject-matter specialists. The SMS service had its origins in the Radio Farm Forum Groups, developed earlier by NAIS throughout the country. Farmers listened to radio programmes about agriculture, discussed the contents and sent comments and queries using paper forms to NAIS in Lusaka. However, the feedback often took a long time to reach the farmers. The pilot SMS service was seen as a way of speeding up the flow of information.

NAIS initially partnered with the International Institute for Communication and Development (IICD) and a local Zambian technology company SMSize (now called Chibanje Mobile) to develop a service to which farmers sent a question by SMS, allowing NAIS agricultural specialists to reply to the sender's phone in the same local language as the original request.

In the text, farmers were expected to put "NAIS, a language code, a space, and then the question", a system which proved difficult in an area with high levels of illiteracy. Training of farmers in its use was not carried out as NAIS staff meant to be doing the training had no resources for travelling to rural areas. A lack of awareness among farmers about the existence of the NAIS SMS-platform and its telephone number was also cited as one of the reasons why farmers were not using the NAIS platform. Farmers also found the cost of the texts too high.

To alleviate some of these problems, the Connect-for-Change (C4C) consortium of IICD together with its preferred technology supplier Text to Change (TTC) attempted to stabilise the technology and user-side of the service during late 2013 and 2014. However, organisational challenges such as responsiveness of the NAIS team to external stakeholders, shortage of IT skills and resource pressures within NAIS continued to influence the sustainability of the service. The NAIS interactive SMS service is still live in its current form with C4C support[10], but future viability post-donor support remains to be seen.

Resolving internal and external responsibilities in implementing the service

As with all development activities, good policies are central to successful ICT4Ag growth. There are many competing claims for limited government resources and policymakers therefore need to be kept fully informed of a service's success. Partnerships can be a major factor in a project's success but if too many people are involved it may become difficult to manage.

An enabling environment is vital for development. The explosion in mobile phone usage in ACP countries has come about, in large part, because governments have liberalised the telecommunications sector, thereby allowing private companies to compete to supply phones and networks that people find affordable. Despite these successes, governments should be aware that other regulations may constrain further growth of the ICT sector by, for example, inhibiting innovation or limiting network expansion. Regarding ICT4Ag, national and local governments, once they have endorsed a new project, need to provide consistent support to its implementation.

The explosion in mobile phone usage in ACP countries has come about, in large part, because governments have liberalised the telecommunications sector, thereby allowing private companies to compete to supply phones and networks that people find affordable

Resource constraints can be caused by a lack of senior management understanding or buy-in of the project. Unless kept regularly informed of project progress and, in particular, its positive impact, managers, both government and private, may see no need to support ongoing operational costs. The more they know about a good activity, the less likely they will be to pull the plug. Managers also need to be aware of the consequences of frequent staff rotations. This had major implications for one of the cases studied, where most people who had been trained were suddenly transferred to new jobs.

Some political and social systems do not seem conducive to development of new initiatives. Where leadership of local organisations is subject to political appointment, a lack of interest in successful implementation on the part of managers has been reported. An ICT project in Tanzania designed to help people report broken-down water pumps failed, in part, because of a cultural reluctance to criticise the authorities[11].

Several projects involved a wide range of stakeholders. This has both strengths and

weaknesses. It does enable the project to more easily call on a variety of skills and even supplementary funding. For example, the lack of knowledge about agriculture of most ICT specialists argues for management by a team with broad expertise. On the other hand, complicated management teams give no flexibility to make speedy changes, as discussed in Case 9 from Uganda.

The lesson is, perhaps, that partnerships should be entered into only when there are clear advantages from doing so. In rural areas, working closely with key community leaders can do much to improve a project's acceptability. ■

Regarding ICT4Ag, national and local governments, once they have endorsed a new project, need to provide consistent support to its implementation

Lisa Wanjiru makes a cash payment to M-Pesa agent Jane Njuguna in Nairobi, Kenya. M-Pesa is a Kenyan cellphone-based money transfer service.

CASE 9   Electronic Uganda National Innovations Systems (EUNAIS)

Country:	Uganda
Implementing parties:	Makere University; Commonwealth of Learning (COL); International Center for Tropical Agriculture (CIAT); United States Agency for International Development (USAID); University of Nairobi; University of Florida
Type of service:	Call centre
Project duration:	2009 – 2011
Source:	Ndagire, Alice: *Voice for the Voiceless Rural Farmer in Uganda.*

Electronic Uganda National Innovations Systems (EUNAIS) was developed in 2009 to increase the effectiveness of Uganda's National Agricultural Research System (NARS) by providing a linkage between smallholder farmers in rural areas of Western Uganda and technical experts able to provide advice on upgrading farmers' production skills. Farmers were also trained in developing their own content in their local language and managing their own website. EUNAIS also aimed to help farmers identify new market opportunities for their production. The plan was to use a variety of ICTs, particularly a call centre. Available data and field research had indicated that around two-thirds of farmers owned a mobile phone.

The system enabled farmers calling the centre to follow automated voice prompts to choose the language and then leave a message requesting information on any agricultural topic. They would then receive an answer from a relevant expert. Unfortunately, the EUNAIS system was used by relatively few farmers and, despite further promotion to try to rectify this, usage never reached cost-effective levels.

The low usage of the service was attributed in part to widespread illiteracy in rural areas, combined with farmers' hesitancy about using new technology for certain activities, despite having already embraced mobile phones. Farmers were particularly reluctant to use the service to attempt to sell products, preferring the traditional way of meeting buyers in local markets. Rapid response by EUNAIS to adapt to such problems was constrained by the large number of stakeholders involved in the project and the consequent difficulty in making quick decisions.

It became clear that the costs of EUNAIS were far too high. The project became dependent on several foreign donors who, in turn, were reluctant to offer further funding because there was no obvious government buy-in. This was in spite of encouraging increases in usage as the word spread among farmers. The multiplicity of donors also led to slow decision-making.

A billboard advertisement for Airtel, promoting its ability to send remittances via mobile phone, in Kampala, Uganda.

ICT4Ag developers need to keep policy makers and donors regularly informed to maintain support.

▶ Further reading

Addom, Benjamin, 2012: *Blogs on ICTs and Agriculture.*
https://benjaminkaddom.wordpress.com/

Barnett, Inka, 2012: *Failed ICT development projects: Sweeping it under the carpet and moving on?*
http://tinyurl.com/pa6ke68

Burrell, Jenna and Elisa Oreglia, 2014: *The Myth of Market Price Information: Mobile Phones and Epistemology in ICTD.*
http://tinyurl.com/qzhnys8

CTA, 2014: *ICTs for Agriculture – Making it happen.*
http://tinyurl.com/p254mzd

World Bank, 2012: *ICT in Agriculture Sourcebook.*
http://tinyurl.com/q4nxhg3

▶ Endnotes

1. Two case study proposals not funded by CTA noted the following as reasons for ICT projects: "….because the farmers are victims of the rule of the intermediary, who buys the product at a low price to sell more expensively…." and "…to reduce the selfish interest that middlemen exercise in the market with subversive tendencies like hoarding and undue price elevations."

2. See, for example, Burrell and Oreglia, 2014 with reference to the use of cell phones by Ugandan fishermen on Lake Victoria.

3. http://tinyurl.com/zpx9gmr

4. Groupe Speciale Mobile Association: Guidelines for Creating Agri VAS Content
    http://tinyurl.com/obtmn2a

5. Easy SMS, an innovative app to translate text into voice and pictures, which was announced in 2012 for smartphone use, does not appear to have been introduced commercially
    http://tinyurl.com/pylqzcz

6. Mark Davies, personal communication

7. http://tinyurl.com/obsbuop

8. http://tinyurl.com/q52dmto

9. Burrell and Oreglia, 2014

10. http://tinyurl.com/p4mpyue

11. Barnett, 2012

The Technical Centre for Agricultural and Rural Cooperation (CTA) is a joint international institution of the African, Caribbean and Pacific (ACP) Group of States and the European Union (EU). Its mission is to advance food and nutritional security, increase prosperity and encourage sound natural resource management in ACP countries. It provides access to information and knowledge, facilitates policy dialogue and strengthens the capacity of agricultural and rural development institutions and communities. CTA operates under the framework of the Cotonou Agreement and is funded by the EU.

For more information on CTA, visit www.cta.int

There should be no shame in experimenting and failing, especially with ICTs

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