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Innovative Farmer Advisory Services Using ICT

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Abstract: Over the past 10 years, there has been a remarkable progress in the use of ICT in African agriculture, especially in the area of farmers' access to market information. Various projects have been developed that integrate ICTs into the dissemination of agricultural information to farmers. Farmers Information Services at the national and regional level are a promising new field of research and application in the emerging field of e-agriculture. This paper discusses several innovative projects using ICTs to deliver information to farmers, focussing its analysis largely on mobile telephony, which has become more widespread recently as a means of disseminating agricultural information to farmers and offers various means of providing agricultural information in areas where internet infrastructure is limited and unreliable. It draws its findings from The Forum for Agricultural Research in Africa (FARA)'s *Inventory of Innovative Farmer Advisory Services using ICT*, that was compiled of all known innovative farmer advisory services or systems currently in design, in existence or recently completed in Africa.

The inventory (66 pages) is the result of an online consultation with the FARA Regional Agricultural Information & Learning System (RAILS) discussion group held during October 2008 and desk study. While not a lot of information was available for some of the projects found, the inventory reveals that many projects are of a pilot nature, implemented by international organizations, have been of short duration and often have not remained after the original donor funding has ceased. This has exposed the need to upscale projects, taking into account the individual context and information needs of farmers and thereby developing services with carefully integrated platforms, with the support not only of private companies and NGOs but investment from national governments as well.

Keywords:
ICT, e-agriculture, innovation, farmers, Africa

1. Introduction

There are no crosscutting initiatives to learn about this new mass technology—which is only adventitiously being incorporated into development projects—or to identify its transformative possibilities. Where is the necessary MOTForce—a Mobile Opportunities Task Force to match the earlier DOTForce—without which mobiles' contribution to development will be left to the market, to chance, or just plain left behind? - Richard Heeks, professor and chair of the Development Informatics Department at the University of Manchester, UK.

Agricultural informatics is a new concept that has arisen following the rapid development in ICT and the internet. Referred to as e-agriculture, agricultural informatics is an emerging field which combines the advances in agricultural informatics, agricultural development and

entrepreneurship to provide better agricultural services, enhanced technology dissemination, and information delivery through the advances in ICT and the internet. The e-Agriculture concept, however, goes beyond technology, to the integration of knowledge and culture, aimed at improving communication and learning processes among relevant actors in agriculture at different levels i.e. locally, regionally and globally.

Throughout Africa, ICTs have become increasingly integrated into information disseminated to farmers. For decades "traditional" forms of ICTs have become more prevalent in advisory service provision. Radio and TV programmes feature agricultural information. Rural telecentres provide information on education, agricultural and health issues and equip rural citizens with skills on how to use computers and provide basic literacy. National ministries of agriculture have attempted to integrate ICTs into the delivery of information and have established district information centres focusing on agriculture. Many NGOs and research organizations have also attempted to facilitate technology transfer in the agricultural sector.

Most farmers access information from extension workers, libraries or websites. The number of extension workers has been decreasing while farming numbers have been increasing, hence the need for innovative services to address this gap. The development of the National Farmers Information Service – NAFIS [*www.nafis.go.ke]*, a voice-based service was one such initiative. Most other initiatives are web-based such as INFONET [*www.infonet-biovision.org*], a web-based service promoting organic farming which is supplemented by *The Organic Farmer* publication. Seeking information from these and other platforms becomes an onerous task for the farmers as it entails ploughing through many publications or surfing a large number of web-pages. Furthermore, for the illiterate farmer this becomes impossible right from the onset. Web-based solutions also bring challenges because internet infrastructure in Africa is still very sparse. Nevertheless, these are very useful resources and all that is needed is to provide an easy way for the farmers to navigate them.

With the widespread use of mobile phones, voice and SMS solutions should find more use as they offer easy accessibility. They also face some challenges: the SMS carries only a limited amount of information and requires a basic level of literacy. Voice-based solutions are complicated to develop as they require machines to produce natural speech, or good speech synthesis. They also do not offer detailed information such as pictorial illustrations as in web solutions. Nonetheless, the voice solution is still by far the most promising platform for the farmer as it can be customised for language, is readily accessible and very natural, as it entails using the mobile phone through direct responses to specific questions.

2. Objectives

This article draws upon FARA's *Inventory of Farmer Advisory Services using ICT* to discuss and analyze innovative farmer advisory services and its potential for providing agricultural information to African farmers. The inventory is a compilation of all known innovative farmer advisory services or systems currently in design, in existence or recently completed in Africa.

This paper does not aim to analyze the effectiveness of each project in the inventory as information on projects is often difficult to attain, particularly if they are implemented by local NGOs, lacking the resources of large international institutions. Much of the information contained in the inventory came from the implementing organisations themselves and critical reviews of the projects often have not been taken or the information is not readily available. A case by case review of each project is, therefore, not the objective of this work. Rather, it serves to provide an overview of the types of services and projects that are in existence or being designed to disseminate information to African farmers in new ways and discusses the

perceived benefits and short-comings of each type of project and analyze the barriers to upscaling existing initiatives. While internet projects have been in existence for a lot longer, mobile telephony has emerged as one of the most innovative ways in which information is being delivered to farmers, and has therefore received more attention in our inventory.

3. Methodology

This inventory is limited to documenting innovative farmer information services. It is focused on projects/services that provide agricultural training and information to farmers directly, through the use of ICTs, rather than documenting services that facilitate exchange of information among researchers and policymakers. It also does not include the many research initiatives that exist to study the possible application of ICTs to agriculture or organizations or projects that focus exclusively on the development of linkages with input agencies, credit organizations and markets through the use of ICTs.

Entries include projects using ICT solutions or implementing ICT-based activities, institutions/groups providing services using ICTs as well as ICT solutions software providers, both at the national and regional level. While many entries are projects with a definitive beginning and end date, others are national or regional information systems providing many agricultural services using ICTs. Some projects are therefore more difficult to categorize but for the purposes of this research the projects have been divided into four categories:

3.1 Voice Information Delivery Services

This includes a telephone-based information delivery service that provides advice on farming methods and market access to improve the lives of rural farming communities. Answers to many of these problems may well be on the internet – but with connectivity, literacy and language barriers, this is way beyond the reach of the vast majority of farmers. Some use call-in centres for agricultural extension support. More complex voice technology uses a simple telephone – community fixed phone or mobile – as the medium of information exchange while sophisticated communication technology and computing applications have been configured at the back-end platform for the provision of the requisite information service. The solution is comprised of a unified messaging platform incorporating Interactive Voice Response (IVR) functionality, integrated with a Customer Relationship Management application to support integrated call handling and management of a very large audio database.

3.2 Radio: Dial-up (Agricultural Information on Demand) and Regular Radio Broadcasts

This includes regular radio broadcasts providing market prices or other agricultural information and dial-up radio that feature a series of short segment audio programs that provide farmers with phone access to relevant information through an automated voice system. This radio system is an information hub featuring a regularly updated, diverse menu of pre-recorded agricultural content. For this inventory we have only kept those projects we consider innovative – such as allowing farmers to ask questions through SMS, or broadcasting information gathered through question and answer vouchers or other innovative means.

3.3 Extension Services Based on Mobile Phone and Database Monitoring

This is a media channel that allows anyone to affordably share market information via mobiles or the internet. By tracking activities and profiles, the service becomes a crucial profiling and

business monitoring tool, and advertising medium. By focussing on profiling, this service can minimize risk in transactions, offer some brokerage services, and provide a revenue stream by permitting advertising and data mining. To date, most licensees have been donor projects.

3.4 e-Learning for Basic Skills, Agricultural Education and Video-Based Approaches

This category covers the provision of information and learning material for agricultural skills. The specific video-based approach has several important advantages to traditional forms of agricultural content, which are typically not in the local language, are intended for a literate audience, use expert terminology, lack grassroots level practicalities, and remain inaccessible in a sea of scattered media. The inventory contains 60 entries and lists [4] projects under category 1; [5] projects under category 2; [16] projects under category 3; and [35] projects under category 4. The countries which are represented are Benin [1]; Burkina Faso [3]; Cameroon [1]; Egypt [1]; Ethiopia [2]; Ghana [6]; Kenya [9]; Malawi [1]; Mali [5]; Niger [1]; Nigeria [1]; Senegal [2]; South Africa [1]; Tanzania [7]; Uganda [9]; Zambia [4]; Zimbabwe [1] and projects operating in more than 3 countries [10].

To identify innovative Farmer Advisory Services using ICT we fine-tuned the conceptual understanding of the social impact of those services and their possible economic impact. The resulting inventory indicates that the majority of the initiatives around rural ICT and the use of mobile telephony in agriculture need a specific capacity to use information and highlights the challenges to upscale those initiatives.

4. Developments

4.1 Measuring the Social Impact

Monitoring the impact of rural mobile telephony in the agricultural sector requires a better understanding of the farmers' context for the adoption and adaptation of an innovative information tool. There are many initiatives on ICTs and small-scale farmers in Africa. However, these tend to be un-coordinated, and information on the different initiatives is not easily accessible, let alone information on their impacts.

The nature of mobile technology development for farmers itself is highly contentious and requires careful research and development to make it 'right,' especially when it comes to livelihoods improvement and poverty reduction in Sub-Sahara Africa. Although it is recognized that the uptake of promising information technologies like rural telephony can be influenced greatly by the availability and/or functioning of input supply, credit systems, land-tenure arrangements, organization of marketing, distribution of benefits, etc., such social-organizational phenomena have mostly been considered as conditions that hamper or enhance adaptation of rural telephony.

When trying to measure the impact of rural telephony the question is thus not just to seek to develop an appropriate information dissemination technology but also to alter the boundaries and conditions that affect the space for change. Resource poor farmers in high risk and diverse, rain-fed environments face very small windows of opportunity for innovation. The mobile phone projects as listed in the FARA inventory often create special conditions to enable and stimulate farmers to utilize the recommended technologies (f.i. Questions and Answer Services – QAS based on text messages). Such special conditions might include access to subsidized inputs, guaranteed marketing of the surplus generated, the creation of special credit schemes, the availability of highly qualified staff or in the case of QAS, accurate and timely information.

But, equally invariably, such projects leave few traces after the special conditions have been withdrawn. Replicability of the development gains is a key issue. The best guarantee for such replicability is to ensure that new communication technologies work within the prevailing physical, socio-economic, cultural and institutional conditions and, if necessary, to stretch those conditions. This approach requires special procedures to adopt a new communication tool on the basis of decision-making that is informed by an understanding of the farmers' context.

A good example is the adoption of mobile phone conferencing. Mary Nyakira of BROSDI/CELAC Uganda explained during the MobileActive 2008 conference how the mobile phone conferencing works and how farmers are enjoying it. It not only contributes to a particular form of democracy and transparency but farmers like having group discussions around a mobile phone with the loudspeaker facility on. The extension worker is "beeped" when the group of farmers is ready to start training. Discussions follow up on a previous field visit, with the extension worker giving advice from out of their office. Taking into account the considerable distances and the fact that extension workers can not afford to visit a particular group of farmers on a weekly basis, mobile phone conferencing is having a tremendous impact.

The majority of farmers are not that well organized, they have no political clout and cannot exert effective demand on agricultural information services. Despite the number of Market Information Prices Services using mobile phone for price information dissemination, the market price information often remains not freely available so that prices are set locally and rather arbitrarily given the actual relative scarcity. More often than not, market prices are determined by the vagaries of weather, transport, monopolistic traders, and so forth.

Rural telephony technologies can only work if they fit within the small windows of opportunities that African small-scale family farmers face. If the farmer is using a specific service for the first time, often due to curiosity, next time s/he will not subscribe to it if the service offered is not valuable.

4.2 Measuring the Economic Impact

The principal challenge confronting governments and the international development community is to ensure that smallholder farmers benefit from commercialization in agriculture by participating in the market. Increased commercialization shifts farm households away from traditional self-sufficiency goals and toward profit and income-oriented decision-making.

Interventions aimed at reducing transaction costs would encourage increased farmer participation in competitive markets to meet the broader poverty reduction objectives. In economic terms, the role of agricultural informatics is to reduce the information search costs in the agriculture value chain and to link the decision to grow with that of to sell. The final objective is reducing total transaction costs to increase the incentives for smallholder farmers to participate in commercial agriculture as opposed to being stuck in subsistence farming.

The absence of effective marketing chains plagues Africa. It affects the possible impact information and the use of mobile phones can have. A marketing chain can be seen as a multi-stakeholder network that is highly integrated and shares a common perspective or goal: to deliver a product as cheaply and efficiently as possible to the consumer. Increasing the efficiency of the whole chain – the purpose of providing agricultural information – is in the interest of all stakeholders, whether they are farmers, processors, transporters, retailers or others. Threat of competition leads chain partners to be highly aware of the 'competitive position' of their chain vis-à-vis others. This awareness leads to 'chain thinking'. Creating such 'chain awareness' is a big challenge in Africa. Three examples suffice:

- In Benin, a large number of unproductive people 'eat' from the export earnings of the cotton produced by small farmers. Benin refuses to sell effective but cheaper pesticides that are available and that could reduce farmers' pesticide costs substantially, simply because that would cut the salesmen's profit.
- In Ghana, the Cocoa Marketing Board is directly involved in pesticide production. They have so far not cooperated in the certification of organic cocoa which would undermine the rationale for mass spraying of synthetic chemicals.
- A woman farmer in Uganda refused to tell the other farmers what she learned at a cheese making workshop in Italy (!). The extension worker found the information on the internet and gave some technical cheese-making training with mobile phone conferencing follow up. The 'chain awareness': "Only large quantities of cheese justify a truck of cheese to Kampala" made the woman join the rest of the group.

5. Results

In the absence of detailed information on many projects, it is difficult to evaluate the impact of each project and determine its success or failure. Little is known about who are benefitting from the projects, how much farmers perceive their income has risen through the services, the accessibility of the services and the reliability and regularity of the agricultural information. The inventory indicates that most projects have an unknown number of users (see Table 1).

Table 1: Number of Users

Number of users per project	Number of projects
1-1000	6
1000-10 000	2
10 000-100 000	6
100 000-1 000 000	1
1 000 000+	3
Unknown	35

To make an assessment on what types of projects are in existence, who and how many people they are reaching, and the sustainability of the projects it is necessary to look at how many projects have been implemented by or in collaboration with foreign organizations or institutions, the average duration of each project, how many projects are or were only in the pilot phase of implementation, in which areas/regions/countries the projects are concentrated and whether the services have been provided in local languages or solely in English or French.

The figures in Table 2 demonstrate that the majority of projects were funded or implemented by, or in partnership with international organizations with local or national NGOs, private companies, or government agencies also playing a large part in many projects.

Table 2: Project Implementers/Partners

Type of organization	Project Implementer/Owner	Project Partner/Funder
International Organization	11	39
Local/National NGO	25	6
Government Department/Agency	9	6
National Agricultural Research Centre	4	3
Private Company	3	10

The numbers reveal that, of the 60 projects contained in the inventory, about half the projects (26) are or were in the pilot phase of implementation (with the status of 5 projects

unknown) and well more than half have been in existence for less than 6 years, revealing that not many projects are firmly established (see Figure 1).

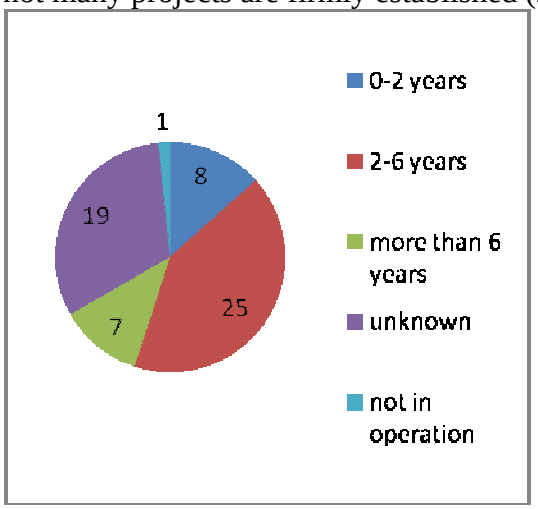

Figure 1: Duration of Project

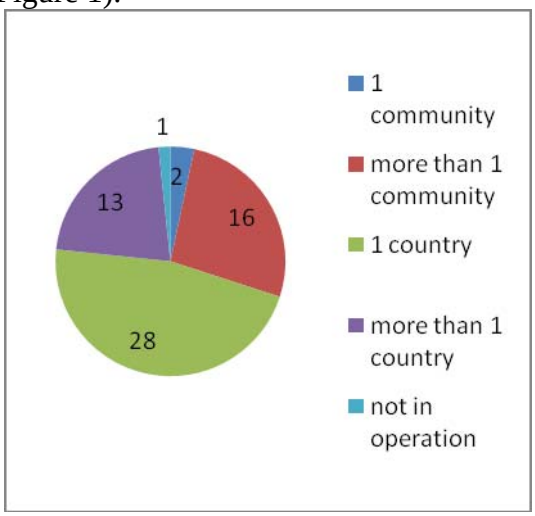

Figure 2: Scale of Project

Almost two thirds have been carried out either nationwide or provide services in various countries (see Figure 2). Information is largely not available, however, about the ability of these services to reach remote, rural locations and the numbers of users of each service and the language in which the information is being delivered.

While some projects have developed that use a variety of services and ICTs to deliver farmer information and are using mobile phone technology at an increasing rate, most innovative farmer advisory services rely exclusively on the internet to provide online training or transmit agricultural information.

Table 3: Technology Used

Technology Used	Number of Projects
Internet	47
Radio	17
Television	2
CD-Rom/video/DVD	6
Mobile phone	22
IVR	4
SMS	16
Telephone (call-in)	4
Dial-Up Radio	1
GIS	1

The many initiatives that provide farmers with information are largely institutional-based, product specific and platform specific. Information is provided by different organisations, each offering a specific product, for example for banana growers, on a given platform, has only web-access and often is in the English language. Coupled with these challenges, the African farmer is faced with poor infrastructure, low literacy and limited language use. Such a model of information delivery has proved to be largely ineffective. A comprehensive model is needed to address the limitations of existing methods, by offering a holistic, one-stop-shop information service on a variety of carefully integrated platforms. Furthermore, a model is needed that implements farmers' feedback, a resource that is used to further enhance information delivery.

5.1 The Capacity to Use Information

The inventory demonstrates how most initiatives around rural ICT and use of mobile telephony in agriculture is donor (or at least external) driven. As long as these initiatives are considered as pilot or submitted to a "proof of concept" inception phase, their impact is limited. The upscale of these initiatives will create new challenges. The more farmers are targeted, the more the content will be questioned by the research community and other stakeholders in the field of agriculture. Every agricultural information provider will want to have its content set the standard for a national service. But different roles can be played by different actors.

Providing weather forecasts on a daily basis is information. Generic data is generated elsewhere and given to the rural community through radio, television, newspaper, rural telecentres, and mobile phone alerts. The rural community does not get involved in the generation, validation, evaluation, understanding and appreciation of this information. In such a "take it or leave it approach", the rural community remains a mere passive observer.

The horizontal transfer of knowledge has a blended learning process. Learning by doing, learning through participatory research, evaluation and knowledge management, CD and intranet-based learning, face-to-face interactions, etc. play a crucial role in capacity building.

There will never be one fit for all system. Different platforms are needed depending on the content, the level of literacy, and the specific information needs.

- The basic information needs for farmers are market information prices, weather forecasts, transport facilities and information on storage facilities. This first type of data is, although vital and of concern to the farmer, quickly outdated and changes constantly.
- The second level of information needed is about crop and cattle diseases, fertilizers, etc. The inventory indicates that several such information services have been developed to provide information in a standard way i.e. question and answers services. The most attractive forms of Q&A service are probably those services which are audio or voice-based because they overcome the limitations of text-based platforms. In some cases, audio files are made accessible to farmers through the use of mobile phones (Kenya, Uganda and Zimbabwe). But these initiatives have just started (NAFIS, Kenya) or have yet to begin (Kubatana, Zimbabwe). The CELAC/BROSDI project of Uganda includes information and innovative techniques directly generated by the farmers themselves.
- The third level is more context and local specific and requires the direct interface between the extension worker and the farmer.

The evolution of an active utilizer constituency is the basic premise for a strong extension framework. The core of extension is in helping people make better choices through the supply of information and in enhancement of people's capacities to process such information and act on it, thereby reducing the transaction costs involved in pursing livelihood options.

5.2 Challenges to Upscaling

The development of active utilizer constituency and horizontal transfer of knowledge have become crucial particularly when viewed in the context of declining resources in formal governmental extension agencies, increasing demand from the rural sectors and new challenges like climate adaptation, bio-technology and farmer innovation techniques.

Formal extension would become fruitful if it becomes a facilitating process for active utilizer constituency and community knowledge management, rather than if it attempts direct interventions and implementations. Such a framework requires a capacity building process among the officials of the formal extension system in innovative farmer information systems,

building the structures, shaping the functions and refining the process through mobilization, organization, technology incubation and systems management.

Innovative information initiatives invite farmers to use and share their traditional knowledge using modern ICT. Rural community and scientists have come together for weather forecasting, blending frontier science and traditional knowledge which influence the decision-making process. When plenty of farmers are reached by a particular farmer information provider the service may become controversial if no consensus was reached prior to the upscale about the content with a large community of agricultural and rural actors.

A second challenge for the upscale of (the presently mainly pilot) ICT and mobile phone projects will be the necessary alliance with a mobile phone company. Several mobile phone providers compete for this "last frontier market". Also, politicians challenge the major mobile phone providers: "Your competitor reaches the rural population with mobile credit services, how do you intend to service the farmers?"

A third challenge is to make sure the information platforms are inter-operational. In an upscale each of the platforms on which farmers' information is delivered has various advantages and limitations, and is often an inadequate solution when used on its own. It is observed here that to provide an effective solution many platforms need to be carefully integrated in such a way as to harness the benefits of individual platforms while avoiding their limitations. In other words, an effective solution must contain all these individual platforms organised carefully so that each falls in its place to fulfill a set objective. The solution then becomes an information matrix whose elements are the individual platforms and whose composition is done on the basis of the set objectives. For the farmers' information service the elements of the information matrix include the following: (a) SMS (text) Platform; (b) Voice platform; (c) Web-portal; (d) Call centre; (e) Extension workers; (f) Libraries; (g) Researchers.

A last challenge is that it is typically difficult to attract the private sector to invest in such ventures in Africa because these entrepreneurs are primarily risk averse and therefore lack the incentives to continue to invest in an unprofitable project, thereby ensuring that projects are often of short duration. This is where the public sector and NGOs can play a huge role by fast tracking these private enterprise initiatives and partnering with local business so that the solution can be sustainable after the time frame of any given project.

6. Business Benefits

If innovative farmer information systems respond to specific farmers' requirements and benefit farmers, mobile providers, researchers and input/market providers alike, there is a better chance for increased sustainability. For instance, when the back-end of the farmer information system contains a call centre, the farmer information system can implement farmers' feedback to be used for localization and respond to specific farmers' requirements such as language and specific products. The SMS platform can be used for alerts, targeted to provide farmers with specific information, thereby creating demand.

When farmers call, they are automatically connected to an IVR (Interactive Voice Recording) which will prompt them to get critical information in either English or their indigenous language. If they are satisfied, they will hang up at this point. If the farmers require further information they can be either referred to a manned call centre, to a website, or to extension workers. In cases where the farmers may wish to get information in their local languages they can automatically be referred to the manned call centre. The call centre can also in some cases refer farmers to the website or to extension officers for further information. The content to be used by the system can be harnessed from libraries and research institutions.

The IVR, the manned call centre and the website can monitor farmers' questions, locations and preferences, then feed this information into the feedback analysis centre. The feedback can pinpoint the required information for various locations and also the language preferences. This feedback can be fed into research institutes for further improvement of the content. It can also be useful as input for advertisers and for farmers education that can be undertaken through sending bulk SMS on topical issues.

Such innovative farmer information systems benefit farmers, mobile providers, researchers and input/market providers, among others. The farmers can have a comprehensive solution from which they can get critical information in the language of their preference. The telecom provider is able to penetrate the rural areas as the bulk of the population is a farming population who can be attracted to a network so as to access the information resource. Researchers have massive data from hundreds of thousands of farmers using the feedback resource. Input and market providers can advertise their products: fertilisers, market bids etc, through a carefully targeting system based on feedback information. Such advertisement guarantees the system's sustainability.

7. Conclusions

It is important to realize that farmers and agricultural labourers should not be treated as mere consumers of generic information. The agricultural sector requires a well-organized learning community in the form of farmers' associations, cooperatives, women's groups, etc.

Innovative farmer information systems are a blended learning process in which face-to-face interaction, learning by doing, learning through evaluation and experience, participatory research, etc. convert the generic information into location specific knowledge and then empower its members through horizontal transfer of knowledge. It should enhance the self-directed learning among the rural community.

There will never be a 'one fit for all' system. But the inventory suggests that systems which use a voice-platform or audio files provide an innovative and promising entry point to farmer information while the other platforms (SMS and web-based platforms) remain essential to provide a back-end offering more detailed information.

The inventory entries indicate many projects are still in the pilot phase and are, or have been of short duration, typically implemented by international organizations, thereby revealing the need to critically review upscaling scenarios and move from pilot to mainstream. In order to move from the implementation of small, pilot projects created in isolation from one another, private companies and governments need to form partnerships to ensure that the service will not be just another pilot project that ends after donor funding ceases.

The absence of comprehensive information suggests that projects need to be more carefully documented, information on the projects needs to be more readily available and project evaluations need to be shared or projects will continue to be implemented in isolation from one another, often repeating the same mistakes that led to the collapse of similar initiatives.

In order to answer the question 'How can we monitor the impact?' we need to look into the broader innovation opportunities of farmers. To monitor the impact of the tool we need to look into: the most effective ways of reaching farmers with timely agricultural information and knowledge (indigenous and external); mechanisms for harnessing the potential of FM radio stations and digital telephony as technologies for communicating agricultural information; options for repackaging agricultural information and knowledge for small scale farmers; and the potential role of an e-repository (of local agricultural content) in Africa for purposes of disseminating local agricultural content.

References

J. Aker. "'Can You Hear Me Now?' How Cell Phones are Transforming Markets in Sub-Saharan Africa." *Center for Global Development*, October 27, 2008, www.cgdev.org/content/publications/detail/894409/.

D. W. Allen and M. Anderson Ochs. "Building Pathways out of Rural Poverty through Investments in Agricultural Information Systems." WorldAgroInfo Design Team Final Report. February 2008. www.worldaginfo.org/files/WorldAgInfo%20Final%20Report%20Web.pdf.

K. Balasubramanian and P. Thamizoli. "Social differentiation in the horizontal transfer of knowledge: A case study from South India." *The Journal of Agricultural Education and Extension.* 2003, 9(2): 51-60.

K. Balasubramanian. "Knowledge Management by the Community: A Paradigm Shift in Extension." Experiences from a Project of M.S. Swaninathan Research Foundation and Commonwealth Learning. 2008.

S. Bartlett. "Making the Marketplace Mobile: A Ghanaian software company helps farmers get a fairer deal for their crops.". CTA. *ICT Update.* Issue 44, August 2008, http://ictupdate.cta.int/en/Feature-Articles/Making-the-marketplace-mobile

M. Davies. "How New Technology can Strengthen Rural Markets" *IFAD.* www.ifad.org/events/lectures/tradenet/index.htm

H. de Silva and D. Ratnadiwakara. "Using ICT to Reduce Transaction Costs in Agriculture through Better Communication: A case-study from Sri Lanka." LIRNEasia, Colombo Sri Lanka. Research carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada, 2008, www.lirneasia.net.

M. Gakuru and R. Tucker. "Sustainability of Research and Development: A Case of Successful Technology Transfer in Spoken Language Technology." HCI 2008 position paper.

M. Gakuru, K. Winters, F. Stepman "An inventory of Innovative Farmer Advisory Services" *Forum for Agricultural Research in Africa*, December 29th 2008, 66 pages www.fara-africa.org/media/uploads/File/NSF2/RAILS/Innovative_Farmer_Advisory_Systems.pdf

I. Howard. "Rural Communication: Is there still a need for telecentres now that there are mobile phones?" *APC News.* Oct 27, 2008, www.apc.org/en/news/wireless/all/rural-communication-there-still-need-telecentres-n.

H. Hambly Odame. "Communicating Agricultural Research in Africa: The New Role of Rural Radio." *Communication Innovation*, June 27, 2007. www.comminit.com/en/node/223240/306.

R. Heeks. "ICT4D2.0." *Computer*, June 2008, 41(6), http://lirne.net/2008/07/ict4d-2/.

R. Heeks. "ICT4D and failure." University of Manchester, Institute for Development and Management, Working Paper Series: Paper No. 11, January 2002, www.sed.manchester.ac.uk/idpm/research/publications/wp/di/di_wp11.htm.

"Increasing Women Farmers' Access to Information in Rural Uganda." *ID21 Rural Development*. www.id21.org/rural/r3ek1g1.html.

H. Munyua. "ICTs and Small-scale Agriculture in Africa: A Scoping Study." IDRC, May 2007, www.idrc.ca/uploads/user-S/12212542261Final_Report_HMunya.pdf.

R. Tucker and M. Gakuru. "Experience with Developing and Deploying an Agriculture Extension System using Spoken Language Technology in Kenya." Spoken Language Technology Workshop, 2008. SLT 2008. IEEE. December 2008.