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The Relevance of Content in ICT Initiatives in Indian Agriculture

Claire J. Glendenning

Pier Paolo Ficarelli

Eastern and Southern Africa Regional Office

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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AUTHORS

Claire J. Glendenning, International Food Policy Research Institute
Post Doctoral Fellow, Eastern and Southern Africa Regional Office
C.Glendenning@cgiar.org

Pier Paolo Ficarelli, International Livestock Research Institute
Knowledge Management Specialist, Knowledge Management and Information System Unit
P.Ficarelli@cgiar.org

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ABSTRACT

In the past decade, many information and communication technology (ICT) projects in Indian agriculture have emerged, either substituting or supporting extension services by providing farmers with access to agricultural information. ICTs have the potential to reach many farmers with timely and accessible content. But the content that the ICTs deliver has more relevance if it is localized and context specific, as this improves the value and actionability of the information, which can have important impacts on farm management. The localization of content is influenced by how the ICT projects access, assess, apply, and deliver content. This paper examines the content development and management processes occurring in six well-known ICT projects in Indian agriculture. There are important lessons to be learned from a case study of this process. Content management and development through ICTs is important to examine because public extension services may be able to increase their efficiency and effectiveness by using these tools to support their work with farmers. Though there are differences in scale and mechanisms of delivery and feedback, all of the case study projects use a network of experts in relevant fields to provide content, though the extent of localization varies. Despite the best efforts of these and many other e-agriculture initiatives in India, there is no easy way for their collective knowledge to be tapped, tracked, and put to use across the different platforms. In fact, there is a critical missing link to bridge the gaps between local or parochial access and serving public needs. To mainstream such ICT efforts and knowledge management in agriculture for rural livelihoods, it is necessary to put in place a centralized search engine, or harvester, to access the decentralized and dispersed digital agricultural information repositories and network of experts.

Keywords: information and communication technology, agricultural extension and advisory services, content management

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ABBREVIATIONS AND ACRONYMS

aAqua	almost all questions answered
CABI	Commonwealth Agricultural Bureau International
CRP	community resource person
CSP	community service person
FAQ	frequently asked questions
ICAR	Indian Council of Agricultural Research
ICRISAT	International Centre for Research in Semi-Arid Tropics
ICT	information and communication technology
IFFCO	Indian Farmers Fertilizer Co-operative Limited
IKSL	IFFCO Kisan Sanchar Limited
IMD	Indian Meteorological Department
IMRB	Indian Market Research Bureau
IVRS	interactive voice response system
KVK	Krishi Vigyan Kendra, district farm science center
MSSRF	M. S. Swaminathan Research Foundation
NGO	nongovernmental organization
NSSO	National Sample Survey Organization
PRA	participatory rural appraisal
Q&A	question and answer
RML	Reuters Market Light
SMS	short messaging service
SOP	standard operating procedure

1. INTRODUCTION

The generation and application of agricultural knowledge is increasingly important, especially for small and marginal farmers, who need relevant information in order to improve, sustain, and diversify their farm enterprises. Agriculture can require substantial knowledge transfer to and among farmers, including information about successful farming practices, new technologies or controls of pest and disease outbreaks, and new markets. In India, information and communication technology (ICT) projects that support such information flows are rapidly growing, with many initiatives in operation today. ICTs can directly support farmers' access to timely and relevant information, as well as empower the creation and sharing of knowledge of the farming community itself. The processes that ICT projects use to source and deliver content are important to examine, because public, private, and nongovernmental organization (NGO) extension services may be able to increase their effectiveness by using these tools.

ICTs in agriculture have the potential to facilitate greater access to information that drive or support knowledge sharing. ICTs essentially facilitate the creation, management, storage, retrieval, and dissemination of any relevant data, knowledge, and information that may have been already been processed and adapted (Batchelor 2002; Chapman and Slaymaker 2002; Rao 2007; Heeks 2002). In the past, television and radio were the main electronic broadcast technologies used to reach rural communities; however, in the past two decades, Internet- and mobile-based channels have emerged. ICTs now include computer-based applications and such communication tools as social media, digital information repositories (online or offline), and digital photography and video, as well as mobile phones (Balaji, Meera, and Dixit 2007). However, in agriculture, despite the rapid spread and potential of ICTs to facilitate farmers' access to information, many of the initiatives face common challenges, such as issues of sustainability, affordability, ease of use, accessibility, scalability, and availability of relevant and localized content in an appropriate language (Keniston 2002; Dossani, Misra, and Jhaveri 2005; Saravanan 2010).

The way in which ICT projects access, assess, apply, and deliver content may increase the likelihood of ICT use by farmers and thus may become an important factor in a project's success. To address the information needs of farmers, relevant content is a key component of ICT projects. The extent to which content is customized and localized to a farmer's condition influences its relevance. *Local content* has been defined as content that is intended for a specific local audience, as defined by geographic location, culture, or language or as content that is socially, culturally, economically, and politically relevant to a given society (Ballantyne 2002). Thus, local content is the expression of a community's knowledge. Local content includes external or global content that has been transformed, adapted, and assimilated into a knowledge base. Yet ICT projects may not always be relevant to local context and needs, because of a disconnect between the project and its end users (Ballantyne 2002). Too often, projects push content to people and pay insufficient attention to the pull, or demand side—that is, what do farming communities really need and want?

As Colle and Roman (2002) identified, many questions need to be considered when examining and localizing the content delivered by ICT projects. By using case studies of ICT projects in Indian agriculture that cover a range of delivery mechanisms, this paper aims to address some of the following questions: What type of content is available? What is relevant content? What mechanisms are used to localize content, and are these mechanisms based on users' needs and demands? What constrains localization of content? What conditions encourage the creation of local content?

This paper analyzes how six case studies of ICT initiatives in agriculture in India handle content management and delivery processes. These case studies were chosen because their focus is on agriculture and on directly addressing farmers. In addition, they have been highlighted as innovative approaches by the media and in expert circles (Srivinasan 2010b). The case studies include Reuters Market Light (RML), IFFCO (Indian Farmers Fertilizer Co-operative Limited) Kisan Sanchar Limited (IKSL), Lifelines, Digital Green, e-Sagu, and aAqua (Almost All Questions Answered). Although RML, IKSL, and Lifelines all use mobile phones to deliver information, they differ in the services they provide. RML is a private, mobile-based service that sends short-message service messages about market prices, weather, and other agroadvisory information to subscribed farmers' phones. IKSL is a value-added service of the cellular service provider Airtel, in partnership with IFFCO that delivers voice messages with some information similar to that sent by RML, but that also operates as a help line. The Lifelines platform is a donor-funded project based on a question and answer (Q&A) interactive voice-response system. aAqua is a start-up company of the Indian Institute of Technology Bombay that works through a Q&A service, but on an open online forum. Digital Green is a nonprofit organization that works through a video-based platform that supports the existing extension services of its NGO partners. The e-Sagu platform, a Media Lab Asia project, requires that local staff take digital photos of farmer fields; these photos are then sent to experts who, in turn, provide the necessary advice.

The structure of this paper is as follows: Section 2 gives a background to examining content in ICT initiatives. Section 3 describes the conceptual framework to analyze the content management and development cycle of ICT projects. In Section 4, the case studies are presented. Section 5 discusses each case study's approach to content management and development. Section 6 concludes the paper with some final remarks.

2. BACKGROUND

Disseminating Agricultural Information

Aside from informal sources like farmers, friends, and private input dealers, the public-sector agricultural extension has been the traditional formal channel by which farmers have gained access to information related to their farming activities. Communicating information to farmers is one of the key roles that agricultural extension is expected to fulfill. Currently in India, the public-sector extension system is seen by the Government of India as the main way to bridge the yield gap that exists between agricultural research outputs and farmer fields (Government of India 2007). However, from the National Sample Survey Organization (NSSO) 2003 survey, India’s public-sector extension system accounts for only a small percentage of farmers’ information sources. In addition, according to this survey, 60 percent of farmers did not access any source of information on modern technology that year (NSSO 2005), with farmer-to-farmer informal exchanges remaining the main channel for accessing agricultural information and new technologies in India. Of those farmers who had accessed information through extension services, one of the major problems identified was the content and relevance of the advice (NSSO 2005).

As the agriculture scenario has become more complex, farmers’ access to a reliable, timely, and relevant information source has become increasingly important. Farmers require access to more varied, multisource, and context-specific information, related not only to best practices and technologies for crop production and weather but also to information about postharvest aspects, including processing, marketing, storage, and handling (van den Ban 1998). Thus, generalized content might not help farmers in different regions, which have their own crops, times, and agroecological specificities. Information that is context specific rather than generic could have important impacts on the adoption of technologies and could increase farm productivity for marginal and small agricultural landholders (Samaddar 2006). Yet, context-specific information is more resource intensive, requiring more information at the farm level, which varies spatially and temporally and with different degrees of specificity (Garforth et al. 2003). An added difficulty is that digitally available public information related to agriculture is generally poor in quantity and generic in quality (Balaji 2009). Despite the potential cost and time associated with generating localized content, access to locally contextualized quality content is more relevant for the poor and more useful to their information needs (Cecchini and Scott 2003; UNDP 2001). Reliable, easily available, quality content that is relevant for farmers’ decisionmaking could also reduce information-seeking and learning costs (Llewellyn 2007).

Therefore, content and delivery mechanisms need to be developed with the target range of farmer characteristics in mind, such as the sociodemographic profile, gender, landholding size, or agroclimatic zone of the user groups (Rivera 1996). A number of factors and attributes of farmers influence information-seeking behaviors, access to information sources and channels, and learning costs. For example, Alvarez and Nuthall (2006) found that in New Zealand and Uruguay, the personality, education, skills, and learning style of dairy farmers were associated with farmers’ use of computerized information systems. In Australia, Llewellyn (2007) found that information acquisition and learning could be explained by farm size, the ability of the farmer to make use of information, and available access to a more localized content source. In Llewellyn (2007), farmers valued information that had been adapted to the local conditions, because this meant less information processing. In India, Ali and Kumar (2011) found significant differences in decision-making among farmers according to their social groupings, income levels, and farm size; those farmers who were not from lower castes and who had larger farm size and income had better decisionmaking and information use capacity for their farms. The Indian NSSO 2003 survey showed that small and marginal farmers accessed less information and from fewer sources than did medium- and large-scale farmers (Adhiguru, Birthal, and Ganesh Kumar 2009). All of these studies illustrate the need to understand the different target groups within rural communities, so that content can be better targeted.

The important questions are: What information does different types of farmers need, and when is that information needed? (Garforth et al. 2003; Narula and Nainwal 2010). The answers can be determined through surveys, participatory rural appraisals(PRA), and focus group discussions, as well as by involving users in the monitoring and evaluation of programs (Colle and Roman 2002; Cecchini and Scott 2003; Meera, Jhamtani, and Rao 2004). However, not all information has to be generated through community demands. For example, information about environmental issues, climate change, and food and nutrition could initially be provided to farmers to start creating awareness or as an entry point to discussing these issues. In addition, encouraging diversification of enterprises—for example, encouraging women to rear goats (Balasubramanian et al. 2010)—will first require information for awareness creation and training purposes. The type of information provided by an ICT project will also depend on each project's motives. For example, private-sector initiatives will provide information that has higher excludability and rivalry and, thus, that is of a more private nature. Public or civil society initiatives, on the other hand, tend to provide information that has lower excludability, because they mainly address issues of public or common good.

Content in ICT Initiatives

All that any knowledge-centric ICT platform does is essentially handle and present data and information. Any relevant agricultural information, which is either enabled or driven by ICTs and which farmers can apply to their farms or which can help farmers make informed decisions about their farming enterprise, could potentially increase agricultural productivity and income (Chapman and Slaymaker 2002). Thus, access to ICTs could reduce transaction costs related to information searching and reduce knowledge and information asymmetries, particularly related to market price information (Chapman and Slaymaker 2002; Bowonder, Gupta, and Singh 2007; de Silva and Ratnadiwakara 2008), because information delivered through ICTs can be timelier and can reach a greater number of farmers directly (Richardson 2006). Aside from content relevance, the success of any ICT project depends on a number of other factors, including the enabling environment; sociocultural factors; the financial capacity of users; the appropriateness, accessibility, trust, and affordability of the technology for users; human capacity and training; and infrastructure (bridges.org 2003). Said otherwise, content is one of the 12 C's, which also comprise connectivity, community, commerce, capacity, culture, cooperation, capital, context, continuity, control, and coherence (UNCTAD 2006). Thus, a more holistic and systemic approach to ICT initiatives increases the likelihood of an ICT's sustainability. Heeks (1999) described this systemic approach as "the information system," which first comprises the information (defined in this paper as the content) that is delivered by the ICT platform. Second, it involves the technology used, such as radio, television, Internet, or mobile phone, as well as the information regarding the device's hardware and software. The information and technology are, in turn, influenced by the processes and activities of the ICT platform itself, as well as by the people who undertake those processes. Finally, the contextual environment in which the platform operates influences all of the above. In operational terms, the information system concept is translated into the need to strategically integrate ICTs into organizational systems by focusing on the needs of the users of the technology, in order to be meaningful and, at the same time, to amplify the developmental intents of the organization (Toyama 2010). Without this integration process, the project becomes "technology looking for a solution" (Parker 1999). The integration of the ICT into the key organizational processes and individual tasks at the different levels in which it operates is the most complex component of an ICT project—but it is a critical one for the ICT project's effectiveness and success.

At the center of the information system is the content provided by any ICT initiative (Heeks 1999). Thus, although many factors play an important role in determining the success of an ICT project, content management and delivery mechanisms are a central component for the project's usefulness in the agricultural development context. In ICT projects, content needs to be gathered, stored, retrieved, adapted, localized, and disseminated (Balaji, Meera, and Dixit 2007). The process by which all of this occurs will influence how relevant, trustworthy, affordable, useful, and usable that information is for the user (Roman and Colle 2003). Moreover, the most appropriate channels and formats for information dissemination need to be considered. These channels include the information delivery mechanism that is the technology itself, as well as the offered language options, with the local language being the preferred one (Mittal, Gandhi, and Tripathi 2010). Agricultural information may need to be interpreted and then translated and evaluated, while also being continually updated and adapted while it is disseminated (Roman and Colle 2003).

The complexities in the process of generating and delivering relevant content mean that content management is a major identified challenge in ICT projects (Chapman and Slaymaker 2002; Colle and Roman 2002; Dossani, Misra, and Jhaveri 2005). Batchelor (2002) stated that many ICT projects still tend to supply generic information. In fact, the most frequent criticism that farmers in India had regarding information provided through mobile phone services was that the information was generic and was considered old and routine (Mittal, Gandhi, and Tripathi 2010). Mittal, Gandhi, and Tripathi (2010) also found that the information's quality, timeliness, and trustworthiness are important features that enable farmers to use the information. Content-related issues in ICT agriculture projects could exist for a number of reasons. For example, the information that communities originally state that they need may not be what they eventually use (Keniston 2002). Low content relevance could also be the result of language and other localization issues, poor awareness of users, or inadequate understanding of local needs by program implementers (Dossani, Misra, and Jhaveri 2005). Many ICT projects may push external content toward local people, reflecting the interests, biases, and limitations of the ICT project itself and being based on what experts think the community needs (Ballantyne 2002; Roman and Colle 2003). On the other hand, relevant and localized content may not be available or affordable, due to the high cost of generating and managing locally relevant content (Keniston 2002). However, in many instances, technology takes precedence over both content and integrating that content within local information flows.

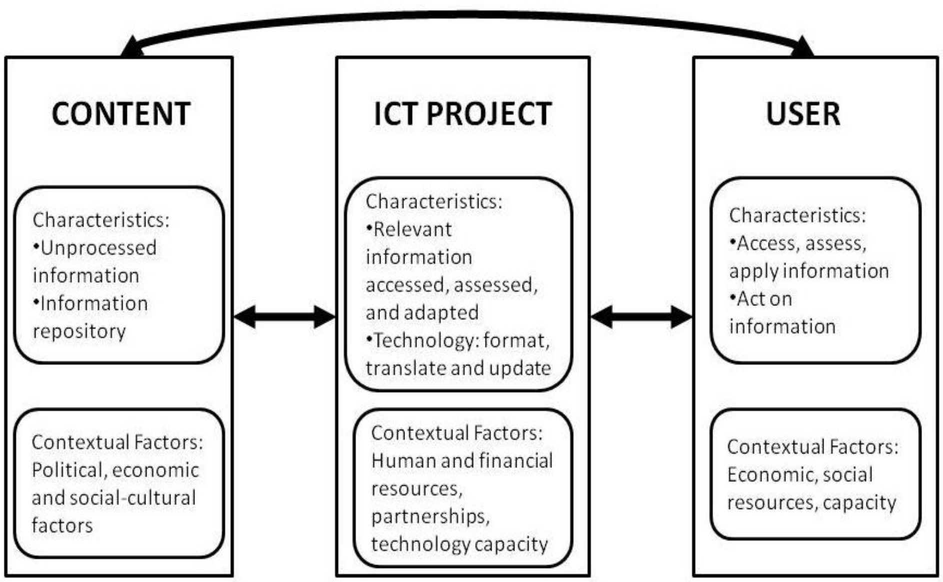
To reduce content issues, much of the existing literature and case study research on ICT projects for development highlights the need for community involvement as well as partnerships with experts for content development (UNDP 2001; Batchelor 2002; Singh 2006; Balaji, Meera, and Dixit 2007; de Silva 2008). To be effective, ICT projects need to build upon, and integrate within, existing systems of local information exchange and flow in rural communities (Roman and Colle 2003). By understanding how information is used locally, the impact of ICTs could be greater (UNDP 2001; Chapman and Slaymaker 2002). Information provided by ICTs must therefore be directly relevant to the lives and livelihoods of the users of that information (Thomas 2009). Contextualized or local content is an important aspect, because it tends to be more responsive to local interests and needs; in addition, individuals often relate better to content that is locally produced (Subramanian, Nair, and Sharma 2005). In agriculture, information generation needs to be a two-way process, with research at the farm level so that contextually appropriate content can be generated (Chapman and Slaymaker 2002; Roman and Colle 2003). A two-way process also enables farmers to share lessons and best practices related to their farm enterprise, thus incorporating farmers' knowledge base into the program (de Silva 2008). By determining the community's information needs, the ICT project can then contextualize the content. To understand the needs of the community that the ICT platform will serve, the articulation of demands from local communities requires iterative interactions with the community and the establishment of trust. Articulation of clear demands by communities requires facilitation competency in needs analysis, where the process is based on real dialogue with community members, which, in turn, requires community organization and empowerment. This complexity often leads ICT projects to fail to serve the needs of the poorest groups in a community (Chapman and Slaymaker 2002).

The value or relevance of content in ICT projects can be conceptualized in the information chain (Heeks 2002, 2005). The information chain considers how content from an ICT project is accessed, assessed, and applied by the client or user of that information. It also considers the content itself, which needs to be relevant and available. To access, assess, and apply the content, users must have the economic resources, including money, skills, and technology, as well as the social resources, such as motivation, trust, confidence, and knowledge. Individuals must be able not only to access that content, assess its relevance, and apply it to a specific decision, but also, ultimately, to act upon the information. This action requires further resources at the user level, including action resources and capacity. For example, content may be available to a community, but it may not be accessible, because of a low level of literacy; or it may be accessible, but it cannot be acted upon because of poor financial capacity to buy the necessary inputs. Unless the entire information chain operates successfully at the user level, there can be no contribution of information provided by ICTs to development (Heeks 2005). As Coudel and Tonneau noted, “Information may seem appropriate, usable, relevant, but it can only be useful if the actors have the capacity to use it and if their environment offers them the opportunity to use it” (2010, 63). A good example of this is described in a review of different ICT initiatives in India by Sulaiman and Ramasundaram (2011). This study did not find any clear correlation between the use of ICT and the empowerment of women. Instead, access to information was found necessary but not sufficient, with additional complementary services and support being required. When ICT is part of an integrated service—for example, mobile information provided to rural women in Tamil Nadu to support goat rearing as part of a microfinance loan—the results have been more positive (Balasubramanian et al. 2010). However, although the social, economic, and action resources influence the information chain, the process of turning content into useful information that can be finally acted upon is a key driver in the chain. This paper refers to this process as the content development and management process, which is explored further in the next section.

3. CONCEPTUAL FRAMEWORK

The conceptual framework used in this paper expands upon Heeks's (2002, 2005) information chain and the information system concepts. In this paper, the information chain starts from the content itself, which flows to the ICT platform and eventually to the user (Figure 3.1). Contextual factors and characteristics influence the activity at each place along the chain. Content requires sourcing and storing, which is influenced by political, economic, and sociocultural environments. The ICT project needs to access, assess, and adapt that content so that it is relevant to the users. This content needs to be formatted, translated, and updated as required, through the type of technology—for example, mobile short messaging service or mobile voice messages. The users must have the capacity and resources to be able to access, assess, apply, and act upon the information provided by the ICT projects. Ultimately, the goal is to develop and manage useful content that users can then act upon. As a two-way process, feedback from users to the ICT projects and to the content can also affect what content is used. Thus, the information and knowledge of the users can influence the content management process all the way up to the content source; in fact, users could even be a source of content.

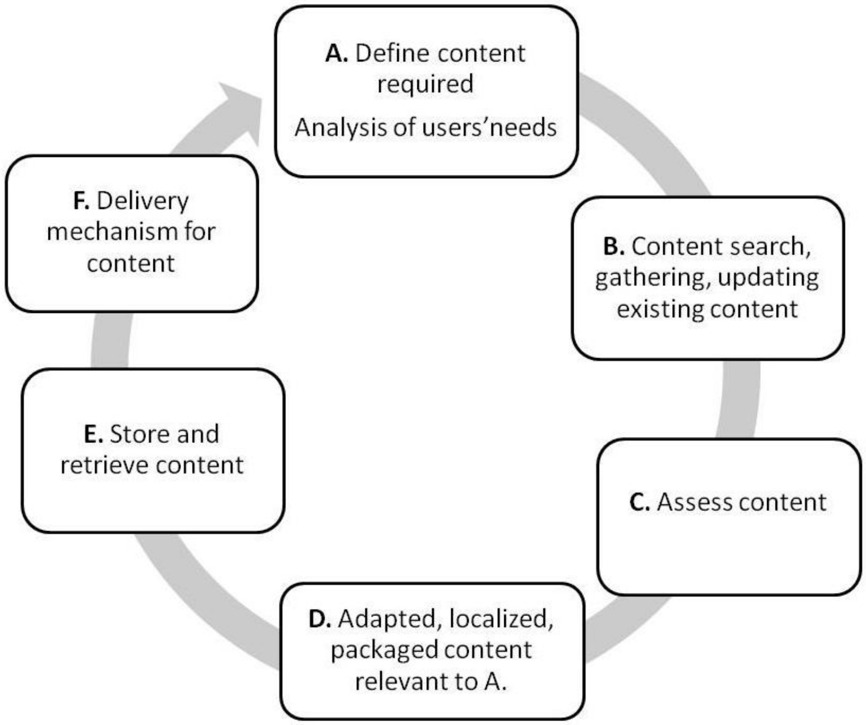
Figure 3.1—The integrated two-way information chain: Activities, resources, and feedbacks



Source: Authors, based upon Heeks (2002, 2005).

The content development and management cycle is described in Figure 3.2. This framework explores how an ICT project accesses, assesses, and applies content to a technology. The content management cycle in Figure 3.2 begins with a definition of the required content to be provided through the technology (A). This definition should begin with an assessment of community information needs into which the project will be established. Once the type of content has been identified, the process for content searching begins (B). Information search can use the local knowledge of the farming community as well as organizational knowledge—for example, information from agricultural universities, national information repositories, or global knowledge sources. Many ICT projects may partner with "experts" for content. Often, ad hoc partnerships with universities or research institutes are supported. Other projects may employ agricultural graduates—sometimes known as *infomediaries*—to gather the required content. The determination of the content's source will influence the accuracy and trustworthiness of the data, which leads to (C): the content collected must be assessed, verified, and qualified in some way.

Figure 3.2—The continuous content development and management cycle



Source: Authors.

Context-specific, localized content is an important aspect of relevant information provision (D)—the information collected must be adapted, localized, and packaged to be relevant to the users. The technology aspects now come into play, with storage and retrieval components (E) and delivery mechanisms and dissemination (F), all of which influence how the content is packaged and made accessible to users. The availability or potential for a human interface, especially at the initial stages of ICT project implementation at stage (F), may be an important factor for information dissemination. Finally, learning from experience through participatory monitoring and evaluation during the cycle is important in order to respond to user-level situations. Continual consultation and feedback from users on the applicability of the content and the use of the technology are important elements of the content cycle's learning process. Although the framework follows logical steps in content development and management, integration of steps may be fluid and dynamic.

In this framework, the content management and development cycle stops at the point of information delivery in ICT projects, without examining the impact or resources required for users to act upon that information, as suggested in Figure 3.1. Although within the content development and management process, the ICT project may ultimately provide relevant content, if the users do not have the right incentives, skills, motivation, confidence, resources, and trust to access, assess, and apply the content, then the development impact of information may be limited (Heeks and Molla 2009).

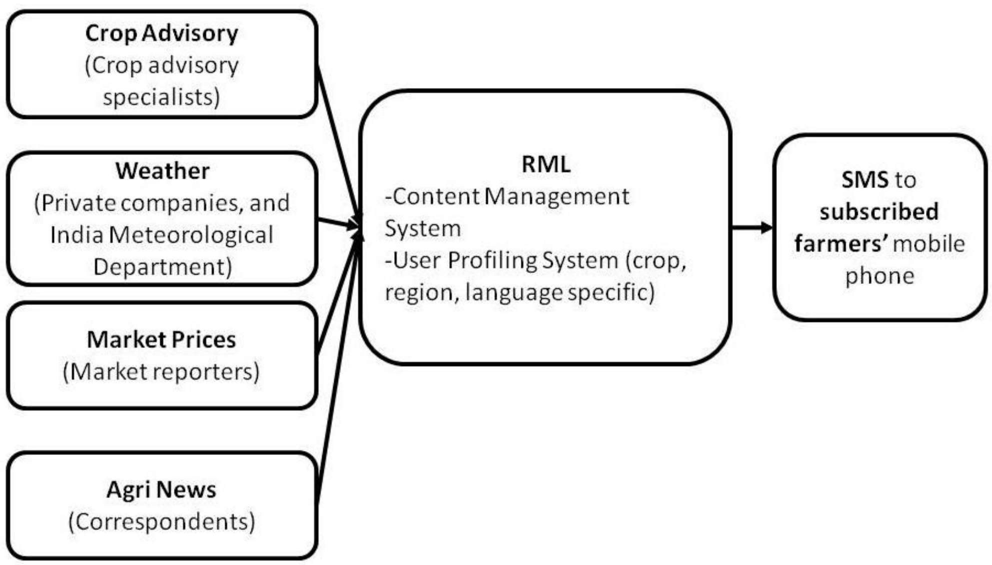
4. THE CASE STUDIES

This section describes the platform of each of the chosen case studies of ICT projects in Indian agriculture. Interviews within the organizations that implement the project were carried out, in addition to literature reviews and some field visits. These case studies were chosen because their focus is in agriculture and because they work directly with farmers. The projects have also been highlighted as innovative approaches by the media and in expert circles (Srivinasan 2010b).

Reuters Market Light

Started in October 2007, Reuters Market Light (RML), a business of Thomson Reuters, is a mobile-SMS that provides personalized information to subscribed farmers, which today number about a million unique subscribers in more than 40,000 villages. The service is delivered through SMS in eight local languages, across 13 states, and over any service provider or mobile phone (RML 2010).

Figure 4.1—Content management process in Reuters Market Light (RML)



Source: RML, 2010.

Farmers purchase a prepaid information card (called RML Direct) over the counter from one of 4,000 retailers. The farmer then calls a toll-free number to subscribe to the service through a call center. During the subscription process, detailed information about the farmer is obtained, including details of crop and market preferences (for two crops and three markets each) and the farmer's location, in addition to preferred language. Daily messages are then delivered at preset times according to the subscriber's profile. Information includes daily spot market prices, localized weather forecasts, and agroadvisories tailored for one crop and the stage in the crop cycle (Figure 4.1). General news is also provided. A user receives between 75 and 100 SMS messages each month. Prepaid packages include 99 Indian rupees (INR) (US$2.21) for one month, INR 350 (US$7.82) for four months, INR 999 (US$22.33) for one year, and INR 1,999 (US$44.67) for two years. RML employs more than 300 content professionals, who collect the required content for the SMS service, mostly for local market price information. The service tracks 150 commodities, the prices for 1,000 markets, and the weather for 2,000 locations (Thomson Reuters 2010). Weather information is localized to a surrounding 50-kilometer radius, and sources are the Indian Meteorological Department and partnered private weather services. Agroadvisory information is developed by the RML team and external partners, which include academia and industry. RML also partners with centrally funded government institutions that are looking for more ways to distribute information to farmers, and hence to contribute content to RML (Preethi 2009). Locally relevant news comes from the RML ground staff and content reporters. This news could include information on a government subsidy, which would also provide details of the corresponding government officer's name and contact details. Although this information may be available in the public domain for free, RML provides customized personalized information directly to the farmer. Agroadvisory messages are sent depending on the date of seed sowing and try to be closely aligned with crop cycles. Revenue is generated through the purchase of the prepaid card (RML 2010).

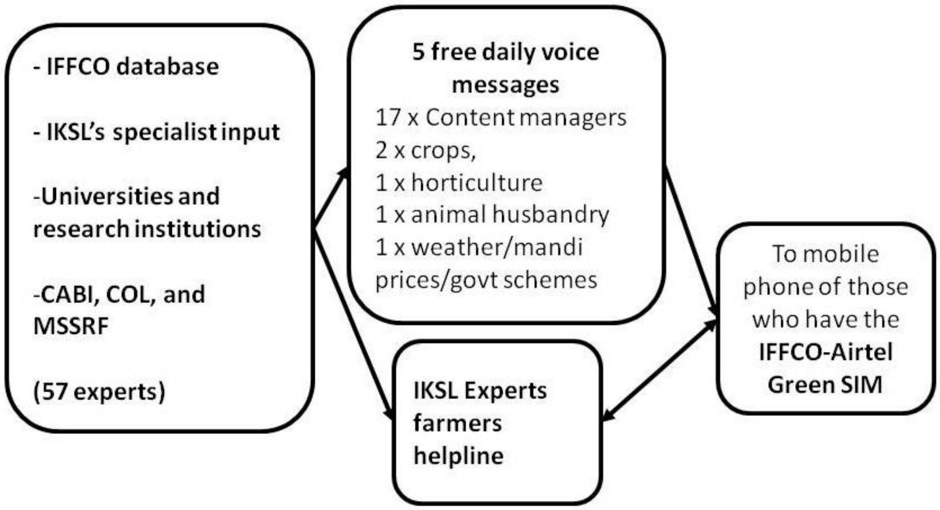
Based on farmer interviews, farmers have described an income impact of 5–25 percent of income due to the SMS service (Mittal, Gandhi, and Tripathi 2010). Customer satisfaction surveys are carried out by the Indian Market Research Bureau (IMRB), which randomly contact subscribers. The satisfaction levels consistently range from 70 to 80 percent, and IMRB found that in some cases, farmers waited to receive RML messages before selling their produce. Fafchamps and Minten (2011) used randomized control trials to see whether there was any difference in prices received by Maharashtra farmers who had used RML and those who had not. The authors did not find any significant differences in price received between the treatment and control groups but RML influenced farmers to change their crops to improve profitability by 14-20 percent. Parker and Weber (2011) find that RML has improved the efficiency of *mandis* and empowered farmers to sell crops more profitably.

IFFCO Kisan Sanchar Limited (IKSL)

Indian Farmers Fertilizer Co-operative Limited (IFFCO) Kisan Sanchar Limited (IKSL) is a partnership between IFFCO and the mobile service provider Bharti Airtel. The initiative started in June 2007 and now covers 18 states in India. Subscribers purchase an IFFCO-Airtel *Green* SIM (subscriber identity module) card, and revenue is generated from the use of talk time by the subscribers. The green SIM card is seen by Airtel as a way to attract customers in rural areas. The main service of IKSL is the provision of five free daily voice messages in the local language to subscribers. To date, around 139,000 voice messages have been developed, and 95,000 messages have been delivered. Information is provided on weather, crop and animal husbandry advisories, market prices, and miscellanea, such as fertilizer availability, electricity timings, and government schemes. If the voice message is not received immediately by the farmer, it can be retrieved by dialing a number at a cost of INR 1 per minute. In addition, a help line service is available, which provides customized advisories at normal call charges. There are approximately 81,000 questions with answers (Q&A) in the repository, with 3,500 calls from farmers monthly with feedback. To encourage users to listen to the messages, quizzes are also held (Figure 4.2). In addition, IKSL conducts phone-in programs, where a subject matter specialist answers calls on a given topic. This option provides farmers a pull mechanism for information, though the main delivery mechanism of IKSL is push through the provision of voice messages.

The voice message content and development are supported in each state by content managers, who are usually postgraduates or doctorates in agriculture science. The content managers are supported by a panel of experts from various agriculture universities and other content partners. Content partners for the voice messages include Commonwealth Agricultural Bureau International (CABI), the M. S Swaminathan Research Foundation in Tamil Nadu, the Commonwealth of Learning, selected agricultural universities, and other institutes of India, including portals like Agricultural Marketing Information Network (Agmarknet), which provides market prices for regulated markets. Comprehensive information for 53 crops and 5 animals, known as fact sheets, have been developed by CABI and national experts and is used as content for the voice messages. The IKSL content team consists of 32 agri professionals. The messages are prepared by subject matter specialists on the relevant area of interest and are then sent to the content manager or jointly prepared. The content managers ensure that these messages are one minute in length. GSMA supported IKSL to develop a robust content management system. Entire information about the content is being documented in "Integrated Information Management System (IIMS)', which works as the repository of content which the content team can refer to while answering the helpline and also for drafting voice messages (GSMA, 2012). A diagnostic mobile-based tool for pests and diseases is also under testing.

Figure 4.2—Content management process in IFFCO Kishan Sanchar Limited (IKSL)



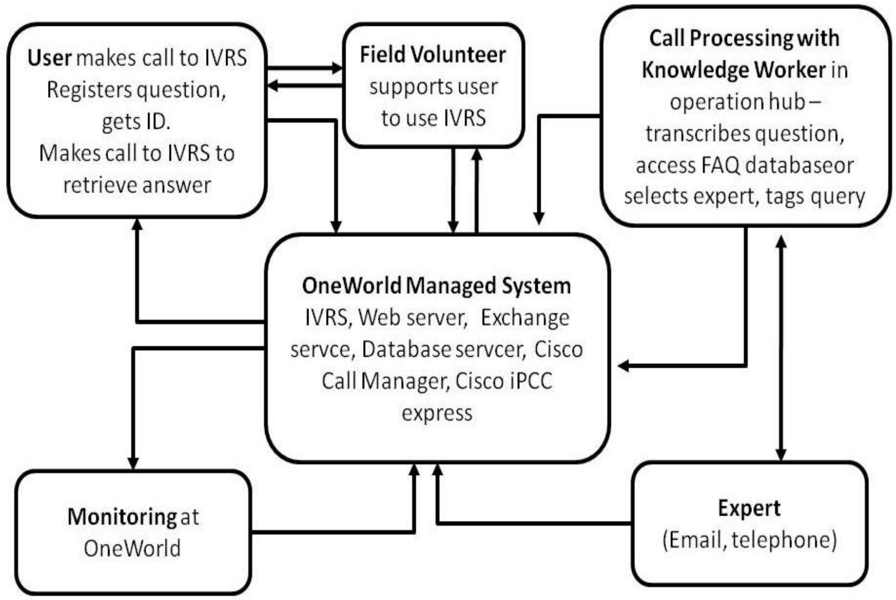
Source: Adapted from Srinivasan (2010a).

Lifelines

Lifelines, a mobile- and Internet-based ICT project in agriculture, was launched by OneWorld.net, a UK-based nongovernmental organization (NGO), in partnership with British Telecom and Cisco in 2006. Today Lifelines serves more than 150,000 farmers in over 2,000 villages, and it partners with three NGOs in areas of the states of eastern Uttar Pradesh, Madhya Pradesh, and Haryana (OneWorld 2010). Lifelines provides answers to farmer queries based on demand. Access to the Lifelines Q&A platform is via an interactive voice response system (IVRS) that routes queries and sends back answers via an intelligent call manager and unified messaging service. The Q&A service is integrated with a Web-enabled application, with a database for the audio files and texts and an exchange server for the IVRS (OneWorld 2010) (Figure 4.3).

The main elements of the Lifelines platform are the field volunteers, the knowledge workers, the knowledge database of frequently asked questions (FAQs), and the panel of experts (Figure 4.3). The Lifelines service is facilitated by field volunteers, who are normally recruited by partner NGOs. One field volunteer can cover 10–12 villages (about 200 people per village). At the same time, the volunteers act as field promoters of the Lifelines platform. The field volunteers are paid a salary by the partner NGO and receive a percentage from the INR 8–10 that the farmer pays for each answered query through Lifelines. Farmers can use their own mobile once they have learned how to navigate the IVRS, but 90 percent of calls to Lifelines are via the field volunteers' phones.

Figure 4.3—Content management process in Lifelines



Source: Adapted from OneWorld Lifelines PowerPoint presentation (Mr. Rahman).

Each recorded question receives an identification number, to be used by farmers when they call back to hear the answer. The query is received by one of the two operation hubs, where seven or eight knowledge workers listen and register farmers' queries. To answer each query, the knowledge worker searches answers from the Lifelines knowledge database, which has about 400,000 stored FAQs. When the query cannot be answered by the knowledge worker, the query is sent, with a summary script of the attached voice recording, by email to the most appropriate expert from a panel of experts, who are subject matter specialists in various agricultural fields. The expert panel includes about 100 active members from a range of institutions, including India's Department of Agriculture, state agricultural universities, and NGOs. Once an answer has been returned, the response is stored by the knowledge worker in the Lifelines knowledge database and played back as a voice message to the farmer. The knowledge worker processes the query within 12–15 minutes, and the answer is delivered to the farmer within 24 hours. Farmers pay the field volunteer once they have received the answer to their queries. On average, the Lifelines service receives about 350 calls a day, with up to 500 calls a day. In Lifelines, farmers who have used the service after each crop cycle have normally shown high satisfaction with the service, though no rigorous quantitative assessment of Lifelines has yet been carried out. However, farmers estimate the perceived impact on their productivity to be around 20 percent.

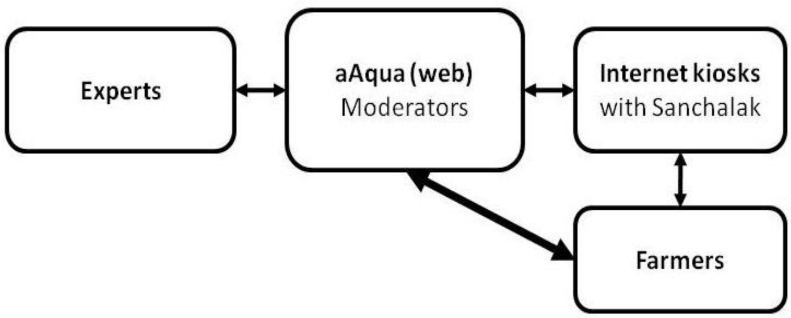
aAqua (Almost All Questions Answered)

aAqua is a free, online, multilingual, multimedia agricultural portal that provides agricultural and weather information and advisories to farmers via the aAqua knowledge bank. Around 65 percent of aAqua users access the portal through personal computers, and the rest access it at office, Internet kiosks or cyber cafes. Individuals register as users by filling out an online form or through a phone interview. Users then post questions to experts via the different spaces provided by the portal. Answers are provided within 24–72 hours, depending on the question.

The aAQUA online service started in Pune district, Maharashtra, in December 2003. The platform was developed by the Indian Institute of Technology (IIT) Bombay, with the support of Media Lab Asia. Since 2006, aAqua has been run by Agrocom, a business incubation company chaired by IIT Bombay. Since aAqua's inception, 32,000 questions have been posted, covering thousands of topics from about 4,000 users in 445 districts (26 states); of which those questions, 11,000 have been answered. The remaining questions still are unanswered. The platform is said to receive one question per hour. Seventy percent of users (estimated at more 15,000) own more than five acres of land.

The system components are a kiosk operator (Sanchalak, the name of the kiosk operator, in Figure 4.4), experts, the Q&A database, a crop recommendations database, a crop disease images database, and a Q&A translations database. Kiosk operators support farmers by storing questions online under a recorded identification. Anyone can answer questions to questions; however, the project also employs 60 experts from Krishi Vigyan Kendra (KVK) Baramati, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Pantnagar University and its KVKs, University of Dharwad and its KVKs, and University of Raichur and its KVKs. The average response time is around 2.9 days. Moderators monitor and filter content and can modify and delete Q&As. Most questions are related to crop production. Retrieval of archived Q&As is possible through a user interface that incorporates text and audiovisual elements. Textual content is stored in a language-independent fashion, which allows users to ask questions in their own language or access content in another language and then view it in their own language (Ramamritham et al. 2009).

Figure 4.4—Content management process in aAqua



Source: Authors.

The aAqua knowledge base is also available to the public offline (via the aAqua box). This feature automatically sends and receives updates when an Internet connection is available; it can also be viewed through a television display. A new smartphone 3G application of the aAqua portal has also been created for different rice varieties (aAqua rice) with the support of ICRISAT.

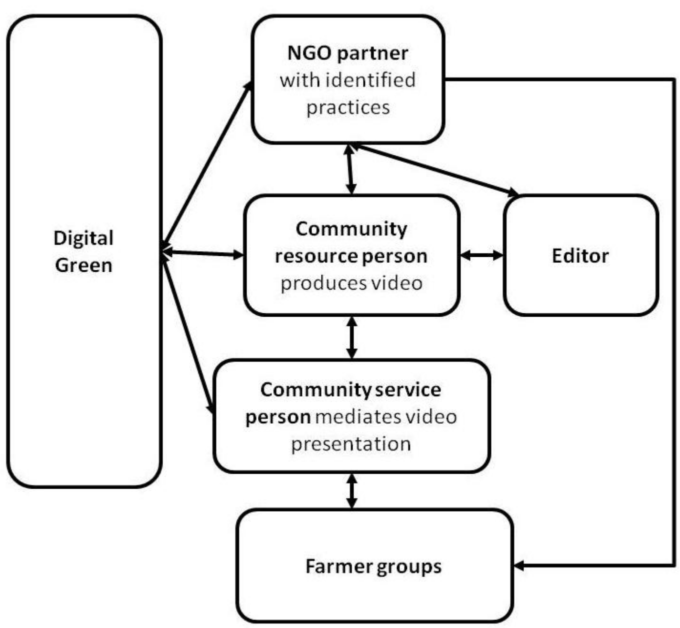
Digital Green

Digital Green is a nonprofit organization that partners with NGOs, and also government agencies like the National Rural Livelihood Mission, to improve the effectiveness of their field extension services by disseminating agricultural practices using video as a medium. The process developed from the idea that farmers prefer interpersonal methods of receiving information on new and innovative farming practices over receiving that information through mass media methods (Gandhi et al. 2009). To date 1,918 videos have been produced, and screened 68,988 times and involving 75,107 farmers (www.digitalgreen.org, accessed January 13, 2012). Digital Green was incubated by Microsoft Research India in 2007, when Digital Green partnered with the Green Foundation in Karnataka. Today, Digital Green partners with seven NGOs (BAIF, PRADAN, Access Livelihoods, Pragati, Varrat, ASA, Society for the Elimination of Rural Poverty (SERP), and Samaj Pragati Sahayog) and in six states of India (Jharkhand, Madhya Pradesh, Orissa, Bihar, Andhra Pradesh and Karnataka). In the future, Digital Green sees itself as an agency for building capacity of different governments and NGOs in using videos to increase the impact of training and of the dissemination of information for different rural development programs. Digital Green receives core funding from the Bill and Melinda Gates Foundation.

The key elements of the platform are the NGO partner capacity for video content generation (storyboards and single technology/practice developed); the making of videos by NGO field staff and community resource people (CRPs); editing and uploading of the videos on a dedicated DG platform supported by a DG anchorperson; and community service provider (CSPs) or video mediators, who present and discuss the video for technology dissemination (Figure 4.5) (Gandhi et al. 2009). Digital Green takes the existing practices identified by the partner NGO as the seed content for the first 15–20 videos, which feature local *early adopter* farmers or farmer groups describing a technology or practice. Each district has three or four CRPs who work in pairs—one camera operator and one facilitator—to film videos. The CRP also identifies interested farmers to record content. The content and storyboard are identified and checked by the NGO's subject matter specialist, who also reviews the videos to ensure the content's accuracy, clarity, and completeness (Gandhi et al. 2009).

Videos are about eight minutes in length and are shown to farmer groups using either a pico projector, which is a handheld, battery-powered digital device capable of storing more than 20 videos, or a compact disc video player attached to a television set. Farmer groups are mobilized by the partner NGO, and these groups are also involved in the selection of CSPs and CRPs. When farmer groups agree to attend video screenings, some commit to providing a small financial contribution (INR 1–2 /farmer organization member per video screening). The CSP is a local mediator who mediates the video screening and who is a resident of the same communities, where they share Digital Green video-based content. There is at least one CSP per village. CSPs conduct at least three screenings each week in each village during suitable evening hours at a location chosen by the CSP and the NGO field staff. CSPs receive a maximum of INR 250 per screening. In many cases, the mediators were the first adopters of the practices; through continued exposure to the videos, they have developed expertise in the techniques being shown. Videos are repeated if the audience demands them. During the video presentations, farmers' feedback, questions, and concerns are transcribed and entered into a database. This information is then reflected in the production of new videos. During the pilot, an assessment of Digital Green was carried out by comparing adoption rates between villages that used the Digital Green system with rates in villages that used a Training and Visit extension approach. In the Digital Green villages, 85 percent of farmers adopted at least one new agricultural practice, whereas only 11 percent did so in the control villages (Gandhi et al. 2009).

Figure 4.5—Content management process in Digital Green

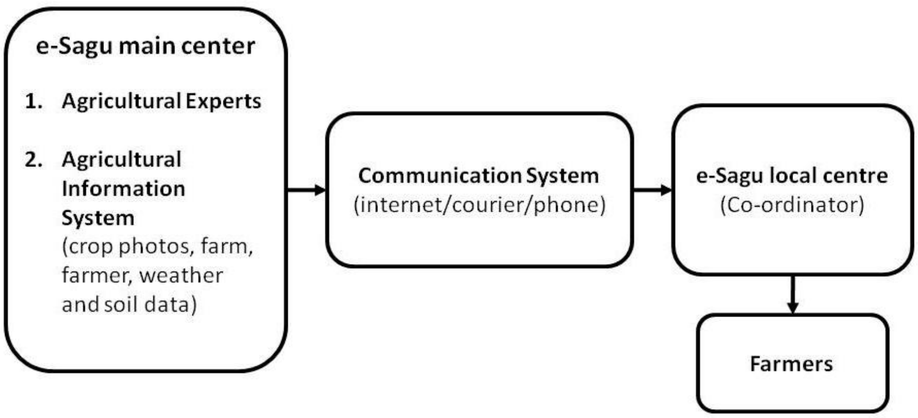


Source: Authors.

e-Sagu

e-Sagu (*sagu* means *cultivation* in Telugu) uses the medium of digital photos of farmers' fields to provide expert advice. Photographs are captured every 15 days by a local coordinator employed by e-Sagu; these photos are then sent to the e-Sagu main center in Hyderabad, where they are examined by experts who provide advice, which is sent back to the local coordinator. The advice is provided on a regular basis (typically once a week) from sowing to harvesting (Reddy, Ramaraju, and Reddy 2009). It is a project of International Institute of Information Technology (IIIT) Hyderabad, funded by Media Lab Asia. Launched in 2004, this service has been tested on 5,000 farms in 35 villages in more than six districts of Andhra Pradesh. The project partners with different NGOs and organizations, such as the Byrraju Foundation, Confederation of Kisan Organizations, Janani Foods Pvt. Ltd., and Bhagavatula Charitable Trust, all of which host the e-Sagu local centers. Acharya NG Ranga Agricultural University is the main knowledge partner.

Figure 4.6—Content management process in e-Sagu



Source: Reddy and Ramaraju (2006).

The key components of e-Sagu's platforms are the scientists and the experts at the main center, the local e-Sagu center, and the coordinator, who takes the pictures and interacts with farmers (Figure 4.6). A local e-Sagu center (a few computers and one computer operator) is established for a group of about 10 to 20 villages. Educated farmers from the village work as coordinators. The coordinator is responsible for the registration of the farmer and the farm data. After registration, the coordinator visits the farm at regular intervals (150 farms per season) and takes four or five photographs of each crop. In addition, the coordinator fills out a feedback form, which contains details of the crop problems and farmer feedback about previous advice. In 2010, the cost of the e-Sagu service, charged to the farmer, was INR 300–500 per season per crop. Farmers can register more than one crop. The photos and text are uploaded on a dedicated e-Sagu portal. If Internet connectivity is not available, a compact disc is prepared with the photographs and feedback forms and is sent by regular mail. The information is accessed at the main e-Sagu center at IIIT Hyderabad, which hosts a small of team of agricultural scientists (of the masters of science level), who in turn are supported by experts identified in the state agricultural university. The agricultural scientists analyze the crop situation in the photos and prepare standardized recommendations based on the crop calendar information stored in the e-Sagu database. Customized advice is added when specific crop problems are detected. At the local e-Sagu center, the expert advice is downloaded electronically through a dial-up Internet connection. The coordinator prints out the advice and delivers it to the farmer. In case of pests and diseases requiring urgent treatment, the advice is sent via SMS directly to the farmers and the coordinator. Advice delivery is in around 24–36 hours.

5. CONTENT DEVELOPMENT AND MANAGEMENT PROCESSES COMPARED ACROSS CASE STUDIES

The case studies in Section 4 contain a range of approaches to manage and develop localized content for farmers. This section analyzes the case studies according to the conceptual framework described in Figure 3.2. This analysis includes how the content was defined, from where it was obtained, how it was localized, how the delivery mechanism influenced content packaging, the feedback mechanisms used, and the experiential learning nature of the cycle.

Definition of Content

Determining what content to provide is important in ICT projects, because it influences the relevance and actionability of that content to the end users (Figure 3.2, Step A). In addition, the excludability and rivalry of the information may influence whether payment is required for the delivery of that information. As described in Section 2, although timely and localized information to context-specific situations may be more costly, it may also have greater impact for targeted groups, such as women (Sulaiman and Ramasundaram 2011). The use of surveys, PRA, focus group discussions, and participatory monitoring and evaluation may help support continual definition of appropriate content in ICT projects. Many of the projects described here emerged from known information gaps and asymmetries in Indian agriculture. The main driver of content in RML is the perceived gap in information access by farmers—namely, access to spot market prices, timely weather forecasts that can affect crops, or local input prices. RML also disseminates relevant news about agricultural topics and government schemes, which may normally be fragmented and difficult to access in India. The services offered are based on the company's market research of farmers' information needs, as well as on a field test marketing program carried out in late 2006 and early 2007 (Fafchamps and Minten 2011).

IFFCO Kisan Sanchar Limited (IKSL) determines content via a mixed strategy, including structured surveys by universities and third parties, needs assessment by in-house teams in different states, crop calendars and analysis of agroclimatic conditions by experts based on existing data, PRAs in focus communities, capture of specific interests of farmers at the initial farmer registration, and provision of a mix of messages capable of covering various areas of interest. In addition, the help line service that IKSL operates receives about 25–30 calls each day in each state; these calls guide the content of the voice messages, based on the feedback received and the types of questions asked.

aAqua and Lifelines recognize that farmers need access to personalized knowledge and advisory services related to their on-farm crop production; this need was not being met by the existing extension system. Lifelines and aAqua attempt to reduce the expert–farmer gap by providing a question and answer (Q&A) platform that farmers can access on a demand basis via mobile and the Internet. Articulation of the farmers' questions on the ICT platform is supported by a human interface in both models, though more so in Lifelines. The framing of the question influences the relevance of the consequent answer.

e-Sagu also recognizes the weakness of the existing extension system, which has a lack of personalized and timely information provided to farmers by the public extension services. e-Sagu considers the content supported by public-sector extensions too generic and sees it as not being based on context-specific situations. The existing content is not developed or updated based on farmers' feedback and on local knowledge, in part due to a lack of specific farmer demands (Reddy, Ramaraju, and Reddy 2009). In addition, e-Sagu claims that farmers are not in a position to detect and report timely crop problems because of ignorance and lack of time, as well as farmer's low capacity to formulate questions for external experts to understand. Therefore, monitoring of the different crops growing on a farmer's field must be provided as a public service to improve productivity and farm returns.

Compared with the other ICT projects included here, Digital Green works to support existing extension services rather than substituting them. When it comes to receiving information on new or innovative farming practices, the Digital Green approach is based on the idea that farmers prefer interpersonal contact over mass media; a human intermediation increases the likelihood of farmers acting upon information (Gandhi et al. 2009). Digital Green believes that farmers must participate and be involved in a dialogue before they will consider changing their behavior and adopting a new agricultural practice. This approach to the use of ICT is unique among the case studies examined here.

In summary, all the case studies arise from a similar problem analysis and have similar aims. They all are trying to bridge the gap between expert knowledge and farmers. But the delivery mechanism by which this problem is addressed differs. These projects provide a mechanism through which expert advice can be given directly to farmers through mobiles (RML, IKSL, Lifelines), Internet (aAqua), photos (e-Sagu), and video with human intermediation (Digital Green). Whereas Digital Green relies on the partnering NGO's expertise to understand user demands, RML and IKSL use PRA in target communities, though mainly at the initial stage of project implementation. Lifelines and aAqua use a Q&A technique—a problem-solving approach—to elicit the needs of users. Using a similar problem-solving approach, e-Sagu takes photos of farmers' fields to generate advisory content.

Source of Content

The process of sourcing the content (Figure 3.2, Step B) influences not only the content quality but also the costs and the time needed to gather appropriate content. It also determines credibility and sustainability, particularly for private approaches like RML and IKSL.

RML collaborates with a network of partners for content generation, in addition to employing more than 300 who collect content that is not readily available, such as market spot prices and locally relevant news. Weather information is provided by Indian Meteorological Department and other private weather services, as needed. Agroadvisory information is provided by experts from various academic and private sources.

Similarly, IKSL collaborates with a number of partners to develop content for its voice messages. Partners include Commonwealth Agricultural Bureau International (CABI), Prof M.S. Swaminathan Research Foundation (MSSRF), Commonwealth of Learning, selected agricultural universities, the Department of Agriculture, and agricultural research institutes. Due to the huge variability in agriculture across India IKSL sourced knowledge from local agricultural institutes and universities (GSMA, 2012). The 32 members of the IKSL content team are supported in preparing voice messages by fact sheets developed by an expert panel of subject matter specialists from various agricultural universities and organizations. CABI provides crop and livestock fact sheets, based on cropping season, ecological zones, and dominant farming systems. These fact sheets are suitable to be directly translated into voice messages in different languages. In other instances, a nominal monetary incentive is offered in the form of study grants to a panel of experts to provide agro advisory information. Both RML and IKSL are mainly push models.

Lifelines, aAqua, and e-Sagu also rely on experts to provide relevant content. However, their approaches are problem solving in nature in order to answer specific user questions. In the Lifelines platform, the knowledge worker's role is critical to make a proper diagnosis of the problem and send an appropriate answer. The ability of knowledge workers (mainly agricultural graduates in Delhi and eastern Uttar Pradesh) to answer a query based on a few minutes of voice record only, without any diagnostic tools, is challenging. The content management cycle in Lifelines has developed from relying almost entirely on the expertise of the expert panel to now using the archived FAQ knowledge database, which has expanded over time. The organization's partnership and network with experts is the strength of its program. The panel of experts receives a monthly honorarium to participate. Another incentive ensuring experts' commitment is the opportunity of establishing a direct link with farmers in the field. The updating of queries occurs when elements are added to the FAQ, which are then flagged.

aAqua relies on expert knowledge from subject matter specialists at KVK Baramati, who are able to access the online forum. e-Sagu also takes a problem-solving approach to content provision, but it does not rely on farmers' demand for content generation. Experts (graduates of agriculture) work in the main center in Hyderabad and virtually visit the farmers' field through photographs sent by coordinators. The required expertise to grasp various problems faced in the farmers' field from photos differs, depending on the experience of the expert and local exposure to field conditions. Recent graduates may lack the required location-specific, crop-specific capabilities that the e-Sagu platform requires, and their skill base needs to be developed (Reddy, Ramaraju, and Reddy 2009).

In Digital Green, the onus is on the NGO partners to provide the relevant agricultural expertise, the agricultural technology, or the package of farm practices that is best suited for or needed by the community, The video-based content topic depends mainly on identified practices or technologies that have been successfully field demonstrated and that were actively disseminated by the partner NGO through conventional extension methods. Videos are produced by CRPs, who are familiar with the local context and who have a basic knowledge of local agricultural practices. CRPs tend to have at least 12 months' experience with the partner NGO, a class 10 education, a basic understanding and interest in handling electronic equipment, good communication skills, and time to work for a program (normally part time). If farmers have an innovation, it may also be included in the video; however, in the majority of cases, it is the expertise of the NGO extension agent that contributes to content (Gandhi et al. 2009). Content themes of videos include innovations, demonstrations, testimonials, approaches, methods, and mistakes (Gandhi et al. 2009). In general, Digital Green produces videos on a single adoptable practice—for example, feeding for the maintenance of cattle—and they avoid the demonstration of complex packages of information.

All the case study ICT projects in this paper form partnerships with experts to source content, whether from Indian Council of Agricultural Research (ICAR) institutes, industry, or NGOs. Due to the noted fragmentation of agricultural content in India, these partnerships are important for sourcing information. In addition, RML hires people specifically for collecting local content that is not available from other sources. Content sources are mainly public sources; however, due to the challenge of translating and disseminating this information, the ICT projects are able to translate and disseminate this information to a larger audience, in some instances for a fee (as with RML) or for free (as with Digital Green). All these ICT projects provide access to information from public organizations, but predominantly through tacit knowledge and people of those organizations, rather than through explicit information resources. These projects are therefore geared toward connecting people and expertise rather than connecting them to databases and information systems, which supports the localization of content.

Assessment of Content

Reliability of content by users can be ensured by appropriate quality of information (Figure 3.2, Step C). If the information is known to be reliable, farmers may be more likely to use the information to make decisions in their farming enterprise. Usability may be increased by sourcing content from farmer perceived trustworthy local sources, which may not necessarily need to be a scientific or government authority. Because all of these projects utilize expert knowledge from the ICAR institutes, NGOs, and other industry partners, the reputation and reliability of the organizations is the base on which quality of content is assessed. Certification of content tends not to be common, with content provided as information only.

RML has two different processes of content assessment, depending on the content source. One is the local content, which is self-generated by employed professionals. This content is cross verified and validated at the state and national levels. External content is ensured by an internal team of market experts (PhDs and agroindustry professionals). This team ensures that the content communicated is accurate and bias free. Because RML sees content as the key to its success, emphasis is on ensuring the quality and relevance of information maintained.

IKSL has periodic surveys conducted by external agencies and quality audits of delivered messages. These audits check for authentic source and that the content provided is adequate, relevant, and accurate. The audits are performed on a random selection from all the voice messages sent each month. CABI is also a certifier of IKSL crop and livestock information, while the fact sheet produced mentions the sources of the information. FACI also devised protocols that cover the standardization of data, content sourcing and editing (GSMA, 2012). Also, because state and national institutions were used to provide content, the trust and quality of content was associated with the reputation of the institute (GSMA, 2012).

In the Lifelines platform, quality assurance occurs concurrently with the Q&A service and is separate from operations. Two auditors, who are more qualified than the knowledge worker with as masters level qualification, listen to each Q&A. They use online public sources of information, coupled with their technical expertise, to verify the correctness of the answer and the interpretation of the question. Risk of poor service quality is always there, but knowledge workers are very cautious, because credibility with farmers is quickly lost with poor answers that can be easily tracked. Knowledge workers are from the area and are familiar with the context within which Lifelines operates. A time delay of 24 hours is introduced in Lifelines to search for the best answer. Lifelines believes in quality rather than in giving immediate answers. aAqua uses independent authorities to verify the quality of answers to responses. e-Sagu has standard operating procedures (SOPs) for taking the digital photos, which ensures quality photos from which agro-advisory is given.

For content generation and verification, the Digital Green process relies primarily on the partner NGOs' extension staff and subject matter specialists. For example, in Karnataka, every video produced must be approved by the BAIF regional NGO director before being disseminated. The expertise of the partner NGO is important to validate the content. A video editor with a rudimentary understanding of content and at least a bachelor's degree also checks the video content. Detailed SOPs also help ensure the quality of the entire process; the SOPs are available publicly on the Digital Green website. Content also develops over time, as farmers view the videos and request additional or different information. Thus, new videos develop based on farmer feedback.

Quality control is addressed in different ways in the different platforms. Quality of localized and context-specific information remains a challenge that does not indicate generic solutions to be mainstreamed. Quality remains embedded in the competency of the content source—that is, in the individuals, the experience, or the reputation of the different content organizations. Content quality assurance is a core responsibility of each ICT platform, requiring continuous monitoring and dialogue with users in order to understand usefulness, determine where improvements are needed, and find out what information is needed. In private initiatives, such as RML and IKSL, users could simply not buy the product if quality becomes an issue. Quality-assurance systems ought to be in place, but such measures as SOPs would be self-determined. For example, quality could be assured through different internal and external content-review mechanisms. This assessment would involve ICT platforms, stakeholders, their partner organizations, and farmers in a continual improvement and learning process about content relevance and its use.

Localization of Content

Provision of content for farmers is more useful if it is location and context specific (Figure 3.2, Step D). Each case study tries to personalize information to its users to make the content more relevant.
In RML, users are provided with information for two crops and three markets, which they identify when they subscribe. Content is targeted because each farmer chooses the crops and local markets of his or her interest. The IKSL messages are localized to the agroecological zone within states, which adds to 61 zones across the country. For example, in Tamil Nadu, IKSL has divided the state into four agroecological zones. In each zone, messages referring to the activities for the growth cycles of crops grown in those zones are disseminated. The IKSL service has been perceived as more unpredictable in the value it delivers and has been described as lacking in relevance to farmers' needs (Mittal, Gandhi, and Tripathi 2010). IKSL is now piloting recording the characteristics and interests of subscribers to better understand its users. IKSL is also promoting 90 focused communities like sugarcane growers, fishermen, goat rearing, vegetable growers, and dairy farmers. These focus groups receive voice messages related to their area of interest.

Content of the Lifelines platform is generated through on-demand specific questions from farmers themselves. Content developed through the platform therefore responds to the local, contextual needs of each farmer. By taking this approach, Lifelines is able to inherently search, package, and deliver information that has the potential to be relevant to its users. The Lifelines approach is similar to the aAqua platform, which relies on queries from users to provide appropriate content. e-Sagu provides expert advice based on photographs of actual farmers' fields. (Farmers can register individual crops in the same field.) Experts provide feedback on the basis of the photos. If no specific problems are identified, generic agronomic recommendations are given based on the agricultural information databases that have been built according to the different crop calendars and weather conditions.

The Digital Green process builds upon the existing capacity present in the partner NGOs, including knowledge and trust within the community. In this process, it is expected that the partners will have the domain expertise necessary, with a determined set of agricultural practices useful to communicate via video. In addition, the NGO partners must be able to work at larger scales, so that there is the potential for expansion. The content is therefore localized to the specific region of the NGOs' work. A crucial aspect identified by Digital Green is that farmers themselves should be included in the videos. In other words, the background of the people depicted in the video is important. In the Digital Green pilot, farmers were more interested in videos featuring people similar to them, with low- and medium-skilled people being generally more trusted. Thus, farmers appeared most swayed by videos of other farmers in the same socioeconomic strata as themselves who had local accents (Gandhi et al. 2009). In addition, farmer interest depended on relevance to the current season and tangible benefits of the application of practice, whereby some immediate benefits could be gained (Gandhi et al. 2009). Because the video is locally produced, farmers are able to personally visit and see the subject of the video.

Localization of content is seen in all of these ICT projects. Despite being a push model, RML tries to target specifically requested information to users. IKSL is beginning to pursue a similar path. Because users need to pay for this information, the content value addition through localization is important. Lifelines and aAqua are pull models that respond to specific questions and thus are the most localized to user demands. These ICT platforms localize content using a problem-solving approach.

As a problem-solving tool for farmers' agricultural queries, voice and Internet may not be completely accurate without seeking additional information regarding the context and situations of the farmers' problems. For example, a yellow-leaf problem could be caused by any number of things and would require further diagnostic tests to determine whether it is a pest or nutrient problem. Lifelines tries to reduce this problem by employing knowledge workers who are familiar with the area of operation. e-Sagu also seeks to reduce diagnosis issues by taking photos directly from farmers' fields. Although e-Sagu may be able to provide targeted information, farmer interest is lacking, and getting farmers to pay for e-Sagu advice has been difficult (Stone 2010). The Digital Green videos are mostly of progressive farmers who are using the practices suggested by the NGO partner. These farmers are also locals, which supports localization of content. This approach provides farmers with an opportunity to visit other farmers' fields not only via video but also face to face if they want to, because the videoed farmers live locally. Although localization of content occurs in these projects, the control of content and priorities is not localized, which means that farmers do not play a role in governance or priority setting beyond the mechanisms already described.

Storing and Retrieval

Computer-based data and information management through the creation and linkages of databases is a key activity of any ICT platform. This management is the core added value of the digitalization of information (and *on the fly* instant connections), which allows a move away from the cumbersome paper-and-folder management and their storage in temporary, poorly accessible archives. The *perennialization* (long-lastingness) of agricultural information offered by the digital revolution has also become a new way to give commercial value to what was, in the past, considered part of the public domain and available for free. Databases allow information to be digitally stored, searched, and retrieved on demand at the click of a mouse. Trends and patterns can be displayed and visualized to help in the management, analysis, and understanding of complex, large-scale interactions and observations. This accessibility generates enormous efficiency gains in terms of time and costs spent in making agricultural content readily accessible, adaptable, and available to farmers through various digital devices.

RML has built its agricultural information database on the already well-consolidated experience and digital infrastructure of Reuters, which manages general market information and news. Because selling information is part of Reuters core business, all the content stored and disseminated to subscribers by RML is not open access and not available to the general public. IKSL has recently started building a database infrastructure for its help line and as the source material for the delivery of its five voice messages per day. These databases are currently closed to public access. The Lifelines knowledge database has stored about 400,000 FAQs. The content management cycle in Lifelines has developed from relying almost entirely on the expertise of its expert panel to now accessing the FAQ knowledge database. Although Lifelines plans to make available its FAQ database for research purposes, the database is presently of closed access. aAqua has 32,000 postings, and related answers are accessible online; yet the Agrocom company has not yet decided on an open-access condition to its database. e-Sagu's data and digital pictures are not available to the public. Digital Green is the only ICT platform studied that has an open-access policy. All videos are uploaded on the social media YouTube. Field data are uploaded and freely available through COCO, an open source website through which the field operations, including adoption rates of video contents and level of farmer participation in the screenings, are graphically displayed in real time.

The lack of access to digital repositories of public agricultural information and their fragmented proliferation are both matters of concern for the future development of ICT in agriculture and extension. RML and IKSL show that the private sector is playing a role in collating, translating, and disseminating agricultural information and providing it to farmers for a fee. Nonprofit organizations are also trying to achieve the same role while also searching for sustainable business models. Investments made by an ICT initiative to customize and localize information for specific contexts and farmer needs turn delivered information into more of a private or club good rather than a public or common pool good. This suggests that greater effort is needed by India's public sector to encourage the development of open-access repositories for information to be publicly available in digital form. Content needs to be open and accessible to be used by private, public, and civil society sectors. While much of this content may come from the public research institutes, private and civil society sectors add value to the information, like RML and IKSL.

Delivery Mechanism

Content dissemination over digital devices is highly influenced by the delivery mechanisms used and determines how content is packaged. For example, information that can be sent by voice message may be different from that sent by SMS or from information that is accessed over the Internet. In many instances, the presence of a human interface is needed to support farmers in the use of content provided. Some channels provide much more context to help interpret a message; others provide only the bare facts. Some channels have entry costs or transaction requirements that may limit usage. Thus, the medium intrinsically influences the message's value and usefulness.

RML delivers content via mobile SMS, which relies on users being literate. Advantages of SMS are that it may be easier to share and store as compared with voice (Mittal, Gandhi, and Tripathi 2010). However, most IKSL farmers reported that the voice message was preferable to an SMS because of literacy concerns. However, Mittal, Gandhi, and Tripathi (2010) found that IKSL voice messages were sent at unpredictable times during the day, though they are typically sent in a five-hour period between 6 and 11 a.m. If subscribers do not access the voice call immediately, they can call the interactive voice-response system and listen to the message at the cost of a local call.

In Lifelines, the content delivery is through recorded voice message, which is valuable for illiterate farmers. The capacity of farmers to use the platform needs to be developed. Despite the use of voice, which avoids problems of literacy, the presence of a human interface (the field volunteer) to help farmers interpret answers and frame queries is important. Meera, Jhamtani, and Rao (2004) found that a trusted qualified human interface is important, particularly with computer systems. Farmers require a human interface to be able to use the system, because of their need to frame and record a question in a few sentences. The minimum qualifications of the field volunteer (a local from the area) is a class 10 level of education or greater. As farmers gain experience with the service, they become better at framing their queries.

Similarly, aAqua uses a kiosk operator to help facilitate farmer usage. However, a survey carried out in November 2010 found that most users (63 percent) accessed aAqua on the Internet in their homes, followed by in their offices (44 percent) (Agrocom 2010). This suggests that different demographic of farmers is target through this intervention compared with other interventions, like Digital Green, Lifelines and e-Sagu, where farmers access to the Internet is very limited. e-Sagu's human interface is also important— the field operator takes photos and then delivers advice from experts. The answer is delivered as text (in English and Telegu) and sent by mail, or it is scanned and sent by email to the e-Sagu local center. The interface with the farmer is face to face at the time the photos are taken and when the answer is delivered on paper. Thus, human interface is relevant here as well.

In Digital Green, video was chosen because of low adult literacy in rural areas. Video can show contextualized content of other local farmers with similar backgrounds, which is well received by farmers (Gandhi et al. 2009). In addition, video is less expensive than other forms of mass media (Gandhi et al. 2009). Screening the video in the presence of a mediator (the community service person, or CSP) is important. The use of other material, such as handouts, during the screening increases farmer participation. Digital Green suggests that without the CSP, the videos would only connect with progressive farmers. The mediators are the ones who make the video more interactive and who facilitate internalization of content for participating farmers. The human interface also facilitates application of the practice or specific technology described in the video. The CSP engages with the farmer group during the screening and takes the feedback to the partner NGOs and CRPs. CSPs' role in strengthening the information chain in this approach is critical to content management. The content is developed and based on local conditions with local people, so it is highly relevant to and trustworthy for farmers who view the videos. Videos may need to be screened more than once, depending on the complexities of the practice; and in some cases, the NGO extension agents are involved in order to provide direct support for adoption (Gandhi et al. 2009). In some instances, the video-based content is integrated with services—for example, a BAIF video on artificial insemination gives directions to farmers on how to obtain resources for this practice.

As the experiences of Lifelines, e-Sagu, and Digital Green show, providing a mix of approaches is important. In these projects, ICT is supported by human intermediation to support users in understanding content delivered through ICT media. Literacy concerns may influence users of text-based services like aAqua and RML, so voice-based and video services, like those from IKSL, Lifelines, and Digital Green, may be important in less literate communities.

Learning from Experiences and Feedback

Much of the literature on content in ICT initiatives suggests that a two-way process, with feedback and participatory monitoring and evaluation of end users, increases the service's relevance. RML does not actively provide two-way communication through its platform. Although there is the option for the farmer to call the toll-free service number with any complaints or suggestions, Mittal, Gandhi, and Tripathi (2010) found that awareness of the customer support service was low. IKSL provides a help line, where farmers can talk directly with IKSL experts. To date, IKSL receives around 3,500 monthly calls with feedback; however, considering the number of users (five million), this may not be sufficient enough to redefine content as needed. Lifelines and aAqua are pull-based initiatives, relying entirely on farmers' demand for answers to questions. The types of questions and the needs of the users influence the experts chosen, who are sought out to answer specific questions. e-Sagu does not involve farmers in content definition; instead, farmers have a rather passive role. Thus, feedback and two-way communication do not play essential roles for the functioning of the e-Sagu platform. In Digital Green, the showing of videos incorporates the obtaining of queries and feedback during the initial video presentations; this feedback may then influence future video presentations. The online field data collection through COCO and the automated analysis both provide further feedback information on content preferences from users on an area or village-cluster basis.

In each project, the extent of user feedback varies considerably. In general, monitoring is normally done on an ad hoc basis using sample surveys, of which content is a small component, analyzed in very general terms (useful or not useful), without the necessary analytical depth (for example, Was a specific piece of information used and for what purpose? or What piece of information would have been more useful instead?). There is much scope for ICT projects to increase the involvement of and feedback from users to increase the relevance and impact of content.

6. CONCLUSIONS

In spite of their different approaches, all studied ICT initiatives try to provide locally relevant content to farmers while reducing the expert-farmer gap. While incentives may differ in each project, from the business models to the donor funded projects, in each of the ICT initiatives there has been a clear effort to make content relevant, accessible and sourced from reliable knowledge sources. Each of the studied ICT projects share similar goals, while using different ICT approaches and pathways. Yet, a common missing element in all projects is the tapping into the content directly by the users. Although not a focus of this paper, ICTs also offer great potential for rural communities to create and share their own knowledge and content. This is included to a certain extent only in the Digital Green project.

The case studies show that localization of content is important, where a Q&A approach or the direct involvement of users in content production can improve such localization. The content sources tend to be local experts and organizations with expert local knowledge. This can support localization of content. Increased feedback and involvement of users would improve content relevance. Dissemination of information may require human intermediation to provide follow-on support on the basis of the information provided, and may also depend on the target users, who could need greater facilitation support to access information. Future research in content development and management processes in ICT needs must focus on approaches or mechanisms that can increase the relevance of content at the farm-level. This can be achieved by improving user feedback into the platforms, and integrate farmer knowledge and information needs into the content management system.

Each ICT project examined here develops and maintains content databases. This shows that introduction of ICTs into agricultural projects may be an effective way to restructure and systematize agricultural information within an organization. ICTs have the further potential to disseminate and customize agricultural information on a large scale as RML and IKSL show. Yet, in most of these initiatives content databases are exclusive with their access being closed. The only two exceptions are Digital Green, which provides an open source database of videos, and aAqua, which stores archived Q&A, that are openly available. Despite being closed databases, the major content source in these projects is from public institutes.

ICTs have also the potential to enable greater sharing of information within agricultural public institutes, where expert knowledge can be freely shared. One option could be to create an Indian ‘agri-google’, that is to say a central national agricultural information search engine linking those searching for agricultural content to the network of knowledge experts nationally and globally. Another consideration is the integration of ICT platforms in existing public agricultural institutions to ensure the sharing of expert tacit knowledge with farmers. The public sector must ensure that digital content is freely available to private and third sector ICT initiatives that deliver agricultural content. The institutes of ICAR are the major producers of agricultural content. In addition, any digital content needs to be promoted in regional languages. Investments in each state of India to build a repository of localized and validated information in agriculture must be pursued.

An important activity of public institutions in agriculture is to ensure that content provided by ICT projects is of a certified quality. Quality assurance and accuracy of digital content will require greater attention as ICT platforms expand, and a structured and coordinated approach would be necessary. Currently, quality assurance of content still remains connected to the source of the content. In order to ensure quality, a body or panel could be established to certify and validate the content management systems of ICT platforms, as well as suggest standards for content management in ICT programs. One example is that content databases need to include references from where materials are sourced. This is important in agriculture, where information is an important input. Like seed certification, which is publicly monitored, certification of information is also necessary. This forum could consist of members from the public, private and third sectors. Validation of content is important to protect farmers’ interests, because they may have inadequate analytical skills to assess its value.

Another activity to ensure quality in content is to train the people who work on the content of ICT platforms. This certification could give training on applying content to an ICT platform. For example, what is a good agro-advisory message to give on a phone via SMS or voice? Such training would build the capacity for the content manager to adapt content for different digital devices (like video, and mobile phone) and also capacity to interact with farmers remotely (for example, through help lines). Strengthening communication skills will be important in such certifications, where scientific content needs to be explained simply to farmers who have low levels of formal education. It could be the role of public institutions in agriculture to develop a curriculum in ICT for agricultural development and support ICT platforms to facilitate farmers' access to quality agricultural information.

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2033 K Street, NW
Washington, DC 20006-1002 USA
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Fax: +1-202-467-4439
Email: ifpri@cgiar.org

IFPRI ADDIS ABABA

P. O. Box 5689
Addis Ababa, Ethiopia
Tel.: + 251 (0) 11-617-2500
Fax: + 251 (0) 11-646-2927
Email: ifpri-addisababa@cgiar.org