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NECESSARY BUT NOT SUFFICIENT: INFORMATION AND COMMUNICATION TECHNOLOGY AND ITS ROLE IN PUTTING RESEARCH INTO USE

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NECESSARY, BUT NOT SUFFICENT: INFORMATION AND COMUNICATION TECHNOLOGY AND ITS ROLE IN PUTTING RESEARCH INTO USE

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Abstract

This is the first of two linked papers dealing with information and computing technology (ICTs) and the question of putting research into use. This, the first paper, takes the experience of South Asia to review the scope of ICT applications in development practice as a tool for putting research into use for innovation. The findings from this study suggest that ICTs in general have not contributed effectively to the challenge of putting new knowledge into use as they are mostly used to support traditional communication tasks — such as information dissemination and training. The paper argues that this under-utilisation of the potential of ICTs could be due to: a lack of appreciation of the new communication-intermediation tasks required for innovation, underestimation of the roles of intermediaries and their capacities for innovation and lack of networks needed for communities to make use of the information provided through ICTs. Although the understanding on communication, innovation and extension has changed substantially in the past two decades, there is still a big gap between theory and practice. This paper contends that this gap needs to be bridged if ICTs are to effectively contribute to putting new knowledge into use.

Key words: Information and Communication Technology, Development, Agricultural Research, Innovation, Policy, Innovation Management, Knowledge, Knowledge Management, South Asia

JEL Codes: D8, D83, N5, N55, O13, O19, O31, O32, O33, O53, Q12, Q13, Q16

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LIST OF ACRONYMS

AGMARKNET	-	Agricultural Marketing Information Network
BRRI	-	Bangladesh Rice Research Institute
CD-ROM	-	Compact Disc Read Only Memory
CGIAR	-	Consultative Group on International Agricultural Research
CRISP	-	Centre for Research on Innovation and Science Policy
CRT	-	Central Research Team, RIU
CTA	-	Technical Centre for Agricultural and Rural Cooperation (CTA)
DFID	-	Department for International Development, UK
DVD	-	Digital Versatile Video Disc
FAO	-	The United Nations Food and Agriculture Organization
FDI	-	Foreign Direct Investment
FM	-	Frequency Modulation
GDP	-	Gross Domestic Product
GIS	-	Geographical Information Systems
GoI	-	Government of India
GTZ	-	Deutsche Gesellschaft für Technische Zusammenarbeit, now called the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
IADIS	-	International Association for Development of the Information Society
ICAR	-	Indian Council of Agricultural Research
ICRIER	-	Indian Council for Research on International Economic Relations
ICRISAT	-	International Crops Research Institute for the Semi-Arid

		Tropics
ICT	-	Information and Communication Technology
IDI	-	Information and Communication Technology Development Index
IDPM	-	Institute for Development Policy and Management
IDRC	-	International Development Research Centre
IFFCO-IKSL	-	Indian Farmers Fertiliser Cooperative Limited (IFFCO) Kisan Sanchar Limited
IFPRI	-	International Food Policy Research Institute
IGNOU	-	Indira Gandhi National Open University
Infodev	-	Information for Development Program
IT	-	Information Technology
ITU	-	International Telecommunication Union
LINK	-	Learning INnovation Knowledge
MDGs	-	Millennium Development Goals
MSSRF	-	M.S. Swaminathan Research Foundation
MSU	-	Michigan State University
NAARM	-	National Academy of Agricultural Research Management
NCAP	-	National Centre for Agricultural Economics and Policy
NGOs	-	Non-Governmental Organisations
ODI	-	Overseas Development Institute
PWC	-	Pricewaterhouse Coopers
R&D	-	Research and Development
RIU	-	Research Into Use

RML	-	Reuters Market Light
S&T	-	Science and Technology
SEWA	-	Self Employed Women's Association
SIM	-	Subscriber Identity Module
SME	-	Small and Medium Enterprises
UK	-	United Kingdom
UN	-	United Nations
UNCSTD	-	UN Commission on Science and Technology for Development
USA	-	United States of America

1. INTRODUCTION

This is the first of two linked papers dealing with information and computing technology (ICT) and the question of putting research into use. This, the first paper, takes the experience of South Asia to review the scope of ICT applications in development practice as a tool for putting research into use. The second paper will take the analysis from the first paper as a starting point and will focus its analysis specifically on ICT-enabled initiatives that are designed to communicate research and put research into use. It will explore the way the democratisation of ICT applications could transform the research into use process.

The context for these papers is the recent trend in development-orientated research of investing a significant proportion of research funding in research communication. The Research Into Use (RIU) programme follows this practice in line with the policy of its sponsor, the UK's Department for International Development (DFID), which currently seeks to use 30% of all its research funding on communication. This trend responds to a general feeling that good research is often let down by poor communication of findings to clients. The argument put forward, therefore, is that if clients do not know about new ideas from research they cannot use them. This notion, however, is challenged in these two papers on the grounds of being an over-simplification of the way evidence from research is used in the process of innovation and change in different development arenas (Hall, 2009;Court and Young, 2003; Ensor et al., 2008.). Also, communication is now understood not just a process of information dissemination, but a tool to help connect, mediate and broker the relationships and processes that underpin innovation and the technical and institutional adaptations that are associated with it (Leeuwis, 2004; Sulaiman and Hall, 2004; Klerkx and Leeuwis, 2008; Leeuwis and Hall, 2010).

Running in parallel with these research communication debates is the excitement about the transformative potential of information and communication technology (ICT). Improved availability and access to new ICT technologies — especially personal computers, the Internet and mobile telephones — in the last two decades has provided a much wider

choice in collection, storage, processing, transmission and presentation of information in multiple formats. South Asia, and India in particular, has been at the forefront of efforts to use information and communication technologies (ICTs) in rural development. This builds on a longer history of using a variety of communication approaches (radio, television and print) to introduce new ideas and improved practices in development efforts. In the agricultural sector this potentially offers up a key mechanism for putting research-derived ideas, information and technology into use.

Donors, inter-governmental agencies, national governments, NGOs and the industry (IT and non-IT) in South Asia have invested significantly in extending the reach of ICTs through pilot projects. Many of these initiatives have also experimented with new and varied applications in promoting development in areas such as health, agriculture, governance, financial services, employment and education. However, the impact of ICT-driven projects has generally fallen well below the optimistic expectations of their protagonists (Beardon, 2005). Moreover, many are now questioning the sustainability, scalability and impact of such ICT pilots and experiments (Jhunjunwala and Aiyar, 2007).

Using contemporary concepts of communication and innovation this paper reviews the experience of ICT interventions in South Asia of putting new knowledge into use for innovation in agricultural and rural development. The major findings from this paper are as follows. Firstly, ICTs in general have not contributed effectively to the challenge of putting new knowledge into use. They are mostly used to support traditional communication tasks — such as information dissemination and training — at the cost of a wide range of other communication intermediation tasks. Secondly, even in the few instances where they do support new communication intermediation tasks, this is mainly because of the vision of the entities deploying these ICTs and the working relationships they have with communities and other actors in the agricultural innovation system. Thirdly, the paper argues that this under-utilisation of the potential of ICTs could be due to three reasons: a lack of appreciation of the real nature of the communication-intermediation tasks required for innovation, underestimation of the roles of intermediaries and their capacities for innovation and the

lack of networks needed for communities to make use of the information provided through ICTs.

The paper is arranged as follows. The second section presents a brief overview of current debates on extension, communication and innovation and the conceptual framework used for undertaking this analysis. The next section provides an overview of current debates around ICTs in development. This is followed by Section 4, which looks at the experience of different ICT-enabled initiatives in South Asia. Section 5 discusses the role and limitations of ICTs in putting research into use and the major reasons for this. Section 6 presents an analysis of opportunities and limitations of recent efforts at improving research communication and other ICT-enabled initiatives in putting research-derived knowledge and practices into wider use. The conclusions are provided in Section 7.

2. EXPLORING THE ROLE OF ICTS IN PUTTING RESEARCH INTO USE: A CONCEPTUAL FRAMEWORK

Ideas on development, communication and innovation have evolved considerably during the last 50 years. Development practitioners initially regarded communication, especially through mass media, as a powerful tool for transforming rural societies from traditional to modern ones. According to early communication scholars (Laswell, 1948; Schramm, 1954; Rogers, 1962) the communication process was regarded simply as the transfer of messages from a sender to a receiver. Later research revealed the importance of human communication (Kinclaid, 1979), by discussing how the sharing of information with individuals and groups leads to collective action and, ultimately, mutual agreement and mutual understanding. Communication theories such as the Two-Step Flow (Lazarsfeld et al., 1944) and the Diffusion of Innovation (Rogers, 1962) supported this top-down orientation. In this view innovation was considered as a new technology or information developed by researchers, which had to be communicated to rural communities for eventual adoption.

However, the optimistic assumptions of this modernisation paradigm began to vanish slowly over the years and by the 1970s the emphasis had shifted to participatory and decentralised models of communication and development. Participatory communication emphasised the need for dialogues rather than linear, one-way communication. Freire (1970) and several other communicators identified communication as a process that is inseparable from the social and political processes necessary for development. This debate focused on the participation of rural communities in development projects and their involvement in planning and producing the content of communication. One of the limitations of the participatory communication model is its assumption that all participants are equal — an assumption that ignores huge power differentials in developing country situations (Steeves, 1993).

In the 1980s the focus of the debate began to shift to horizontal communication and information exchange rather than persuasion in the diffusion model. The potential for

combining mass media and interpersonal communication also began to be increasingly appreciated. While radio, television and the print media were primarily used to communicate new information and technologies earlier, with the advent of new ICTs these applications are now regarded as conventional or "traditional ICTs". The new ICTs are commonly referred to as evolving applications or technologies that rely on the Internet, telecommunication networks, mobile phones, personal computers and databases.

These new ICTs have the potential of getting across vast amounts of information to rural populations in a more timely, comprehensive, cost-effective and interactive manner. They can also enhance knowledge processes and support knowledge workers to have ready access to organised information even as they promote better communication and interaction with fellow practitioners. Keeping this in view, donors and national governments have recently started to invest heavily in deployment of ICTs for rural development.

However, communication does not merely entail the dissemination of information. While information is independent of context and can easily be transferred, it has to be contextualised in order to become relevant or provide useful knowledge for individuals and communities to act. Many scholars believe that communication should be seen as the process of exchange and negotiation of meaning, wherein information, people and perspectives interact in order to produce socially-shared meanings, definitions or understandings. In this perspective, communication is about the management and construction of local knowledge and practices, instead of focusing merely on information dissemination (Genilo, 2005). Knowledge is the meaning that people derive from information and, therefore, opportunities for dialogue are critical for communities to use this knowledge for social change.

Individuals as well as organisations vary in their ability to access, adapt and apply knowledge. Cohen and Levinthal (1989) defined absorptive capacity as a firm's ability to identify, assimilate, and exploit external knowledge and they considered the level of prior related knowledge as the main determinant of a firm's absorptive capacity. This absorptive capacity is not resident in any single individual, but depends on the links across a mosaic of

individual capabilities. Several studies on the knowledge flows of multinational corporations propose that the absorptive capacity of the receiving unit is the most significant determinant of internal knowledge transfer (Gupta and Govindarajan, 2000). Although technologies can support sharing of knowledge, knowledge sharing is not a technical challenge, but mostly a sociological one (Disterer 2003). Several individuals as well as social barriers can impede knowledge sharing.

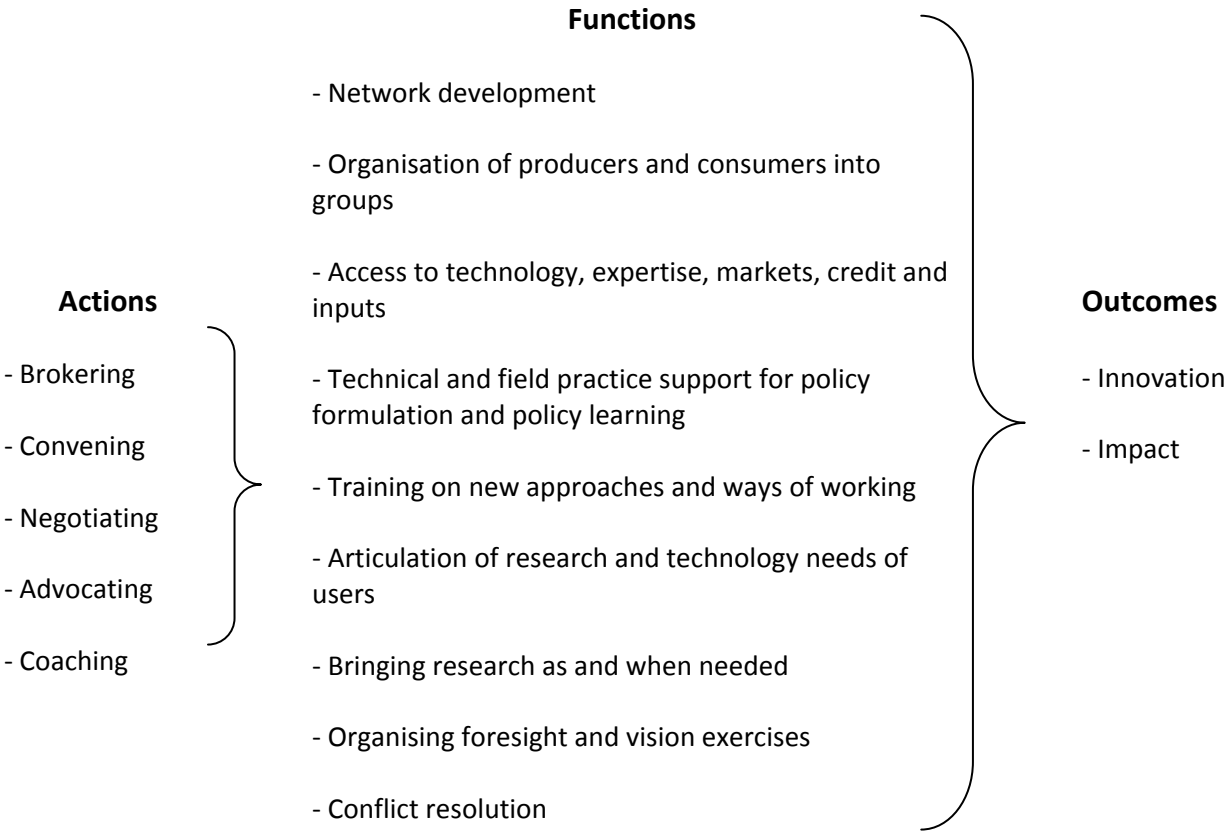
The meaning of innovation — and the role of communication in promoting innovation — has also been evolving over the last few decades. While innovation was considered as new information or technology earlier (Rogers, 1962), during this phase of evolution of development communication it began to be considered as an outcome of interaction among stakeholders, with the role of the communicator being mainly to facilitate this process of interaction (Roling and Wagemakers, 1998). In this kind of a situation, which is termed the "co-creation of knowledge", a group of stakeholders with different and often complementary experiences or knowledge agree on ways forward to improve their shared problem (Roling, 2007). Currently innovation is increasingly recognised as a process by which new knowledge is generated, diffused, adapted and used to result in social and economic change. This process requires interaction and knowledge flows among multiple actors (Hall et al., 2001; 2009). Communication can play a major role in supporting the three essential processes relevant to innovation: *network building*, *supporting social learning* and *dealing with dynamics of power and conflict* (Leeuwis, 2004).

The role of the communicator has shifted from that of a disseminator of information initially to that of a facilitator of interaction subsequently and, more recently, as a broker (Klerkx and Leeuwis, 2008) or an agent playing a wider range of intermediation tasks at a range of interfaces situated within (and between) networks of stakeholders operating in different societal spheres (Leeuwis and Hall, 2010). In other words, the role of communication has broadened from being an intermediary between science and practice to include a wider range of intermediary roles, such as mediation, knowledge brokering, facilitation of exchange, demand articulation, visioning, etc.

In the development sector, extension agencies have traditionally used some of these communication strategies, including advisory communication, organising horizontal exchange in support of diffusion, persuasive mass media campaigns, awareness raising, training, information provision, etc. New evidence indicates that these classic strategies need to be accompanied by other communication strategies and services for innovation to take place (Leeuwis, 2004; Klerkx and Leeuwis, 2009). These other strategies and services include: network brokerage, demand articulation and knowledge brokerage, visioning, process facilitation, interactive design and experimentation, learning-oriented monitoring, exploration of opportunities and constraints, lobby advocacy communication and conflict management.

All these communications tasks are important for innovation management, which is currently understood to be more about connecting the different actors relevant for innovation and helping coordinate coherent action. Sulaiman et al. (2010) have identified the following set of functions and actions as critical for innovation management (See Figure 1 on the following page).

Figure 1. Functions and Actions for Innovation Management



The role of ICTs in putting new knowledge into use, therefore, has to be evaluated based on how ICTs contribute in the sense of the functions and actions listed above. The rest of this paper explores this point by analysing some of the experiences with ICT deployment in South Asia.

3. ICTs IN DEVELOPMENT: THE CURRENT DEBATE

ICTs generally refer to an expanding assembly of technologies that are used to handle information and aid communication. These include hardware, software, media for collection, storage, processing, transmission and presentation of information in any format (i.e., voice, data, text and image) through computers, the Internet, CD-ROMs, email, telephone, radio, television, video, digital cameras, etc. While radio, television and the print media were the primary tools to support communication earlier, the advent of new ICT technologies in recent years has resulted in these now being regarded as traditional ICTs. The new ICTs are commonly referred to as "evolving applications" or technologies that rely on the Internet, telecommunication networks, mobile phones, personal computers and databases. When discussing ICTs in general, however, we also need to look at traditional ICT applications and the emerging convergence of many of these with the new ICTs.

We are currently witnessing something of a revolution in both the nature and role of media as well as in the ICT technologies currently being employed in rural development. There is now a growing body of literature on the potential and benefits of using these technologies for wider rural development. Many development initiatives have clearly revealed the huge potential of ICTs in improving efficiency, efficacy, effectiveness and reach of rural (as well as urban) service delivery and shown how these technologies could ensure much-needed transparency in both government and business.

The role of ICTs is recognised in Millennium Development Goal No. 8 (MDG8), which emphasises the benefits of new technologies, especially information and communications technologies, in the fight against poverty. "With a 10 percent increase in high-speed internet connections, economic growth increases by 1.3 percent," observed a recent World Bank report on Information and Communication for Development (World Bank, 2009). The same report also observed that "Connectivity — whether the Internet or mobile phones — is increasingly bringing market information, financial services, health services to remote areas, and is helping to change people's lives in unprecedented ways".

However, as Chapman and Slaymaker (2002) noted, the contradiction between the potential for ICTs to address the challenges faced by rural development and the current failure to harness them for this purpose is striking. There is increasing realisation that the digital divide — the gap between those who have access to technology and those who do not — is not merely technological. There is a social divide between the information rich and poor in societies and there is also a digital gap between women and men in society (Huyer and Mitter, 2003). However, the rapid spread of mobile phones in developing countries has contributed substantively to a reduction in the digital divide, something other ICTs such as computers have not yet managed to achieve (Samii, 2010). The International Telecommunication Union (ITU) of the United Nations estimates that there are 4.6 billion mobile subscribers and forecasts that by end of 2010 there will be 5 billion mobile subscribers, making mobile phones the most rapidly adopted technology in history and the only technology sector that has not suffered in the recent economic downturn.

Do ICTs really contribute to all round development? The jury seems to be still out on that question. In the 1990s, at the height of the technology boom, rural ICTs were heralded as catalysts for 'leapfrog' development', 'information societies' and a host of other digital-age panacea for poverty. Now they have largely "fallen out of favour" (Economist, 2005). However, the World Bank is estimated to have spent between $1 and $2 billion on "ICT-for-development" projects. InfoDev (the Information for Development programme hosted by the World Bank) has a budget of $10-15 million per year (Wakelin and Shadrach, 2001).

Initially it was felt that easy access to information — be it on health, agriculture, education or government schemes — would at some level lead to individuals being able to act on that information and empowering themselves (Heeks, 1999). There is enough evidence in the review of ICT projects in South Asia to suggest that targeted applications could help to increase and/or protect livelihood assets of the poor by mitigating their vulnerabilities (de Silva, 2008). However, much of this evidence is only anecdotal, and there is now an increasing need for research that fully understands the developmental and empowerment implications of ICTs. For instance, issues around gender and ICTs are very complex and the existing research is very thin (Melhem and Tandon, 2009). Some researchers (e.g., Heeks,

2006; Thompson, 2008) have argued that much of this literature does not address the question of what is actually meant by development. Beardon (2005) argues that the impact of ICT-based projects has generally fallen well below the optimistic expectations generated by their protagonists, and consequently they have developed a bad reputation in development circles.

More people have now started to question the sustainability, scalability and impact of such ICT pilots and experiments. Jhunjunwala and Aiyar (2006) observed that "only a few organisations in India have taken up ICT initiatives in any comprehensive manner and have tried to build services which can be scaled up and have a long-term sustainable impact on the society. Reluctance to commercialise and scale these projects has led to their collapse as soon as the intervening agencies move out". In other words, many ICT projects in South Asia lack a self-sustaining capacity after the experimental phase, usually because they are funded by international agencies that cease funding after a period of time and user communities are too poor to carry on with the projects (Prasad, 2008).

Investments related to ICT applications, especially Internet-enabled computers, have been a matter of great concern because of the high costs associated. However, the wider availability of cheaper mobile phones, newer applications associated with them (Mobile 2.0) and cheaper network charges, have offset this concern to some extent; many now believe that future of ICTs lies in their applications through mobile phones. There is a lot of hype around the provision of a range of information, especially market information, through mobile phones these days. However, the link between availability of market price information and better price realisation is not that direct (Lehr, 2007; Mittal et al., 2010). "While ICTs, and specifically Mobile 2.0-based agricultural applications, do have a role to play in reducing transaction costs for small farmers to engage more effectively in agricultural markets, other constraints such as access to credit and relevant infrastructure (from transport to storage) need to be met" (Lokanathan and de Silva, 2010).

A common criticism of ICT for development projects is that they fail to build on existing systems of work in a participatory manner and therefore do not achieve local input and local

ownership. There is often a gap between the design of an ICT project and the reality of what can unfold on the ground and its long-term implications for women (Melhem and Tandon, 2009). There is a broad range of ICTs available, each with its strengths and weaknesses with respect to the context in which it is used. It is the context that determines the range of tools that are relevant and the context is dynamic — although opportunities for converging different tools exist. In other words, there is no ideal ICT application that fits all situations. Keniston and Kumar (2003) indicate that there has been a tendency for well-meaning government officials, international agencies and NGOs to think narrowly when it comes to uses for ICT applications — for example, in terms of "a computer in every village", a scattering of "information kiosks' throughout the country or for "universal computer-based education". If the true potential of ICTs is to be fully realised, this mindset has to be challenged.

4. ICTS AND INNOVATION MANAGEMENT IN SOUTH ASIA

Despite the fact that South Asia (mainly India, Pakistan, Nepal, Bangladesh, Sri Lanka and Bhutan) has undergone unprecedented technological and economic transformations in recent decades, it has greater numbers of undernourished and poor people than any other developing region. The region has the highest density of populations living in rural areas and working in smallholder agriculture. About 70% of the countries' populations, and about 75% of their poor, live in rural areas. Most of the rural poor depend on rain-fed agriculture, livestock, fragile forests, and/or casual and often migratory employment.

The so-called traditional ICTs — radio, television and the print media — did play a major role during the Green Revolution in the 1970s and 1980s. In the past two decades South Asia has been a major hub for rural ICT experiments. Some commonly used ICT applications or tools include: tele-centres, web portals, call centres, mobile phones, community radio, video, and digital photography. GIS, e-mail, audio and video conferencing are also being used increasingly by researchers and development professionals.

There has been considerable growth in connectivity, content, and capacity of the ICT sectors of South Asia in the last decade (Pradhan and Liyange, 2010). However, the region's countries still lag behind developed countries in the ICT development Index (IDI) published in 2010 by the International Telecommunication Union (ITU), which is the UN agency for Information and Communication Technology. Of the 159 countries in the IDI, Sri Lanka ranks 105th, India is 117, Bhutan 123, Pakistan 128, Bangladesh 137 and Nepal 142 (ITU, 2010).

In recent years governments in South Asia have prioritised ICT deployment in development efforts. Starting with a website for every state department or organisation, which provides information on activities and other general information, every country also has a ministry or nodal agency to deal with ICTs, as well as having policies in place to promote ICT applications. These policies have an explicit focus on improving universal access to ICTs, encouraging transparency through e-governance, supporting the IT industry and endorsing

new applications that provide information on agricultural technology and market prices to rural communities.

The private sector has been helping to improve ICT access and develop new and useful applications relevant for rural communities. For instance, the rapid spread of mobile phones in India has come about through the active involvement of the private sector. It is also at the forefront of developing new and varied applications to provide agricultural information, including weather data, prices, technology tips, etc. to rural subscribers. In Bangladesh, Grameen Phone had a SIM card market share of 43% (as of March 31, 2010). In 2006, Grameen Phone introduced Health Line, a 24-hour medical call centre manned by licensed physicians, and BillPay, which allows utility bill payments over mobile phones.

There are several innovations in ICTs and knowledge management occurring in the region and many of these focus on disseminating a wide range of agricultural and rural information to producers and other knowledge intermediaries. Applications such as remote sensing and Geographic Information Systems (GIS) are increasingly used in planning interventions in agriculture, forestry, geology, etc — for example, estimating crop acreage in different regions and studying drainage patterns in watershed development programmes. Similarly video and audio conferencing facilities are used for quick and interactive knowledge exchange. An overview on various ICT tools/applications employed in South Asian countries is provided in Table 1.

Table 1: ICTs for Putting New Knowledge into Use in South Asia

OLD ICTs	Functions	Content	Delivery Format
Radio (e.g., **India:** Farm and Home, *Kisan Vani*; **Bangladesh:** *Desh Amar Mati Amar*)	- Information Dissemination	- Information on technology; critical farming practices relevant to seasonal schemes of the government; advertisements on new products; commodity prices in different markets; talks with experts on new technology	- Special agricultural programmes; news announcements; talk by farm experts; phone-in-programmes (both recorded and live)
	- Distance learning	- Lectures broadcast from open universities on various educational programmes - Farm school on radio, with courses delivered on one crop/enterprise as one lesson per week, spread over 12-15 weeks	- Mostly programmes of a 30-60 minute duration every morning and evening. Some programmes are also rebroadcast
TV (e.g., **Bangladesh**: *Mati O Manush, Shyamol Chaya, Haridye mati O Manush, Nodi O Jibon*; **India:** *Krishi Darshan, Annadata, Jaikisan, Krishi Deepam;* **Sri Lanka:** *Mihikatha Dinuwo, Govibimata Arunalu*	- Information dissemination	- Information on technology; critical farming practices relevant to the season, schemes of the government; advertisements on new products; commodity prices in different markets; talks with experts on new technology	- News announcements; talks by experts; question and answer sessions as part of phone-in-programmes (recorded and live); demonstrations; success stories
	- Distance learning	- Lectures from open universities	- Mostly programmes of a 30-60 minute duration every morning and evening. There are also re-runs of some programmes.
Print media (e.g., regional and local language dailies and magazines)	- Information dissemination - Distance learning	- Information on technology, farming practices, advertisement on new products	- News reports, question and answer columns, tips, articles (News dailies: One page, once a week; Magazines: One issue per month)

NEW ICTs			
Internet-enabled computer centres (Information kiosks/ knowledge centres/ common service centres/ telecentres) **India:** Village Knowledge Centres of MSSRF; ITC's e-choupal; The government of India's Common Service Centres **Sri Lanka**: Cyber units of the Department of Agriculture's Nenasala programme; Sarvodaya multi-purpose telecentres **Bangladesh**: Community Information Centres of Grameen Phone	- Dissemination of information - Training in computer skills - Forum for interactive learning when centres are owned/managed by rural development NGOs - Distance learning	- Wide variation in content, depending on the objective of the centre, ownership, governance, revenue model, etc. - Information on government services, market prices, technology, weather, availability of inputs - In a few cases, locally-relevant content in a local language	- Information is generally intermediated through an employee of the computer centre - The information is also accessible through other means/media (notice boards, public address system, mobile phones, etc.) - Information accessed all through the day during a centre's working hours (around 10 hours a day)

Portals **Sri Lanka**: The Department of Agriculture's Govi Gnana Seva **Bangladesh**: The Department of Agricultural Marketing's SME Portal; Cell Bazaar; BRRI Knowledge Bank; Hat Bazaar **Nepal:** e-Haat Bazaar **India:** India Development Gateway: agriwatch; Agmarknet, aAqua	- Dissemination of information - e-commerce - Distance learning	- Information on crop production, management and protection - Agricultural statistics, news, information on inputs (sources) - Dissemination of price information in various markets across the country - e-commerce (linking producers to traders/consumers) - In a few cases, portals managed a question-and-answer forum	- Portals vary widely in their content, regular updates, user friendliness, use of visuals, etc. - Most provide generic information. Increasingly portals provide dynamic information (e.g., current prices and weather updates)
Call Centres **Sri Lanka:** Toll-Free Agricultural Advisory Service-1920 **Bangladesh**: SME Helpline Jigyasha 7676 **India:** Kisan Call Centre-1800-180-1551	- Dissemination of information and interaction with experts, especially advisory communication (e.g., specific problems answered by experts)	- Information on technologies, crop protection, sources of information, etc.	- Answers on specific queries from experts located at call centres and at other locations - Available during fixed hours during the day and in some cases 24-hour service
Mobile Phones **India:** Reuters Market Light (RML); IFFCO-IKSL; Tata m-Krishi	- Information dissemination - Different kinds of information provided by the service provider	- Information mostly on weather; prices of commodities in different markets; crop and animal husbandry advisory services; information on government schemes; - information on conditions at sea (wave height)	- Mostly paid services available to subscribers - Mostly as text messages or voice-mail

Community Radio Nepal: Radio Sagarmatha, Vijaya FM, Baglung FM **Sri Lanka:** Kothamale Community Radio, **India:** Sangham Radio, Kongu FM radio, Mandakini ka awaaz, Krishi Community Radio	- Information dissemination - Raising awareness - Advocacy communication	- Wide range of information on rural life, agriculture, forests, health, handicrafts, etc. - Greater the ownership by the community, greater the involvement of the community in content generation and the content becomes more locally-relevant	- Format varies; Broadcast in most cases, but some communities have gone for narrow casting and cable casting until they collect enough resources to establish full-fledged stations - Content broadcast in local dialects for a few hours in the morning and evening every day. In a few cases broadcast throughout the day
Video **India:** Digital Green, Video SEWA	- Information dissemination - Advocacy communication - Training - Capacity Building - Mobilisation	- In agriculture, used to promote new technologies and good practices in farming - Used to raise awareness on women's issues; to mobilise communities around issues of common concern and also used as a training tool	- Screening instructional videos prepared locally to promote specific technologies with the support of a trained facilitator - Screening videos in community meetings, training programmes and workshops with policy-makers
Interactive CD-ROMs/ Touch Screen Technologies **Sri Lanka**: IMM CD-ROM **India:** Touch screen kiosks	- Information Dissemination	- Mainly related to production of different crops or enterprises	- Interactive multimedia CD-ROMS distributed to agricultural extension agencies for use by farmers in cyber units or communication centres of the Department of Agriculture/ veterinary hospitals/ clinics/ knowledge centres
Digital Photography India: e-Seva and e-Velanmai	- Providing information, mainly on plant	- Advice based on digital photos depicting the growth of crops and symptoms of pest and disease attack	- Digital pictures mailed to experts and advice received through e-mail, on mobile phones or as printouts

	management		- Turnover time of 1-3 days
Video and Teleconferencing India: Virtual academy for semi-arid tropics	- Information Dissemination - Knowledge exchange	- Depending on the nature of the problem being presented and availability of the expert (advisory on cropping, water and soil management) - Quality of interaction and exchange based on the facilitation and intermediary skills of the rural infomediary as well as his/her understanding of practical agriculture	- Interactive discussions, question and answer sessions with experts and feedback on problems and technologies facilitated by an intermediary organisation in the field - Usually once a week or fortnight at a designated time when the satellite bandwidth is specifically allotted for this activity
Remote Sensing and Geographic Information Systems (GIS)	- Collecting and assessing information	- Assessment of area for land use planning, watershed management, crop acreage estimation and assessment of crop damage for insurance purposes	- As maps and data to be used by research and development agencies

The major features of the initiatives listed out in Table 1, which discuss the use of ICTs in rural development in South Asia, are summarised below:

(i) *ICTs are mostly used to disseminate information*

Rural communities need information and ICTs provide that which is of immediate relevance or use to them. Improved access to ICTs, both old and new, has helped communities connect with the outside world. Better coverage and improved quality of the telecommunication infrastructure (land lines, mobile phone service, Internet cafes, telecentres, etc.) in recent years has helped communities access a wide range of information and contact the sources of this information.

Most of the ICT and Knowledge Management applications focus on disseminating information. Much of this information is generic and disseminated in a top-down fashion. For instance, most portals have the following sets of information: a package of practices for cultivation of a particular crop; eligibility requirements to benefit from a certain scheme; tips; crop calendars; information on input and planting material sources; weather updates; prices of outputs in major markets, etc. Portals vary considerably in terms of user friendliness, use of visuals and regular updates. Although many of these portals/website used only English as the primary language earlier, they are now becoming bilingual and, more recently, use local languages. This is also true for radio, television, print media, interactive multi-media CD-ROMS and touch screen kiosks, which are all used to disseminate information on new technologies or ideal cultivation and management practices in crop production and livestock rearing.

While most of the information flow is one-way — with not many opportunities for interaction — call centres, helplines and question-answer forums (a-Aqua) provide opportunities for farmers to ask relevant questions and get expert opinions in return. In the case of digital photography (e-Sagu and e-Velanmai in India), which is used mainly to diagnose diseases, pest attacks or poor growth, farmers get advice on what measures need to be taken based on the digital images of affected areas/crops that are e-mailed to experts. However, the quality of response depends on the familiarity of the expert with the agro-

geographic situation in the area around the farm. In the case of call centres in India, it was noted that the staff at the call centre often does not have adequate experience in the matter and access to a proper expert is often difficult. Moreover, to make proper use of information available from experts, farmers need to have access to the recommended inputs, which are not available locally in most cases (Sulaiman et al., 2011).

The same holds true for market price information provided over mobile phones. Although the provision of price information over mobile phones has played an important role in reducing transaction costs in the value chain (De Silva and Ratnadiwakara, 2008), in order for small scale farmers to engage more effectively in agricultural markets other constraints such as access to credit and relevant infrastructure (from transport to storage) need to be met. Another study concluded that while more progressive farmers may subscribe to these applications, it takes time for those at the bottom of the pyramid to be comfortable with accessing such services (Lokanathan and de Silva, 2010).

(ii) *Lack of local relevance of content, which is also not customised to the capacity of users*
The value of information provided by ICT applications greatly depends on its local relevance, whether it can be customised to a farmer's resource situation, as well as his/her capacity (networks and access to complementary sets of support services) to use that information. Old ICTs, such as radio, television and print media, also suffer from the fact that they do not offer customised information, and what they do offer is through one-way transmission. However, with the rising trend of live or phone-in-programmes, there are greater possibilities for interaction with experts.

Telecentres mostly depend on information available on web portals. Only in a few cases — such as the knowledge centres run by the M.S. Swaminathan Research Foundation (MSSRF) in India — extra efforts have been made to collect locally-relevant information and customise it for local communities. The Sarvodaya agri-clinics in Sri Lanka have also made efforts to get relevant information from other sources and translate it into simple, farmer-friendly communication material, such as leaflets, booklets, video CDs, and e-books that are available to visitors to the agri-clinics.

Initiatives that use ICTs have also tended to focus on the issue of connectivity, with not enough attention paid to the generation of relevant content or efforts to build capacity. Repackaging and adding value to information (downloading, simplifying, translating, and adapting information into local languages) as well as documenting and uploading local information are all critical steps toward enhancing relevance and, therefore, increasing user-friendliness of telecentres (Gurumurthy, 2006).

But who is responsible for helping telecentres generate local content? Quite often, public sector research and extension organisations simply do not have locally-relevant or location-specific knowledge. How can they then support initiatives that are trying to generate locally-relevant content? All these are issues that are yet to be resolved.

Developing locally-relevant content also has cost implications. Based on a review of ICT projects in South Asia, de Silva (2008) reported that: "ICT projects that successfully facilitate the information needs of the rural poor generally use participatory approaches with target communities, not just to articulate their information needs but often to generate and disseminate the content locally". While telecentres following the community model with donor funding might be able to invest resources to generate locally-relevant content, those following a for-profit business model may find it difficult to earn enough to reinvest in this crucial activity. With increasing emphasis on the need for a gradual transition from donor dependency to sustainability, there is every likelihood that this activity may get sidelined even in the days to come.

Mobile phone-based agricultural services, such as RML in India, have started to hire people to collect information from local markets, which they then customise for their subscribers. Community radio seems to be the only ICT tool where locally-relevant content is generated in consultation with local communities and is then disseminated in local dialects. For instance, the Vijaya FM station in Nawalparasi district in Nepal broadcasts programmes in 7 languages, including Chepang, Tamang, Magar, Tharu, English and Nepali.

The success of community radio essentially depends on the extent of community control over the station and programming. For instance, of the 51 community radio stations in India, 43 are run by educational institutions and only 8 are managed by NGOs (Pandey, 2010). While NGO-managed community radio stations have been able to develop and broadcast a much more diverse portfolio of programmes, those managed by educational institutions are run on very rigid lines, with the content obviously influenced by the expertise in or objective of the educational institution. While Nepal has been liberal with setting up community radio stations, India has been quite rigid in granting licenses to NGOs, although the policy was liberalised in 2006.

Does the information disseminated through ICTs reflect the information needs of rural communities, especially women? This is not always the case. Studies have shown that a "majority of women in rural areas are engaged in agricultural labour and livestock rearing and there is a need for information on small-holding livestock, small business ventures, value addition, marketing products, and ways of improving remuneration and conditions of unskilled and migrant labourers" (CRISP, 2009). This kind of information is often not available. Information on crop management and market prices, which is what is generally provided through ICT applications, is often not a priority for the majority of rural women.

(iii) *ICTs for training rural communities*

ICTs are used as tools to train rural communities in a few cases. One such initiative is the case of the instructional videos by Digital Green in India. Digital Green produces videos that are instructional in nature — mainly recordings of demonstrations that are made when an extension agent teaches farmers a new technique. One important feature of the company is that it tends to include local farmers in these instructional videos. The videos are also location-specific and feature local farmers who will be familiar to a particular audience, as opposed to experts in idealised conditions. Mediators or local resource personnel organise screenings of these videos during the evening (between 7 and 9 PM).

Video SEWA, also from India, uses videos to raise awareness about social or economic issues faced by poor and working women. The videos are used as a tool to articulate problems and

demands, while at the same time formulating strategies and informing members about government policies and programmes for the self-employed, including national development plans and programmes. The initiative screens these videos on mobile vans, which they take from community to community.

Organisations such as MSSRF have been using telecentres as a forum for training. However, this has more to do with the wider objective of the organisation than the ICTs available. The cyber units in Sri Lanka under the Department of Agriculture can be used for training, but their potential has not been fully realised due to several administrative issues within the government department (Wijekoon and Rizwan, 2010). Newer applications using mobile phones are currently being tested in India, where the phones are being used as communication and conferencing systems to organise training programmes for rural women near or even at their homes. These conference calls between experts and the farmers require only a loudspeaker (so that the conversation can be heard by everyone gathered at the meeting), a mobile connection and an active SIM card.

(iv) *ICTs in policy advocacy*

There is very little evidence to show that ICTs have been effectively used for policy advocacy. Forest Action, a think-tank on forest management issues in Nepal, has been using community radio to influence policy. As part of the Forest Action project under RIU, it has partnered with four community radio stations in Nepal (Radio Sagarmatha, Baglung FM, Radio Parbat, and Vijaya FM) to broadcast programmes every fortnight on experiences in changing institutions and policies relating to community forest management through action research. This has helped create greater awareness of issues and solutions not only among forest communities but also district forest department officials. Forest Action also participates in community radio-organised talk shows on forest management along with other stakeholders, including senior policy-makers from the forest department.

Video SEWA from India also uses ICTs for policy advocacy in terms of using videos to create visibility and initiate policy changes around women's issues. Video SEWA screens these videos in meetings with government officials and policy-makers. It has also been using these

videos for income generation, wage negotiations, legal interventions and teaching new skills (Balit, 2007).

(v) *ICTs in knowledge management*

Knowledge management generally refers to the sharing of knowledge inside and from an organisation to the outside. This involves generating, capturing and disseminating knowledge. Researchers have pointed out two kinds of knowledge: tacit (context-specific personal knowledge embedded in individual experiences, and, thus, difficult to share) and explicit (that can be easily articulated and transmitted). Knowledge management deals with both the experience and understanding of people in organisations (mostly tacit) as well as information artefacts such as documents and reports (which are explicit) available within organisations and outside them. While explicit knowledge is easy to share or transmit, sharing tacit knowledge is difficult, although not entirely impossible. Tacit knowledge plays an important role in providing meaning to explicit knowledge as well as contributing to the development of new knowledge. ICTs can support the transformation of tacit knowledge to explicit and vice versa (See Table 2).

Table 2. Technologies that can Support Transformation of Knowledge

Tacit to Tacit E-meetings Synchronous collaboration (chat)	**Tacit to Explicit** Answering questions Annotation
Explicit to Tacit Visualisation Browsable video/audio of presentations	**Explicit to Explicit** Text search Document categorisation

Source: Marwick (2001)

The major challenge in knowledge sharing is not technological, but more sociological (Disterer, 2003)]and there are many barriers to knowledge sharing within and between organisations. For instance, sharing knowledge is often seen as additional work because of the time necessary for reflection, documentation and communication. Lack of incentives for undertaking this “additional work” constrains individuals from sharing knowledge. Bureaucratic and hierarchical organisations have formal administrative procedures, which prevent the sharing of knowledge and new ideas. Moreover, in the process of knowledge transfer, recipients have to de-codify messages. This is not simply a process of

understanding words at face value, but one that requires recipients to possess or acquire context-dependent knowledge necessary to de-codify messages.

The most important tools deployed for knowledge management include organisational webpages and special portals created for specific commodities, sectors and enterprises or for specific activities such as e-commerce. Electronic databases, audio and video recordings, and multi-media presentations are also used widely to capture and disseminate knowledge. E-mail and e-discussions are now commonly used to share experiences among research and development professionals. “Solution exchange” — the online community of professionals in diverse disciplines that is facilitated by FAO — is a case in point.

Agropedia is a current initiative that aspires to manage and organise the widespread knowledge in the Indian agricultural domain by building up an agricultural ‘e-community’ and strengthening the networks among different members of this community. It is a platform where both specialists in agricultural research and education as well as others interested in agriculture can make lasting contributions to a vast and growing knowledge base. A similar initiative, “w*ikigoviya”,* exists in Sri Lanka.

Although expert systems (software that manipulates encoded knowledge to solve problems in a specialised domain that normally requires human expertise) are widely used in various agricultural sectors in developed countries, their use in South Asia is limited. E-commerce through Internet telephony (e.g., cell bazaar, Bangladesh) and other SME portals are picking up, but in the case of agricultural commodities there has not been much success, except in the case of commodity exchanges and futures trading.

There has been a certain cache to the idea of using ICTS for knowledge management in development circles. This has sparked a mushrooming of websites and portals around a single commodity or enterprise, which indicates that there may be problems with sharing knowledge across various competing organisations in the same sector. A careful analysis of these websites and portals indicates that these are mostly used for disseminating generic information and there is very little contextualisation to convert this to relevant knowledge

that could be acted upon. Very few websites and portals have means for interaction in order to enable knowledge sharing or exchange. Quite often individuals lack human networks to exchange information and negotiate its meaning with each other. These networks are important for integrating this knowledge into existing knowledge and practice systems.

Wherever these kinds of networks or groups (self-help, common interest, commodity, user, etc.) exist, communities are better placed to use information obtained through ICTs. The impact of ICTs, therefore, is felt more in a group context. The group context is, thus, a better forum for deploying ICTs if the new knowledge generated externally has to be applied and used. This brings us next to the related issue of human intermediation.

(vi) *Human intermediation: Organisational agenda and quality of intermediation*

ICTs hold a lot of promise for those organisations working at the grassroot level with community groups that have a broad development agenda, focusing on social inclusion, gender issues and pro-poor development. These organisations generally have qualified and competent personnel with skills to gauge what kind of information is important to target communities and who then choose which ICT applications are appropriate for particular situations. For instance, MSSRF uses village knowledge centres not just to provide information, but also as forums for community meetings and training. Video SEWA uses videos for network building, training and policy advocacy, while barcoding and e-marketing are critical for managing its marketing operations and expanding its sales. Forest Action successfully used community radio in Nepal to raise awareness as well as in policy advocacy because it is well-placed at the interface of policy and community engagement. From the cases reviewed it is clear that it is not the technology, but an organisation's vision and its working relationship with rural communities that allows it to deploy ICTs for better impact. The platforms that these organisations create for dialogue help communities make meaning out of the information they receive, which could then be applied as knowledge.

Human intermediation is always important, no matter how advanced or superior a technology is. In the case of Digital Green, farmers sit and watch videos with interest mainly because the facilitator make the experience interactive, by periodically pausing play and

asking questions to gauge their comprehension of content. If necessary the facilitator replays the video and makes a follow-up visit. The role of intermediaries in bridging the "last mile connectivity" has been acknowledged in the literature (Colle and Roman, 2002; Heeks, 2002; Rajalekshmi, 2007; Sien and Furuholt, 2009). Heeks (2002) suggests that good intermediaries bring more to the process than simple connection to information and communication data and hardware. Emphasising the importance of 'trust', Rajalekshmi (2007) observed that in terms of e-governance services, it may be more appropriate to use ICT applications within existing intermediary institutions, such as local hospitals. It appears that ICTs have greater potential if used to 'enable the enablers'. In other words, ICTs should be used to enable processes within the larger context of development, rather than being the defining characteristic of a full-fledged programme. As Toyama (2010) notes, development experts who promote ICTs as a way to relieve global poverty should pay more attention to the human beings who use it.

(vii) *ICTs in distance learning*

Distance learning is a field of education that focuses on teaching students not physically present in traditional educational settings such as classrooms, but in physically distant and often distributed locations. Learners typically use various materials (books, CD-ROMs and media such as television, radio, the Internet and the post) to replace direct, face-to-face interaction with tutors. In recent years, telecentres have been used as interfaces for distance learning.

ICT training — mostly basic training in ICT literacy — is a primary means of generating income in most telecentres in Sri Lanka. A study by Wattegama (2008) found that for 43% of telecentres in Sri Lanka, the key sources of income were education and training. In India common service centres are increasingly serving as locations for distance learning. For instance, Srei Sahaj, a private service provider, is currently partnering with the Indira Gandhi National Open University (IGNOU) to launch a skill development programme on computer education in its 29,000 service centres.

Bangladesh Open University now using television and radio to supplement its distance learning programmes, which have traditionally used only the print media. On an average 13 television lectures and 16 radio lectures — by the university's academics and subject specialists from other institutes — are aired every month. Instruction through the use of e-mail, computer aided learning technologies and teleconferencing is still limited (infoDev and PWC, 2010). The Indian Council of Agricultural Research (ICAR) is currently developing e-learning systems and content in the major agricultural subject domains. E-learning projects in seven major disciplines (agriculture, dairy, veterinary studies, horticulture, fisheries, agri-business and home science) are being implemented in 20 universities (Rao et al., 2010). Although these are not intended for distance learning, the creation of interactive and multi-media course content and its delivery as online (web) and offline (CD/DVD) content is expected to enhance classroom teaching.

Agarwal (2005) observed that e-learning initiatives in India had benefited only privileged and urban students, by and large. He cites only very few examples of ICTs being deployed to promote non-formal learning among rural communities. The Telecentre.org Academy is a global initiative to provide telecentre managers with training, capacity building, and professional development opportunities. Some authors also feel some older technologies have been ignored regardless of their reach. For instance, technologies such as radio, which are far-reaching and effective for people in isolated areas, have not received the attention they deserve, while newer technologies, such as the Internet, which primarily benefits a privileged strata of society thus far, has received widespread attention in South Asia (Berman, 2008).

5. THE ROLE AND LIMITS OF ICTS

Information and communication technology is necessary and critical for putting new knowledge from research and elsewhere into use, but is not sufficient for bringing about innovation. Our analysis reveals that ICTs — as they have so far been deployed — have mostly contributed to traditional communication tasks, such as information dissemination, awareness raising, mass media campaigns, advisory communication and awareness training (See Table 3). Although these tasks are important, they have to be accompanied by other communication strategies if innovation is to happen. These include: network and knowledge brokering, advocacy communication, visioning, process facilitation, learning-oriented monitoring, etc. ICTs have not, however, contributed adequately to these communication-intermediation tasks that are critical for innovation.

Table 3. Typology of ICT-Enabled Initiatives

ICT-enabled initiatives	Examples	Contribution to putting research into use	Limitations	Impact Logic
Portals: Providing information and advice on technologies, price information, networking research and development community	AGMARKNET, India http://agmarknet.nic.in/ Rice Knowledge Management Portal (ICAR in partnership with others), India http://rkmp.iari.res.in Govi Gnana Seva, Sri Lanka www.ggs.lirneasia.org Katalyst Bangladesh (Swisscontact and GTZ) www.katalyst.com.bd e-Haat Bazaar, Nepal http://www.b2b.com.np Solution exchange, India (FAO) www.solutionexchange.net.in Agropedia http://agropedia.iitk.ac.in/	Dissemination of information E-commerce Networking and sharing information and best practices among the research and development community Disseminating new research findings to other researchers and policy-makers	Mostly generic information that is static, but increasingly dynamic information on weather and prices For putting information into use, farmers would require help in adapting it to local contexts as well as access to a complementary set of services and networks to make use of this information, including access to technology Policy-makers and researchers need a complementary set of activities (meetings, workshops, conferences, policy dialogues) to have adequate impact	Access to information will lead to technology adoption, reduce price asymmetry and bring about policy change
Public information media: Rural radio/ television/ Internet/ social media/ print media, etc. (broadcast to a wide audience)	RIU TV www.researchintouse.com/tv/index.html New Agriculturalist www.new-ag.info	Mainly about creating awareness through disseminating information Used in distance learning to a limited extent	Information provided is too broad and to make use of this information, farmers need contact with other locally relevant sources	Access to information will lead to technology adoption

	PANOS www.panos.org.uk/relay Rural radio and television broadcasts Newspapers and popular farming journals			
Telecentres: Public access points for information through computers	MSSRF, India www.mssrf.org/iec.html Sarvodaya, Sri Lanka www.fusion.lk/ Community information centres of Grameen Phone, Bangladesh ,	Mainly dissemination of information available on the Internet Rarely used as a venue for interactive learning	Generic information available on the Net has limited applicability; Needs human intermediation and resources to develop and adapt information relevant to local needs	Access to information will lead to technology adoption
Call centres: Mostly toll-free numbers for seeking information on inputs, government programmes, crop advice	Toll-free agricultural advisory services (India, Bangladesh, Sri Lanka)	Dissemination of information Problem solving advisory services	Experts often do not have adequate understanding of the agro-ecological, socio-economic and infrastructure situation, therefore reducing the use of the information	Interactive information access can improve relevance of information and lead to better adoption
Community Radio: Locally owned radio stations developing and broadcasting locally relevant information over a	Radio Sagarmatha, Nepal Sangam Radio, India Kothamale Community Radio, Sri Lanka	Raising awareness Disseminating relevant and timely information in the local dialect to communities	Requires technical support, resources for programme development at the local level Sustainability of community radio is an issue	Access to locally-generated information will lead to technical

limited geographical area		Advocacy communication in a few cases		innovation
Virtual Extension: Training and advising farmers through video, digital photography and video conferencing	Digital Green Video, India Crop advice through digital photography (*e-Sagu*, India) Video conferencing (ICRISAT, India)	Information dissemination Training Problem solving Advisory support	Effectiveness depends on quality of human intermediation and existence of market and complementary resources and institutional arrangements	Access to interactive training advisory services will lead to technology adoption
Distance learning: For extension personnel, other information intermediaries and rural producers (new technologies, new skills)	Indira Gandhi National Open University, India Yashwantrao Chavan Maharashtra Open University, India	Training/ Technical Capacity Building through degree/ diploma/ certificate programmes:	Useful but requires complementary institutional development in the wider innovation system	Building knowledge and skill development of intermediaries and farmers will lead to technical change
Mobile-based advisory services (voice and text-based advisory services)	Reuters Market Light, India IFFCO-IKSL, India Katalyst Bangladesh	Disseminating information (weather, prices, advisory tips on crop, animal management, government programmes, conditions at sea)	To make use of the information/ advice, farmers need access to resources, facilities and other social networks	Dynamic information dissemination will lead to improved and timely production and market practices

In terms of the innovation management functions listed in Section 2 (See Figure 1), ICTs have contributed only to advocacy for institutional and policy change and toward improving access to sources of expertise and market information. While ICTs have improved communication and networking among researchers, mostly, and to a lesser extent among development professionals, there is no evidence to show that they support better articulation of producers' needs for technical support or direct research to work on demand-led problems. Their contribution to developing networks or towards brokerage is questionable, although there is evidence to indicate that ICTs "enable the enablers" engaged in wider rural development tasks. To put it differently, it is not the merits of the ICT tool, per se, but the vision of organisations and their working relationships with other actors in the agricultural innovation system that allows ICTs to be deployed effectively for supporting tasks of policy advocacy, learning and visioning. The under-utilisation of the potential of ICTs is primarily due to the following reasons:

(i) There has not been much realisation of the importance of the real nature of communication-intermediation tasks required for innovation. Due to historical reasons, most organisations in the agricultural innovation system in South Asia are stuck in a linear paradigm that emphasises a transfer of technology approach to innovation. This paradigm focuses on traditional communication tasks that emphasise information dissemination through ICTs at the cost of several other potential communication-intermediation tasks that ICTs could better contribute to. ICTs are, therefore, primarily viewed and used for disseminating information. This finding is also supported in an email discussion organised by the website e-agriculture.org recently, which came to the conclusion that "currently ICT use is mainly focused on information dissemination, whereas true information management applications are less developed (e-agriculture.org, 2009).

(ii) There has not been much appreciation of the role of the intermediary and the capacities required for managing innovation. As Toyama (2010) notes, "technology — no matter how well designed — is only a magnifier of human intent and capacity. It is not a substitute". Lack of appreciation for intermediation has led to its under-estimation and, thus, under-

investment in human resources (both quantity as well as quality) required for delivering the full potential of ICTs.

Innovation management depends on a crucial set of actions, such as brokering, convening, negotiating, coaching, mediating and disseminating. ICTs can support innovation management in organisations that have a tradition of undertaking wider communication-intermediation tasks. However, there aren't many organisations that are capable of undertaking these tasks at the three levels of innovation management: field, meso and policy levels. Even those organisations that are capable of this task face difficulties in accessing relevant knowledge from research or from technology-focused organisations that operate independently from other actors in the agricultural innovation system.

(iii) Rural communities quite often have limited capacity (in terms of human networks and resources) to make proper use of information; without this information received through ICTs do not make much sense. Only when information helps people communicate and participate — and allows them to make informed choices — does that information become knowledge (Panos, 1998). With a few exceptions, information provided through ICTs is generic, delivered in a top-down fashion and has limited operational significance for those who access it in this way. Most ICT initiatives have focused more on the tool and less on the content. While technological advancement and falling costs of tele-communication have expanded the availability and access to ICTs, there hasn't been much attention to developing customised and locally relevant content. In most cases, the practice has been to have the tool first and then look for content. The basic assumption is that once the information is disseminated, it will eventually be used.

6. IMPLICATIONS FOR RIU

The experience of the ICT initiatives in South Asia reviewed in this paper should be seen as cautionary tale for the Research Into Use (RIU) programme. Information and Communication Technology is not a panacea for the problem of weak uptake of research. This is not because ICTs are not a powerful new way of linking people and information. Rather, this is a problem of 21st century technology being held back by simplistic notions of agricultural extension, as discussed in Roger's 1962 classic, *Diffusion of Innovations*. The challenge really is to find a way of marrying up new ICTs with newer, broader thinking about the role of communication in the innovation process.

One of the limitations of the review of ICTs in South Asia presented above is that it is based on secondary sources, which have themselves been skewed by old policy thinking of good practice and orchestrated development initiatives. Yet one of the key features of the ICT revolution is that it has enabled users to innovate with how they use ICTs. Examples include open source activities for developing user-friendly software, open access and free online encyclopedias, such as Wikipedia. The need for user community-validated information (in many spheres of activity) is also driving users to innovate with the use of ICTs on blogs and in social media, such as Twitter and Facebook.

It is ever more apparent that ICTs do not mean technology whose development can necessarily be planned and owned by policy stakeholders. Rather, these are enabling technologies that are shifting the locus of innovation towards users. So, in a sense, the question about the role of ICTs in putting research into use is not a question of how to use ICTs, per se. Increasingly it is a question of who decides how to use ICTs and how those communication innovations can be supported and diffused. In other words it is about the democratisation of communication and the rejection of the notion of the primacy of the external expert in the design of communication -orientated applications. Equally it means that any given organisation can no longer be the owner and deliverer of information, but just one of the many users.

If RIU is to make more effective use of ICTs it needs to have a better understanding of the strengths and limitations of current specific research communication and ICT-enabled research into use initiatives. But it also needs to explore the rapidly expanding category of democratic applications (blogs, Twitter, Facebook, etc.) and reflect on how to use this trend more effectively. The companion paper to this takes these questions as a starting point.

7. CONCLUSION

If ICTs are to contribute meaningfully to innovation management, there has to be a fundamental rethinking of our approach to agricultural and rural development. Although the initial hype around ICTs has since subdued, there is a need to shift the discussion around ICTs from one of more coverage to that of better and more meaningful use of ICTs for innovation management. Lack of empirical evidence on the contribution of ICTs — and the reluctance to report and learn from failures in ICT experiments — has led to disillusionment about the role of ICTs among the development community. ICTs are clearly not a substitute for human intermediation and the limits of stand-alone ICT initiatives should be clearly understood. ICTs cannot solve the underlying institutional bottlenecks that constrain organisations from interacting with each other. Addressing these issues is important if the full potential of ICTs is to be realised. Information and knowledge alone is not enough to ensure behavioural change and there is always a need for opportunities, platforms or networks for dialogues and sharing information and knowledge. Although the understanding on communication, innovation and extension has changed substantially in the past two decades, there is still a big gap between theory and practice. This gap needs to be bridged if ICTs are to effectively contribute to putting new knowledge into use.

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