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Identifying Information and Communication Technology Use Capacity Needs of Extension Networks

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Abstract

Information and Communication Technology (ICT) has the potential to address critical considerations within rural advisory service (RAS) networks, specifically, getting the right information to audiences in a timely and appropriate manner. ICTs are technologies that facilitate knowledge and information sharing. For RAS networks, ICTs can be an important tool to ensure that both explicit and tacit information is shared with network members with the anticipated benefit of increased capacity of the network. Although the importance of ICTs are well documented within the literature, there are limited guidelines for what specific network capacities in ICT use are needed to better provide support for RAS providers to fulfill their responsibilities. Using the Delphi process, a panel of 31 experts from 24 countries arrived at consensus on 51 specific ICT use capacities associated with effective RAS networks. The results of the research provide a practical framework for RAS providers and networks to develop ICT use related capacity building and tactical planning activities.

Keywords: Information Communication Technology (ICT); ICT use; Delphi; evaluation; capacity assessment

Introduction

The ability to bring agricultural research into the field where it can be used to increase productivity is one of the major issues facing present-day agriculture around the globe (Davis & Sulaiman, 2014). Rural advisory service (RAS) providers (otherwise referred to as extension professionals) strive to support farmers by providing vast arrays of information ranging from the latest field management practices to financial service tools (Aker, Ghosh, & Burrell, 2016). However, linking the most recent agricultural research to the farming community, where it can be used in a timely manner, is extremely difficult in most developing countries (Maningas, 2006). RAS networks (known as extension systems in many parts of the world) struggle to serve farming communities because of low farmer to extension professional ratios (Dhanavel & Sheriff, 2017) which hinders their frequency of contact, especially in times when their services are most needed (e.g. harvesting time) (Assefa, Tegegne, Gebremedhin, & Hoekstra, 2016).

Information is considered one of the most important factors in socio-economic transformation (Asenso-Okyere & Mekonnen, 2012). In the agricultural sector, RAS providers play a vital role in the transformation process; encouraging farmers to actively engage in the agricultural information system but are limited by their physical ability to transfer information (Christoplos & Kidd, 2000). Information and communication technologies (ICTs) are one way that information can become more readily available (Aarts, Humphreys, & Gall, 2014; Johnson, Shoulders, Edgar, & Dixon, 2018; Rahman, 2017; Swanson & Rajalahti, 2010). If used appropriately, ICTs can enable RAS providers to transfer information at a much more rapid rate (Dhanavel & Sheriff, 2017; Zijp, 1994).

Nair and Devi (2011) defined ICTs as "all forms of technology used for creation, acquisition, processing, storage and dissemination of vocal, pictorial, textual and -based numerical information by microelectronics combination of computing and telecommunications" (p. 4). Claro and colleagues (2012) defined literacy in Information and Communication Technology (ICT) as "the capacity to solve problems of information, communication and knowledge in digital environments" (p. 1043). They also noted that ICT literacy requires both functional skills (mastery of ICT applications) and higher-order (synthesis and evaluation) cognitive skills. In the broadest form, ICTs can be modified to address various needs and can take form on many platforms. The most widely used ICTs are available through the telephone, television, video, teletext, voice information systems (radio), personal computer, fax, and internet (Warren, 2002). With the advent of wireless technology, the world has witnessed a 70% increase in mobile technology use in rural areas of developing countries (International Telecommunication Union, 2011). As a result, the telecommunication (mobile) aspect of ICT has established new social connections among rural communities in parts of world that were previously deemed impossible to reach (Patra, Singh, & Pati, 2016).

ICT use has proved to be an effective medium for communicating with farmers who have immediate information needs (Richardson, 2003). For example, market prices, timely production practices and plant protection research findings can be transferred to any individual within seconds online (Dhaka & Chayal, 2010). Given agriculture is a knowledge intensive sector, the effective and efficient translation of agricultural data obtained from research into useful information has also been found to be

helpful in making real-time decisions (Hu, Zhang, & Duan, 2016).

However, there is a caveat. Due to the speed and frequency by which ICTs advance, the skills required to utilize them often changes so it is difficult for RAS providers and farmers to keep up with the latest technology (Mehta, 2003). In addition, language barriers complicate the process of ICT use (Kumar & Sankarakumar, 2012). The challenges associated with ICT use could result in frustration and a reduced utilization in the agricultural sector (Meera, Jhamtani, & Rao, 2004). For example, Tata and McNamara (2016) found an inability to use ICTs and inadequate ICT infrastructure were major barriers preventing ICTs from being utilized to their fullest potential. Therefore, RAS networks at the country, regional, continental and global level need to offer strong support for ICT use so that RAS providers may have a better chance of staying up to date on the latest technology and can more readily use ICTs in their work when delivering information. Unfortunately, the capacities a RAS network needs to appropriately provide support for ICT use among RAS providers within their realm of influence is largely unknown and undocumented within the literature. This research was conducted to fill this gap by identifying the network capacities needed so that support can be provided and RAS providers can better fulfill their mission using ICTs effectively.

Theoretical Framework

In the context of this study, social capital theory can be applied to identify the capacities needed for RAS networks to better utilize, and train RAS providers to utilize ICTs. Being abstract in nature, social capital can be interpreted based on operational measures (Narayan & Cassidy, 2001). One way of interpreting social capital is based on a networks perspective, which studies relationships, both between people and within groups (Woolcock & Narayan, 2000). Social capital theory assists in understanding and predicting relationships, along with norms, which are rooted in social structures (Narayan & Cassidy, 2001). Lin (2003) defined social capital "as the resources embedded in social networks accessed and used by actors for actions" (p.25). Resources in social networks enhance outcomes because they enable the flow of information (Lin, 1999). Additionally, it has been found that established networks–at the organizational level–typically provide wide access to updated information on technological advancements (Inkpen & Tsang, 2005).

Since many researchers and RAS providers in developing countries are not well equipped with the capacity to use ICTs effectively (Mtega & Msungu, 2013) an increase in social capital through new connections between individuals could impact ICT use initiatives (Gaved & Anderson, 2006), and this would, in turn, increase ICT utilization within the farming community. Curry (1997) identified that RAS providers should be capable of appropriately transferring generated knowledge within networks and relay it to end users. Therefore, it is important to identify the strategic capacities RAS networks need (Bryson, Ackermann, & Eden, 2007) so they can assist RAS providers and, ultimately farmers, in utilizing ICTs to their fullest potential.

Purpose & Research Objectives

The purpose of this study was to identify the capacities needed for a RAS network to be effective in ICT use. The study was driven by the following research objectives:

1. Create a comprehensive list of potential ICT use capacities.

2. Arrive at a consensus on the specific capacities necessary for a RAS network to be effective in ICT use.

Methods

The methods associated with this article are identical with those described in detail in Lamm, Lamm, Davis, and Swaroop, (2017), which was part of a larger project that gathered multiple thematic areas (Lamm et al., 2017). Based on recommendations in the literature (Zhang, Jia, Lin, & Tan, 2013) a summary of the methods are provided; however, readers are encouraged to review the manuscript (Lamm et al., 2017) for additional methodological details.

Study research objectives were addressed using a modified Delphi method research design to gain experts' opinions regarding the development of a consensus listing of the capacities needed for a RAS network to be effective in ICT use. Through the Delphi process, expert opinions regarding effective ICT use in RAS networks were collected and analyzed until consensus on the final list was achieved (Dalkey & Helmer, 1963; Ziglio, 1996).

Expert panelists, composed of individuals actively engaged in RAS representing different geographies, levels of experience, and organizational structures, were nominated by the Global Forum for Rural Advisory Services (GFRAS) organization (Garson, 2014; Okoli & Pawlowski, 2004). A diverse group of experts were identified to minimize the potential for bias in the process (Garson, 2014). The expert panel, composed of a purposive sample of 31 RAS professionals, were outlined in detail in (Lamm et al., 2017).

> The 31 experts that participated in the panel represented RAS practitioners, funding organizations, farmer and advocacy groups, academic institutions, research institutes, policy makers, and other affiliated RAS support organizations (for example consultants and agricultural supply companies). Panelists had a range of experience with RAS exposure ranging from four to 45 years, with an average tenure of 18 years. Panelists represented the following countries: Bangladesh, Belgium, Bulgaria, Ecuador, Fiji, Georgia, Ghana, Guyana, India, Ireland, Italy, Lao People's Democratic Republic, Malawi, Nicaragua, Nigeria, Pakistan, Philippines, Samoa, Solomon Islands, South Africa, Switzerland, Uganda, United States of America, and Uzbekistan. (p. 97)

The Delphi method, using three rounds, was used to complete the study, the researchers followed recommendations in the literature to develop the processes and instrumentation (e.g. Delbecq, Van de Ven, & Gustafson, 1975; Lamm et al., 2017; Lamm, Lamm, Davis, & Swaroop, 2018; Nistler, Lamm, & Stedman, 2011). In round one, experts listed five of the most important capacities in a RAS network to be effective in ICT use, by using a short phrase or word (Gliddon, 2006). Expert responses were analyzed and aggregated, or expanded, where appropriate (Garson, 2014; Gliddon, 2006) using the Dedoose qualitative analysis

software (Dedoose, 2016). Round One responses were used to develop the Round Two of the questionnaire.

In Round Two of the Delphi, expert panel members' level of agreement with the capacities identified in the initial round were captured. The capacities identified were used to ask participants to indicate their level of agreement or disagreement that each item listed was an important capacity for RAS networks relative to ICT use. The expert panel used a five point Likert-type scale (1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neither Agree nor Disagree*, 4 = *Agree*, 5 = *Strongly Agree*) to note the item's level of importance. Scores for each item were then averaged, and to remain in Round Three an item had to receive a mean score greater than 3.25 (Garson, 2014). Round three established the expert panel members' level of consensus with the remaining capacities, by asking whether or not the item should be retained. Remaining items with at least 75% expert member agreement were retained (Garson, 2014).

Prior to research engagement Internal Review Board approval was obtained from the University of Florida. All three rounds of the Delphi were administered online and followed the Tailored Design Method (Dillman, Smyth, & Christian, 2008). The protocol included a pre-notice email sent to all panelists prior to start of the process. An invitation to complete Round One of the Delphi was sent approximately two days later. Each round of the process included three reminder messages in addition to the original invitation. Delphi results were downloaded and analyzed using the Statistical Package for the Social Sciences (SPSS) version 21. Thematic analysis, for qualitative responses, was conducted using the Dedoose qualitative analysis software (Dedoose, 2016). The panel of 31 experts had the following response rates: Round One: 94%, Round Two: 87%, and Round Three: 94%. Response rates of greater than 70% per round within Delphi research have been deemed acceptable in previous research studies (Keeney, Hasson, & McKenna, 2011).

Results

Following Round One, 62 capacities were identified by the expert panel (Table 1). Next, panelists indicated the level of importance they associated with each capacity in Round Two of the Delphi. Of the 62 capacities from the first round, there were 11 items that were removed as they did not achieve the established minimum threshold mean score of at least 3.25 to be retained; therefore 51 capacities were included in the third and final round. The mean values for the capacities ranged from 4.41 to 2.89 (Table 1). Experts associated the highest level of importance with the statement "A country fora or regional RAS network should connect nationally."

Table 1
*Delphi Round One and Two Results: Level of Importance for ICT Use Capacities (*n = *62)*

Capacity	*M*	*SD*
Connect nationally	4.41	0.75
Use ICT tools to disseminate information	4.37	0.93
Have information and communication technologies that are accessible	4.33	0.68
Use internet capabilities	4.22	0.85
Connect globally	4.19	0.92
Have tools that are seen as user-friendly	4.15	1.06

Connect locally	4.15	0.99
Have a website arranged in an organized manner	4.11	0.89
Promote ICT use to enhance networking	4.11	0.80
Use ICT tools to collect information	4.11	1.01
Have information and communication technology infrastructure in place	4.07	0.68
Have network officers with access to ICT information	4.07	0.78
Provide sources of information that are adaptable for different users	4.07	1.04
Use ICT to link stakeholders to RAS professionals	4.04	0.81
Have a website available with access to all information	4.04	1.19
Integrate ICT into reaching the larger objectives of the network	3.96	1.02
Have a website that is updated on a regular basis	3.96	1.09
Have RAS professionals that are using ICT tools	3.96	0.90
Have a positive attitude towards ICT tools	3.93	0.96
Communicate in local language(s)	3.89	1.12
Have RAS professionals that know what ICT tools are available	3.89	0.97
Have at least one individual trained in specific ICT tools	3.89	1.12
Use ICT tools for monitoring and evaluation	3.85	1.13
Communicate via distance	3.81	0.74
Communicate using social media	3.81	0.74
Have at least one individual devoted to communication/ICT	3.81	1.11
Select appropriate ICT tools	3.81	1.18
Have RAS professionals that trust the information system	3.81	0.83
Manage records, reports, publications, etc. electronically	3.78	0.97
Have processes in place to reach individuals without internet access	3.74	1.20
Have network officers that are able to source information	3.70	0.95
Promote ICT use as a way to leverage partnerships	3.70	0.87
Share success stories using ICT tools	3.67	0.88
Have discussion groups where RAS professionals interact online available	3.59	1.01
Establish and use virtual networks	3.59	1.15
Have members that freely discuss communication skills needed to utilize ICT tools	3.59	0.97
Have a well-trained, expert ICT division present	3.56	1.28
Offer advisement on the best use of ICTs and their limitations	3.50	1.17
Have evidence of ICT literacy amongst RAS professionals	3.48	1.19
Communicate with farmers using apps/SMS texting	3.48	1.01
Seek financial support for ICT tools	3.48	1.34
Prioritize ICT use in the network	3.44	1.22
Have web page design and management skills	3.44	1.09
Utilize regular phone or online meetings (e.g. Skype, Zoom, GotoMeeting, Adobe Connect)	3.41	0.89
Deliver programming using television and radio	3.37	1.21
Have developed e-learning tools that are being used by RAS professionals	3.33	1.39
Provide support services for ICT tools	3.30	1.27

Communicate in English	3.30	1.10
Use visual communication for long distance conversations/training	3.30	1.23
Offer training on ICT tool use	3.26	1.43
Provide financial support for ICT tool adoption	3.26	1.40
Have evidence of ICT managers	3.23	1.27
Provide regular updates on technology	3.19	1.21
Develop E-learning tools	3.15	1.29
Conduct research on comparative advantages of ICT tool use	3.15	1.35
Provide apps that are being used by RAS professionals	3.11	1.31
Provide access to tablets, GPS equipment, cameras, etc. for RAS professionals	3.11	1.42
Have facilities required for distance learning available	3.07	1.41
Develop appropriate apps	3.04	1.29
Recognize price of ICT use with RAS	3.04	1.16
Perform market analysis on the benefits of new ICT tools prior to implementation or rejection	2.93	1.30
Have video conferencing available	2.89	1.42

For Round Three, panelists were asked to indicate whether each of the capacities should be kept or removed to establish consensus. Amongst the 51 capacities from Round Two there were 39 capacities that achieved a level of consensus greater than the threshold of 75% (Table 2).

Table 2
Delphi Round Three Results: Level of Consensus with ICT Use Capacities (n = 51)

Capacity	Consensus %
Have tools that are seen as user-friendly	100.0
Use ICT tools to disseminate information	100.0
Connect nationally	100.0
Use ICT tools to collect information	96.6
Connect globally	96.6
Use internet capabilities	96.4
Have information and communication technologies that are accessible	96.4
Manage records, reports, publications, etc. electronically	96.3
Have a positive attitude towards ICT tools	93.1
Have a website that is updated on a regular basis	93.1
Have a website available with access to all information	93.1
Have network officers with access to ICT information	93.1
Promote ICT use to enhance networking	93.1
Use ICT tools for monitoring and evaluation	93.1
Communicate using social media	92.9
Communicate via distance	92.9
Have discussion groups where RAS professionals interact online available	89.7
Use ICT to link stakeholders to RAS professionals	89.7
Provide sources of information that are adaptable for different users	89.7

Have a website arranged in an organized manner	89.7
Have RAS professionals that trust the information system	89.7
Connect locally	89.7
Have information and communication technology infrastructure in place	89.3
Have network officers that are able to source information	86.2
Promote ICT use as a way to leverage partnerships	86.2
Have processes in place to reach individuals without internet access	86.2
Select appropriate ICT tools	85.7
Establish and use virtual networks	82.8
Have RAS professionals that are using ICT tools	82.8
Have at least one individual devoted to communication/ICT	82.8
Communicate in local language(s)	82.8
Share success stories using ICT tools	82.8
Utilize regular phone or online meetings (e.g. Skype, Zoom, GotoMeeting, Adobe Connect)	82.1
Communicate in English	79.3
Have members that freely discuss communication skills needed to utilize ICT tools	79.3
Have web page design and management skills	79.3
Have at least one individual trained in specific ICT tools	79.3
Integrate ICT into reaching the larger objectives of the network	78.6
Have evidence of ICT literacy amongst RAS professionals	75.9
Prioritize ICT use in the network	72.4
Provide financial support for ICT tool adoption	72.4
Have RAS professionals that know what ICT tools are available	72.4
Use visual communication for long distance conversations/training	72.4
Have developed e-learning tools that are being used by RAS professionals	72.4
Deliver programming using television and radio	72.4
Have a well-trained, expert ICT division present	71.4
Offer advisement on the best use of ICTs and their limitations	69.0
Seek financial support for ICT tools	69.0
Offer training on ICT tool use	69.0
Communicate with farmers using apps/SMS texting	67.9
Provide support services for ICT tools	62.1

Conclusions, Implications & Recommendations

An important component to RAS network effectiveness is ensuring the right information is provided to stakeholders, ICT is therefore an important area when considering the broader RAS mandate. Although multiple ICT definitions exist, Nair and Devi (2011) defined ICTs in its simplest form as "technology used for creation, acquisition, processing, storage and dissemination of vocal, pictorial, textual and -based numerical information by microelectronics combination of computing and telecommunications" (p. 4). Linking agricultural research to farming communities is a critical need for every area across the globe (Maningas, 2006). This occurs when effective ICTs are utilized to share information in a timely manner that is

readily available (Aarts et al., 2014; Johnson et al., 2018; Swanson & Rajalahti, 2010). The results of this study indicated that it is possible to develop a list of capacities associated with effective ICT use within RAS networks using a social capital theoretical foundation (Woolcock & Narayan, 2000).

This study used a network view of social capital where a RAS experts were asked to participate in a Delphi process to identify ICT capacities associated with effective use. The results of the study were consistent with the existing literature indicating how a variety of platforms used in ICTs (Warren, 2002) can contribute to assisting with telecommunication needs in rural areas of developing countries (International Telecommunication Union, 2011; Patra et al., 2016) to disseminate important agricultural information (Dhaka & Chayal, 2010; Richardson, 2003). An implication from these results is that ICT capacities derived from a panel composed of RAS network experts from across the globe can serve as a baseline for both RAS network analysis and capacity building (Bodin & Crona, 2009).

Consistent with other Delphi studies, an important limitation to note is the results are only as valuable as the quality of insights provided by the expert panel (Garson, 2014). To mitigate the potential for bias a purposive expert panel selection process was employed. Gathering a diverse group of RAS experts representing various geographies and stakeholder types minimizes the possibility of having a narrow perspective or range of experiences represented in the final results.

There were three capacity areas the expert panel unanimously agreed RAS networks should possess for effective ICT use. First, having tools that are seen as user-friendly. Second, using ICT tools to disseminate information. Third, connecting nationally. Although previous ICT research focuses largely on social and economic improvement (Aarts et al., 2014; Dhanavel & Sherriff, 2017; Kumar & Sankarakumar, 2012; Meera et al., 2004; Swanson & Rajalahti, 2010; Tata & McNamara, 2016) or specific technologies (Mehta, 2003; Richardson, 2003), there is a need to identify the specific ICT support needed for RAS providers to fulfill their mission. The results of this research indicate RAS networks have a different set of needs and criteria than other contexts. Therefore, scholars and practitioners need to develop ICT systems and processes that are more contextually appropriate for a RAS audience.

A recommendation from this study is that RAS networks use this set of ICT use capacities in two primary ways. First, the final set of 39 capacities may be a very valuable baseline upon which to measure both perceived and verified capacity (Aker et al., 2016). From a capacity assessment perspective, a robust and rigorously developed set of capacities has the potential to provide additional consistency and harmonization of language and understandings across RAS networks globally (Davis & Sulaiman, 2014). Second, the results of any capacity assessments should be used to inform specific capacity building plans and activities. Linking specific plans to noted needs should provide RAS networks a framework upon which to tactically plan and prioritize (Bryson et al., 2007).

In addition to the internal RAS network recommendations a second set of inter-RAS network recommendations are posited. Specifically, a primary recommendation is to work towards adopting common language and meaning related to ICT use amongst RAS networks globally (Davis & Sulaiman, 2014). One of the challenges associated with the RAS

networks is the tension between reacting to local needs (Richardson, 2002) while balancing the need to evolve and keep pace with best practices globally (Dhaka & Chayal, 2010). Adopting common language helps to bridge this chasm. When disparate networks share common language related to ICT use it is possible that needs are better understood, issues are more rapidly ameliorated, and best practices are more readily shared (Inkpen & Tsang, 2005). Future research is recommended to use the results of the present study and develop a scale that can be used to measure ICT use across different RAS networks consistently.

Once common language, understanding, and consistent measurement is established an additional recommendation would be to transparently share assessment results in a pluralistic manner (Christoplos, & Kidd, 2000). When networks are able to learn from one another there is the potential for rapid improvements globally. The network effect anticipated with social capital theory (Woolcock & Narayan, 2000) therefore may have impacts both within a RAS network internally as well as between RAS networks more broadly.

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