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An Analysis of Access and Use of ICTs by Agricultural Researchers in Iran

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ABSTRACT

Information and Communication Technologies (ICTs) have affected all sectors including the agricultural sector. ICTs play an essential role in sharing knowledge and information and networking among different actors of the agricultural sector. Agricultural researchers, as the main actors of generating and developing knowledge and technology, need to use the unique capacities of ICTs. The current situation of access to ICTs and the extent and skill of agricultural researchers in using ICTs need to be evaluated to take advantage of this capacity. In this study, 141 researchers from six agricultural research institutes of Iran were selected by multi-stage random sampling method to survey their access, purpose, skill, and extent of using ICTs. The findings indicated that researchers had access to the main ICT tools such as computers and the Internet. Researchers mainly used ICTs for information acquisition, chatting and sending messages, and finding educational materials and resources. Most of the researchers use e-mails, search engines, and social networks every day. The primary skills of most researchers were good at working with computers. Job experience and skill in using ICTs explained 46.7% of the variance of using ICTs.

Keywords: Agricultural researcher, Information acquisition, Information and communication technologies.

INTRODUCTION

The agricultural sector is one of the main economic sectors of Iran. The importance of the agricultural sector in Iran's economy has always been emphasized for such purposes as food security, environmental sustainability, entrepreneurship, employment, income generation, and export growth (Sharifzadeh *et al.*, 2014). However, this sector faces several challenges such as unsustainable food security, water and land resources limitation, climate change, soil erosion and degradation, drought and so on. Creating the basis for improving access to and use of ICTs is one of the most effective actions to meet these challenges (Falaki *et al.*, 2008).

ICTs refer to such components as hardware, software, data management technology, and network and telecommunication technology, which will help humanity to face and manage changes (Laudon and Laudon, 2012). They include older tools (print, radio, television, video, fax), modern tools (computers, the internet, web-based applications, cellular phones, CD-ROMs) (Colle and Roman, 2003) and, recently, Web 2.0-based tools (the second generation of the web). In addition to the capabilities of former ICTs, Web 2.0-based tools have such capabilities as collective

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knowledge production and user-to-user information exchange (Choudhury, 2014).

The achievement of sustainable agricultural development depends on a robust and efficient agricultural research system, which is the main source of generation and development of technologies and knowledge in this sector (Dalrymple, 2000).

The International Service for National Agricultural Research (ISNAR), a renowned international organization, has proven the importance of using new ICTs for the development of agricultural research (ISNAR, 1999).

Often, the dispersion of researchers throughout national, institutional, and geographic boundaries has led to more use of ICTs for communications among them in recent years (Ward, 2016). Some studies showed that ICTs could enable researchers to improve agricultural researches through facilitating data gathering, electronic sharing, exchange of research findings, enhancing networking at a global level with more efficiency and effectiveness, and linking with farmers and understanding their needs (ISNAR, 1999; Glendenning and Ficarelli, 2012; Awuor *et al*., 2013).

The effective use of these technologies, especially in developed countries, has not only improved research activities but has also made their agriculture sustainable (Salau and Saingbe, 2008; Agbetuyi and Oluwatayo, 2012; Nnadi *et al*., 2012). Sustainability of agriculture is achieved by the tools of ICTs, which provide public access to information and tools for public participation in decision making, information dissemination, government accountability, public awareness, promotion of the best practices, alternative livelihoods, mapping, and environmental monitoring (Nnadi *et al*., 2010; Nnadi *et al*., 2012).

ICTs, especially social networks such as Facebook and LinkedIn, empower people to connect themselves, collaborate, and share information (World Bank, 2017). It is assumed that collaboration among scientists and researchers increases the productivity of scientific researches (Duque *et al*., 2005). With the increasing importance of collaboration in the knowledge production process, new ICTs make distant collaboration possible (Olson and Olson, 2000). ICTs, especially the internet, increase collaboration among researchers (Shrum, 2005). For example, email, despite the lack of visual contact, is compatible with the needs of international researchers to share information and communication across multicultural teams regardless of language, distance, and cultural barriers (Ward and Given, 2017).

Agricultural researchers use different ICTs in the following aspects: connecting with national and international colleagues and discussing scientific issues with each other, applying skills and knowledge in the fields of work, reading journals, and representing empirical evidence for their actions like photos or movies. In addition, they use ICTs to identify opportunities and find potential partners for research projects, solve the challenges they face in their organizations (Singh and Yuvaraj, 2012; Sokoya *et al.*, 2012; Banmeke and Oose, 2012; Chisenga *et al.*, 2014; Falaki *et al.*, 2008; Parmar, 2012; Ghasemi *et al.*, 2011).

There are a number of factors that have to be taken into consideration before implementing ICTs in agricultural communities: accessibility to appropriate and adequate infrastructures and ICTs (Sharifzadeh *et al.*, 2008; Barakabitz *et al.*, 2015; Chisenga *et al.*, 2014; Sokoya *et al.*, 2012; Angello and Wema, 2010; Ospina and Heeks, 2012; Mtega and Msungu, 2013; Lawal-Adebowale *et al.*, 2014; Singh and Yuvaraj, 2012; WorldBank, 2011, 2017), the skills and knowledge of users to apply these technologies (Lawal-Adebowale *et al.*, 2014; Chisenga *et al.*, 2014; Angello and Wema, 2010; Ospina and Heeks, 2012; Mtega and Msungu, 2013; OECD, 2016; WorldBank, 2011, 2017; Kale *et al.*, 2016; Husseini and Safa, 2009; Movahedi and Nagel, 2012), status of using ICTs (Sharifzadeh *et al.*, 2008; Lawal-Adebowale *et al.*, 2014; Barakabitz *et al.*, 2015; Angello

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and Wema, 2010; Ospina and Heeks, 2012; Mtega and Msungu, 2013), and socio-demographic characteristics such as age and institutional factors (Rasouliazar *et al.*, 2013; Alipouri, 2016; Yaghoubi and Shamsayi, 2004; Singh and Yuvaraj, 2012; Parmar, 2012).

Many Iranian agricultural researchers produce knowledge and technology in several agricultural research institutes around the country. An effective and productive agricultural research system needs to benefit from efficient and up-to-date information and use the power of ICTs. Thus, knowing the accessibility and use of ICTs by agricultural researchers is necessary. Moreover, till now, no studies have reported the accessibility and use of ICTs by Iranian agricultural researchers. Hence, the findings of this study will help planners to formulate effective policies for the use of ICTs and to integrate ICTs into this context before spending substantial sums of money. Therefore, this study aimed to study the accessibility and use of ICTs by agricultural researchers in Iran. To accomplish this, the specific goals were the following:

- Determining the status and place of access to ICTs by researchers;
- Exploring the purpose of using ICTs by researchers;
- Determining the extent of ICT use by researchers;
- Assessing the skill level of researchers in using ICTs;
- Identifying the effective factors of using ICTs by researchers.

MATERIALS AND METHODS

The present study is quantitative regarding its nature, non-experimental regarding the degree of control of variables, and practical regarding its goals. It was carried out in a descriptive-correlative manner. The present quantitative study provides a detailed description of issues concerning ICT use by agricultural researchers in Iran. It also investigates some correlations between the possible factors that influence ICT use.

The statistical population included 316 agricultural researchers working in six agricultural research institutes of Iran (Table 1). Indeed, 175 researchers from these institutes were selected as the samples by using Krejcei and Morgan's Sample Size Table (Krejcei and Morgan, 1970). A questionnaire was used for collecting the data of this study. Multi-stage random sampling method with proportional allocation was used to access the samples and complete the questionnaires (first, agricultural research institutes were selected purposively, and then the samples were selected randomly). The questionnaires were distributed among the researchers, and after three follow-ups, 141 questionnaires were completed.

The questionnaire had five sections. The content and face validity of the questionnaire was confirmed by a panel of professors and experts of Tarbiat Modares

Table 1. The statistical distribution of the agricultural researchers at research institutes, extracted sample and completed questionnaires.[a]

Selected Institute	*N*	*n*	*Q* no
Seed and Plant Improvement Institute	72	40	37
Iranian Research Institute of Plant Protection	91	50	45
Dryland Agricultural Research Institute	39	22	21
Agricultural Engineering Research Institute	30	17	11
Animal Sciences Research Institute of Iran	39	21	10
Research Center for Agriculture and Natural Resources of East Azerbaijan Province	45	25	17
Total	316	175	141

[a] *N* = Population size; *n* = Sample size, *Q* no = Number of completed questionnaires.

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University and Agricultural Research, Education, and Extension Organization of Iran (AREEO).

To determine the reliability of the questionnaire, 15 copies of the questionnaire were completed by researchers at the Research Center for Agriculture and Natural Resources of Tehran Province. After data collection, Cronbach's Alpha coefficient was calculated for the items that were questioned by the ordinal scale. The details of the questionnaire are shown in Table 2.

All statistical analyses were done using $SPSS_{22}$. Descriptive statistics (mean, frequency, percentage, and standard deviation) and inferential statistics (spearman and Pearson correlation analyses, and regression analysis) were used to analyze the data.

RESULTS

According to the findings, the mean value of the respondents' age was 45.1 years, and the highest frequency (mode) belonged to those aged 50 years old. The majority of the respondents (73.05%) were male while 25.53% were female. The mean value of job experience was 17.45 years. The educational level of 60.28% of the respondents was PhD degree, followed by 36.17% Master's, and 2.13% Bachelor's degrees.

Table 3 shows access status and place of access to ICTs. The results indicated that almost all respondents, i.e., 98.6 and 97.9%, respectively, accessed computers and the Internet as essential tools of new ICTs. The majority of the respondents (87.2%) had access to printers, and 73.8% of them had access to scanners. Investigating access to online database tools, which provide free or low-cost access to journals and information on agriculture and related sciences, showed that 72.3% of the researchers had access to the local online databases and 66.7% of them had access to international online databases. Also, 80% of the respondents had access to CD-ROMs containing abstracts and findings of agricultural researches.

Table 4 shows the frequency of using ICT tools based on the purpose. According to the results, the item "information acquisition" had the highest mean and was in the first rank, the item "chatting and sending messages" was in the second rank, and the item "finding educational materials and resources" was in the third rank. The total mean of the items in this section was 2.33, which meant that the frequency of ICT use was between low to moderate.

The web-based tools are important for daily work and research. Therefore, the extent of the use of these tools was assessed (Table 5). The findings indicated that 90.7 and 82.9% of the researchers used, respectively, search engines and emails every day. Also, 69.5% of the respondents used Web 2.0-based messengers such as Telegram every day while 61% used local online databases every day.

Table 6 shows the ranking of respondents' skills in using ICTs. Based on the results, the item "Word processing software (e.g., Microsoft Office Word)" had the highest mean and was in the first rank and its mean was 4.36, which shows that the skill of respondents in this item was between high and very high. The item "broadcasting video and personal photos on the Internet (like

Table 2. Sections of the questionnaire and Cronbach's Alpha for studied scales.

Section	No of Items	Measurement scale	Cronbach's Alpha
Availability to ICTs	37	Nominal[a]	-
Purpose of using ICTs	29	Ordinal[b]	0.91
Extent of using the ICTs	16	Ordinal[c]	0.84
Skill in using ICTs	24	Ordinal[d]	0.85
Socio-demographic characteristics	4	Nominal, Interval	-

[a] (Yes/No); [b] (Not at all, very low, low, moderate, high, very high); [c] (Daily, 2 or 3 times on week, more than 3 times on week, Once in 2 weeks, monthly, at all), [d] (Very low, low, moderate, high, very high).

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YouTube)" had the lowest mean and was in the last rank. The mean in the item "Advanced search through search engines (like Google)" was 4.12 and was in the second rank. The mean of "Electronic communications facilities (such as E-mail, Messenger)" was 4.07 and its rank was the third. The total mean of the skills was 2.79, which means that the total skill was between low to moderate.

Pearson and Spearman correlation coefficient was used to investigate the correlation between individual characteristics, access to ICTs, skill in using ICTs, and the extent of ICT use. The results indicated that the age and job experience of the researchers had a negative and significant correlation with the extent of ICT use at the 0.01 level. Skill in using ICTs, access to ICTs, and the purpose of using ICTs had a positive and significant correlation with the extent of ICT use at the 0.01 level (Table 7).

The regression model (Enter method) was employed to predict the effect of independent variables on ICT use by the researchers.

The variables age, literacy rate (dummy coded), job experience, access to ICTs, the purpose of using ICTs, and skill in using ICT were inserted into the regression equation, and the significance of each of them was calculated. Two independent variables had a significant effect on using ICTs. These variables were "skill in using ICTs" (X1) and "job experience" (X2) (Table 8).

The model is specified as follows:

$Y= -4.160+0.375X_1$ *(Skill in using ICTs)* $-0.521X_2$ *(Job experience)*

Skill in using ICTs and job experience explained 46.7% of the variation of ICT use among the researchers. If the job experience increases by one year, then score of using the ICTs is reduced by 0.521.

DISCUSSION

The results of the study showed that there was good access to some basic tools such as computers, laptops, the Internet, digital cameras, and CD-ROMs, but access to local and international databases was not assessed to be good.

Using ICTs for such purposes as information

Table 3. Place of access to ICTs (%).

Tool	Not access	Access						
		Institution	Home	Private centers	Both home and institution	Both in the institution and private centers	Both in the home and private centers	All places
Computer	1.4	33.3	8.5	-	54.6	-	-	2.1
Laptop	18.4	7.8	62.4	-	11.3	-	-	-
Internet	2.1	17.7	7.8	-	71.6	-	-	.7
Digital camera	20.6	16.3	39	-	24.1	-	-	-
Video recorder	29.8	11.3	45.4	.7	12.8	-	-	-
GPS	53.2	27	12.8	-	7.1	-	-	-
Printer	12.8	48.3	7.1	.7	29.8	-	-	.7
Scanner	26.2	48.2	12.1	-	13.5	-	-	-
CD-ROM	19.9	23.4	15.6	-	41.1	-	-	-
Local online database	27.7	48.9	5	-	17.7	-	.7	-
International Online databases	33.3	46.8	4.3	.7	14.2	-	.7	-

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Table 4. Purpose of Using ICTs.

Item	Mean[a]	*SD*	Rank
Information acquisition	4	1.01	1
Chatting and sending messages	3.7	1.02	2
Finding educational materials and resources	3.7	1.03	3
Carrying out job tasks	3.62	1. 31	4
Sharing information	3.3	1.27	5
Transmition of files and texts	3.22	1.30	6
Study of electronic magazines and newspapers	2.87	1.37	7
Online reference databases (Wikipedia, Encyclopedia)	2.83	1.52	8
Engaging in collaborative research	2.80	1.29	9
Sharing pictures, photos, and videos	2.77	1.37	10
Participation in discussion	2.72	1.26	11
Making links with other research institutions	2.67	1.26	12
Introducing new agricultural initiatives and agricultural innovations	2.56	1.36	13
Using to create, save and edit online documents and spreadsheets	2.52	1.48	14
Meeting new people	2.35	1.31	15
Presentation of audio-visual information	2.16	1.57	16
Fun	2.10	1.32	17
Online counselling	1.72	1.37	18
Mobilizing stakeholders to hold scheduled meetings	1.67	1.33	19
Launching agricultural news/creating awareness of new agricultural issues and challenges	1.64	1.37	20
Communicating with extension agents and experts	1.61	1.35	21
Downloading music and games	1.58	1.36	22
Uploading event pictures	1.55	1.42	23
Publishing and maintaining blogs	1.53	1.45	24
stakeholders networking	1.52	1.43	25
Video conference	1.46	1.48	26
Communicating with farmers	1.37	1.36	27
Uploading video clips	1.35	1.35	28
Buying, selling and doing business	1.03	1.25	29

[a] Mean ranges from 0 to 6, (0= Not at all, 1= Very low, 2= Low, 3= Moderate, 4= High, 5= Very high). The mean used to rank items, and the standard deviation item used for ranking in the case of equal mean.

Table 5. The extent of using different Web-Based Tools (%).

Tool	Rank by daily use	Daily	2 or 3 Times a week	More than three times a week	Once in 2 weeks	Monthly	At all
Search engines such as Google	1	90.7	5	1.4	0.7	2.1	-
E-mail	2	82.9	8.6	2.9	2.1	3.6	-
Telegram	3	69.5	8.5	5	1.4	1.4	14.2
Local online databases	4	61	16.3	5	5	5.7	7.1
Organizational website	5	48.9	8.6	8.6	5	2.2	26.6
Messenger	6	17.1	11.4	3.6	5.7	13.6	48.6
International online databases	7	15.6	11.3	9.2	10.6	25.5	27.7
Researchgate	8	12.1	20.6	5	12.8	17.7	31.9
LinkedIn	9	11.3	15.6	5.7	9.2	11.3	46.8
Specialized software in your institution	10	9.9	16.3	9.2	8.5	28.4	27.7
Wikipedia	11	7.8	24.1	7.8	10.6	24.8	24.8
Blogs	11	7.8	9.2	9.2	13.5	23.4	36.9
Google +	12	7.1	7.1	5.7	4.3	14.9	61
Slide sharing sites	13	1.4	2.1	1.4	6.4	12.8	75.9
Skype	13	1.4	4.3	0.7	4.3	9.9	79.4

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Table 6. Ranking of respondents' skill in using ICTs.

Skill	Mean[a]	*SD*	Rank
Word processing software (e.g., Word)	4.36	.72	1
Advanced search through search engines (like Google)	4.12	1.06	2
Electronic communications facilities (Such as E-mail, Messenger)	4.07	1.1	3
Presentation software (Like PowerPoint)	3.93	1.04	4
Library resources and online science journals and eBooks	3.33	1.34	5
Online science spaces (Academic and academic sites, Wikipedia)	3.27	1.24	6
News-information spaces (Databases)	3.19	1.21	7
Digital imaging tools (Such as digital cameras)	3.15	1.29	8
Use the Internet to improve the quality of education	3.07	1.47	9
Research-statistical facilities: Data analysis software, online surveying.	3.03	1.22	10
Install and upgrade various computer programs	3.01	1.31	11
Search in specialized agricultural libraries	2.91	1.23	12
Possibility to publish and retrieve short scientific articles in the form of scientific e-journals	2.82	1.36	13
Internet media: Internet radio and television	2.7	1.39	14
Data creation and management software (Such as Access)	2.58	1.26	15
Skills in solving the problems encountered in Internet calls	2.51	1.21	16
Work with web 2.0-based tools such as virtual social networks like LinkedIn, etc.	2.31	1.24	17
Internet research facilities such as simulators, laboratories or virtual labs	2.25	1.25	18
Creating Internet groups to exchange and discuss with colleagues, farmers and extension agents (Such as News Group)	2.08	1.19	19
Video communication systems: such as webcam, video conferencing.	2.05	1.14	20
Web design and editing software (Like the front page)	1.87	1.15	21
Using e-learning software (e.g. Web CT)	1.70	1.08	22
Create a blog to publish favorite topics	1.69	1.06	23
Broadcasting video and personal photos on the Internet (Like YouTube)	1.68	1.15	24

[a] Mean ranges from 1 to 5, (1= Very low, 2= Low, 3= Moderate, 4= High, 5= Very high). The mean used to rank items, and the standard deviation item used for ranking in the case of equal mean.

Table 7. Correlation between the selected characteristics and using the ICTs.

Factor	Variable	Type of test	*r*	*P*
Age	Extent of ICT using	Pearson	- 0.234**	0.006
Job experience	Extent of ICT using	Pearson	- 0.364**	0.000
Skill in using ICTs	The extent of ICT using	Spearman	0.686**	0.000
Access to ICTs	Extent of ICT using	Spearman	0.411**	0.000
Purpose of using ICT	The extent of ICT using	Spearman	0.450**	0.000
Age	Skill in using ICTs	Pearson	-0.248**	0.004
Job experience	Skill in using ICTs	Pearson	-0.321**	0.000

** Significant at the 0.01 level.

Table 8. Regression coefficients of variables influencing the ICT using among researchers.

Indicators	Unstandardized coefficients		Standardized coefficients	*t*	Sig
	B	Std Error	Beta		
(Constant)	-4.160	9.013		-0.401	.689
X_1 skill in using ICTs	0.375	.019	0.539	5.380	0.000
X_2 Job experience	-0.521	.067	-0.348	-2.113	0.037
R-square= 0.515	sig F= 0.000	F= 10.725	Adjusted R-square = 0.467		

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acquisition, finding educational materials and resources, chatting and sending messages, carrying out job tasks, information sharing, and transmission of files and texts were scored moderate to high, in agreement with the findings of Banmeke and Oose (2012) and Ghasemi *et al.* (2011). As informal contact tools, chatting and sending messages lead to frequent opportunities for communication and have been shown to be an important part of science communication and collaboration (Kraut *et al*., 1988). Based on the findings, the use of ICTs to link with other researchers and scientific collaborations was between low to moderate. This result could be due to a lack of interest for scientific collaboration and institutional and policy problems, for example, policies which do not encourage the use of ICTs and communication with other researchers and actors. Also, these uses of ICTs constituted the main uses of ICTs and other uses were neglected. The total use of ICTs for the mentioned purposes was from low to moderate. This means that ICT capabilities are still not widely used and the reason could be the poor skill of researchers. Falaki *et al.* (2008) also pointed to the low use of ICTs by agricultural extension experts in Iran.

Despite the importance of web-based tools in linking and communicating with colleagues and other actors in the agriculture sector, using these tools was low for these purposes. In this regard, ResearchGate and LinkedIn can be mentioned. Low skill in working with Web 2.0-based tools and social networks resulted in the low use of these tools. Also, the complexity and time-consuming nature of these sites, lack of the Persian language in the capabilities of these sites, and also the poor English language skills of researchers can be other reasons for the low use of these sites. Scientific collaboration at international level requires English language proficiency (Hwang, 2005), and lack of this skill is a barrier to scientific collaboration internationally even if researchers have access to ICTs. Ward and Given (2017), Ward (2016), and Hwang (2005, 2013) also referred to the English language as a communication constraint in their studies.

E-mails and search engines were found to be utilized well. E-mail was the dominant ICT used by agricultural researchers in developing countries such as India, Ghana, and Kenya (Duque *et al*., 2005). Also, using search engines and e-mails was a high priority for agricultural extension experts in the studies of Ghasemi *et al*. (2011) and Falaki *et al*. (2008). Researchers' skills in the basic uses of ICTs, e.g. word processing, advanced search, and electronic communications, were high. Therefore, these results were in line with each other. Telegram Messenger is used every day by most of the researchers, probably because it is easy to use, has Persian language capability, and has high speed.

Age had an opposite effect on the skill in using ICTs. Most of the researchers were middle-aged, and since these ICTs are new, many researchers had not been trained in the public education system to use them. These results are consistent with the results of Kale *et al*. (2016), Yaghoubi and Shamsayi (2004), Singh and Yuvaraj (2012), and Parmar (2012).

Age and job experience had a negative and significant relationship with the use of ICTs. Age was related to job experience, and age and job experience were against the use of ICTs. Accordingly, as age and job experience increased, the use of ICT decreased. These findings are consistent with the results of Rasouliazar *et al.* (2013) and Alipouri (2016).

Job experience had a negative effect on ICT use while skill in using ICTs had a positive effect on ICT use. In the study of Ghasemi *et al.* (2011), job experience was effective in explaining the use of ICTs by agricultural experts. In studies conducted by Lawal-Adebowale *et al.* (2014), Chisenga *et al.* (2014), Angello and Wema (2010), Ospina and Heeks (2012), Mtega and Msungu (2013), OECD (2016), World Bank

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(2011, 2017), Kale *et al*. (2016), Husseini and Safa (2009), and Movahedi and Nagel (2012), skill in using ICTs was referred to as an important factor on ICT use.

CONCLUSION

This study identified the access and use of ICTs by some Iranian agricultural researchers. Careful ICT selection according to specific tasks and various cultural, institutional, economic, and social contexts of users help them to continue using ICTs in researchers and communications (Ward, 2016). In general, use of the unique capabilities of ICTs in all fields, especially research, scientific cooperation at the national and international levels, and linking the actors of the agriculture sector is not at the desired level and requires creating infrastructures, policy-making, and institutionalization to encourage users to employ these technologies. Also, it is suggested that training courses on the uses of ICTs be held to improve the digital literacy and skills of the users and that institutes be equipped with the required hardware and software for research activities. This study, like all studies in the field of social sciences, was confronted with the following limitations:

Since data of the use of ICTs by agricultural researchers was not available, self-reporting surveys were used. For further research, it is suggested that specific capabilities of ICTs such as improving communication be considered, and communication by ICTs within national and international agricultural research teams be explored.

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REFERENCES

1. Agbetuyi, P. A. and Oluwatayo J. A. 2012. Information and Communication Technology (ICT) in Nigerian Educational System. *Mediterranean J. Soc. Sci.,* **3(3):** 41-45.
2. Alipouri, M. 2016. Investigating Economic, Social and Personal Factors Affecting Acceptance of Information and Communication Technology (Case Study: Rural Area of Babolsar. Unpublished Master Thesis of Agricultural Economics, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran. (in Persian)
3. Angello, C. and Wema, E. 2010. Availability and Usage of ICTs and E-Resources by Livestock Researchers in Tanzania: Challenges and Ways Forward. *IJEDICT*, **6(1):** 53-65.
4. Awuor, F., Kimeli, K., Rabah, K. and Rambim, D. 2013. ICT Solution Architecture for Agriculture. *IST-Africa 2013 Conference Proceedings*, International Information Management Corporation.
5. Banmeke, T. O. A. and Oose, M. O. 2012. Assessment of the Use of Social Network Tools (SNTs) By Agriculture Researchers in South West Nigeria. *CIIMA*, **12(3):** 35- 50.
6. Barakabitze, A.A., Kitindi, E.J., Sanga, C., Shabani, A., Philipo, J. and Kibirige, G. 2015. New Technologies for Disseminating and Communicating Agriculture Knowledge and Information: Challenges for Agricultural Research Institutes in Tanzania. *EJISDC*, **70(2):** 1-22.
7. Chisenga, J., Kedemi, R. and Sam, J. 2014. The Use of Social Media in Agricultural Research Workflows in Ghana and Kenya. *Agric. Inf. Worldwide*, **6:** 48-57.
8. Choudhury, N. 2014. World Wide Web and Its Journey from Web 1.0 to Web 4.0. *IJCSIT*, **5 (6):** 8096-8100
9. Colle, R. D. and Roman, R. 2003. *Handbook for Telecentre Staffs*. Cornell University, Ithaca.
10. Dalrymple, D. G. 2000. *The Role of Public Agricultural Research in International Development*. Oregon State University Extension Service Special Report 1017, June 2000. http://citeseerx.ist.psu.edu/viewdoc/downloa

[DOR: 20.1001.1.16807073.2019.21.6.10.9]

d?doi=10.1.1.475.4259&rep=rep1&type=pdf. Last Accessed 12-10-2016.
11. Duque, R. B., Ynalvez, M. A., Sooryamoorthy, R., Mbatia, P., Dzorgbo, D. B. S. and Shrum,W. 2005. Collaboration Paradox: Scientific Productivity, the Internet, and Problems of Research in Developing Areas. *Soc. Stud. Sci.,* **35(5):**755–785
12. Falaki, M., Shabanali Fami, H., Iravani, H., and Movahed Mohammadi, H. 2008. A Comparative Analysis of the Extent of Knowledge of, and Application of Information Technology by the Agricultural Extension Professionals in Iran. *IJA*S, **2-38(3):** 69-80. (in Persian)
13. Ghasemi, J., Nazari, S., Gharoon, Z., Rohani, H. and Gholifar, E. 2011. Factors Affecting Use of Information and Communication Technology (ICT) by Agricultural Extension Experts, in Khorasan Razavi Province. *IJAEDR,* **42(1):** 93-104. (in Persian)
14. Glendenning, C. J. and Ficarelli, P. P. 2012. *The Relevance of Content in ICT Initiatives in Indian Agriculture.* IFPRI Discussion Paper 1180. International Food Policy Research Institute (IFPRI), Washington, DC.
15. Husseini, S. M. and Safa, L. 2009. Factors Affecting the Use of Information and Communication Technologies (ICTs) by Iranian Agricultural Faculty Members. *World Appl. Sci. J.*, **6(8):** 1123-1127
16. Hwang, K. 2005. The Inferior Science and the Dominant Use of English in Knowledge Production: A Case Study of Korean Science and Technology. *Sci. Commun.,* **26(4):** 390-427.
17. Hwang, K. 2013. Effects of the Language Barrier on Processes and Performance of International Scientific Collaboration, Collaborators' Participation, Organizational Integrity, and Interorganizational Relationships. *Sci. Commun.,* **35(1):** 3-31.
18. ISNAR. 1999. *Agricultural Research Information System (ARIS)*. ISNAR Pub. No. 59, The Indian Council of Agricultural Research.
19. Kale, R. B., Meena, M. S. and Rohilla, P. P. 2016. Determining Factors and Levels of E-skills among Agriculture Experts of Krishi Vigyan Kendras in India. *J. Agr. Sci. Tech.*, **18(20):** 1749-1760
20. Kraut, R., Egido, C. and Galegher, J. 1988. Patterns of Contact and Communication in Scientific Research Collaboration. Paper Presented at the *Proceedings of the 1988 ACM Conference on Computer-Supported Cooperative Work*, Portland, Oregon, United States. http://portal.acm.org/citation.cfm?doid=62266.62267
21. Krejcei, R. V. and Morgan, D. W. 1970. Determining Sample Size for Research Activities. *Edu. Psychol. Measur.,* **30:** 607-610.
22. Laudon, K. C. and Laudon, J. P. 2012. *Management Information Systems: Managing the Digital Firm*.12th Edition, Prentice Hall.
23. Lawal-Adebowale, O. A., Ojesanmi, O. A., Banmeke, T. O. A. and Adeniran, A. A. 2014. Analysis of Agricultural Research Institutes' ICT Integration and Needs for Research Development in Southwest Zone of Nigeria. *Afri. J. Agric. Sci. Technol*., **2(1):** 31-43.
24. Movahedi, R. and Nagel, U. J. 2012. Identifying Required Competencies for the Agricultural Extension and Education Undergraduates. *J. Agr. Sci. Tech.,* **14:** 727-742.
25. Mtega, W. P. and Msungu, A. C. 2013. Using Information and Communication Technologies for Enhancing the Accessibility of Agricultural Information for Improved Agricultural Production in Tanzania. *EJISDC,* **56 (1):** 1-14.
26. Nnadi, F.N., Chikaire, J., Ejiogu-Okereke, N. and Nwakwasi, R. N . 2010 Information and Communication Technology (ICT) For Food Production and Distribution. *Proceedings of the 44th Annual Conferences of Agriculture Society of Nigeria,* Ladoke Akinkal University of Technology, Oyo State.
27. Nnadi, F. N., Chikaire, J., Atoma, C. N., Egwuonwu, H. A. and Echetama, J. A. 2012. ICT for Agriculture Knowledge Management in Nigeria: Lessons and Strategies for Improvement. *Sci. J. Agr. Res. Maneg.*,1-8.
28. OECD. 2016. *Skills for a Digital World", Policy Brief on The Future of Work*. OECD Publishing, Paris.
29. Olson, G. M. and Olson, J. S. 2000. Distance Matters. *Hum-Comput. Interact.,* **15(2-3):** 139-178.
30. Ospina, A. V. and Heeks, R. 2012. ICT-Enabled Responses to Climate Change in

[DOR: 20.1001.1.16807073.2019.21.6.10.9]

Rural Agricultural Communities. Strategy Brief 2: "*Climate Change, Innovation and ICTs Project*". http://www.niccd.org/ICTs_and_Climate_Change_in_Rural_Agric_Communities_Strategy_Brief.pdf.

31. Parmar, S. 2012. Use of E-Joumals and CD-ROM Databases by Fraternity of CCSHAU, Hisar, India. *IJIDT,* **2(1):** 62-66.
32. Rasouliazar, S., Sadighi, H. and Chizari, M. 2013. Professional Information and Use of Information Technology by Researchers and Specialists at Staff Level of Jehad-Keshavarzi. *Iran. Agr. Ext. Edu. J.*, **8(2):** 139-153. (in Persian).
33. Salau E. S. and Saingbe, N. D. 2008. Access and Using Using of Information and Communication Technologies (ICTs) among Agricultural Researchers and Extension Workers in Selected Institutions in Nasarawa State of Nigeria. *PAT,* **4 (2):** 1-11.
34. Sharifzadeh, A., Abdollahzadeh, G. H. and Sharifi, M. 2008. Integrating Information and Communication Technologies in the Iranian Agricultural Research System. *Int. J. Edu. Devlop. Using ICT,* **4(4):** 159-170.
35. Sharifzadeh, A., Abdollahzadeh, G. H. and Sharifi, M. 2014. Diagnosing Management of Agricultural Research and Technology Development under the Agricultural Innovation Framework. *Agr. Eco. Dev.*, **28(1):** 71-82. (in Persian)
36. Shrum, W. 2005. Reagency of the Internet, or, How I Became a Guest for Science? *Soc. Stud. Sci.*, **35(5):** 723–754.
37. Singh, A. P. and Yuvaraj, M. 2012. Creating Global Village of Agricultural Practice through Social Networking: Opportunities and Threats. *World Library and Information Congress: 78th IFLA General Conference and Assembly*, Helsinki. http://conference.ifla.org/ifla78
38. Sokoya, A. A., Onifade, F. N. and Alabi, A. O. 2012. Establishing Connections and Networking: The Role of Social Media in Agricultural Research in Nigeria. *World Library and Information Congress: 78th IFLA General Conference and Assembly*, Helsinki. http://conference.ifla.org/ifla78
39. Ward, W. 2016. Exploring in-Person and Technologically-Mediated Communication within International Agricultural Research Teams. Unpublished Doctoral Dissertation, Charles Sturt University, Waga Wagga, NSW, Australia. Retrieved from: http://trove.nla.gov.au/version/235880785
40. Ward, S. W. and Given, L. M. 2017. Assessing Technologies for Information Sharing in International Research Teams: Developing an Intercultural Heuristic Evaluation Tool. *80th Annual Meeting of the Association for Information Science and Technology*, October 27-November 1, 2017, Washington, DC, VA.
41. World Bank. 2011. *Information and Communication Technologies for Agriculture e-Sourcebook*. World Bank, Washington DC.
42. World Bank. 2017. *Information and Communication Technologies for Agriculture e-Sourcebook*. World Bank, Washington DC.
43. Yaghoubi, J. and Shamsayi, E. 2004. Assessing Effective Factors in Using Internet by Faculty Members of Agricultural College of Zanjan University, Iran. *In:* "*Proceedings of the 20th Annual Conference of the Association for International Agricultural and Extension Education (AIAEE)",* (Ed.): Connors, J. J. Dublin, Ireland.

[DOR: 20.1001.1.16807073.2019.21.6.10.9]

ارزیابی دسترسی و استفاده از فناوری‌های اطلاعات و ارتباطات توسط پژوهشگران کشاورزی ایران

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چکیده

فناوری‌های اطلاعات و ارتباطات (فاوا)، تمام بخش‌ها از جمله کشاورزی را متأثر ساخته‌اند. فناوری‌های اطلاعات و ارتباطات نقش مهمی در اشتراک‌گذاری دانش و اطلاعات، و شبکه‌سازی بین کنشگران مختلف بخش کشاورزی ایفا می‌کنند. پژوهشگران کشاورزی به عنوان کنشگران اصلی تولید دانش و فناوری، نیازمند بهره‌مندی از ظرفیت‌های منحصر به فرد این فناوری‌ها هستند. برای بهره‌برداری از این ظرفیت، باید وضعیت فعلی دسترسی، میزان استفاده، و مهارت آنها جهت استفاده از فناوری‌های مذکور مورد ارزیابی قرار گیرد. در این مطالعه، ۱۴۱ پژوهشگر از شش موسسه تحقیقات کشاورزی کشور برای بررسی وضعیت دسترسی، هدف، میزان مهارت، و میزان استفاده‌شان از فاوا انتخاب شدند. یافته‌ها نشان داد که پژوهشگران به ابزارهای اصلی فاوا مانند کامپیوتر و اینترنت دسترسی داشتند، به طور عمده از فناوری‌های اطلاعات و ارتباطات برای کسب اطلاعات، گفتگو و ارسال پیام‌ها، پیدا کردن مواد آموزشی و منابع استفاده می‌کردند. اکثر پژوهشگران از ایمیل و موتورهای جستجو، و شبکه‌های اجتماعی به‌صورت روزانه استفاده می‌کنند. مهارتهای اصلی اکثر پژوهشگران برای کار با کامپیوتر خوب بود. سابقه کار و مهارت در استفاده از فناوری‌های اطلاعات و ارتباطات، ۴۶/۷٪ از واریانس تغییرات متغیر وابسته (استفاده از فاوا) را تبیین نمودند.

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