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Survey on Informatization Status of Farmers for Introducing Ubiquitous Agriculture Information System

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Abstract

Purpose: The modern IT can give enormous impacts on the agricultural production and consumption. However, farmer's ability to use IT devices has been known as one of the critical factors on success of IT in agriculture. This survey study was performed to evaluate the informatization status of farmers and to draw a strategy to develop and distribute a ubiquitous agricultural information system. **Methods:** A survey questionnaire with 19 questions on the degree of IT devices such as computers and smartphones and their utilization were developed. The survey was questioned 3 groups of farmers in Gyounggi Province and analyzed statistically by the χ^2 test. **Results:** The order of IT devices distribution were computers, smartphones, smart TVs and tablet PCs in all groups. The ratios of ownerships of the devices are 97.7, 78.6%, 31.4%, 17.8% respectively. The active farmers in this survey showed higher informatization level than that of native and the general farmers. **Conclusions:** The ubiquitous agricultural information system was judged to be developed for the computer because spread and use of it exceeds the other devices. Also, the information system based on the smartphone could be a complementary way if the rapid of the smartphones continues and proper education on use of the phone is provided.

Keywords: Agricultural information technology, Informatization status, Rural informatization, Ubiquitous

Introduction

Modern information technology have brought so-called "ubiquitous computing environment" in our daily life. In agriculture, farmers get agricultural information from the internet (Oh et al., 2011). Agricultural information means the knowledge required involved in the process of agro-fishery products production, sale and consumption (Kim et al., 2010) or information on agricultural production, distribution, and agro produce market etc. (Yu, 2003). Information technology is an effective way of overcoming the inconvenience of physical distance which prohibits rapid information exchange between farmers and consumers or between productions, shipment, and consumption (Kang et al., 2001). Yu and Lee (2008) discussed the benefits of using IT properly in agriculture and impact on farm income and agricultural growth. In particular, IT are useful in tracing food production, which is one of the hot issue in agriculture, because it can save farmers time of farming record keeping and provide better reliability on the information by use of sensors and computers (Kwon et al., 2012).

In developed countries, agricultural information systems based on ubiquitous computing environment are regarded as the future-oriented technology (Sørensen et al., 2010) and researches on the agricultural information technology are active (Kaloxylos et al., 2012; Sørensen et al., 2011).

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WSN (Wireless Sensor Network) based on wireless communications and the Internet (Liqiang et al., 2011; Zhang et al., 2012) for monitoring environmental and growth status of crops, in-situ data recording technology on agricultural machinery operation (Steinberger et al., 2009) and RFIDs (Radio Frequency Identification) for agricultural marketing or livestock management (Liu et al., 2013; Voulodimos et al., 2010) are typical examples of the new research trend. The ubiquitous environment helps farmers to obtain necessary information easily and to make a judgment about a particular situation by using it (Zhang et al., 2012).

In line with the global research trend in the agricultural information technology, a lot of similar studies have been accomplished in Korea (Kim et al., 2009). However, it is easily foreseen that the developed IT cannot be successfully used in farm unless the farmers are able to use and handle the IT devices and the agricultural information system.

Korea Government enacted 'Framework Act on Informatization Promotion' and 'Act on Solving Digital Divide' to promote informatization (Yu and Lee, 2008). In the agricultural sector, 'Basic plan for Agriculture and Rural Informatization' from 2007 to 2011 was announced to establish infrastructure and to make agricultural information available in the ubiquitous environment (Kim et al., 2010).

However, the gap of the informatization between urban and rural areas in Korea is obvious and has been increased (Kim, 2001; Oh et al., 2011). The gap was raised by the difference in the speeds of the Internets (Kang et al., 2001) and aging of farmers that is related to lack of ability to acquire information (Oh et al., 2011). Kim et al. (2010) reported that 91.7% of the surveyed farmers had never used e-commerce such as agricultural products sales through the Internet etc. and 60.9% of them did not know how to use computers account. Also, 37.6% of the surveyed farmers used internet and only 1.5% of overall managed homepage or blogs (Kim et al., 2010).

Our research team is developing a farm management information system with WSN for orchard, which collect environmental information of outdoor and the fruit-storage rooms in orchards and provide services on the cloud system. The information system would be naturally adopted and spread by active farmers as benefits of using such high-technology then the general farmers would perceive it. In designing the ubiquitous computing system, decision of the main information device was necessary. Recently, personal phone has been replaced by the smartphones, which can provide more freely access to the internet. Also, recent evaluation on farm informatization including the smartphone was rarely reported. This survey study was performed to evaluate the informatization status of active farmers and to draw a strategy to develop and distribute a ubiquitous agricultural information system.

Materials and Methods

Survey method and surveyee

There was a difference in the informatization level between farmers who received a related education and those who did not (Oh et al., 2011). The surveyees were divided into three groups to draw a strategy of farm informatization; Back-to-the-farm group (A), active farmers group (B) and general farmers group (C). Farmers in group A were trainees of a special education program for re-settlement in rural area, which was held by Gyeonggi-do Agricultural Research & Extension Services in May 2012. Farmers in group B were attendee of a specialty education on farming program at the same time and at the same place. Farmers in group C were participants of local agro-produce festival held in May 2012 at Suwon Korea. Group A could be considered as representatives of urban citizens. Group B and group C could be representatives of farmers who received IT education and farmers who did not receive related education. The survey was carried out by face-to-face interview with questionnaire handouts in Gyeonggi Province.

Questionnaire

The questionnaire was designed to evaluate which IT devices were widely spread among the farmers, how effectively farmers use the devices and which difficulties farmers were suffering in using the devices. The questionnaire shown in Table 1 consisted of a total of 22 questions as follows: 4 questions about whether to have IT devices, 3 questions about computer operation and utilization, 3 questions about smartphone and tablet PC operation and utilization, 3 questions smart TV operation and utilization, 6 questions about with which device they use the Internet and 3 questions about national agricultural information systems.

Special care was necessary in making the questions and related selection items because some of the surveyee

Table 1. Summary of questions in the questionnaire

Item	Question	Option
Possession of IT devices	Type of TV	Cathode-ray-tube , Flat screen TV, Smart TV
	Type of mobile phone	Folder type, Slide type, Touch phone, Smartphone
	Whether to have a computer	Yes, No, I don't know
	Whether to have Tablet	Yes, No, I don't know
Computer operation and utilization	Where to obtain use information	Regular education, short course, Self-study, seller, people around, others
	Available work	Internet, word processing, data reduction, Programming, Others, No
	Inconveniences of using	Slow, Internet disconnection, frequent failures, others, No
Smartphone/ tablet operation and utilization	Functions available	Web surfing, Application use, Data reduction, email, others, No
	Mainly used functions	Call, Text message, applications utilization, Web surfing, photo shooting, No
	Inconveniences when using	Poor call quality, wireless Internet, low battery, others, No
Smart TV operation and utilization	Purchase Plan	Yes, Specific plan, Vague plan, No. I don't know
	Functions available	Watching TV, VOD, Games, Internet, Others, No
	Mainly used functions	Watching TV, VOD, Games, Internet, Others, No
Device used for information search in the Internet	Subscribing Internet News Articles	Computer, smartphone, smart TV
	Searching General Information	Computer, smartphone, smart TV
	Searching Agricultural Information	Computer, smartphone, smart TV
	National Agricultural Information System	Computer, smartphone, smart TV
	Personal Blog, Mini Homepage	Computer, smartphone, smart TV
	Facebook, Twitter	Computer, smartphone, smart TV
National Agricultural Information System	Awareness	FoodSafety, GAP (Good Agricultural Products), Farm2Table, NCPMS (National Crop Pest Management System), iCOOP certification center
	Use	FoodSafety, GAP, Farm2Table, NCPMS, iCOOP
	Reliability	From "NO" to "YES", five levels

might do not know the items. Some questions were given with illustration as shown in Figure 1 to help the respondents of the survey could understand and easily select the items.

The IT devices in the questionnaire belonged to personal devices or home electronics which were known to be used. Possession of the IT devices such as desktop or laptop computers, tablet PCs, smartphones and smart TVs were surveyed. The smart TV had not been widely spread. However they were included because wide screen of them was thought as a strong point as a future IT devices for old-aged farmers with low vision.

To evaluate how effectively farmers use the IT devices, the type of information and the type of devices used for searching information and understanding of farmers on the functions of each device were surveyed. The type of

Figure 1. Example of an illustrated question designed for easy understanding.

information in the Internet included internet newspapers, general portal service, general agricultural information, agricultural information supplied by agricultural governmental institute, and SNS (Social Network Service) such as personal blog, Mini Homepage, Facebook or Twitter. Also, the source of knowledge on use of the IT devices and difficulties in using the IT devices were asked in the questionnaire.

Statistical analysis

The number of responses by all groups and the number of responses of each choice item were converted to a percentage in case of the question with singular choice. In case of questions with multiple choices, each choice given to the question was considered independently and the number of responses shown in the choice among all respondents by group was converted to a percentage.

Statistical differences in the frequency of responses among groups or items were analyzed by the chi-square (χ^2) test. The χ^2 test is one of independence test methods and can be used to obtain distribution differences between groups based on expected frequencies and observed frequencies (Aron et al., 2012). In the χ^2 test, if p-value is less than that of the significance level, the null hypothesis can be rejected. In this study the null hypothesis was rejected, if p-value is less than the significance level of 0.05, the null hypothesis was "There is no difference between the groups". The statistical program for χ^2 test was R (2.15.2, R Foundation for Statistical Computing, Austria).

The samples of the survey were limited as farmers in Gyeonggi Province and the sample size was not large enough to draw reliable statistics. Therefore, the results of this survey analysis may differ from the nationwide farmers' status. So comparison and contrast were conducted by referring to '2012 Information Gap Index and Status Survey' Literature (NIA, 2013) of National Information Society Agency.

Results and Discussion

Demographical characteristics of the surveyee

Total number of the surveyee was 135. Number of samples in the groups A, B and C are 47, 50 and 38 cases. Age distributions of each group was compared by the χ^2 test as shown in Table 2. According to the test, three groups showed statistically same (p=0.06806) age distribution.

However, sexuality, level of education, annual income of a farm, type of farming of the surveyee showed differences between groups. Percentage of male famers in group A, B and C were 80%, 61% and 82% respectively. Level of education showed statistically significant difference between groups (p<0.001). The education level was found to be higher in the order of group A, B and C. In group A, 33.3% of them graduated graduate schools and 23.3% of them graduated high schools or less. In general farmers, 2.9% of them graduated universities and 64.7% of them graduated high schools or less. In active farmers, 15.9% of them graduated universities and 35.6% of them graduated high schools or less. The types of farming of the surveyee were orchard (47%), vegetable cultivation (20.8%), multi-crop cultivation (20.8%), rice cultivation (2.1%) and the others farming (8.3%). Annual income of the farmers ranged from 10 to 400 million won and average of the annual income was 90 million won.

Table 2. Age distribution of the surveyee (Unit: people)

Group	30s	40s	50s	60s	70s	80s	Total
Back-to-the-farm group	3(10)	6(20)	15(50)	5(16.7)	1(3.3)	0(0)	30(100)
Active famers group	1(2.3)	10(22.7)	26(59.1)	7(15.9)	0(0)	0(0)	44(100)
General farmers group	3(8.8)	6(17.6)	22(64.7)	2(5.9)	0(0)	1(2.9)	34(100)

The number in parentheses is the percentage by group (Unit: %)

Table 3. Education levels of the surveyee (Unit: people)

Group	High school or lower	College	Graduate school	Total
Back-to-the-farm group	7(23.3)	13(43.3)	10(33.3)	30(100)
Active farmers group	17(38.6)	20(45.5)	7(15.9)	44(100)
General farmers group	22(64.7)	11(32.4)	1(2.9)	34(100)

The number in parentheses is the percentage by group (Unit: %)

Infrastructure of agricultural informatization

National Information Society Agency (NIA) reported "2012 Standard Investigation Results (NIA, 2013)". According to it, the PC-based informatization level of farmers was evaluated as 64.8% of the national average. Number of PCs per farm household was 0.62 units. Percentage of farmer who used the Internet was 40.2%. National averages of them were 0.82 and 78.4% respectively. In the mobile-based informatization, overall level of farmers was 25.3% of the national average. Numbers of smartphones and tablet PCs per capita was 0.19 units in contrast with 0.62 units of national averages. The report also pointed out that the gap of informatization between farmers and nation had been decreased every year but the gap in the mobile-based area was larger than the PC-based area. The reason of such gap was attributed to the facts that farmers were old to accept new IT devices rapidly and live in isolated areas without wired or wireless network.

Possession of IT devices was surveyed by singular choice questions. Table 4 summarized the possession status of IT devices. The order of the widely used IT devices were surveyed as computers (97.7%), smartphones (78.6%), tablet PC (31.4%) and smart TV (17.8%).

Table 4 shows larger values of number of computers per household and number of smartphones per capita than those reported in 2012 Standard Investigation Results (NIA, 2013). Also number of computers per household and number of smartphones per capita in Table 4 are larger than those of farmers in the NIA report. This difference could be explained with the following facts: 1) NIA surveyed all households including 4 underprivileged classes (Disabled, low-income, elderly, farmers), 2) Annual incomes of the surveyee that was 90 million won were larger than average income of farmers which was 31 million won (Statistics Korea, 2013), 3) Average age of the surveyee was younger than average age of farmers (Sixties or older farmers were known to be 44.7% of the total (Statistics Korea, 2011) but in this survey they were only 1.3%), 4) The surveyee in this survey were working adults.

Similarly, number of smartphones per capita in this survey was larger than those in the NIA report. In the Group C, the possession ratio of smartphones was 55.3%, which was smaller than that of nation but still larger than that of farmers in the NIA report. This difference was judged to be due to the same reason mentioned above.

The χ^2 test on possession of IT devices was carried out. Computers ($p=0.8076$) and smart TVs ($p=0.0732$) did not show statistical difference but smartphones showed statistically significant difference between groups ($p<0.01$). The above discussion could be summarized as the active farmers group possessed more IT devices than the general farmers group.

Table 4. Possession of IT devices (Unit: %)

Classification	Back-to-the-farm group (A)	Active farmers group (B)	General farmers group (C)
Computer	100 (45)	100 (50)	92.1 (38)
Smartphone	80.9 (47)	95.7 (46)	55.3 (38)
Tablet PC	39.5 (38)	32.5 (40)	18.5 (27)
Smart TV	10.6 (47)	21.2 (33)	23.7 (38)

The number in parentheses is the number of total respondents by each item (Unit: people)

Agricultural informatization in the PCs-based area

Source of computer knowledge for using computers were summarized in Table 5. According to the weighted average in Table 5, most useful source to farmers was found as self-study and information education programs offered by local agricultural technology centers. This result is similar to the previous study (Choi et al., 1996). They reported that 50% of poultry farms obtained computer knowledge information by self-study. The reason why farmers rely on self-study to get the computer knowledge might be due to the fact: 1) The surveyee might be only persons who could learn or want to learn in their village,

Table 5. Source of knowledge for using computers

Classification	Back-to-the-farm group (A)[a)]	Active farmers Group (B)[a)]	General farmers group (C)[a)]	Weighted average[b)]
Information education	21.3	28.0	18.4	23.0
Short course	12.8	16.0	13.2	14.1
Self-study	44.7	46.0	36.8	43.0
Seller	2.1	2.0	0.0	1.5
People around	44.7	38.0	31.6	38.5
Others	6.4	24.0	10.5	14.1

a) (Response frequency by each group/Number of total respondents by each group) x 100 (%)
b) Standard persons surveyed by each group (A: 47, B: 50, C: 38) Weighted average (%)

2) Considering that rural area entered the stage of super-aged society, and 3) Computer knowledge are abundant in the Internet and use of intuitive graphical symbols in the operating system makes it easy for farmers to learn by themselves. In this question, numbers of response on 'Seller' were too small to perform the χ^2 test. When numbers of response on "Seller" were added to those on "Others", no significant differences between the groups was found (p=0.2461).

Most important function of the personal computer was investigated as for searching information in the Internet. Table 6 showed that the order of computer works which farmers do was accessing the Internet, word processing, data management by spread-sheet program, and programming. The type of computer works showed statistically significant differences between the groups (p<0.05). The differences were clear in cases of "word processing" and "data management". Considerable number of famers in group B answered that they could do programming and use computer for other work. This fact shows that computers are not only office-ware but also tools for automatic greenhouse or livestock building operation. Personal computers are considered as home-electronics because there are lots of game-wares and fun-wares for computers. The Group B also had more interest in use of the computer and acquired more knowledge on computers than the general famers.

Inconveniences in using PCs were surveyed and its result was shown in Table 7. The inconveniences between groups showed statistically significant differences (p<0.05). However, items of 'slow computer speed' (p=0.3876), 'internet disconnection' (p=0.9724), and frequent failure' (p=0.09331) did not show significant differences in all groups. The statistical differences between groups were highly significant (p<0.01) in the item of 'no inconvenience'. There might be two reasons in high response on the item of 'slow speed of computer'; improper management and low physical specification of farmers' PCs. Computers have been supplied farmers with some subsidies, so that farmers are not willing to buy them at their own expenses. Also, some farmers interviewed complained that the computer speed became quite slow compared with to that of new one. Without regular computer virus checking and re-installing, all users could suffer the slow speed. Kim and Kwon (2006) reported that computer performance was degraded because unnecessary files account for resources due to negligent management or spyware. Item of 'Others' in Table 7 were virus infections or virus warnings. The difference between group A and group B or C might be caused by difference in using the vaccine program regularly.

Table 6. Type of computer works which farmers do and could do

Classification	Back-to-the-farm group (A)[a)]	Active farmers group (B)[a)]	General farmers group (C)[a)]	Weighted average[b)]
Internet	83.0	88.0	68.4	80.7
Word processing	76.6	80.0	36.8	66.7
Data management	40.4	48.0	15.8	36.3
Programming	6.4	12.0	5.3	8.2
Others	4.3	14.0	7.9	8.9
No	4.3	0.0	5.3	3.0

a) (Response frequency by each group/Number of total respondents by each group) x 100 (%)
b) Standard persons surveyed by each group (A: 47, B: 50, C: 38) Weighted average (%)

Table 7. Inconveniences encountered when using computers

Classification	Back-to-the-farm group (A)[a)]	Active farmers Group (B)[a)]	General farmers group (C)[a)]	Weighted average[b)]
Slow Computer Speed	42.6	52.0	39.5	45.2
Internet disconnection	29.8	28.0	28.9	28.9
Frequent failure	4.3	12.0	13.2	9.7
Others	4.3	14.0	2.6	7.4
No	23.4	8.0	10.5	14.1

a) (Response frequency by each group/Number of total respondents by each group) x100 (%)
b) Standard persons surveyed by each group (A: 47, B: 50, C: 38) Weighted average (%)

Agricultural informatization in the mobile area

The farmer's awareness about functions of smartphones and tablet PC was asked with a multiple choice question and shown in Table 8. When only Group A and Group B were compared, there was no difference in knowledge on smartphone functions between the two groups (p=0.9541) and Group C was found to be different from other groups. In particular, Group C showed significantly lower responses than Group A and B in case of web surfing (p<0.001), applications utilization (p<0.001) and email transmission and reception (p<0.01). This could be interpreted as the informatization level of the general famers is much lower than that of active farmers. Some farmers, who use the computer as an automatic control device for greenhouse environment, pointed-out that continuous operation of the control program was an important issue.

The frequently used functions of smartphones were asked with a multiple choice question and shown in Table 9. Here, 'frequently' meant using once or more often a day. There was no statistically significant difference (p=0.2389) between group A and group B but between group C and group A or B significant difference (p<0.05) existed. Frequently used functions are in the order of text message, telephone, camera and internet. Group A and B used all functions frequently but group C did not use applications and web-browsers often.

Inconveniences in using smartphones in Table 10 shows statistically significant difference among the groups

Table 8. Functions of smartphones which farmers can use

Classification	Back-to-the-farm group (A)[a)]	Active farmers group (B)[a)]	General farmers group (C)[a)]	Weighted average[b)]
Internet	63.8	64.0	28.9	54.1
Applications (Apps)	51.1	48.0	15.8	40.0
Data reduction	19.1	24.0	13.2	19.3
Email	68.1	68.0	34.2	58.5
Others	4.3	6.0	2.6	4.5
No	12.8	12.0	31.6	17.8

a) (Response frequency by each group/Number of total respondents by each group) x 100 (%)
b) Standard persons surveyed by each group (A: 47, B: 50, C: 38) Weighted average (%)

Table 9. Functions of smartphones which is used frequently

Classification	Back-to-the-farm group (A)[a)]	Active farmers Group (B)[a)]	General farmers group (C)[a)]	Weighted average[b)]
Telephone	66.0	64.0	28.9	54.8
Text message	68.1	68.0	47.4	62.2
Applications (Apps)	46.8	42.0	10.5	34.8
Internet	51.1	56.0	13.2	42.2
Camera	44.7	58.0	26.3	44.4
No	2.1	10.0	15.8	8.9

a) (Response frequency by each group/Number of total respondents by each group) x 100 (%)
b) Standard persons surveyed by each group (A: 47, B: 50, C: 38) Weighted average (%)

Table 10. Inconveniences in using smartphones

Classification	Back-to-the-farm farmers (A)[a)]	Active farmers (B)[a)]	General farmers (C)[a)]	Weighted average[b)]
Call quality	4.3	12.0	18.4	11.1
Wireless internet	29.8	30.0	18.4	26.7
Short battery run time	42.6	62.0	21.1	43.7
Others	4.3	16.0	5.3	8.9
No	14.9	6.0	21.0	13.3

a) (Response frequency by each group/Number of total respondents by each group) x 100 (%)
b) Standard persons surveyed by each group (A: 47, B: 50, C: 38) Weighted average (%)

($p<0.001$). Smartphone users often complain about short battery run time because smartphones consume power in proportion to time and frequency of use. Trend Monitor (2011) reported that 79.9% of smartphone users suffer short battery run time. Also, Seoul Marketing Research (2011) reported that 50.0% of smartphone users selected the battery inconvenience and 18.2% select the unstable network and wireless internet. However 21.1% of Group C was quite small compared to 79.9% and 50.0% in the reports. The inconvenience items were in the order of short battery run time and access to wireless internet.

The fact that general farmers did not feel short battery run time could be interpreted as they used smartphones less often than group A and group B. General farmers pointed out poor calling quality more often compared to other groups ($p<0.05$). This could be also attributed to rural wireless network problems or the fact that they used smartphones less often.

Agricultural informatization in the TV area

Smart TVs were least distributed IT devices. In this survey less than 20% of farms owned them. Survey result on the use of smart TV did not show any statistical differences due to small sample sizes. Most farmers did not understand capability of smart TVs, 37.3% of them did not tell the difference between general TVs and smart TVs. They used smart TVs for watching general TV programs or using VOD (video on demand) services regardless of groups.

Usage of IT devices for searching information

Survey result on IT devices used for searching specific information on the Internet was summarized in Table 11. The devices used for searching information showed no differences between the groups (computer $p=0.06745$, smartphone $p=0.1677$). Smart TVs, which have capability of searching information, were seldom used for searching information. Most frequently used device was computers except when using SNS (social network service) such as Facebook, Twitters, etc. ($p<0.001$). In case of SNS, there was no difference between devices ($p=0.06462$). Song (2011) reported that smartphones have convenience of direct access to SNS via applications at any time any place. Table 11 showed that smartphones were used more often for accessing to SNS than computers, even if there is no statistical difference. Table 11 also showed that which information farmers were seeking frequently. Reading newspapers, searching general information at portal services and searching the national agricultural information showed frequencies larger than 70% in case of computers.

The table also shows that farmers do not search often the national agriculture information provided by EPIS (Korea agency of education, promotion and information service in food, agriculture, forestry and fishery), NAQS (National agricultural products quality management service), RDA (rural development administration), MAFR (ministry of agriculture, food and rural affairs), etc..

Four representative national agriculture information such as Food safety (provided by MAFR), GAP (MAFR), Farm2Table (EPIS), NCPMS (RDA) were selected and asked the surveyee if they know existence of each information, if they visit the sites regularly and if they rely on the provided information with 5 pts. Likert scaled question.

Survey on the question is summarized in Table 12. Level of awareness and use were represented with

Table 11. IT devices used for searching specific information on the Internet

Classification	Computer[a]			Smartphone[a]			Smart TV[a]		
	A[b]	B[c]	C[d]	A[b]	B[c]	C[d]	A[b]	B[c]	C[d]
Reading Newspaper on Internet	76.6	62	50	34.0	44	21.1	0	4	10.5
Searching General Information	74.5	66	44.7	36.2	50	31.6	0	4	5.3
Searching Agri. Information	72.3	72	55.3	21.3	30	7.9	2.1	4	2.6
Searching Agri. Institutes	27.7	36	31.6	6.4	18	2.6	0	2	2.6
Personal Blog or Mini Homepage	53.2	66	42.1	14.9	36	15.8	0	2	0
Facebook, Twitter etc.	14.9	36	13.2	25.6	48	13.2	0	2	0

[a] (Response frequency by each group/Number of total respondents by each group) x 100 (%)
[b] Back-to-the-farm group
[c] Active farmer group
[d] General farmer group

Table 12. Levels of awareness, usefulness and reliability of the national agriculture information

Classification	Levels of awareness and usefulness[a)]		Level of reliability[b)]	
	Active farmers (B)	General farmers (C)	Active farmers (B)	General farmers (C)
FoodSafety	60.0 (6.0)	36.8 (10.5)	3.4	3.3
GAP	44.0 (12.0)	39.5 (15.8)	3.4	3.3
Farm2Table	10.0 (0.0)	13.2 (2.6)	3.2	2.9
NCPMS	34.0 (16.0)	31.6 (15.8)	3.5	3.3

[a)] Percentage of response: Percent of knowing persons (Percent of frequent users)
[b)] Likert's 5 pts scale (Strongly unreliable 1, Slightly unreliable 2, Neutral: 3, Slightly reliable 4, Strongly reliable: 5)

percentage of answered farmers in the group. Numbers coming first means the percentage of farmers who aware the national farm information and numbers in the parenthesis mean percentage of regular users. Most widely known national agriculture information is in the order of FoodSafety, GAP, NCPMS. However most often used information is in the order of NCPMS, GAP and FoodSafety. This gap between awareness and usefulness was judged to be practical usefulness of the information in farming. NCPMS provides useful information on pest and forecast of disease to farmers. Reliability of the information was evaluated with 5 pts scale where 'Strongly reliable' item gets 5 and 'Strongly unreliable' gets 1. All the national agriculture information systems except Farm2Table were evaluated as 3.3 of reliability level, which means slightly reliable.

Analysis and discussion of survey results

Informatization level of farmers were evaluated as lower than the native (NIA, 2013), the active farmers group in this survey showed higher informatization level than that of native and the general farmers groups: Famers in group B possessed more IT devices than the native (Table 4) and their capability in using various functions of smartphones was evaluated much higher than the general farmers (Table 8 and 9). Also they have eagerness to learn computer knowledge by themselves (Table 5). The smart TVs, which have wide screens with VOD function, are expected to replace the traditional TVs are not evaluated as a possible IT devices for the agricultural information system at this moment. The number of smart TVs per capita is too small and farmers do not aware their functions.

Ubiquitous agricultural information technology pursues using the ubiquitous environment provided any time any places for increase of agro-products and economic benefits, that is difference between the PC-based and the mobile based agricultural information system. In agricultural field such as paddy, uplands, orchard, even in the greenhouses, access to computers are limitedly permitted only in farmhouse, head house of orchard and greenhouses. In designing the farm information system, selection of a main IT device could determine the ubiquity and reliability of the system. In Table 4, the most widely spread and used IT devices were PCs and the mobile IT devices except the smartphones showed relative small numbers per capita. Smartphones provide so strong ubiquity to users that its future role in agriculture should not be neglected. Specifically functions of voice recognition and camera could be potential data input methods in the agricultural information system. According to the above discussion, it seems to be most feasible to develop a dedicated PCs-based agricultural information system which could provide optimal screens for the both of computers and smartphones and receive data from the smartphones or the future IT devices. PCs are used as only agricultural device for information searching and environment controlling in greenhouses and livestock buildings but also home electronics for the Internet, games, etc.. If a dedicated embedded computer for agricultural information systems which are required to run all days, farmer's receptivity to the information system will be increased. When the inconveniences that famers are suffering in use of computers (Table 7) are considered, agricultural system with internal virus checking program or equal function in any method are judged to be helpful in accelerating spread of the agricultural information system.

The web-based agricultural information system has the following strengths: 1) it will be relatively easy for farmers to use it because they are used to use PCs in the Internet, 2) compatibility issues resulted from the difference of the operating systems could be relatively easy to be resolved (Reis and Gribble, 2009), 3) it will provides excellence in scalability because various IT other information

devices such as smartphones and smart TV could access the Internet (Lee and Lee, 2010). The highly important factor in developing an agricultural information system is doubtlessly usefulness of the information.

Conclusions

This survey study was performed to evaluate the informatization status of active farmers and to draw a strategy to develop a ubiquitous agricultural information system. A survey was carried out in Gyounggi Province in 2012. Total number of respondents was 135. The surveyed result and previous reports on farm informatization were compared to draw a strategy to develop and distribute a ubiquitous agricultural information system. The surveyees were divided into three groups; farmers from cities, active farmers and general farmers. The survey data was analyzed with the χ^2 test. The demographic analysis showed that three groups have similar distributions in age, but different distributions in education. The results of the analysis about the survey study are summarized as follows:

(1) The active farmers in this survey showed higher informatization level than that of native and the general farmers groups. This result is different from the report (NIA, 2013), in which informatization level of farmers were assess as lower than the native.
(2) The order of IT devices distribution was the same in the three groups: computers (97.7%), smartphones (78.6%), smart TVs (31.4%) and tablet PCs (17.8%)
(3) The smart TVs, which have wide screens with VOD function and are expected to spread widely, were not evaluated as possible main IT devices for the agricultural information system at the moment of survey.
(4) The most feasible agricultural information system is judged as a dedicated PCs-based agricultural information system because spread and use of it exceeds the other devices. Also, the smartphone could be used as a complementary device.
(5) The web-based agricultural information system in the Internet has the following strengths: 1) relatively easiness for farmers to use, 2) easiness in resolving compatibility of the operating systems, and 3) excellence in scalability.

Conflict of Interest

The authors have no conflicting financial or other interests.

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