The Greek farmers' ICT skills and the intra-rural digital divide formation

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Abstract

The phenomenon of the digital divide is one of the main study objects in contemporary societies. This paper focuses on the intra-rural digital divide, presenting a typology based on empirical data retrieved from two Greek Regional Units in a sample of 339 farmers. A scale of 23 ICT skills performed to detect the cognitive and technical ICT skills of the farmers. The Exploratory Factor Analysis demonstrates a solution of 5 skill groups. Considering the factor scores and the farmers' socio-demographic characteristics, a Two-Step Cluster Analysis is carried out, releasing three types of digital maturity. Non-familiar with ICTs are the "Digitally Ignorant" farmers, who are low educated, relatively old in age and full-time farmers. Assuming that several innovations in the agricultural sector require increased ICT skills, "Digitally Matures" is potentially the most innovative; however, they are not primarily farmers, a fact that limits this possibility. We argue that human resource development policies in the agricultural sector should focus on "Digitally Teens" as their main occupation is being farmers and their ICT skills could be encouraged through training.

Keywords: *Digital divide, Intra-rural digital divide, ICT skills, digital maturity, Greece, Factor analysis, Two-Step cluster analysis*
JEL classification: O33, Q16, Z13

Introduction

The digital divide is nothing more than a reflection of the existing, varied and diachronic social differences on the modern information world, conveying inequalities in *access to* and *use of* Information and Communication Technologies (ICTs). The broad framework that fits the term digital divide, i.e., access to information and communication, has been studied since 1970. At that time, under the Project 27-18 Minnesota Agriculture Experiment Station, Tichenor, Olien and Donohue (1970) structured the "knowledge gap" hypothesis, formulated *"as the infusion of mass media information into a social system increases, segments of the population with higher socio-economic status tends to acquire this information at a faster rate than the lower status segments, so the gap in knowledge between these segments tends to increase rather than decrease"* (Tichenor et al., 1970:159-160; Donohue et al., 1975).

In the mid-1980s, at the "dawn" of the Internet revolution, access to information was added to the sociological approach to class discrimination, under the term "information haves and have-nots" (Gantt and Claiborne, 1985). The introducers of the term, Gantt and Claiborne (1985:2) predicted that as the information age expands, the main crisis point

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will be the gap between those computing literate individuals who can function in the information society and those who cannot.

The terms of “knowledge gap” and “information haves and have-nots” are linked to the digital divide phenomenon, embodying the concept of digital inclusion and defining the access to ICTs, ICT skills and ICT usage (Warschauer 2007; Livingstone and Helsper, 2007; van Dijk, 2006; Selwyn, 2003; Parsons and Hick, 2008; Tsatsou, 2011). Warschauer (2004) identifies the digital divide as a social stratification that stems from knowledge creation through ICT, and van Dijk (2005) concludes that digital divide is a social and political issue rather than a technological one.

The expansion of the broadband network, geographical differences, and social inequalities among rural areas resulted in the intra-rural digital divide phenomenon. The intra-rural digital divide is particularly interesting and defined as *"the emergence of a digital divide which creates pockets of relative or even absolute disadvantage within agricultural society"* (Warren, 2002:6) describing the existing digital inequalities within and between agricultural societies (Skerratt and Warren, 2003; Koutsouris, 2010; Ekeanya et al., 2018). Salemink et al. (2017:360) conclude that “*the hampered diffusion of technologies and the lower average levels of education and skills in rural areas have a negative impact on the adoption and use of ICTs”*. The intra-rural digital divide, i.e. the limited access to ICT and the lack of relevant skills, is one of the main weaknesses in the sustainability of agricultural holdings and rural development (Kurmanalina et al., 2020; Erdiaw-Kwasie and Alam, 2016).

The aim of this paper is to study the intra-rural digital divide, presenting results of the empirical research conducted in Greek agricultural holders. Our goal is to identify the intra-rural digital divide patterns classifying the farmers' digital maturity, based on their ICT skills and socio-demographic characteristics. The questionnaire developed includes a scale of 23 technical and cognitive ICT skills and a set of socio-demographic variables. The sample was retrieved from two Regional Units of Greece (Heraklion and Kilkis). Through Exploratory Factor Analysis, we identify the underlying skill dimensions in the 23 ICT skills scale. In order to determine the patterns of the intra-rural digital divide, we applied a Two-Step Cluster Analysis based on the extracted factors of farmers’ ICT skills and their socio-demographic characteristics.

Literature review

As rural development is imperative, ICT provides a vast potential to reduce poverty by integrating isolated rural populations into economies and markets. Effective use of ICT services helps farmers improve their commercial viability by increasing their agricultural productivity and profitability (Kayumova, 2018:2). Research shows that young farmers benefit from the impact of ICT, as ICT has been found to catalyze and accelerate organizational development and value chain work, especially in relation to involvement, motivation and commitment of young farmers to improved management and development of their farms (Plechowski, 2014).

Berman (2006) stated that the effectiveness of different information transfer methods depends on the farmer's ability and the following practices followed in problem identification and analysis, information gathering, critical thinking, and evaluation of results. Alvarez and Nuthall (2006 in Csótó, 2017:2) concluded that the adoption of software by farmers results from a complex model of interdependence on structural factors, such as the specificities of farms and farmers, as well as the objectives and practices that intermediate. Gupta (2006) and Gallagher et al. (2005) argue that rural people who have a lower educational level are computer illiterate. This illiteracy acts as an impediment to access ICT tools, contributing to high risk of information poverty. Moreover, Gao and Zang (2018) estimating the rural computer penetration on rural residents' income, conclude that *"there are huge potentials for rural residents to boost their income using computers"* (Gao and Zang, 2018:27).

Recent research in rural areas found out that the factors like gender, social participation, awareness, affordability of ICT, economic motivation and income are significant for farmers to adopt ICTs (Laxmipriyau et al., 2018). The technological evolution demands the parallel development of ICT skills of the farmers, as the digital divide consists a threat to the performance of rural partnerships (Erdiaw-Kwasie and Alam, 2016), farm sustainability and broadly rural development (Herdon, Botos and Várallyai, 2015).

One of the most recent concepts in the digital divide phenomenon is called digital maturity. Digital maturity *"draws on a psychological definition of "maturity" that is based upon a learned ability to respond to the environment in an appropriate manner"* (Kane, 2017 in Kane et al., 2017:5) and refers on *"how organisations systematically prepare to adapt on ongoing consistently digital change and the status of its digital transformation"* (Kane, 2017). Digital maturity involves adapting the organization to compete effectively in a growing digital environment, and it is beyond the simple application of new technology, as it is aligning the organization's strategy, workforce, culture, technology and structure to respond to the digital aspirations of stakeholders (Kane at al., 2017). In other words, the organization's digital maturity refers to the ability to adjust to the continuous, ongoing and rapidly changing digital landscape.

In Greece, the discussion about intra-rural digital divide was developed in six studies. The first one was published in 2005 by Samathrakis et al. The survey was conducted in a sample of 567 livestock farmers in the prefecture of Thessaloniki to identify the ICT use and determine the main factors that could increase ICT adoption. Samathrakis et al. applying descriptive statistics methods found that the most important results were that only 10% of the sample possessed a computer, which was usually installed in their residence (75.4%) while only 14.5% used the computer in their farm as a business tool, 5.5% were Internet users, and 3.5% email users. 57.8% of the farmers who did not own some ICT device, declared that the difficulty in using a computer is the most important reason for not possessing one. Moreover, most of the farmers responded that they did not intend to buy a personal computer despite the fact that they may be funded for such a purchase, which showed farmers' low interest to invest time on ICT usage (Samatrhakis et al., 2005). Samathrakis et al. (2005) indicated that the most widely adopted ICT device was the mobile phone (60.7%) but prominently used for communication purpose. The authors concluded that the adoption of ICT in the Greek livestock sector was shallow, and more efforts are needed to increase the level of ICT use by Greek farmers. Also, taking into account that the Greek livestock farmers widely used mobile phones and the difficulty that farmers declared in using a computer, authors suggest that mobile phones can be used to deliver to farmers IT applications and services to farmers that are easily accessible and easy to use.

The next research was conducted by Alexopoulos et al. (2010), in a sample of 853 rural youth retrieved from 7 out of the 52 Greek Prefectures (2005), the majority of whom were farmers as a primary occupation. The research aimed at exploring which socio-demographic, economic, and other characteristics of young rural inhabitants were related to PCs' use, the ownership of PCs and the use of the Internet, utilizing a Probit Model. The results showed that one out of five farmers were PC users; 90.4% had a PC at home and 65.7% had Internet access. Also, Alexopoulos et al. (2010) found a statistically significant relationship between ICT use and mobility (removal from the principal residence for at least six months, for studies), as the sample with mobility experience indicated significantly more frequent ICT users. Probit model for farmers showed that age of spouse younger than 31 years old, spouse's education higher than low secondary schooling, knowledge of foreign language, mobility for studies and propensity to access advice through the Internet, influenced the use of PCs, the ownership of PCs and the use of the Internet, i.e. all three Probit models. Moreover, in the Probit model for PC use, Alexopoulos et al. (2010) found that the probability of computer use was increased when the farmer has participated in collective actions, was positive to pay for advice and to access advice through the Internet, and was using the Internet as a primary source of information. In the case of PC ownership Probit model, the probability of having a PC at home increased when the farmer had participated in collective actions, had attended vocational training, was accessing advice through the Internet, and was using the Internet as the primary source of information. Finally, Alexopoulos et al. (2010) concluded that as many farmers are deprived of access to PCs and the Internet, they are excluded from certain information regarding political and public affairs and, thus, from participation in political, social and cultural practices. It is proposed that policies be developed to acquire technical and cognitive capacities to inhabitants and farmers in rural areas, to reduce the second level of the digital divide (Alexopoulos et al., 2010).

Michailidis et al. (2010) conducted the third research to a sample of 490 farmers in the Region of Western Macedonia. The sample was selected randomly from a list of all the farmers of the region, compiled by the Regional Directorate of Agriculture. Based upon the usage scale of mobile telephone, PC, printer, Internet use and email, Digital Subscriber Line, satellite television, GPS, wireless connection, DVD and CD player, dial telephone, FAX machine and beeper a two-step cluster analysis was used to explore the different levels of farmers' ICT adoption and a categorical regression model to explain this variation. Two-step analysis classified three farmers' profiles based on attributes characteristics of ICT use. The first one was labelled as "High tech" and comprises 10% of the sample, who are mobile phone users, PC users, internet users, and very often users of email. "High tech" farmers are mainly males, single, less likely to farm on a full-time basis, less likely to earn their income exclusively from agriculture but with larger average estimated net worth. The second one was labelled as "Medium tech" and comprises 40% of the sample and consists of the limited or rare use of the Internet and email and the limited or often use of a personal computer. The third one was labelled as "Low tech" and comprises 50% of the sample, who were rare users of mobile phones, PC, Internet and email. Categorical regression analysis shows that the most influential factors predicting ICT adoption are the farmers' annual income, farmers classification (the results of Two-step cluster analysis), familiarity with ICT's and educational level. Furthermore, Michailidis et al. (2010:259) asked farmers to indicate the preferred information delivery approach from a list of 14 communication techniques, and the results show that "High tech" farmers expressed a greater need for the intensification of most of the techniques and significantly higher preference for computer-assisted instructions, video conferences and farmer involvement in applied research. Michailidis et al. (2010:259) concludes that the farmers who do not have (or are not able to acquire) the ability to use ICTs, particularly the Internet, may well be deprived of capabilities to participate in development processes and improve their lives, as a symptom of the intra-rural digital divide.

The next research was conducted by Botsiou (2012). Performing personal in-depth interviews to 29 farmers at the Regional Unit of Kilkis (northern Greece) and using the Content Analysis method, Botsiou (2012) studies the farmers' professional, educational, digital and informational profile. The content analysis released five types of farmers' ICT educational profile and consists of the sum skills in ICT, ICT skills acquisition method, attitudes towards ICT, the impact of the social environment on ICT use, and the farmers' willingness for ICT training (Botsiou, 2012:146-147). The farmers in Type D had no ICT skills, they were trying to develop some with the help of their friends and family (informal education), and they were interested in participating in ICT training programs. Only Type A have attended an ICT training course (formal or non-formal). The farmers in Type E had no ICT skills and negative attitudes towards ICTs, being the group of farmers with an in-depth educational gap. Botsiou (2012) concluded that agricultural education programs should develop ICT skills to develop positive attitudes towards new technologies, personalized and inquiry-oriented, and rely on adult education principles.

Following Botsiou (2012), Botsiou and Dagdilelis (2013) published a study on the intra-rural digital divide based on the farms' info-technological profile. Conducted in-depth interviews to 29 farmers of the Regional Unit of Kilkis and applying Content Analysis taking into account the attitudes on ICT, satisfaction level of the acquired ICT skills, the social support on ICT usage, the ICT needs of the farm and the managing mean of the info-technological needs of the farm, Botsiou and Dagdilelis (2013) ascertained four info-technological farm types (profiles). Particularly interesting is the second info-technological profile, in which ICT management to meet the needs of the farm has been undertaken by a member of the farmer's family. This type demonstrated the younger members of the family, who were familiar with the use of ICT, as a "key point" in the modernization of the farm and the support and strengthening of the family farming (Botsiou and Dagdilelis, 2013).

The sixth research concerns the adoption of innovations related to new technologies, particularly precision agriculture (PA). The study was conducted by Kountios et al. (2018) in the Reginal Unit of Serres in a sample of 110 young farmers, aiming at examining young farmers' educational needs, their attitudes and the level of adoption, and their preferred training methods. The main methodological analysis framework included a categorical principal component analysis (CatPCA) and a categorical regression (CatReg). CatPCA indicated two dimensions in opinions and attitudes towards PA, labelled as "Conditions and benefits of PA" and "Information and education for PA". The main characteristics of these two dimensions were examined using a CatReg. The results showed that the annual family income explains almost entirely the importance that young farmers give to the conditions and benefits of the adoption of PA; thus young farmers with lower incomes tend to pay attention to the benefits and conditions of PA. Regarding the "Information and education for PA" dimension, is affected by the level of education and annual family income, with the annual family income interpreting almost entirely this dimension. Kountios et al. (2018) concluded that young farmers are familiar with the concept of PA or had already adopted some to PA methods, considering that their active participation in structuring and organizing agricultural programs is crucial. Additionally, Kountios et al. (2018:12-13) confirmed that if the farmers want to increase their farms' economic performance, they should be convinced to adopt PA methods. Finally, it is suggested that private companies should be allies in the PA diffusion through highly trained PA managers, and specialized services to farmers who want to use PA.

Methodological Framework

In light of the above discussion, this paper aims to identify the forms of the intra-rural digital divide in Greece. The survey was conducted in the Regional Units (RU) of Heraklion and Kilkis in Greece (Northern and Southern Greece). Kilkis is located on the mainland and Heraklion on the island area. Almost all of the country's production systems meet in the two regions: tree crops, horticulture, arable, vineyards and grapevines, cereals, livestock plants, industrial plants, beekeeping, pigs, sheep and goats, cattle (ELSTAT, 2013).

The settlements' selection in which the farmers' sample was drawn, was carried out with proportional stratified random sampling, in 10%. The stratification criteria were: (i) degree of the urbanization[1] (urban/rural settlements) (ELSTAT, 2011), (ii) mountainous subclass of the settlements (mountainous, semi-mountainous, lowlands) (ELSTAT, 2011) and (iii) settlements' broadband access ADSL 24 mb/s[2]. Subsequently, the sample of the farmers was drawn by random sampling within the indicated settlements. In more detail, according to the NUTS system, Heraklion RU consists of 193 local communities (LAU 1), where 181 are defined as rural, and Kilkis R.U. of 84 in which 80 are defined as rural. According to the mountainous and broadband internet connection criteria, 26 settlements demonstrated, 18 of which belong to the Heraklion RU and 8 to the Kilkis R.U.

In order to calculate the minimum required size sample, we applied the Daniel formula (1999) (Formula 1). As population size, we defined the total number of farms located in the communities (LAU 1) in which the 26 settlements of our research are located. According to ELSTAT (2009), the total number of farms in the 26 communities (LAU 1) is 4,074. At the pilot study in a sample of 39 farmers, 66.6% answered that they are ICT users (n=26). Following Daniel (1999 in Naing et al., 2006) and considering the population size N=4.074, confidence level α=0.05 (Z=1.96), expected proportion P=66.6% and precision d=5%, the minimum required sample size calculated n΄=315. The sample size obtained in the present study is n=339 and therefore exceeds the minimum required.

$$n' = \frac{NZ^2P(1-P)}{d^2(N-1)+Z^2P(1-P)} \quad \text{(Formula 1)}$$

The research conducted through face to face interviews using a structured questionnaire. The questionnaire includes the sample's socio-demographic characteristics, equipment and access to ICTs, and a scale of 23 self-report items regarding farmers' technical and cognitive ICT skills. In order to construct the scale, we combined different researches and transformed older statements. In more detailed, as technical and cognitive ICT skills considered the software skills (file management, spreadsheet management, email management) (Woodburn et al., 1994; Ascough et al., 1999; Ascough et al., 2002; Batte, 2005; Alexopoulos et al., 2010; Michailidis et al., 2011; van Deursen et al., 2012; Botsiou, 2012), hardware skills (peripheral device management, technical issues management) (Ascough et al., 2002; Botsiou, 2012), operational Internet skills (operating an Internet browser, operating Internet-based search engines) (Ascough et al., 2002; van Deursen et al., 2012; Botsiou, 2012), advanced Internet skills (creating a blog, set up a pop-up blocker) (Michailidis et al., 2011; van Deursen et al., 2012; Botsiou, 2012) and formal and information Internet skills (Gurstein, 2003; van Deursen et al., 2012; Botsiou, 2012). We constructed the scale transforming older statements in order to structure ICT skills in affirmative statements *("I can…", "I am able to …" "I find it difficult to…"*) and asked participants to state their degree of agreement in these statements (Likert five-point: 1=The statement does not apply to me, to 5=The statement applies completely to me).

Data analysis involved descriptive and inductive statistics, Exploratory Factor Analysis and Two-Step Cluster Analysis, using SPSS Statistics 23. The factor analysis and clustering are two widely used digital divide research methods (see Stahl, 2017; Bikos et al., 2018; Michailidis et al., 2010; Santos et al., 2020; Borg and Smith, 2017). We used Exploratory Factor Analysis to identify the underlying skill dimensions in the 23 ICT skills scale. The factors were extracted by the principal component (PC) method and then rotated by varimax rotation. The suitability of the sample was examined through Bartlett's test of sphericity (Bartlett, 1954), the adequacy of sampling through the Kaiser-Meyer-Olkin measure (Kaiser and Rice, 1974), the Measure of Sampling Adequacy (MSA) for each ICT skill through the anti-image covariance matrix (accepted ≥0.6) (Hair et al., 1995), and the proportion of each ICT skill that can be explained by the factors through Communalities (loadings ≥0.4). During the Exploratory Factor Analysis process, we took the following into account: (a) the Kaiser criterion and the corresponding tables for determining the number of factors that result (eigenvalues greater than 1), (b) the proportion of each ICT skill that can be explained by the factors, (c) the loadings in factors (≥0.4) (Hair et al., 1995), and (d) the interpretability of the factors.

We used the Two-Step Cluster Analysis method to identify and classify the intra-rural digital divide patterns. The Two-Step clustering algorithm produces solutions based on mixtures of continuous and categorical variables and for varying numbers of clusters (Mooi and Sarstedt, 2011). The factor scores and the farmers' socio-demographic characteristics were used as input variables in Two-Step Cluster Analysis.

Results

Descriptive and inductive statistics

The majority of the responders are male (92.3%). One out of four farmers are under 35 years old (24.5%), 23.6% are between 35-44 years old, 23.9% between 45-54 years old, 17.7% between 55-64 years old, and one out of ten farmers are more than 65 years old (10.3%). 29.8% of the responders have attended six years of education (primary school), 23.6% nine years (secondary school), 29.8% 12 years (high school), 5.3% 14 years of education (post-secondary education) and one out of ten farmers (10.6%) are university graduates (16 years of education). The majority (73.2%) have never been moved to another place for studies or work (mobility experience). Also, two out of three farmers are stating farming as a primary occupation (63.4%).

Internet access at home and at least one ICT device (PC/tablet/laptop) have the majority of the responders (82.0% and 82.9% respectively), while less than the half (41.0%) are Smartphone owners. 62.8% are ICT users, while 37.1% are quite experienced

(ICT usage >8 years). The majority have never been trained (either formal or non-formal) on ICT usage (75.5%).

The digital divide is present both in age and education, as the inductive statistics indicated that the relatively younger farmers and the most educated are more frequently ICT users (χ^2=78.247, p≤0.001 and χ^2=75.763, p≤0.001 respectively), have an ICT device (PC/tablet/laptop) in their household (χ^2=29.488, p≤0.001; χ^2=17.672, p≤0.0), are smartphone owners (χ^2=98.301, p≤0.001; χ^2=33.242, p≤0.001), and have been trained on ICT (either formal or non-formal) (χ^2=21.732, p≤0.001; χ^2=65.803, p≤0.001). Moreover, the most experienced ICT users (>8 years) have the highest level of education (>12 years) (χ^2=24.006, p≤0.001), and attended some ICT course (χ^2=32.649, p≤0.001).

The primary occupation seems to influence the intra-rural digital divide shaping, as the full-time farmers are less likely to be ICT users than the part-time farmers (57.2% of the full-time farmers and 72.6% of the part-time farmers are ICT users) (U=11281.000, p≤0.05). Moreover, 72.0% of the less experienced on ICT usage (<1 year) are farmers as the main occupation, and 53.2% of the most experienced (>8 years) are farmers as a secondary occupation (U=4550.500, p≤0.05). It is worth noting that the farmers with a relatively higher educational level state farming as a secondary occupation significantly more frequently (χ^2=22.854, p≤0.001), which indicates that the most educated rural inhabitants invest their qualifications mainly in the non-agricultural sector.

Regarding the relationship between mobility and the intra-rural digital divide formation, in previous research has been found that labour or educational mobility reduces social exclusion (Alexopoulos et al., 2010), as it offers a form of social learning on ICTs (Cartier, et al. 2005). In reverse to previous researches we find that the majority of the ICT users (65,3%) have never experienced mobility (U=8432.500, p≤0.001), which is also observed to the majority (54.4%) of the most experienced (>8 years) and less experienced (84.4%) ICT users (<1 year) (U=4098.500, p≤0.05). Moreover, we notice that the majority of farmers with no mobility experience (79.0%) have an ICT device at home (PC/ laptop/tablet) (U=9662.000, p≤0.05), and are smartphone owners (64.7%) (U=9303.000, p≤0.05). In summary, we note that mobility does not affect the adoption of ICT, and we believe that the observed differences with the previous research (Alexopoulos et al., 2010) result from the expansion of the broadband network and the diffusion of ICTs in rural areas.

ICT use is also related to household ICT equipment, as the farmers who are ICT users have an ICT device at home (PC/tablet/laptop) (U=4175.500, p≤0.001) and Internet access (U=2491.000, p≤0.001). Comparing this finding with that of Samathrakis et al. (2006), we can argue that the digital divide in rural areas is decreasing in the last decade.

To study the farmers' ICT technical and cognitive skills, we developed a scale of 23 self-report statements based on international literature and previous qualitative research, as described in the methodological framework. The 23 statements were answered only by the ICT users (n=213), and the results are presented in Table 1. The highest acquired skills are the browser running skill (Q20.5), finding information in Greek (Q20.19) and opening a new tab in the internet browser (Q20.11). Low acquired skills are the ability to recognize a website that is virus related (Q20.14), connecting and setting up a printer (Q20.1), handling basic formulas in a spreadsheet (Q20.3), and installing new software or to updateing an old one (Q20.4). The lowest acquired skills are repairing a computer technical issue (Q20.15) and creating a Blog (Q20.10). In summary, we observe that the low and lowest acquired skills appear in advanced ICT skills (hardware skills, advanced software and advanced Internet skills).

Table 1. Descriptive statistics on farmers ICT skills

ID	ICT skills	M	SD
Q20.1	I can connect and set up a printer on my PC	2.26	1.728
Q20.2	I can copy and paste a hole file	3.10	1.837
Q20.3	I can handle the basic formulas of spreadsheet applications	2.42	1.678
Q20.4	I can install new software or update an old one	2.04	1.582
Q20.5	I can run my Internet browser to navigate	4.44	1.051
Q20.6	I can send an email with an attachment	3.09	1.810
Q20.7	I can post to an online forum	2.79	1.877
Q20.8	I know how to start or participate in a video conference (such as Viber and Skype)	3.44	1.824
Q20.9	I can download music and movies using peer to peer file share technology	3.19	1.866
Q20.10	I can create a blog	1.73	1.347
Q20.11	I can open a new tab on my internet browser	3.84	1.672
Q20.12	I can download photos from the Internet	3.69	1.722
Q20.13	I can use and set up an add-blocker	3.03	1.815
Q20.14	I can recognize a hazardous and malicious link	2.43	1.626
Q20.15	I am able to repair a computer technical issue on my own	1.89	1.394
Q20.16	I find it difficult to return to a web page I have visited before	2.41	1.642
Q20.17	I find it difficult to trace how did I end up to a web page	2.60	1.720
Q20.18	It tires me to search on the Internet	2.42	1.578
Q20.19	I can easily find the information I need in Greek	4.04	1.484
Q20.20	I have difficulty to decide the proper keywords for a search on the Internet	2.60	1.562
Q20.21	I am confident that my search results are valid	3.33	1.539
Q20.22	I can assess the reliability of website content	3.08	1.591
Q20.23	I usually compare the content of a webpage with that of others to determine the most reliable source.	3.19	1.644

Explanatory Factor Analysis of farmers' ICT skills

Using a principal components method of extraction and varimax rotation, we performed exploratory Factor Analysis on the scale of 23 self-report farmers' ICT skills. Kaiser-Meyer-Olkin measure of sampling adequacy confirmed that the data and sample size is adequate for factor analysis (0.910). Bartlett's test of sphericity is 1750.079 ($p<0.001$), which supported the hypothesis that all correlations, tested simultaneously, were statistically different from zero. MSA indicated that all variables could be included in factor analysis [anti-image correlation values between 0.695 (Q20.18) and 0.955 (Q20.6)], and Communalities that all variables are acceptable. These statistical values provide minimum standards that should be met before conducting a factor analysis. The first five factors explained 40.32% (internal consistency α=0.923), 8,61% (internal consistency α=0.806), 5.76% (internal consistency α=0.627), 5.35% (internal consistency α=0.741) and 4.51% % (internal consistency α=0.663) of the variance respectively. The solution of five factors explained 64.55% of the variance, which is acceptable (Hair et al.,1995). The reliability analysis results showed that none of the items should be excluded from the primary number of the items. Furthermore, the value of Cronbach's alpha (a) reliability coefficient was found equal to 0.927, indicating that the measure of 23 self-report farmers' ICT skills is reliable.

The results of Exploratory Factor Analysis are presented in Table 2. Factor 1 is comprised of ten ICT skills, with factor loadings from 0.481 to 0.824. The variables that form the first factor are: the handling of basic formulas in spreadsheet applications (Q20.3), repairing a computer technical issue (Q20.15) or managing peripherals (Q20.1), updating or installing a software (Q20.4), recognizing malicious and hazard links (Q20.14), using advanced content creation tools such as Blog management (Q20.10), copying and pasting a file (Q20.2), posting on an online forum (Q20.7), using and setting up an add-blocker (Q20.13), and sending an email with an attachment. For the above activities, a series of skills and abilities are required. For example, in order to post on a forum, the users must be certified by email; therefore, they must use the email services. Also, they must be able to adapt to different variations of graphical interfaces, which can be achieved only through experience. Since those variables concern advanced software, hardware and Internet skills, the first factor is labelled *"High requirement ICT skills"*.

Factor 2 is comprised of three ICT skills, with factor loadings from 0.628 to 0.747. These variables are the ability to start or participate in a video conference (Viber, Skype) (Q20.8), downloading music and movies (Q20.9), and downloading photos (Q20.12). Since these skills relate to multimedia and communication management skills, the second factor is labelled *"Communication and multimedia skills"*.

Factor 3 is structured by four variables, with factor loadings from 0.576 to 0.735. These variables identify lacks in (some) formal and information Internet skills (van Deursen et al., 2012), i.e., the disability to decide upon proper keywords for a search on the Internet (Q20.20), the feeling of discouragement to make an Internet search (Q20.18), the disability to find a web page that they have visited before (Q20.16), and the feeling of online disorientation (Q20.17). As the third factor consists of variables that describe potential management difficulties in content search, the third factor is labelled *"Potential difficulties"*.

Factor 4 is comprised of three variables, with factor loadings from 0.643 to 0.793. The variables that form the fourth factor are the abilities to assess the reliability of a website content (Q20.22), evaluate the source of information found (Q20.23) and validate the search results (Q20.21). Since these skills relate to evaluating web resources, the fourth factor is labelled *"Evaluation of online recourses"*.

Factor 5 comprised of three ICT skills with factor loadings from 0.574 to 0.785. These skills relate to basic browsing skills, as the abilities to find any information in Greek, running the Internet browser to navigate, and opening a new tab on the browser. The fifth factor is labelled *"Basic browsing skills"*.

Table 2. Results of Exploratory Factor Analysis

Clustering the intra-rural digital divide: Digitally Ignorant, Teen and Mature farmers

		Factors				
ID	**ICT skills**	**1**	**2**	**3**	**4**	**5**
Q20.1	I can connect and set up a printer on my PC	0.722				
Q20.2	I can copy and paste a hole file	0.610				
Q20.3	I can handle the basic formulas of spreadsheet applications	0.824				
Q20.4	I can install new software or update an old one	0.817				
Q20.5	I can run my Internet browser to navigate.					0.666
Q20.6	I can send an email with an attachment	0.481				
Q20.7	I can post to an online forum	0.575				
Q20.8	I know how to start or participate in a video conference (such as Viber and Skype)		0.747			
Q20.9	I can download music and movies using peer to peer file share technology.		0.663			
Q20.10	I can create a blog	0.633				
Q20.11	I can open a new tab on my browser.					0.574
Q20.12	I can download photos from the Internet		0.628			
Q20.13	I can use and set up an add-blocker	0.570				
Q20.14	I can recognize a hazardous and malicious link	0.692				
Q20.15	I am able to repair a computer technical issue on my own	0.772				
Q20.16	I find it difficult to return to a web page I have visited before			0.608		
Q20.17	I find it difficult to trace how did I end up to a web page.			0.576		
Q20.18	It tires me to search on the Internet.			0.686		
Q20.19	I can easily find the information I need in Greek.					0.785
Q20.20	I have difficulty to decide the proper keywords for a search on the Internet			0.735		
Q20.21	I am confident that my search results are valid.				0.643	
Q20.22	I can assess the reliability of website content.				0.793	
Q20.23	I usually compare the content of a webpage with that of others to determine the most reliable source.				0.736	

To identify the patterns of the intra-rural digital divide in the Greek rural sector, we conducted Two-Step Cluster Analysis (Mooi and Sarstedt, 2011). In Two-Step Cluster Analysis were included nine (9) variables, which are the five (5) new variables that were forced from the Exploratory Factor Analysis (factor scores), and also the age group, educational level, ICT training and primary occupation of the responders. The optimum solution of three (3) clusters is presented in Table 3 (silhouette measure of cohesion and separation is 0.4). To label the clusters, we adopt the digital maturity concept (Kane et al., 2017) and Michailidis et al. (2010) "view" of cluster labeling.

The first cluster is labelled *"Digitally Matures"* and includes 32.4% of the sample. This cluster describes the highly skilled farmers in basic browsing and communication and multimedia, medium-high skilled both in the evaluation of online resources and high requirement ICTs and medium-low score in potential difficulties. The "Digitally matures" farmers have attended (at least) 12 years of formal education, have been trained on ICT, aged younger than 35 years old, and their main occupation is off-farming.

The second cluster includes 42.9% of the sample and is labelled *"Digitally Ignorant",* as it describes farmers who are either non-ICT users or low ICT skilled. These farmers are primary education graduates (54.9% on six years of formal education) who have never been trained (formal or non-formal) on ICT use, aged 55-64 years old and they are full-time farmers (32.3%).

The third cluster is labelled *"Digitally Teens"*, includes 24.7% of the sample and describes farmers who are highly skilled at basic browsing, medium-low skilled both at evaluating online resources and high requirement ICTs, and medium-low scored in potential difficulties. *"Digitally teen"* farmers have never been trained on ICT use, aged 45-54 years old, attended nine years on formal education, and they have farming as a primary occupation.

Table 3. Results of Two-Step Cluster Analysis

	Cluster 1 Digitally Matures		**Cluster 2 Digitally Ignorant**		**Cluster 3 Digitally Teens**	
	M	SD	M	SD	M	SD
Basic browsing skills	4.49	0.698	0.34	0.916	3.77	1.238
High requirement ICT skills	3.14	1.155	0.15	0.388	1.60	0.866
Communication and multimedia skills	3.99	1.238	0.18	0.524	2.67	1.546
Evaluation of online resources	3.62	1.233	0.23	0.683	2.67	1.337
Potential difficulties	2.28	1.097	4.68	0.927	2.45	1.199
Years of education	12 years (51.4%)		6 years (54.9%)		9 years (45.8%)	
Training on ICT	Yes (60.6%)		No (95.8%)		No (86.7%)	
Age group	<35 (47.7%)		55-64 (32.6%)		45-54 (37.3%)	
Primary occupation	Off-farming (66.1%)		Farming (70.1%)		Farming (89.2%)	
N	109		144		83	

Discussion and Conclusions

We studied the ICT skills of Greek farmers and their sociological features. Our research follows up on previous studies on the intra-rural digital divide in Greece (Samathrakis et al. 2005; Alexopoulos et al., 2010; Michailidis et al., 2010; Botsiou, 2012; Botsiou and Dagdilelis, 2013).

At first, we notice that both young and highly educated farmers are more frequently ICT adopters. Part of our results is in line with Warren (2002; 2004), Stiakakis et al. (2009), Alexopoulos et al. (2010), Michailidis et al. (2010) and Michailidis et al. (2011) addressing the general phenomenon of the digital divide, as we found that both young and highly educated farmers are more frequently ICT adopters. Nevertheless, taking into account the results of the previous studies in Greek agricultural sector (Samathrakis et al., 2006; Michailidis, Koutsouris and Mattas, 2010; Alexopoulos, Koutsouris and Tzouramani, 2010) and the results of our research, we observe a relative increase of ICT users, ICT owners and experience on ICT usage: nowadays, about 6 out of 10 farmers are ICT users, of whom 4 out of 10 are experienced more than 8 years, while more than 8 out of 10 farmers have some ICT device in their household (PC/tablet/laptop) and 4 out of 10 are Smartphone owners.

Moreover, comparing the findings of our research with those of Alexopoulos et al. (2010), it is clear that mobility plays a reverse role in ICT adoption nowadays. In our study, while mobility shows a statistically significant relationship with the use, experience and equipment of ICT, our findings have opposite features of Alexopoulos et al. (2010), as the majority of the ICT users, owners and more experienced in ICTs have never experienced labour or educational mobility. Nowadays, mobility does not really "affect" ICT adoption. These findings are interpreted as a result of ICT diffusion in rural areas and farmers' familiarization with ICT.

Our research demonstrates three types of farmers regarding ICT familiarization that can be correlated with Michailidis et al. (2010) findings. The "Digitally Matures" farmers are well acquainted with ICTs, profiled as the most educated and relatively youngest, with farming as a secondary occupation, a feature that is also found in the "High tech" farmers of Michailidis et al. (2010). Non-familiar with ICTs are the "Digitally Ignorant" farmers, as well as the "Low tech" farmers of Michailidis et al. (2010) research. The "Digitally Ignorant" are low educated, relatively older, and full-time farmers. From the above, only the "Digitally Mature" farmers have attended an ICT training course. The "Digitally Teens" farmers are middle-aged, middle educated, medium-skilled on ICTs, as well as the "Medium tech" of Michailidis et al. (2010) research, and full-time farmers.

The "Digitally Matures" are young and well educated, but they are not engaged in agriculture as primary occupation farmers. Assuming that several agricultural sector innovations require increased ICT skills, this category of farmers is arguably the most innovative. However, they are not primarily farmers, which limits this possibility. Based on our conclusions, policies should focus mainly on "Digitally Teens" as they are farmers as the main occupation and could enhance their knowledge through training.

Our research makes several contributions to the literature. First of all, this study adds to the growing literature on intra-rural digital divide that examines whether farmers are adjusted to the continuous, ongoing and rapidly changing digital landscape. Secondly, our study results help provide a better understanding of the educational ICT needs of the farmers and suggest solutions to the socio-economic development of the agricultural sector. Thirdly, the ICT technical and cognitive skills scale, designed for our research's needs, is highly reliable and potentially usable in the development of training programs on ICT skills for farmers. Even though our research results and conclusions refer to the case of Greece, its methodological uniqueness can be useful for an international audience.

One major limitation in this study could be addressed in future research: our research was conducted in two Regional Units, which are in a medium-depth geographical digital divide. The study of areas in a deeper geographical digital divide is likely to demonstrate more features in the intra-rural digital divide phenomenon. Therefore, a future research direction is the study of Regional Units with a strong geographical digital divide, such as those of the Pindus mountain range.

As Gantt and Claiborne (1985:3) state, information age provides an avenue to reduce the inevitable gap between the haves and the have nots. We conclude that in the ongoing digital revolution, the ICT diffusion in rural areas increased the ICT users, defining, in parallel, qualitative forms of the intra-rural digital divide. Various factors forced the ICT diffusion in the agricultural sector: broadband network expansion, the evolution of mobile internet technology, the development of user-friendly and inexpensive devices, the increase of farmers' educational level. The agricultural sector in Greece is in "digital blossom", which can be enhanced through the development of ICT training programs for farmers, aiming at farmers' ICT skills encouragement, thus contributing to the digital maturity of the agricultural sector.

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Footnotes

[1]According to the ELSTAT (2011), rural communities are those with up to 1.999 inhabitants.

[2]Data were drawn by the Broadband Geographical Map of EETT (2016) and in contact with the managers of the Kilkis and Heraklion RU broadband services.