INFORMATION AND COMMUNICATION TECHNOLOGIES AS AGRICULTURAL EXTENSION TOOLS

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Abstract: *Knowledge and innovation society are becoming priorities to the welfare and quality of life of the rural population. This is based substantially on scientific and technological progress. Information and Communication Technologies (ICTs) accelerate rural development by contributing to more efficient management and rapid knowledge dissemination. ICTs are defined as a different set of technological tools and resources used for communication and for the creation, processing, dissemination, storage and information management. The rapid revolution in modern agriculture has led to investigations in many regions. One of them is the rural region of the prefecture of Pella that exists many years in the agricultural sector. The objective of this research is to evaluate the adoption of ICTs among farmers and determine the importance of agricultural extension as an information source in the region of Central Macedonia. For this purpose, the approaches of summary statistics in combination with multivariate statistical analysis techniques have been used. In particular, through the statistical package SPSS (v.16.0), there were employed two correlation methods: (a) the categorical regression model and (b) the two-step clustering. The primary research data were collected using a specifically constructed questionnaire, supplemented by personal interviews with farmers of the prefecture of Pella. The sampling result was to collect a general sample of 303 valid questionnaires.*

Keywords: Categorical Regression, Central Macedonia, Information and Communication Technologies, Rural development, Two-step clustering

JEL Classification Codes : C420, D190, R580

1. INTRODUCTION

During the last decade a number of occasions was resulted from scientific research and technological progress (Baily and Lawrence, 2001; Jorgenson, 2001; Litan and Rivlin, 2001). That progress is based mainly on the improved productivity and circumstantially on the changes on labour relations. More concretely, this progress is owed partly to the integration of hardware and software in production processes, in the growth of new services and products (including internet) and in the improved contacts between enterprises and consumers (including e-commerce).

The basic adoption theory of a lurking idea is that the individuals, that will likely adopt this idea (adopters), do not adopt it independently but they are also influenced by other adoption decisions. In agricultural production, most producers that have adopted an innovation were prompted by the possibility that other producers will imitate them as well. The higher the probability the more powerful the motive. The early adopters' influence to late majority is often called "word of mouth communication" (Rogers, 1995:292). This term refers to a much broader set of phenomena from producers who simply talk to each other. For example, a producer is affected by another simply by observing his/her behaviour (Kibwana et al., 2001).

The preparation of this research was accrued from the need to be investigated the extent of ICTs adoption in agriculture. The conducting of this research was defined geographically in a region of Greece with long term history in agriculture, Pella's Prefecture; therefore it is possible to be a useful source of information. In particular the aim is to examine to what extent producers have been adopting ICTs. This is the case of producers in Pella's Prefecture.

The following sections refer to innovations in agriculture and in particular in ICTs, summarize the main features of Pella's Prefecture. It then moves on to present the methodological framework of analysis and the main results of statistical investigation. Finally, comments are made on the results, some policy extensions and ideas for more research and further exploitation of results are being presented.

2. INNOVATION IN AGRICULTURE

Founding father of the diffusion of innovations theory is Everett M. Rogers. According to Rogers (1995), initially, an innovation is adopted by a small group of people / innovators, who are followed shortly by the early majority, who then are copied by the late majority, etc. Adoption is perceived as a linear process driven by a copy behaviour or imitation principle (Rogers, 1995; Crawford and Di Benedetto, 2000: 228): initially, an innovation is adopted by a small group of innovators, soon followed by the early adopters, which are copied by the less innovative early majority etc.

Using Rogers (1995) five adopter categories of: innovators, early adopters, early majority, late majority and laggards as a framework several general factors related to innovative behaviour are identified in the diffusion literature. When contrasted with laggards, innovators tend to be younger, more formally educated individuals who actively seek information about new ideas (Rogers, 1995; Scheuing, 1989).

In the future, according to Akca et al. (2007) knowledge will manage of the world, provided that it gives power to the people, in states, to direct governmental and nongovernmental organizations. Specifically, ICTs are one of the key areas of future technology to make its presence strongly felt in the early 21st century (Ege, 2002; Michailidis and Papadaki-Klavdianou, 2010).

The ICTs' emergence started with the so-called "information revolution" (Jankowski and Van Selm, 2001:217) or "technological revolution" (Sheth, 1994: 11), the evolution from industrialism to "postindustrialism" (Lyon, 1995), or from an industrial society towards an "information society" (Servaes and Heinderyckx, 2002: 92; Ricci, 2000: 142). On the supply-side, as well as on the demand-side, things kept evolving.

Heeks (1999) defined ICTs as "recording, processing, storage and reporting electronic tools". ICTs are the engine of innovation and technological development. In particular, information technology has developed rapidly, on one hand because of better functionality of electronic circuits and on the other hand due to software development, so within 50 years came from a 40 tones massive computer (ENIAC) in a palmtop. Computers, in the late 20th

century, are able to control complex manufacturing and other processes, manage large databases and carry out a very large volume of arithmetic operations needed in space technology, in nuclear power plants, meteorological departments, research centers etc.

Internet and its applications contribute to communication's active facilitation, particularly in improving the speed of data transfer and information internationally. Apart from these, the contribution of internet growth in the creation of world village is also due to the reduction of communication cost as well as data transport and information from one end of the world to another.

The new emerging data, make necessary the use of advanced information and communication systems by the Greek rural businesses. Technological advances have significantly reduced the one-dimensional approach to electronic information. Now desktop computers are only one of many tools available to retrieve and process information. Today's users are in possession of a number of technologies, from very complex, such as laptops, mobile PDA type, to very simple, such as portable storage drives USB type, all available to facilitate the work of transport and information storage (Bills et al., 2006).

Over the past twenty years, ICTs have been dramatically developed affecting all social, economical and cultural activity. They include: computer equipment (computers, terminals, printers, electronical storage parts etc.), communication equipment and software.

In the near future, both change in labour relations and qualifications of workers make it necessary to optimize the capacity of producers for successful involvement in the operation of agricultural system so that to become modern producers who can cope with current conditions and problems. Agricultural development which increases farm incomes and ensure sustainability of the natural resources in production is central to overall economic growth and development. ICTs offer a wide range of opportunities to knowledge management in agricultural development.

ICTs adoption in agriculture is influenced by several factors, some of these are the type of agricultural population, its development pace and the heterogeneity in the character of individuals, as well. Over the years, the attitude parameters of producers towards the adoption of innovations are changing. This is the fact that at a more recent moment in time producers who initially abstained decide later to adopt these technologies (Diederen et al., 2002).

Age proved to has a direct correlation with the decision of using a computer. Elderly producers do not use many sources of information as their younger colleagues; it is more likely to rely on their experience (Batte et al., 1990a; Huffman and Mercier, 1991; Batte et al., 1990b). Results from a series of studies in the U.S. and UK, show that farm size is associated with the adoption degree of using the computer and its e-information. Producers with large farms and thus higher economical status tend to have more positive attitudes in ICTs' adoption (Batte et al., 1990b; Fearne, 1990; Schnitkey et al., 1991).

According to Lasley et al. (2001) regardless of the technological expertise level, Iowa producers in the U.S. want a wide range of information channels for agricultural activities. Furthermore, these data showed that regardless of the number of available advanced ICTs, there is a strong preference for direct, personalized communication.

Study of Samathrakis et al. (2005) came to the conclusion that ICTs adoption by producers in the Greek livestock occurs at very low levels. In a research carried out in the U.S. by La Rose et al. (2007) covering four counties, one in Michigan, one in Kentucky and two in Texas, regarding the benefits of the Internet , it was proved that before processing the information people must first believe that have the ability to use this innovation in order to achieve these results. According to a research of Michailidis et al. (2008), held in Greece and particularly in western Macedonia, producers respondents were not generally able to identify

either the costs or time saving, or production profits that resulted from their access to such technologies. However, through statistical analysis it was determined that the special assessment that producers have got on ICTs appeared to be associated with the use of e-mail, e-banking, education, weather and social and recreational uses. In recent years there has been a growing awareness of the role and potential importance of broadband in rural areas. There are a number of empirical studies relating to access to broadband and ICTs use in rural environments in the U.S. (Strover, 2003; Strover et al., 2004) suggesting that there are significant differences in the availability of broadband services between urban and rural areas (Grubesic, 2003; Grubesic and Murray, 2002, 2004). ICTs potential to promote new learning objectives, change traditional teaching practices and develop new teaching methods has been recognized by many researchers (Wilson and Lowry, 2000; Papadaki-Klavdianou et al., 2000; Michailidis et al., 2009).

3. METHODOLOGY

The research took place at Pella's Prefecture, located in Macedonia and belongs to the region of Central Macedonia. It is bordered to the north by the Former Yugoslavian Republic of Macedonia (FYROM), to the east by Kilkis' Prefecture, to the south east by Thessaloniki's Prefecture, to the south by Imathias' and Kozani's Prefectures and to the west by Florina's Prefecture. Its capital is the city of Edessa. The Prefecture occupies an area of 2.505,8 Km2 the majority of which is covered by farmland, forests and pastures. It has an area population of 132,386 inhabitants.

It has a particularly high rate of employment in primary sector. In recent years, it is also observed an intense activity in the secondary sector and primary in tertiary where tourism and culture emerge as economic sectors with particular outlook and positive contribution in improving the living standards of local residents. The primary data research, collected using a specially constructed questionnaire, supplemented by personal interviews with producers in the Prefecture of Pella. The research lasted from March to May 2008. The reliability and validity of individual sections/questions in the questionnaire have been checked by the statistical technique of Categorical Principal Components Analysis using the statistical program SPSS for Windows version 16.0 (SPSS, 2008). The results of repeated measurements are consistent and therefore the measurement procedure is reliable because the equivalence factor (reliability) α-Cronbach (0,712) is sufficiently high. In regard to validation, the categorical principal components analysis has distinct effects on the validity structure and on the validity of distinct multidisciplinary variables investigated. To the remaining sections of the questionnaire, the reliability and validity tests are based on previous international research literature, which made the relevant controls and therefore do not need to be repeated.

As a sampling frame are defined the nominal lists, from which the sample is selected. In this paper, the available nominal lists were the lists taken from Edessa's Municipality. As sampling unit was one person from each list. Participants were selected at random from the compiled lists. For the purposes of this research , the minimum required sample was set at 303 people, for confidence interval 95% (a = 0.05) and acceptable means of error ± 4%, according to Crimp's type (1985) mentioned concerning the determination of sample size for random sampling: $n = \frac{pqZ^2}{E^2}$. Where: n is the sample size, Z is the reliability coefficient, E is the acceptable margin of error, p is the rate that we want to assess and q equals to 1-p.

For the best description of the situation prevailing in the agricultural population of Pella's Prefecture on the extent of ICTs adoption was applied descriptive statistical analysis

through SPSS v.16.0 (SPSS, 2008) which investigated forty-eight (48) attitudes/views, using the five-point Likert scale (where 1=extreme negative attitude and 5=extreme positive attitude), eleven (11) affirmation-denial variables and five (5) of simple choice. For the statistical investigation of individual characteristics and attitudes/views of the producers in Pella's Prefecture about the adoption degree of ICTs, with parallel segmentation of those in given distinct groups (clusters) was selected the method of two-step cluster analysis which is being used when some of the variables are categorical or suspected to be linear the relation between variables (SPSS, 2003). The technique of two-step cluster analysis is an exploratory tool designed to identify clusters of similar observations from a large number of them, based on categorical and/or continuous variables (features) group, with statistical controls proceedings of independence of variables and regularity controls of distribution of continuous variables and polynomial division of the categorical. Two-step cluster analysis uses as a measure of similarity between the clusters the logarithm of maximum likelihood distances. The choice of clusters' optimal number is based on the information criterion by Bayes (BIC) of Schwartz or criterion by Akaike (AIC). Furthermore, the two-step cluster analysis program provides results of descriptive statistical measures and frequencies in each cluster and the number of observations in clusters. For the search of the dominant determinant characteristics of each cluster were audited by Kruskal-Wallis and Mann-Whitney combined with $\chi 2$ tests in frequency tables.

To investigate the relationship of the producers' characteristics in clusters and the adoption of ICTs was preferred, in each cluster, the method of categorical regression (Meulman et al., 2001), which is an extension of classical statistical technique of regression analysis and is used when some of the variables are numerical (interval or ratio) or suspected that the relation between variables is linear (SPSS, 2008). Categorical regression quantifies data of categorical variables with the performance of numerical categories, while having as a purpose the excellent linear regression of transformed variables (Kooij and Meulman, 1997). Thus, is given the predictability of the dependent variable values for any combination of quantified variables. Variables categories are quantified in a way so the square of the multiple correlation coefficient between the dependent variable and the independent group, to be maximum. The effect of each independent variable on the dependent is described with the corresponding regression coefficient. For any change in an independent variable the sign of regression coefficient indicates the direction of change of the dependent variable.

4. RESULTS

From the descriptive statistical analysis the results are as expected and are described the use of statistical tools and standard deviation. Almost all the respondents are producers as a main occupation (74.6%). The female gender constitutes a minority as the head farm, not an unexpected situation for the Greek agricultural households (7.6%). The largest percent has the age between 36 and 45 years (42.9%). The majority of respondents are married (71.9%) with four-member families (45.9%) and come from agricultural families (98.7%). Regarding educational level most of the producers in the sample have got elementary education (primary, 26.4%) and have graduated from High School (22.4%). The annual gross farm income and the total annual gross income of the largest percent of respondents is low (5,000-10,000 €). It is determined that, basically, the agronomist-producer communication is carried out by conventional means, personally and by telephone. Specifically, after the personal communication (85.2%) follows the communication through telephone (66.3%) and the communication through internet (37.3%). As for the overall application of innovations, about

55.8 percent has got advanced technology television in possession. About 51.8 percent has got a computer, but those who use it are basically the children of the household (65%). The vast majority of the producers in the sample had never ordered anything through internet (88.4%). Half of the respondents agree (52.5%) that innovation's meaning is directly linked to increased production costs. Yet, they believe that ICTs can contribute in increasing their income, which is why about 44.5 percent interests to adopt ICTs. Respondents mostly use mobile phone (73.2%), very few computer (23.5%), few the internet (20.2%), fewer teletext (13,9%), about 12.2 percent has got e-mail and the lowest use of ICTs have the fax (7,6%), DSL (7,6%) and GPS (5,9%). Yet, about 59.1 percent of respondents is willing to adopt ICTs. Confidence degree of respondents in ICTs is high as about 90.4 percent is gathered at the first three scale degrees (very much, very and enough). Most respondents (51.2%) agree that new technology adoption improves their social status. It is investigated that about 70.3 percent responded negatively that there are no people in their close environment (friends, relatives, neighbors) adopting innovations in agriculture. With regard to innovations in education the respondents who participate or have participated in training seminars (45,9%) agree that ICTs are being used, for example video projector, computers, internet etc. About 52.5 percent believes that the agronomists are adequately informed about ICTs. The respondents believe that they can acquire the necessary knowledge about ICTs, in order of priority, with frequent contact with the agronomist (91,8%), with seminars (90,8%), being based on their experience (75,3%), with informative booklets (62,3%) and with reading appropriate books (33,4%). The majority agrees that the age has an important role in the adoption of ICTs and that they do not have difficulty in ICTs' application. Finally, the sample's producers were asked to make their self-criticism with regard to the ICTs use. It is observed that most of them declare that are expert users (54,4%), about 23,4 percent considers that it belongs in the category of laggards, about 9,6 percent is the advanced users category, follows the category of those who are not interested (8,3%) and finally about 4,3 percent declared that it is identified with innovative users.

Using the gathered data from the responses of the producers and with the application of two-step cluster analysis, after being tested for its size through the technique of nonlinear principal components analysis, was resulted the optimum solution of four clusters. Of the 303 observations 85 are included in the first cluster, 74 in the second, 70 in the third and the remaining 74 in the fourth cluster. The basis for selecting the clusters was the demographic characteristics of the respondents (Table 1).

Table 1. Clustering distribution

		N	% of Combined	% of Total
Cluster	1	85	28,1%	28,1%
	2	74	24,4%	24,4%
	3	70	23,1%	23,1%
	4	74	24,4%	24,4%
	Combined	303	100,0%	100,0%
	Total	303		100,0%

A search is carried out for possible relations between demographic characteristics of producers and ICTs adoption, at each one of the clusters separately. Further, the results of categorical regression for the four clusters of producers are presented in Table 2. It is found

that the producers of the second cluster are differentiated, in some way, by the producers in other clusters, as to the willingness degree of adopting ICTs.

Specifically, it was found that the producers in the second cluster can be classified as innovators, the producers in the first and third cluster as early adopters and finally the fourth cluster producers as laggards.

As regards to the distribution of observations in different clusters, it is also confirmed from Table 2, that the first cluster is constituted mainly by married, male producers of Aridaia, aged of 36-45 years, with medium education (High school), coming from agricultural family, with agricultural annual income of 15,000-20,000€, non-agricultural annual income of 15,000-20,000€ also, who reside in four-membered households. The second cluster is differentiated as for the region (Exaplatanos), the educational level (middle or superior education), the number of household members (three), their annual agricultural income (>35,000€) but also their non-agricultural annual income (>35,000€). The third cluster is differentiated concerning second as for the region (Aridaia), the marital status (single), the educational level (basic or medium education), the annual agricultural income (5,000-10,000€) but also their non-agricultural annual income (5,000-10,000€). Finally, the fourth cluster is differentiated in relation with the second as for the region (Aridaia), the age of producers (46-60 years), the educational level (basic education), the number of household members (four), the annual agricultural income (5,000-10,000€) but also their non-agricultural annual income (5,000-10,000€).

Table 2. Distribution of categories of demographic characteristics for clusters

Variables	1st Cluster	2nd Cluster	3rd Cluster	4th Cluster
Gender	Male 87.0%	Male 89.2%	Male 97.1%	Male 97.3%
Age	36-45 years 47.0%	36-45 years 55.4%	36-45 years 51.4%	46-60 years 48.6%
Place of residence	Aridaia 38.8%	Exaplatanos 25.7%	Aridaia 61.4%	Aridaia 36.5%
Marital status	Married 88.2%	Married 69.0%	Single 68.6%	Married 97.3%
Number of household members	4 65.9%	3 44.6%	3 37.1%	4 55.4%
Origin from agricultural family	Yes 100.0%	Yes 98.6%	Yes 97.1%	Yes 98.6%
Educational level	High school 41.2%	Lyceum General 33.8%	Lyceum Technical 27.1%	Primary 59.4%
Main occupation	Priv. employee-Producer 64.7%-9.4%	Civil servant.-Producer 47.3%-29.7%	Priv. employee-Producer 51.4%-11.4%	Retired - Producer 87.8%-5.4%
Agricultural income	15,000-20,000€ 55.3%	>35,000 € 48.6%	5,000-10,000€ 42.8%	5,000-10,000€ 59.4%
Non-agricultural income	15,000-20,000€ 47.0%	>35,000 € 27.0%	5,000-10,000€ 72.8%	5,000-10,000€ 58.1%

The following Table (Table 3) presents the observations' interpretation of each cluster. Concretely, the first cluster represents medium aged (36-60 years), male producers of Aridaia who have intentions to adopt ICTs but do not have satisfactory income so as to proceed in such investment, in other words they are producers of high interest but no innovators. The second cluster represents middle aged producers of Exaplatanos with high income

(innovators). In the particular cluster, despite the overwhelming majority of males in all clusters, it is worth to be noticed that it is observed the biggest gathering of female producers. The third cluster represents medium age residents of Aridaia, with mixed education, who will adopt innovations after being preceded the producers of second cluster. And finally, the fourth cluster represents elderly (46-60 years), traditional producers of Aridaia with low income (5,000-10,000 €).

Table 3. Interpretation of observations of clusters

Cluster			
1st	2nd	3rd	4th
Middle aged, males, primarily producers but also private employees, with mixed education, residents of Aridaia, of high interest but no innovators and with total income 15,000-20,000 €	Middle aged (36-45 years), males, primarily producers but also civil servants, residents of Exaplatanos with high educational level and very high income (> 35,000€).	Middle aged (36-45 years), single, males, primarily producers but also private employees, residents of Aridaia, with mixed education.	Elderly with low education, traditional producers of Aridaia, pensioners of low income (5,000-10,000 €).

Categorical regression gave factor price of multiple determination R^2=0.313, which indicates that 31.3% of the variance of the transformed values of the dependent variable is explained by the transformed values of independent variables involved in regression equation. Furthermore, the variance analysis gave a value of F=3.908, corresponding to a zero level of statistical significance, indicating the good fit of categorical regression model to transformed data. As regards to the relative importance of independent variables, which are indicated to the adoption degree of ICTs, is observed by Table 4, that slightly high values (>0.100) of relative importance show the variables of the Number of Members of Household, the Occupation, the Comprehensive Income (annual), the Use of ICTs in Seminars and the Observation of Innovation/ICTs Seminars.

Table 4. Standard regression coefficients

	Standardized Coefficients		F	Correlations			Importance	Tolerance	
	Beta	Std Error		Zero-Order	Partial	Part		After Transformation	Before Transformation
Gender	.064	.061	1.098	.044	.074	.062	.009	.931	.911
Age	.067	.068	.963	.070	.070	.058	.015	.755	.561
Place of residence	-.152	.061	6.176	-.160	-.174	-.147	.078	.930	.938
Marital status	-.127	.072	3.167	-.020	-.126	-.105	.008	.681	.684
Number of household members	-.211	.069	9.406	-.154	-.213	-.181	.104	.735	.864
Educational level	.068	.065	1.093	-.095	.074	.062	-.021	.826	.710
Occupation	-.178	.066	7.341	-.310	-.190	-.160	.176	.809	.827
Total income	-.298	.062	23.095	-.346	-.324	-.284	.329	.909	.851
Use of ICTs in Seminars	.191	.062	9.413	.230	.214	.181	.140	.899	.829
Observation of Innovation Seminars	.138	.063	4.848	.247	.155	.130	.109	.890	.849
Adoption of innovations by people around	.048	.066	.528	.192	.052	.043	.030	.790	.778
Adoption of innovations by family	.064	.063	1.021	.118	.072	.060	.024	.883	.771

Dependent variable: Willingness to adopt innovation/ICTs

Particularly, from the standardized regression coefficients (Table 4), of independent variables, higher price shows the one that corresponds to the variable: Total Income and follow, in sequence, the variables: Occupation and ICTs Use in Seminars.

From the zero-order coefficients (Table 4) those of higher rates are the coefficients which are related to the Total Income (r=-0.346), Occupation (r=-0.310) and Observation of Innovation/ICTs Seminars (r=0.247), indicative of bilateral relation (negative in the first two and positive in the third) connecting each of the corresponding independent variables on the dependent, disregarding the presence of all others.

The partial correlation coefficients (Table 4), with the removal of linear relation of other variables, both from this independent as from dependent variable, are being presented with a higher price in the variables of Total Income, Number of Household Members and with successively lower prices in other variables. The rate -0.324 of partial correlation coefficient of Total Income explains the percent of 10.49 of the variance (-0.3242) of regular values of the dependent variable, when the effects of all other independent variables will remove. In terms of the partial correlation coefficients (Table 4), the highest is presented to be the correlation between the dependent variable and the variable of Total Income. The relative importance of independent variables (Table 4) is higher for the variable of Total Income, followed in order by the variable of Occupation and Observation of Innovation/ICTs Seminars. Collectively these variables explain the 64.5% of total importance. Multicollinearity lack is particularly obvious from the very high levels of independent variables, too (Table 4), which show the contribution of variance of each independent variable without being explained by other independent variables.

5. CONCLUSION

This paper investigates the possible relations between the variable referred to the adoption degree of ICTs (dependent) and the other independent demographic variables. From the descriptive statistical analysis it is resulted that with regard to basic innovations made in Pella's area is observed that there is no special action. Mobile phone is used by almost all the producers. The majority of producers have got a computer at their disposal, but the household members who use it are primarily the young aged, their children. The producers do not proceed, apart from some exceptions, to further activities related to e-services, e-commerce and e-banking, while most of them do not even know their meanings. In terms of entertainment and comfort, most producers tend to modernization and thus to a corresponding familiarity. The cautious attitude towards new technologies by the producers is interpreted in some way by the fact that they believe the meaning of innovation is directly linked to increased production costs. With regard to social factors, social promotion through the adoption of new technologies might play a role for the producers. Most of them agree that innovations contribute to the ease and convenience of life, increasing production efficiency and effectiveness, entertainment, professional recognition and prestige.

The vast majority of the producers agreed that frequent contact with the agronomist can provide the necessary knowledge for the mentioned technologies. The result obtained shows that ICTs can complement and not replace traditional methods, suggesting the possibility of increasing rather than reducing the demand for extension of such education/training. They are mainly based on their experience as most of them classify themselves in the category of "expert users", very few feel for themselves that are innovators, while those who describe themselves as "laggings" and "not interested" maybe few but not non-appreciable as a

number. Furthermore, almost all the producers believe that ICTs have contributed to their life improvement, from enough to very much.

Practically, the results of this research could be useful in selecting a appropriate policy to promote ICTs as they determine the scope of such a targeted policy. In addition, these results indicate the need of separating the population of producers into clusters in order to be assessed in more detail the diffusion parameters of innovations in each cluster and be reclaimed more personalized adoption of ICTs policies.

Applying two-step cluster analysis are revealed a number of interesting results. Specifically, four clusters of producers and, more importantly, significant differences among the four clusters on the variables relating to the use of ICTs are identified. In other words, producers of Pella's Prefecture behave differently, as to the degree of ICTs adoption, according to the cluster in which are classified.

Future cross-country research about this issue would be a useful complement to the results presented here, so as to be presented the effectiveness of statistical methods and to identify and list the possible developments in the dissemination of innovations, in relation to information and communication.

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