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*Full Length Research Paper*

# Factors affecting the adoption of agricultural innovations in Erzurum Province, Turkey

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**In order to determine the factors affecting the adoption of agricultural innovations, 169 farmers were reviewed in 7 counties that may represent Erzurum province in terms of social, economic and cultural aspects. The data were analyzed in LIMDEP software using logistic regression method and the results were presented in tables. The innovations examined in the study were adoption of artificial insemination, membership to cooperative, having automatic waterer in stables and making use of incentives for agricultural production. The results of the analysis indicated that the age, education level, and income level of the farmers, operational goal of the farm, participation in extension studies, making use of mass media means and benefitting from agricultural incentives were influential on the adoption of innovations to a great extent. The study concluded that in order to improve the efficiency of studies on the adoption of innovations significantly, it was necessary to hold extension studies constantly and intensively, utilize the mass media means effectively in addition to other methods, include the innovation in the support scheme for a definite period of time and encourage the businesses for commercial production.**

**Key words:** Adoption of innovations, LIMDEP, logistic regression analysis, Erzurum.

## INTRODUCTION

The concept of agricultural innovations covers “the new or developed inputs and methods used in agricultural production process”. These are technical practices increasing the production or yield (Tatlıdil, 1997). The adoption and spread of agricultural innovations help speed up technology transfer and make technological production more useful. One of the most marked features of today’s world is the rapidly changing technology. The techniques and methods of production improve constantly. In every stage of agricultural production, countless technological innovations are presented to the farmers (Tatlıdil, 1997). Adoption to changing conditions is only possible through rapid application of the innovations (Atsan et al. 2009; Özkaya et al. 2005).

Introduction to technology and the spread of new technologies is one of the aspects to help improve life standards of those living in the rural area and attain agricultural improvement. Agricultural improvement is generally referred as the level of technology that farmers adopt to increase production. Agricultural progress is the process in which technical information and innovations are directed to and adopted by farmers. In short, it is the positive reaction of farmers to change (Kızılaslan, 2009).

The introduction of agricultural innovations to farmers and their adoption can be provided by agricultural extension activities. Agricultural extension is one of the most important tools for the survival of agriculture (Özkaya et al. 2005). In addition, agricultural extension studies play an important role in increasing the agricultural productivity and developing the sector (Bernet et al. 2001; Olgun 1994; Oktay et al. 1995; Boyacı 1998; Wadsworth 2003; Yurttaş 1979). It is not easy to persuade the farmers about adopting and practicing the proposals offered to them through extension activities (Sezgin, 2008). The production of knowledge, its transfer

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**Table 1.** The number of questionnaires in each district.

| District | Number of questionnaire |
|---|---|
| Merkez | 25 |
| Aşkale | 19 |
| Pasinler | 31 |
| Oltu | 23 |
| İspir | 22 |
| Çat | 23 |
| Karayazı | 26 |
| Total | 169 |

into a form comprehensible by farmers and extension, and its perception and utilization by farmers take place in a cycle complementing each other (Boyacı 1998; Oktay et al. 1995; Bernet et al. 2001). Therefore, it is quite important that farmers should adopt and practice the agricultural innovations so that both the efficiency of agricultural extension studies can be obtained and investigations can attain intended goals. With this aim, the study determined the factors effecting the adoption of agricultural innovations. The outcome of the study is thought to contribute to future investigations on the same issue.

## MATERIALS AND METHODS

### Materials

169 interviews conducted in 7 districts of Erzurum province made up the primary material of the study. In addition, the related literature, the information obtained from public and private institutions and web sites made up the secondary material.

### Methods

#### *Data collection*

In the study, "The Purposive Sampling Method" was used to select the counties. 7 counties, namely Aşkale, Pasinler, İspir, Oltu, Çat, Karayazı and the central county, located in the north, middle and south that might represent Erzurum province in terms of socio-economic and geographical aspects were selected as the survey area. The sample size was determined considering land assets of 16,383 enterprises which were registered to Direct Income Support scheme of the District Directorate of Agriculture. The number of the questionnaires was determined using Simple Random Sampling Method. According to this method, the following formula was used to determine the number of questionnaires (Çiçek and Erkan, 1996).

$$n = \frac{N\sigma^2}{N-1D^2+\sigma^2} \qquad D = \left(\frac{d}{t}\right)^2$$

where n=sample size, N=unit number in the population, σ = standard deviation, d= reasonable error term ($\bar{x} \times 0.10$), $\bar{x}$ = mean and t= t value of t-distribution table for a certain confidence interval
In the study, these values were estimated as:

N= 16383, σ= 64.31, d= $\bar{x} \times 0.10$, $\bar{x}$ = 84.52 and t= 1.65

$$n = \frac{16383(64.31)^2}{16382\left(\frac{8.5}{1.65}\right)^2 + (64.31)^2} = 155$$

The number of questionnaires to be given to the farmers was estimated as 155. An additional number of questionnaires, as much as 10 % of the sample size, was added to the total sample in case there should be some shortcomings or errors in some of the questionnaires and therefore the total size should not represent the population. As a result, a total of 171 questionnaires was conducted. 2 of the questionnaires had some missing information, so they were excluded. Thus, a total of 169 questionnaires were included in the analysis. Table 1 presents the district distribution of the questionnaire size. Domestic and foreign resources and the views of the specialists helped design the questionnaire form.

#### *Data analysis*

The data obtained from the survey conducted in Erzurum city during the study was transferred to LIMDEP standard software. Logistic regression analysis was used to analyze the data and the results were presented in tables.
The functional form of the regression model estimating the factors that affect the adoption of the innovations regarding stockbreeding was as follows:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9)$

Y; adoption of artificial insemination - yes; 1, no; 0 (Kukla), $X_1$; features of the business owner, $X_2$; features of the enterprise and $X_3$; making use of agricultural extension activities.

## RESULTS AND FINDINGS

### The results of the regression analysis

Artificial insemination application is not popular in the study area. In addition, there are some beliefs among the people in the area that artificial insemination is a wrong, sinful and objectionable method. In recent years, several institutions and non-governmental organizations have held extension studies in the area to make artificial insemination popular. These efforts tried to eliminate the biases on artificial insemination and apply it appropriately. The adoption of artificial insemination was taken as dependent variable in the logistic regression analysis (Table 2). This dependent variable was explained with 8 independent variables. The factors of all parameters were significant. Farmer age was found to be statistically significant at 1 % level regarding the adoption of artificial insemination and younger farmers had a tendency to adopt it. Farmers with high education level were also more inclined to adopt artificial insemination. This variable

**Table 2.** Logistic regression analysis results for the adoption of artificial insemination.

| Variable | Factor | Standard deviation | P value |
|---|---|---|---|
| Constant | -3.9890 | 1.9767 | 0.0436 |
| Regional difference (Central County: 1, others:0) | -0.4509 | 0.6494 | 0.4875 |
| Age | -0.7830 | 0.2159 | 0.0003*** |
| Income | 0.0578 | 0.3430 | 0.8662 |
| Education | 1.2331 | 0.5329 | 0.0207** |
| Making use of incentives | 1.6026 | 0.4979 | 0.0013*** |
| Operational goal of the enterprise | 0.6633 | 0.6540 | 0.3105 |
| Participating in agricultural extension studies | 1.7998 | 0.5841 | 0.0021*** |
| Benefitting from mass media means | 1.1818 | 0.3662 | 0.0013*** |
| Log likehood:-63.5392 | McFadden $R^2$: 0.3989 | $X^2$ (8): 84.3304*** | |

** *P<0.01; ** P<0.05; * P<0.1.

**Table 3.** Logistic regression analysis results for cooperative membership.

| Variable | Factor | Standard deviation | P value |
|---|---|---|---|
| Constant | -4.6105 | 1.7014 | 0.0067 |
| Regional difference (Central County: 1, others: 0) | -0.1079 | 0.3966 | 0.7855 |
| Age | -0.5151 | 0.1839 | 0.0051*** |
| Income | 0.0004 | 0.0001 | 0.0002*** |
| Education | 0.6140 | 0.3978 | 0.1227 |
| Land assets | 0.0251 | 0.0614 | 0.6834 |
| Making use of incentives | 1.1860 | 0.3969 | 0.0028*** |
| Participating in agricultural extension studies | 1.0440 | 0.5253 | 0.0468** |
| Benefitting from mass media means | 0.0183 | 0.3236 | 0.9549 |
| Log likehood: -80.7673 | McFadden $R^2$:0.2923 | $X^2$ (8): 66.7128*** | |

***P<0.01; ** P<0.05; * P<0.1.

This variable was also statistically significant at 5 % level. It was determined that making use of incentives, participating in extension studies and benefitting from mass media means had a positive affect on adopting artificial insemination and that it was statistically significant at 1% level.

Cooperatives provide important facilities and possibilities for the farmers such as lowering the cost of agricultural production inputs and marketing the farmer products. Regarding this, membership to cooperative was taken as dependent variable and 8 independent variables were used in the logistic regression analysis (Table 3). The factors of all parameters were significant. According to the results of the analysis, young farmers were inclined to cooperative membership and this variable was found to be statistically significant at 1 % level. It was determined that farmer income level and making use of incentives had a positive affect on cooperative membership and that these variables were also statistically significant at 1% level. On the other hand, it was also found out that participating in extension studies had a positive affect on cooperative membership and that it was significant at 5% level.

A vast majority of farmers in the study area did not have automatic waterer to meet the daily water needs of the animals in their stables (Sezgin, 2010). A normal cow needs 75 - 80 liters of water a day. This proportion is bigger for cows with higher milk yield, because about 87 % of milk consists of water. However, animals in Erzurum city are generally watered once a day especially in winter months (Yavuz, 2007). This causes a considerable yield loss. Therefore, this issue was dealt in the latest extension studies to a great extent. To express the dependent variable, having automatic waterer system, 9 independent variables were used. The results were presented in Table 4. The factors of all parameters were significant. It was determined that farmer age had a negative affect on having automatic waterer system and that it was at 1 % significance level. It was also found out that farmer income had a positive affect on having automatic waterer system and that it was at 1% significance level. It was determined that commercial production was an increasing factor for having automatic waterer system and that it was statistically significant at 10% level. The animal breed found in the farm affected having automatic water system at 10% significance level.

**Table 4.** Logistic regression analysis results for having automatic water system.

| Variable | Factor | Standard deviation | P value |
|---|---|---|---|
| Constant | -0.3132 | 1.5450 | 0.8394 |
| Regional difference (Central County: 1, others: 0) | -0.2655 | 0.3726 | 0.4761 |
| Age | -0.4690 | 0.1792 | 0.0089*** |
| Income | 1.0668 | 0.2904 | 0.0002*** |
| Education | 0.2672 | 0.3303 | 0.4186 |
| Cooperative membership | 0.1742 | 0.5816 | 0.7646 |
| Operational goal of the business (commercial:0 family consumption:1) | -0.5202 | 0.2983 | 0.0812* |
| Making use of incentives | 0.6196 | 0.3857 | 0.1081 |
| Animal breed (culture:1, hybrid:2, domestic:3) | -0.4167 | 0.2264 | 0.0656* |
| Participating in agricultural extension studies | 1.0421 | 0.5335 | 0.0508* |
| Log likehood: -90.9039 McFadden $R^2$: 0.2026 | | $X^2$ (9): 46.1969*** | |

** *P<0.01; ** P<0.05; * P<0.1.

**Table 5.** Logistic regression analysis results for making use of incentives

| Variable | Factor | Standard deviation | P value |
|---|---|---|---|
| Constant | -1.7579 | 1.2074 | 0.1454 |
| Regional difference (Central County:1, others:0) | 0.2562 | 0.3545 | 0.4698 |
| Age | -0.3403 | 0.1629 | 0.0367** |
| Income | 0.0001 | 0.0001 | 0.2890 |
| Education | 0.5912 | 0.3964 | 0.1359 |
| Operational goal of the business (commercial:0 family consumption:1) | -0.2487 | 0.4043 | 0.5385 |
| Participating in agricultural extension studies | 0.8003 | 0.4581 | 0.0806* |
| Benefitting from mass media means | 0.7892 | 0.2846 | 0.0056*** |
| Log likehood: -96.2849 McFadden $R^2$: 0.1481 | | $X^2$ (7): 33.4888*** | |

** *P<0.01 ** P<0.05 * P<0.1

The farmers having culture breed animals were inclined to having automatic waterer system. Participation in extension studies also affected this variable positively and it was found to be at 10 % significance level.

Due to some structural features of the agricultural sector, this sector needs implementation of supporting policies. Thereby it will be possible to improve the living conditions of producers and therefore, the country's development level (Topçu, 2008). With the implementation of supporting policies, the intention is to guide the production and obtain sustainable production, improve the quality, increase the productivity in production and encourage the product diversification (Yavuz et al. 2004). With this regard, making use of agricultural incentives was taken as dependent variable and 7 independent variables were used in the regression analysis (Table 5). It was determined that young farmers were inclined to making use of agricultural incentives and that this independent variable was statistically significant (P<0.05). It was found that participating in agricultural extension activities had a positive affect on making use of incentives and that this independent variable was statistically significant (P<0.1). Following the agriculture related broadcast in mass media means also had a positive affect on making use of incentives and it was statistically significant (P<0.01).

## RESULTS

The center of agricultural development always involves human activities such as improving, processing, disseminating, sharing and using information. Today, the information-based nature of farming is increasing (Kızılaslan, 2009). Therefore, it is quite important that farmers should adopt and use recent information technologies in order to increase agricultural productivity and provide rural improvement. In this regard, determining the factors affecting the adoption of agricultural innovations was thought to shed light future investigations.

In this study, 169 farmers in 7 districts of Erzurum Province were given a questionnaire and the data obtained from the survey was analyzed in LIMDEP standard software using logistic regression analysis. Adopting artificial

insemination, cooperative membership, having automatic waterer system in the stable and making use of agricultural incentives were taken as agricultural innovations. Agricultural extension training activities were performed in the districts and villages in the study area in the context of projects implemented recently.

According to the regression analysis results, it was determined that farmer age, making use of incentives, participating in agricultural extension training activities and benefitting from mass media means had a positive influence on adopting artificial insemination and that it was statistically significant ($P<0.01$). Another variable affecting the adoption of artificial insemination was farmer education level and it was also found statistically significant ($P<0.05$). It was found that the age and income of farmer and making use of incentives influenced cooperative membership and that it was statistically significant ($P<0.01$). Participating in agricultural extension training activities had a positive influence on the adoption of this innovation. It was also found to be statistically significant ($P<0.05$).

Another innovation investigated in the study was having automatic waterer in the stable. It was determined that this innovation was influenced by farmer age and income and that it was statistically significant ($P<0.01$). Other variables affecting this innovation were operational goal of the business, animal breed raised in the enterprise and participating in agricultural extension training activities. They were also statistically significant ($P<0.01$). The last innovation studied was making use of incentives. This was influenced by farmer age ($P<0.05$), participating in agricultural extension training activities ($P<0.1$) and benefitting from mass media means ($P<0.01$).

## Conclusion

It was determined in parallel to the reports of Türkyılmaz et al., 2003 and Kutlar and Ceylan, 2008 that age, educational status and income level influenced the adoption of agricultural innovations. In addition, it was found in parallel to the studies of (Aktaş and Özal, 2003) that participating in agricultural extension training activities was also an effective factor on the adoption of innovations. It was also determined in the study in parallel to the studies of Sezgin 2010, Türkyılmaz et al., 2003 and Çiçek et al., 2008 that benefitting from mass media means had an influence on the adoption of agricultural innovations. In addition, making use of incentives and operational goal of the business was also effective on the adoption of innovations.

In the light of the results obtained, it is necessary to hold training meetings for farmers so that agricultural innovations can be adopted. It can be stated that introducing the innovations and explaining the benefits it will provide clearly will be effective on the adoption of the innovation. In addition, as reported as a result of the study, mass media means, which affect the adoption of agricultural innovations positively, should be used to introduce the innovations.

As agricultural supports are promoting and encouraging factors for innovations, an innovation should be taken into support scheme for a certain period before the acceptance and adoption of the innovation. In addition, encouraging the enterprises for commercial production will influence the use of recent techniques and methods in production positively.

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