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Full Length Research Paper

Analysis of the factors affecting the adoption of innovations in dairy farms in Erzurum Province, Turkey

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The main objective of this study was to determine the factors affecting the adoption of innovations in dairy farms in Erzurum, Turkey. To this end, data obtained by simple random sampling method from 154 dairy farms in Erzurum province were used. Six innovations, which were expected to be adopted by the producers have been taken up. The dependent variable of the study was divided into three categories, which are low, medium and high acceptance levels of the innovations. The data from 147 dairy farms were used for this study. "Ordered Probit" model was used. It was concluded that the old people had difficulty with respect to adoption of innovations. The ones who raise culture breeds instead of indigenous ones and the enterprises that take more advantage of the support policies for animal husbandry tend to adopt innovations earlier than the others. The education status, animal breed and benefiting from the government support policies were also found to be statistically significant. In conclusion, the government policy that will raise the educational level of the farmers, support farmers to raise culture breed animals, encourage them to establish associations, will also facilitate the adoption of innovations on the part of the farmers in general.

Key words: Innovation, dairy farm, ordered probit, Erzurum.

INTRODUCTION

Agricultural sector in Turkey still has an important role in the economy of the country. It is very important that the enterprises in this sector keep up with the current developments in the world. In this connection, the farmers should be informed of the innovations and be provided with the modern equipments and tools, and, as a result, increase production and productivity. In the atmosphere of globalization, it is necessary to produce cheaper and higher quality products that would be able to compete in local as well as international markets. This will only be possible by giving up old traditional production techniques and adopting new and modern ones.

Adoption of agricultural innovations is extremely important for the country agriculture and consequently for the development of the people in the rural areas. A way of reducing production costs in agricultural enterprises is to use the state of the art technologies (Türkyılmaz et al., 2003). The acceptance of new technologies by farmers, no doubt, will contribute to the improvement of the economical profitability in shot term and the living condition of people in the long term (Boz et al., 2002).

In a study conducted by Tatlıdil (1989) in Polatli District of Ankara Province, it has been determined that some factors such as crop type, mechanization level, the size of the farm, the age of the farmer and income level, have had a significant effect on the adoption of sprinkle irrigation system by the farmers who deal with both crop production and animal husbandry.

In a study conducted by Türkyılmaz et al. (2003) to determine the effects of socio-economical factors on the adoption of innovations in cattle farms in Aydin Province, it has been determined that the level of adoption in small and medium size farms was low in 25%, medium in 55% and high in 20% of the farms. On the other hand, in large size farms, the adoption level was medium in 50% of the farms, while it was high in the other 50% of the farms.

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In a study conducted by Aktaş et al. (2005) to determine the profile of the farmers who are early adopters of cumin crop in Sanliurfa Province, it has been determined that, they had a low level of education, small farms, low level of social status, low level of managerial talents and low level of connections with local and national information canals. This must be because of the specific nature of cumin crop which requires an extraordinary labor and generally cultivated in small parcels of land. The cost of labor is very low in that area.

In a study conducted by Boz and Akbay (2005) in Kahramanmaraş to determine the factors affecting the adoption of corn cultivation, it has been concluded that, socio-economic variables such as the level of education, income level, the size of the farm, the size of irrigated field, tractor ownership, credit usage, investment trend, frequency of visits to the provincial center, opinion leadership, and frequency of interaction with the extension officers had a significant effect on the adoption process.

The Province of Erzurum is a province having high cattle breeding potential, located in the north eastern part of Turkey. While it has 5% of the available cattle in Turkey, it has only 2.5% of the produced beef (Turkstat, 2005). The climatic conditions of the region, geographical structure thereof and presence of vast pasture give an advantage of stock-breeding when compared with the other production areas (Yavuz, 2006). The producers came across a great deal of innovations in bovine breeding area, by increasing the stock-breeding subsidy amount twice as much in the budget of 2005 when compared with 2004 of the Ministry of Agriculture and Rural Affairs, and increasingly going up each year thereafter by means of the bovine breeding improvement project that come into effect in Erzurum in the same year. While a part of the producers adopt innovations easier, a great majority thereof have had difficulty in its acceptance.

As can be seen in the studies mentioned earlier, the factors affecting the adoption of innovations play an important role in the activities aimed at improving the agricultural practices and as a result, the quality of life of the farmers. Certain qualifications on the part of the farmers facilitate adoption of innovations which plays an important role in improving agriculture in the region. The objective of this study was to determine the factors affecting the adoption of innovations in dairy farms in Erzurum Province. These factors are related to the characteristics of both the farmers and the farms.

MATERIALS AND METHODS

Population and the method used for sampling

The main material for the study was questionnaire given to the farmers face to face in 16 villages in the districts of Ispir, Hinis, Pasinler and Karayazi of Erzurum Province. The number of animals and the number of operations of these villages have been taken from the District Agricultural Directorates, and the accuracy of these data and the number of bovine animals pertaining to these villages were cross checked and verified by the numbers obtained from the veterinarian data system provided by the authorities of the Erzurum Animal Health Branch Directorate. According to the obtained data, the number of commercial activities for which a questionnaire will be carried out has been calculated for each province by the simple random sampling method as per the following formula (Güneş and Arikan, 1988). By means of this method, the chance of units entering the sampling is equal. The method, from this aspect, is also called sampling and unconstrained as well. With the calculation of sample statistics, the weight of each one is taken as equal. This method is an appropriate one where the population is not large enough and it is easy and cheap to reach sampling units (Çiçek and Erkan, 1996).

By considering the fact that some of the questionnaires will not reflect the realities and not represent population, the number of questionnaire was increased by 5%. In the research, for determining the number of enterprises, the data were evaluated within the limits of 5% margin of error and 95% confidence limits:

$$n = \frac{N * \sigma^2}{(N-1) * D^2 + \sigma^2}$$

where, n = sample volume, N = number of enterprises in population, σ^2 = population variance, D = d/z value, d = acceptable error ($\bar{x}$ =0.05) and z = Z value in the Standard Normal Dispersion table according to the acceptable error ratio.

For Erzurum:

$$n = \frac{1458 \times 12.1}{1457 \times \left(\frac{10.65 \times 0.05}{1.96} \right)^2 + 12.1} = 147$$

147 + (147*0.05) = 154 polls.

The data were collected in October 2007 and the analyses were conducted in the LIMDEP statistical program (Greene, 1995).

Data analysis

In order to realize the main objective of the research, the fundamental statistics such as average, standard deviation and chi-square were used. To realize the sub goal, the ordered probit model was used.

There are a lot of factors which come into play on acceptance and rejection of innovations. According to Rogers (1995), there are five characters having influence on the individuals to adopt innovations. These are relative usefulness, appropriateness, complexity, testability and observability. The relative usefulness denotes the degree of perception of an innovation as compared to previous application; the appropriateness indicates degree of perception of consistency of an innovation with existing values beliefs, past experiences and present requirements; the complexity denotes the degree of difficulty of perception of an innovation; the testability shows the ability of innovation in at least a limited area for

testing; and the observability denotes the ability for the farmers to see the results emerging from the application of innovation.

In this study, 6 innovations which are required to be adopted during the recent years by the farmers are taken up. Stable technique, keeping farm record, milking technique, silage making, cooling tank and artificial insemination seen as the innovations that are to be accepted by the farmers. When examined closely, the relative usefulness of these innovations can be seen in western provinces. The productivity of the farmers who use these innovations will be increased and hence the improvement in profits thereof will be achieved. It may be stated that these innovations are understandable and their conclusions can be seen by everyone. There is no way in which everybody would accept an innovation right away when it emerges. The acceptance process of any innovation is reviewed in five groups. These are: innovators, early adopters, early majority, late majority and the laggards (Rogers, 1995; Yurttaş et al., 2007).

The dependent variable of the research is divided into three categories which are low, medium and high as the acceptance level of the innovations in the dairy farms. Six innovations such as stable technique, keeping farm records, milking technique, silage making, cooling tank, artificial insemination are dealt with. Those who use none of these innovations or those who use only one of them are categorized as low adoption level, while those who use 2 or 3 are classified as medium and those who use 4 and more are classified as high.

Dependent variable having three levels was able to use ordered probit model in the analyses, since a normal regression model (OLS) shall assume equal differences among the three categories of the dependent variables, which may come up with biased results.

Dependent variable has natural limitation. This yields biased results even if the multinomial logit model is used. Therefore, being the dependent variable as intermittent categories and being natural limitation in these categories indicates that the ordered probit model is the best method to be applied (Mohamed and Abdel-Aty, 2001; Boz et al., 2002). The ordered probit model, wherethe dependent variable is coded as; 0 = low, 1 = medium and 2 = high, is expressed as follows:

$y^* = bx + \varepsilon$ $\varepsilon \sim N[0,1]$
$y = 0$ if $y^* \leq 0$,
$y = 1$ if $0 < y^* \leq \mu_1$,
$y = 2$ if $\mu_1 < y^* \leq \mu_2$

Where, y^* denotes the non observable dependent variable, μjs indicates the threshold values forming the ranges to be taken by y in the model being estimated together with β, while ε donates the vector of error terms that displays normal distribution and N [0,1] indicates the dependent variable observable, denoting the adoption probability of innovations (Greene, 2008).

Probability $(y = 0) = \Phi(-\beta'x)$,
Probability $(y = 1) = \Phi(\mu_1 - \beta'x) - \Phi(-\beta'x)$,
Probability $(y = 2) = 1 - \Phi(\mu_1 - \beta'x)$

To derive positive result from all these probabilities, μ values are required to be $0<\mu1<\mu2<...<\mu j-1$. Φ indicates cumulative normal distribution function.

RESULTS AND DISCUSSION

At the dairy farms, it has been determined that the average age is 44.4 (Table 1). Again in the same table, it is observed that 94.2% of the producers who have participated in the questionnaire are married and the average number of person in the family is 6.4. In the region where the study was done, the average milk productivity is 7 kg per animal. While there are a lot of government support policies in the field of breeding, the farmers in the area where the questionnaire is carried out, are able to take advantage of only 1.2. The test to determine the acceptability of the meaningfulness of the result is as follows:

$LR = -2(\text{Log likelihood}_{\text{limited}}) - (\text{Log likelihood}_{\text{unlimited}})$
$LR = -2(-162.377) - (-82.503)$
$LR = 159.748$

According to testing, the LR value is bigger than the $\chi^2_{(8)}$: 15.507 critical value at 5% level. That is, explanatory value of the estimated model is accepted. The threshold value has been determined to be statistically significant.

According to regression analysis results, the sign of parameters was found to be meaningful at adoption level that is explained by eight dependant variables of innovation at the dairy farms in the Erzurum Province (Table 2). It is observed that the old people have difficulty with respect to adoption of innovations and again the innovation adoption level of farmers that have more individuals in the family is also low. The ones who raise culture breeds instead of indigenous ones and the farmers that draw more advantage from the breeding policies adopt innovations easily. The education status, animal breed and use of subsidies status from the breeding policies are also found to be statistically significant.

In the study, in dairy farms, when marginal effects are considered according to the level to adopt innovations, increasing number of individuals in family reduces the probability by 1% for the subjects to be members of high adoption level category. When considering the probability of some other essential variables to be in the group that has low innovation adoption level, increasing the duration of education reduces the probability of subjects to be in the group that has low innovation adoption level by 14%. The use of subsidy advantages increases the probability of the farmers to be in the high level by 6% and decreases the probability to be in the low level by 22%.

In this study, it was concluded that, the education level, the animal breed of the farm and use of advantages of subsidies status are effective on the adoption level. Education level has positive influence on the innovation adoption level. This outcome shows similarity with the studies being made by Türkyılmaz et al. (2003) and Weir and Knight (2000). The innovation adoption level of the farmers who draw more advantage from the breeding policies becomes higher. Although, from the statistical standpoint, the age, productivity and membership are not

Table 1. Definition of the variables and statistical summaries.

Variable and its code	Name of variable	Average	Standard deviation
Age (continuous variable)	Age	44.4351	13.2344
Marital status of head of the family: Married = 1, single = 0	Marital status	0.9416	0.2356
Number of persons in the family (continuous variable)	Number of persons	6.3701	2.3845
Education (education term): Not literate = 1, literate = 2, primary school = 3, junior high school = 4, high school = 5, university = 6	Education	3.4740	1.0676
Association or membership of cooperative: Member = 1, not member = 0	Membership	0.4870	0.5015
Owned animal breed: Indigenous = 0, Indigenous + crossbred =1, crossbred = 2, crossbred + culture = 3, culture = 4	Animal breed	1.6753	1.3425
Milk production kg / per head / day (continuous variable)	Productivity	6.9864	3.9017
Number of policies being used in respect to breeding (each)	Policy	1.1753	1.0171
Dependent variable: Adoption level: Low = 0, medium = 1, high = 2	Adoption	0.7597	0.8008

Table 2. Analysis results of ordered probit.

Variables	Coefficient	Standard error	Marginal Effects		
			Probability (y = 0)	Probabilit (y = 1)	Probability (y = 2)
Age	-0.0086	0.0107	0.0034	-0.0025	-0.0009
Marital status	0.7513	0.5294	-0.2908	0.2443	0.0464
Number of individual	-0.0952	0.0545	0.0372	-0.0271	-0.0100
Education	0.3638*	0.1412	-0.1420	0.1037	0.0383
Membership	0.2739	0.2736	-0.1065	0.0774	0.0292
Animal breed	0.6777**	0.1540	-0.2645	0.1931	0.0713
Productivity	0.0839	0.0560	-0.0327	0.0239	0.0088
Policy	0.5637**	0.1481	-0.2200	0.1606	0.0593
Constant	-.2864**	1.1116			
Threshold value (Mu)	1.8426**	0.2397			

*Considerable at 0.05 level; **considerable at 0.01 level. Model $\chi^2_{(8)} = 159.75$.

considered as significant according to the results, it shows similarities in terms of coefficients with the previous studies. Rogers (1995) indicated that the ones who adapt innovations early are younger than the ones who adapt the same late. The reason why this is not so in this study must stem from the fact that the average age of the farmers in the sample was 44. This high average made it difficult to distinguish between the young and the

old. At the end of the study, it was also observed that the innovation adoption level by the young ones is higher. Sakarya (1993) showed that, the productivity is one of the most important factors affecting profitability in the farms. It was concluded that membership of the farmers in social organizations such as cooperatives or associations have positive influence on the adoption level. Özçatalbaş (2000) has obtained similar results.

Conclusion

As a result of this study, it has been concluded educational level of the farmers in the study area is an important problem to be overcome. The analysis of data clearly shows that there is a strong and positive correlation between the level of education and the level of adoption of innovations. On the other hand, the herd of cattle in the area mainly consists of local indigenous breed which are not known for high milk or meat yield. Table 1 shows the quantity of the indigenous breed in the samples.

The level of social relations of the farmers was determined to be an important factor affecting the adoption process. The more social relations the farmers have, the earlier they tend to adopt innovations. The farmers who are members of farmers organizations or non government organizations are among the early adopters of the innovations.

After determining the factors affecting the level of adoption of innovations, the following recommendations, taking the peculiarities of the farmers into consideration, can be made to increase the tendency for the farmers to adopt innovations:

1. The level of education and training of the farmers should be increased so that the farmers can benefit from the government support policies. The average educational level for the farmers in the area should be increased at least to elementary school level and they should be aware of the importance of the education for their livelihood. They should be aware of the fact that their quality of life would have been much higher, if they had had a higher level of education in the past;
2. The number of low yielding native breed cattle should be decreased, while the number of pure cross breed culture type of cattle should be increased. This will both increase the production and the tendency of the farmers to adopt innovations. High yielding animals make it possible to decrease the production cost and thus increase the profitability and income. Increased income will encourage the farmers to adopt innovations. The farmers need to be educated by the government agencies and the number of farms raising culture breed animals should be increased;
3. The government should make it attractive to establish producers' organizations and the farmers should be encouraged to become members of such establishments. Some farmers do not have an alternative to animal husbandry. Therefore, the public agencies should take this fact into account and design the subsidies and other support policies accordingly. These measures will help improve the chance for the farmers to adopt innovations better.

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