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Full Length Research Paper

Analysis of the factors affecting the instrument and machinery assets in enterprises that deal with agricultural production: The case of Erzurum Province

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The aim of this study was to determine the factors affecting the agricultural instrument, machinery and tractor assets of the enterprises in the central district villages of Erzurum province and the marginal effects of these factors. The Binomial Probit Model was used for this purpose. Education level of the farmers, their population, the size of the land, number of land parcels, disaster situation, crop cultivation and monthly income were found as factors affecting instrument and machinery possession. According to the study results, a unit increase in the education level of the farmers, their family population and in land assets they possess led to an increase of 17.85, 16.58 and 0.26% in their instrument and machinery possession possibility, respectively. Similarly, a unit increase in the number of land parcels, crop cultivation and monthly income led to an increase of 2.81, 38.58 and 0.04% in their instrument and machinery possession possibility, respectively. In addition, a unit increase in the education level of the farmers, land possession, the number of land parcels, crop cultivation and monthly income led to an increase of 19.55, 0.22, 15.39, 29.54 and 0.04% in the possibility of the enterprises to possess tractors.

Key words: Agricultural instrument, machinery and tractor assets.

INTRODUCTION

Agricultural production is a process with a variable structure, and requires gathering a number of many different inputs. In addition, the features of each input that enters to the production process also changes per se within a wide range. This dynamic structure of agriculture requires a planning to enable the most productive use of all inputs which enter to the production process, because the purpose of advanced agricultural technological applications is to increase the productivity as well as the yield. Increasing the productivity in agricultural enterprises can be realized not only by performing these applications separately and ideally, but also by a good planning and organization which will enable the efficient and rational use of the production inputs (Anon., 2009a). Agricultural mechanization is a production technology and does not affect the productivity increase directly. But it increases the efficiency of different technological applications.

Mechanization presents development and application at different levels in different Countries. This difference can be watched particularly in agricultural enterprises. In other words, mechanization is being applied in each agricultural enterprise at different levels, depending on the technical and economical structure of the enterprise. Agricultural mechanization has many known benefits. However, a mechanization implemented without planning has also some disadvantages. For example, mechanization tools inputs have the largest share within the whole agricultural inputs, and therefore, implementing an unplanned mechanization may cause an important expense burden on the enterprise scale. Excessive mechanization can lead to an increase in unemployment in the rural sector. Unplanned mechanization can jeopardize the balance between the agricultural and industrial sectors in disfavor of agriculture. Mechanization tools usually work dependable on fuel. Unplanned

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mechaniczation negatively affects the general energy balance of the country (Anon., 2009b). When considering the advantages and disadvantages of the agricultural mechanization, it can be postulated that the rate of agricultural mechanization in Turkey is not at desired levels. The usage level of both instrument-machinery and tractors is insufficient. The causes of this situation are related to the agricultural and social structure. Intense population and high rate of population increase, high prices of agricultural machinery and interest rates, against the low buying power of the farmers, lack of technical information on the part of the farmers, problems created by the losses caused by inappropriate use and maintenance due to lack of education, and not giving an appropriate importance to research and education related to agricultural mechanization are the most important factors in this issue. Furthermore, lack of a consistent mechanization policy, small size of land holdings and large number of parcels within enterprises which hinder appropriate agricultural mechanization applications are also important factors (Anon., 2009c). There have been many studies on this issue. Some of them are; Dernek (1981), Cetin and Rehber (1987), Belknap and Saupe (1988), Isik et al. (1988), Saner (1989), Gregory et al. (1990), Kasap et al. (1991a), Cetin and Yüksel (1994), Toga (1994), Cetin et al. (1998), Cetin (1999), Demircan and Soysal (2002), Demircan (2002), Hossary (2002), Andrade and Jenkins (2003), Birinci et al. (2003), Tora and Hansson (2004), Akin, (2005).

Agricultural instrument and machinery, in other words agricultural mechanization, is of capital importance from the point of implementing the agricultural activities in accordance with the technique and in appropriate time and increasing the manpower productivity (Karlı et al., 1995). This point is very important, particularly for Eastern Anatolian Reegion and the attraction center of the region, Erzurum. Therefore, the purpose of the study is to determine the factors affecting the agricultural instrument, machinery and tractor assets of the enterprises in the central district villages of Erzurum province and the marginal effects of these factors. In addition, this study has importance, since it is a complementary study for the studies mentioned above.

MATERIALS AND METHODS

Materials

The data of the study were obtained by a survey carried out with heads of farm families in Tuzcu, Tepekoy, Borekli, Kumbet, Guzelyurt, Derebogazi, Yagmurcuk, Sogucak, Cayirtepe, Dumlu, Yolgecti, Yesilyayla, Umudum, Uzunahmet, Ciftlik and Uzunyayla villages of the central district of Erzurum in 2008

Methods

House numbers in central villages which were obtained from Erzurum Provincial Directorate of Agriculture were considered as the basis to determine the number of villages, and property assets for setting variation to determine the number of surveys to be done. Numbers of villages and surveys were set by the Simple Random Sampling Method. In accordance with this method, the following formula was used to determine the number of villages and enterprise surveys (Cicek and Erkan, 1996):

$$n = \frac{N * S^2 * z^2}{(N-1) * d^2 + S^2 * z^2}$$

The characters in the formula are:
n: Sample size
N: Number of enterprises in the population (2283)
S: Standard deviation (53.44)
z: z value (1.645)
d: Acceptable error $(\bar{x} * 0.10)$
$\bar{x}$: The average of the sample (76.6)

Sample size of villages and enterprises for the survey were determined within 90% confidence interval and with 10% deviation from the average. Accordingly, number of villages to collect data for the survey was determined as 37. Bearing in mind the financial possibilities and time factor, 16 villages were chosen through Telic Sampling according to the land properties in the villages of Erzurum central district and survey number was found as 125. Taking into consideration that some of the surveys would not reflect the reality and would not represent the population, 20% (25 surveys) addition was done. After the evaluation of the results, it was understood that 23 surveys could represent the population and thus, these surveys were included in the study. In conclusion, 148 surveys were held in 16 sample villages and Binomial Probit Model was used in the relevant analyses.

Theoretical framework

In case that a qualitative dependent variable is used in econometric studies, Limited Dependent Variable Regression Models are used. An independent variable showing two situations expresses occurrence or non-occurrence of an incident. In case of occurrence the value is expressed as “1”, and in case of non-occurrence the value is “0” (Gujarati, 1995). Three methods are used in estimating this type of models, which are: Linear Probability Model, Logit Model and Probit Model. The Linear Probability Model is quite reliable concerning the risk of probability to be out of the limits 0 -1, while Probit and Logit models are quite reliable concerning the risk of probability to be within the limits 0-1 (Gujarati, 1995; Sarimeseli, 2000). In Probit Model, it is assumed that occurrence or non-occurrence of an incident or the decision depends on an invisible benefit index. This mentioned benefit index is expressed in I_i, and depends in independent variables: So that, the higher I_i index, the higher probability of realization, that is, the occurrence of the mentioned incident. I_i is expressed by the following formula:

$$I_i = B_1 + B_2 X_i$$

The characters mean:

$B_1 =$ Constant value,
$B_2 =$ Coefficient fort the variable expressed by X,
$X_i =$ Value of the independent variable

Table 1. The Demographic features of the farmers.

	Min.	Max.	Average	Standard deviation
Age (Years)	22	82	42.6	13.81
Education (Years)	1	6	3.3	0.98
Population (Individuals)	1	16	6.7	2.69
Population working in agriculture (Individual)	1	5	1.9	1.02

Source: Original calculations.

Table 2. The characteristics of the enterprises.

	Min.	Max.	Average	Standard deviation
Land property (da)	0	600	78.7	90.16
Land parcel number (Units)	0	25	6.4	4.68
Non-agricultural income (TL)	0	1500	155.9	309.65
Crop income (TL)	0	22500	2983.1	3863.51
Animal products income (TL)	0	15400	3552.1	3256.89
Total animal assets (Cattle)	0	71	14.8	13.83

Source: Original calculations.

Table 3. Quantities of instrument-machinery possessed by the farmers.

Quantity of instrument-machinery	Possession of Instrument-Machinery				Total	
	No		Yes			
	Number	%	Number	%	Number	%
0	87	100	0	0	87	58.39
1	0	0	12	19.35	12	8.05
2	0	0	8	12.9	8	5.37
3	0	0	13	20.97	13	8.72
4	0	0	23	37.1	23	15.44
5	0	0	6	9.68	6	4.03
Total	87		62	100	149	100

Source: Original calculations.

The relationship between the occurrence and non-occurrence with I_i is expressed as “1” if it occurred, and “0” if did not occurred. For each dependent variable, the mentioned incident starts to occur after a certain value (critical or start value) of I_i. If the starting value is expressed as I_{i}*, the incident will occur only if I_i value exceeds I_{i}*, otherwise will not occur. The probability of I_{i}* to be lower than I_i or equal can be calculated according to the following formula. I_i expresses the occurrence probability of the incident, and the P_i the Probit Model.

$$P_i = P_r(Y = 1) = P_r(I_i^* \leq I_i) = F(I_i)$$

In Probit models, R^2 value, which expresses the certainty co-efficient, is not considered concerning whether the functional form of the model was chosen properly. Therefore, the co-efficient and P values are considered concerning the most appropriate way to prepare the model (Gujarati, 1995; Akkaya and Pazarlıoglu, 1998).

FINDINGS AND DISCUSSION

The demographic features of the farmers residing in the study region are given in Table 1. Accordingly, average age of the farmers in the central district of Erzurum was determined as 42.6. Average member number of farmer families is 6.7. Number of members working in the agricultural sector was calculated as 1.9. on the average.

The features of the enterprises located in the study area are given in Table 2. The average land property of these enterprises is 78.7 da, average land parcel number is 6.4. In addition, the income from the animal products is higher than the income from crop

Table 4. Status of instrument-machinery possession according to the enterprise types.

		Possession of instrument-machinery		
		No	**Yes**	**Total**
Vegetative production	N	5	2	7
	%	5.75	3.23	4.70
Animal production	N	27	10	37
	%	31.03	16.13	24.83
Mixed production	N	55	50	105
	%	63.22	80.65	70.47
Total	N	87	62	149
	%	100.00	100.00	100.00

Source: Original calculations.

Table 5. Probit model estimations concerning the factors affecting the status of enterprises for possessing instrument/machinery and tractors.

Variables	**Possession of instrument-machinery**		**Possession of tractor**	
	Co-efficient	**Stand. Dev.**	**Co-efficient**	**Stand. Dev.**
Constant	*** -5.2343	1.0383	*** 4.4347	0.9829
Education level	* 0.4786	0.2761	** 0.5648	0.2816
Population	** 0.4323	0.2128	0.3404	0.2115
Availability of land	*** 0.0068	0.0026	** 0.0061	0.0025
Number of land parcels	* 0.0732	0.0418	* 0.0690	0.0400
Disaster situation	** 0.7541	0.3267	0.4250	0.3219
Crop cultivation	*** 1.2671	0.4409	** 1.0078	0.4310
Monthly income	** 0.0011	0.0005	** 0.0011	0.0005
Receiving help for disaster	0.5160	0.3700	0.3958	0.3667
The highest probability	-67.5363		-68.3004	
Chi square	67.2707		59.6291	
P	0.0000		0.0000	

Source: Original calculations.
*, **, *** show the statistical importance level of 0.10, 0.05 and 0.01, respectively.

production. Total animal assets was maximum 71 cattle, and on the average 14.8 per enterprise.

Instrument-machinery quantities possessed by the farmers are given in Table 3. It was found that 58.39% of the agricultural enterprises in the central district of Erzurum do not possess any agricultural instrument-machinery, while 41.61% possess these items. 8.05% of these enterprises possess one instrument-machinery, 5.37% two, 8.72% three, 15.44% four, and 4.03% five instrument-machinery. Status of instrument-machinery possession according to the enterprise types is given in Table 4. 4.70% of the enterprises deal with vegetative production, 24.83% with animal production, and 70.47% deal with both vegetative and animal production (mixed production). 3.23% of enterprises dealing with vegetative production, 16.13% of enterprises dealing with animal production, and 80.65% of enterprises dealing with mixed production possess agricultural instrument-machinery. Estimations concerning the probit model for the factors affecting the status of enterprises for possessing instrument/machinery and tractors are given in Table 5. Accordingly, a positive correlation was found between education level, population, the size of the land, number of land parcels, disaster situation, crop cultivation, monthly income and instrument and machinery possession and this situation is statistically important. In addition, a positive correlation was found between the education level, the size of the land, number of land parcels, crop cultivation, monthly income and the desire of the enterprises to possess tractors, and this situation is statistically significant.

The parameter values of the marginal effects of the factors which affect possession of instrument/machinery and tractors by the enterprises are given in Table 6. Accordingly, for each unit increase in the education level of farmers, population of farmer's family and the land that they possess, the probability of the enterprises to possess instrument-machinery increases by 17.85, 16.58 and 0.26%, respectively. Similarly, for each unit increase in the number

Table 6. Marginal effects of the factors which affect possession of instrument/machinery and tractors by the enterprises.

Variables	Possession of instrument-machinery		Possession of tractor	
	Co-efficient	Stand. Dev.	Co-efficient	Stand. Dev.
Constant	*** -0.6107	0.0504	*** -0.6702	0.0474
Education level	* 0.1785	0.0986	** 0.1955	0.0909
Population	** 0.1658	0.0813	0.1233	0.0761
The size of the land	*** 0.0026	0.0010	** 0.0022	0.0009
Number of land parcels	* 0.0281	0.0161	* 0.1539	0.1162
Disaster situation	** 0.2892	0.1245	0.0250	0.0146
Crop cultivation	*** 0.3858	0.0886	** 0.2954	0.0898
Monthly income	** 0.0004	0.0002	** 0.0004	0.0002
Receiving help for disaster	0.2016	0.1440	0.1485	0.1407

Source: Original calculations.
*, **, *** show the statistical importance level of 0.10, 0.05 and 0.01, respectively.

of land parcels, crop cultivation and monthly income of the farmers, the probability to possess instrument-machinery increases by 2.81, 38.58, and 0.04%, respectively. Furthermore, the probability of the farmers who have faced a disaster in the study region to possess instrument-machinery is 28.92% higher than the others. Again, a unit increase in the education level of the farmers, the size of the land, number of land parcels, crop cultivation and monthly income increases the probability of the enterprises to possess a tractor by 19.55, 0.22, 15.39, 29.54 and 0.04%, respectively.

RESULTS

In the study area, central district of Erzurum, average age of the farmers is 42.6, population of a farm family on the average is 6.7. Average size of land of agricultural enterprises is 78.7 da, number of parcels on the average is 6.4. Education level of the farmers, population, size of the land, number of land parcels, disaster situation, crop cultivation and monthly income were found as factors affecting the possession of instrument-machinery, while education level, size of the land, number of land parcels, crop cultivation and monthly income were found as factors affecting the possession of tractors. The most important factors affecting the possession of instrument/ machinery and tractors are crop cultivation and education level. The probability of the farmers who faced a disaster in the study region to possess instrument-machinery is 28.92% higher than the others.

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