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Analysis of Factors Affecting the Innovation Level of Agricultural Operators

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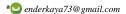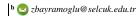*Corresponding author

ARTICLE INFO	ABSTRACT
	In this research, it is aimed to determine the factors affecting the innovation level of agricultural enterprises. Konya province was chosen as the research area because it is one of the important agricultural production centres in Türkiye. Stratified random sampling method was used within the scope of the study. A total of 268 agricultural enterprise owners were interviewed face to face and survey data were compiled. Multiple regression model was applied in the analysis of the factors affecting the perception of innovations by the operator. In this research, considering the characteristics of the data collected by the questionnaire, the linear regression model, which uses functional forms in regression models, was used. In the study, innovation index was taken as the dependent variable in the linear regression model. Independent variables were determined as education, experience, number of parcels, amount of land, active capital, amount of land, agricultural income, following innovations, receiving training on agricultural issues, participating in agricultural activities, following events related to agriculture on social media and cooperation with institutions. As a result of the model, a positive relationship was determined between education, experience, number of parcels, amount of land, active capital, amount of land, agricultural income, following innovations, receiving training on agriculture-related issues, participating in agriculture-related activities, following agriculture-related events on social media and cooperation with institutions and innovation index.

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Introduction

The agricultural sector, which is among the most important strategic sectors, provides a great service by using plant and animal production techniques for the nutrition of living things. Agriculture, which is an important item in the economies of countries, is increasing in value day by day. Due to the increase in the world population, the importance of agricultural production is increasing due to issues such as providing food needs and protecting natural resources.

From the day mankind started agricultural activities until today, it has been a quest to obtain the most products. The innovations that emerged in this process have contributed to mankind. Innovations have been among the most important competitive tools in the conduct of economic activities. As long as technological innovations exist, the concept of innovation will always exist in the lives of human beings. Strategic decisions about innovation will be effective in the future of businesses. Agricultural enterprises need to follow innovations in order to produce under competitive conditions. In fact, not only in the agricultural sector but also in all sectors, innovative businesses lead the sector. In this context, when we look at the terminology of the concept of innovation, which is widely expressed today, it has passed from the Latin word "innovatus" to English. Innovation, which consists of the words "in" and "novatus", means a unique and previously unknown star (Dinler Sakaryalı, 2016).

In the dictionary of the Turkish Language Association, the word innovation is used in the sense of "innovation". Innovation is defined as the application of a new or significantly improved product (goods or services) or process, a new marketing method or a new organizational method in business practices, workplace organizations or external relations (Kılavuzu, 2005). For the first time, the concept of innovation was defined by economist Joseph Alois Schumpeter as "the introduction of a new product or a new quality of an existing product, the introduction of a new production method, the opening of a new market, finding a new source for the supply of raw materials or semi-processed goods, having a new organization in any sector"(Schumpeter, 1981)

Agricultural enterprises need to benefit from innovations at the maximum level in order to keep up with the competition in today's conditions. What is important here is the increase in production. Naturally, the increase in yield will increase the income of enterprises. In order for enterprises in rural areas to carry out sustainable agricultural activities, they must earn sustainable income. Innovation is an important tool in achieving sustainable income.

Countries make political choices to become sufficient with agricultural production within the country without being dependent on foreign countries in terms of food security. Recent events, especially the pandemic process, have revealed how strategically important agriculture is. While the world population was 7.5 billion in 2022, it is estimated to reach 8.5 billion by 2030 and 10 billion by 2050. Depending on the population growth, it is estimated that there should be a 70% increase in agricultural production to meet the world's food needs (Food ve Nations, 2017).

The new trend of our world is population growth and, accordingly, how will food supply be provided to feed people? Scientists are conducting many studies to find the answer to this question. It is necessary to find a way to provide food supply with existing production resources without harming the environment. In order to get more efficiency with existing production resources, especially innovations should be utilized. This study was conducted to determine the current innovation status of agricultural operators and to make the necessary analysis.

Materials and Methods

The data used in the study were compiled from primary and secondary sources. The source of the primary data to be used in the study was obtained from the survey data conducted with agricultural enterprise owners. Agricultural enterprises in Konya province, Akşehir, Altınekin, Beyşehir, Bozkır, Cihanbeyli, Çumra, Ereğli, Hadim, Ilgın, Karapınar, Karatay, Kulu, Seydişehir and Yunak districts were determined as the main mass of the study. Factors affecting the innovation level of agricultural operators were examined. Face-to-face surveys were conducted with agricultural operators in the region where the investigations were carried out. The surveys belong to the production period of 2020. The secondary data analyzed consist of data obtained as a result of researching resources in the field of sustainability. Within the scope of the doctoral study titled "Innovation Perception of Agricultural Enterprises and Determination of Innovation Level for Sustainability", the ethics committee decision of Selçuk University Social and Human Sciences Scientific Research and Publication Ethics Committee dated 14/07/2020 and Decision No: 2 was taken. Neyman Method, one of the stratified sampling methods, was used to calculate the sample volume of the research (Yamane, 1967)

$$n = \frac{[\sum(N_h S_h)]^2}{N^2 D^2 + \sum[N_h(S_h)^2]} \tag{1}$$

$$D^2 = d^2/z^2 \tag{2}$$

In determining the number of samples drawn from the main mass, 5% error and 99% confidence limits were used and the following formula was used to distribute the sample numbers to the strata (Yamane, 1967).

$$n_i = \frac{(N_h S_h)n}{\sum N_h S_h} \tag{3}$$

Multiple regression model was applied in the analysis of the factors affecting the perception of innovations by the operator. If we define regression analysis briefly, it is a method used to model the dependent variable in statistical analysis applications (Tarı, 2015). Multiple regression analysis, which we used in the analysis, is used when more than one factor affecting the dependent variable is effective, unlike simple regression analysis.

The dependent variable Y parameter used in the multiple regression model is determined by a linear combination of k-1 number of independent variables (X1,X2,.....,Xk). Expressions such as X1,2,3 refer to the independent variable. Multiple linear regression analysis model;

$$Y_i = b_o + b_1 X_{i1} + b_2 X_{i2} + \ldots\ldots\ldots + b_k X_{ki} +_{ui} \tag{4}$$
İ=1, 2, ……, n

The assumptions of the multiple regression model are that the error term is a stochastic variable, the mean of the error term is taken as zero. The distribution of the error term is normal. The independent variable has a constant value and there is no relationship between the independent variable and the error term. There is no strong and complete relationship between the independent variables, the independent variables are not stochastic, there are no measurement errors and the model is applied correctly (Dikmen, 2012).

Multiple regression model reveals the average relationship between the dependent and multiple independent variables and the estimated model is expected to represent the actual situation. The variance of the error term arises depending on the changes in the independent variable. Within the scope of the study, the Spearman Rank Correlation coefficient was obtained with the help of the statistical package program by using Spearman Rank Correlation, which is frequently used in the literature. The following t formula was applied to determine whether the obtained coefficient is statistically significant. If the obtained t account value is greater than the two-tailed t table value, it is concluded that there is variance in the estimation model (Kalaycı, 2005).

$$t_{(hes.)} = (r_s \sqrt{(n-2)})/\sqrt{(1-r_s^2)} \tag{5}$$

In this study, considering the characteristics of the data collected through the questionnaire, the linear regression model, which uses functional forms in regression models, was used. When the literature is examined, it is seen that the socio-economic structure of enterprises is examined in the studies on innovation. In this study, innovation index was taken as the dependent variable in the linear regression model. Independent variables were determined as education, experience, number of parcels, amount of land, active capital, amount of land, agricultural income, following innovations, receiving training on agricultural issues, participating in agricultural activities, following agricultural events on social media and cooperation with institutions (Table 1).

Table 1. Factors Affecting the Innovation Index

	Data Type	Calculation Type	Calculation Type
Innovation Index	Dependent	Continuous	Likert scale
Education	Independent	Ordinal	Measured data
Experience	Independent	Continuous	Measured data
Land Amount	Independent	Continuous	Measured data
Parcel Number	Independent	Continuous	Measured data
Active Capital	Independent	Continuous	Measured data
Agricultural Income	Independent	Continuous	Measured data
Following Innovations	Dummy variable	Nominal	0: Not following 1: Following
Receiving Education on Agricultural Issues	Dummy variable	Nominal	0: Not receiving education 1: Receiving education
Participation in Agricultural Activities	Dummy variable	Nominal	0: Not participating 1: Participating
Following Agricultural Events on Social Media	Dummy variable	Nominal	0: Not following 1: Following
Collaboration with Institutions	Dummy variable	Nominal	0: Not collaborating 1: Collaborating

Table 2. Summary Table

	Business Groups				Businesses average
	15-50	51-150	151-500	501-+	
Innovation Index	71.340	73.820	79.200	78.080	75.610
Business land (da)	33.640	95.770	271.590	791.910	256.860
Average number of parcels (pieces)	1.440	2.360	3.480	4.220	3.090
Agricultural Income Avg. Bus. (TL)	7.834.61	63.732.89	218.511.78	990.614.68	237.100.72
Total Active Capital Avg. Bus. (TL)	559.716.830	1.484.891.180	4.023.104.570	12.411.560.330	3.896.860.850

Findings and Discussion

On average, 1.29% of the population is illiterate. While 0.46% of the population is literate, 53.75% are primary school graduates, 15.08% secondary school graduates, 21.31% high school graduates and 8.18% university graduates. Rogers ve Shoemaker (1971) in their study on the diffusion of innovations, determined that there is a significant relationship between the level of education and the adoption of innovations.

The average land size per enterprise in the agricultural enterprises surveyed is 33.64 da in the first group, 95.77 decares in the second group, 271.59 decares in the third group and 791.91 decares in the fourth group, and the average enterprise land is 256.86 decares. The average number of parcels and their sizes increase with a linear proportion as the land holdings of the agricultural holdings increase. The average parcel size is 83.04 decares and the average number of parcels is 3.09 pieces. The presence of agricultural land, its distance to the center of the agricultural enterprise, the number and width of parcels have an effect on the success of the enterprise in terms of the effective use of the working day and the application of agricultural mechanization (Erkuş ve ark., 1995). As the amount of land of agricultural production enterprises increases, labour productivity also increases (Bozdemir ve Bayramoğlu, 2018).

It was determined that the innovation index of the enterprises examined was 75.61% on average, agricultural income was 237,100.72 TL on average, total active capital was 3,896,860.85 TL on average (Table 2). The innovation levels of the analyzed enterprises were evaluated econometrically. In the model established, the power of independent variables to explain the dependent variable, R^2, was determined as 0.685 (68.5%). This value shows that 68.5% of the changes in the dependent variable can be explained by the changes in the independent variables (Table 3). The validity of the model was determined by F test. The F result was found to be 50.617 at 1% significance level. According to the results, the model is valid. Within the scope of the study, the variance inflation factor (VIF) was used to determine whether there is a multicollinearity problem in the model. This value is required to be less than 5. When Table 3 is examined, since the VIF value of the parameters is less than 5, there is no multicollinearity problem in the model. In order to increase the validity and reliability of the model, the changing variance (CV) was examined with the Spearman correlation test and the Spearman correlation coefficient was calculated as -0.7372. The value of the Spearman rank correlation coefficient test statistic was found to be -0.7315 and since this value was smaller than the t-table value, it was concluded that there was no changing variance.

When the complementary statistics of the variables in the model are examined, it is determined that the model fits the data because of the tests applied in Table 4. It was tested whether the parameters were statistically significant. The variables of education, experience, amount of land, number of parcels, active capital, agricultural income, following innovations, receiving training on agricultural issues, participating in agricultural activities, following agricultural events on social media and cooperation with institutions were found to be significant.

Table 3. Factors Affecting the Innovation Index in the Examined Businesses

	Unstandardized Coefficients		t	Severity Level	Linearity Statistics
	Coefficient	Std. Mistake			VIF
Fixed Term	48.500	2.354	20.603	0.000	
Education	0.953	0.397	2.205	0.029	1.300
Experience	0.092	0.030	2.779	0.014	1.205
Amount of Land	0.002	0.003	0.927	0.040	1.979
Number of Parcels	-0.793	0.173	-4.53	0.000	1.242
Active Capital	3.75E-07	0.000	1.992	0.040	1.495
Agricultural Income	5.47E-04	0.000	3.145	0.002	1.244
Following Innovations	0.995	0.955	1.035	0.030	1.229
Receiving Education on Agriculture-Related Subjects	1.569	0.350	3.472	0.000	1.513
Participating in Agriculture-Related Activities	1.345	0.352	3.993	0.000	1.957
Following Agriculture-related Events on Social Media	0.236	0.359	1.922	0.023	1.490
Cooperation with Institutions	3.490	0.397	9.774	0.000	1.734

R^2=%68.5 DW=1.596 F=50.617 (0.000)

Table 4. Descriptive Statistics on Factors Affecting the Innovation Index

	Average	Std. Deflection
Innovation Index	76.5746	11.01098
Education	2.903	1.17636
Experience	33.2239	14.29027
Amount of Land	256.403	186.52351
Number of Parcels	4.0485	2.32425
Active Capital	2999289.6	3337367.4
Agricultural Income	161935.75	250557.43
Following Innovations	0.6194	0.48644
Receiving Education on Agriculture-Related Subjects	3.6194	1.3114
Participating in Agriculture-Related Activities	3.5224	1.45708
Following Agriculture-related Events on Social Media	3.3769	1.367
Cooperation with Institutions	3.209	1.25763

The effect of the independent variable on the dependent variable in the model was analyzed by examining the signs and parameter values of the coefficients in Table 3. a positive relationship was found between the first variable, education, and innovation index. Increasing the education of the agricultural enterprise owner increases the use of innovation. This situation is also seen in studies that education has a positive effect on innovation in the agricultural sector (Feder ve ark., 1985; Lin, 1991). In various studies, in addition to formal education, proximity to agricultural education institutions is a positive factor affecting the development of innovation (Cullinan ve ark., 2013).

One of the parameters that increase the use of innovation is experience. In Italy, it has been determined that organic producers benefit from the advice and experience of producers with more experience than themselves (Santucci, 2003). It has been determined that the farmer's experience may have a positive or negative view of innovations and this situation will affect his perception, that farmers perceive it as an innovation after a farmer applies it for innovations, and that the small enterprise scale and the risk perception of farmers are effective in this (Ghadim ve Pannell, 1999). The knowledge, level and use of agricultural business managers increase labour efficiency and the efficiency level of decisions (Bayramoğlu ve ark., 2014).

Increasing the number of parcels is a factor that decreases the innovation index. As the number of parcels increases, the number of activities to be carried out in the enterprise also increases. It causes inefficient use of resources.

Another factor affecting the innovation index is active capital. All wealth elements brought together in the agricultural enterprise are called active capital. A positive relationship was found between the increase in wealth in the agricultural enterprise and the innovation index and the relationship between them was statistically significant. Active capital shows the source of assets used in enterprises and the increase in capital will increase the level of technology to be used in enterprises. As a matter of fact, as seen in the studies, there is a positive relationship between asset capital and technology utilization, and the intensity of enterprises increases due to capital utilization (Tosun ve Güneş, 2018).

Another factor affecting the innovation index is agricultural income. While it is an expected result that the enterprise with increasing agricultural income will tend towards innovations, a linear relationship was determined statistically. Negatu ve Parikh (1999) Another factor affecting the innovation index is agricultural income. While it is an expected result that the enterprise with increasing agricultural income will tend towards innovations, a linear relationship was determined statistically (Boz ve ark., 2011). The business owner who

follows innovations could be aware of the changes occurring in the ecosystem and to make timely decisions.

Receiving education on agriculture-related issues is another factor affecting the innovation index. A business owner who is educated in agriculture is willing to follow and implement agricultural innovations. Because such an individual is open to change and development. By participating in training, business owners will have information about innovations. Thanks to the knowledge about innovations, they will gain two-way gains. These are skill development and better decision making (Ghadim ve Pannell, 1999). Türkyılmaz ve ark. (2003) Found that the educational status of business owners is an important factor in the adoption of innovations and that the adoption of innovations increases as the educational status increases. Studies show that education is a factor that increases the level of innovation.

Another factor affecting the innovation index is participation in agricultural activities. Operators involved in agricultural activities may have the opportunity to access information sources. The prerequisite for an individual to be educated is to want to be educated. Operators involved in agricultural activities are inevitably in a state of interaction. Especially through agricultural fairs, technical trips and demonstrations, they will have the opportunity to access new technologies.

In our statistical study, it was determined that following agricultural events on social media is a factor that increases the innovation index. Today, technological developments have made it easier to access information. Especially the development in internet and telephone technologies has made it possible to reach the remotest places in rural areas. This technological development has enabled farmers to follow social media. Various agricultural mobile applications and websites have paved the way for operators to follow innovations more easily and actively.

A positive relationship was determined between the innovation index and cooperation with institutions. With this variable, the importance given by agricultural enterprises to relations with institutions is examined. The importance level of 12 different institutions, which are thought to contribute to the innovation capacity of agricultural enterprises, was determined by the enterprise managers during the survey phase. By taking the average of the importance levels of different institutions, the data for the variable of cooperation with institutions were created. Thus, it was tried to measure the effect of the importance given by all enterprises to cooperation with institutions on the use of innovation. It is seen that the innovation index of the enterprises that cooperate with institutions is 3.4 points higher than the enterprises that do not.

Conclusions and Recommendations

In Türkiye, the education level of the population living in rural areas is lower than those living in urban areas. The level of education of entrepreneurs in agricultural enterprises makes a difference especially in issues such as business efficiency, organization, following and using technology. Another parameter that increases the use of innovation is experience. Experience brings success not only in the agricultural sector but also in all sectors. Experience is a factor that enables the employee to have knowledge about all situations that the employee may encounter in business life and to make the right decision in times of crisis.

Farmer training and extension services branches, which were abolished by the Ministry of Agriculture and Forestry, should be included in the organizational structure again. Education and extension services should be reorganized taking into account today's developments. It is of great importance that innovation is presented objectively without a commercial approach. Necessary technical and training activities should be carried out to equip extension staff.

Strategic plans for the use and transfer of technology in support policies should be created. With the policies to be created, small-scale agricultural enterprises that have difficulties in accessing technology due to their capital structure should be supported. Decision-making processes should be carried out in a fast manner.

Agricultural and food fairs, which are an important tool in accessing agricultural innovations, should be organized regionally. Those in certain regions should also be planned to be international. All kinds of support should be provided for the participation of leading companies in agricultural innovation.

Consultancy service units should be established to enable agribusinesses to follow needs-based innovations and receive the right information. These units should make the necessary feasibility on an enterprise basis and draw up the innovation profiles that the enterprises need. Financing sources such as grants and loans should be offered for the use of the identified innovations.

Financial leasing and joint use of machinery should be supported so that business owners can benefit from modern technology. Modernization of agricultural enterprises should be ensured through grants. Enterprises that are modernized and provide a certain level of technological innovation will have the chance to compete.

Information

This study is based on the Doctoral Thesis completed by Ender KAYA in the Department of Agricultural Economics at Selçuk University Graduate School of Natural and Applied Sciences

Conflict of Interest Statement

The authors declare that there is no conflict of interest among them.

Contribution of Researchers

The authors declare that they have contributed equally to the article.

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