A PANEL DATA ANALYSIS ON ORGANIC AGRICULTURAL PRODUCTION: THE CASE OF TURKEY

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ABSTRACT

Agriculture is one of the oldest livelihoods that humanity has been dealing with since hunting-gathering activity. Over time, the increase in population has led people to new technological developments in agricultural production, thus increasing the amount of production. While there are positive developments in agriculture with technological developments, the use of chemical fertilizers, wrong irrigation, erosion, and the destruction of diversity in the soil has brought up the problem of sustainability of agriculture. This situation has triggered the development of organic agriculture. Organic agriculture started to develop in the early 20th century, first in Europe and then in America. Climate change and the prominence of sustainable agriculture have brought importance to organic agriculture. Organic agriculture, which started to develop in Turkey in the 1990s, has rapidly increased the amount of production with the development of the organic product market. As of 2020, 50 thousand farmers carry out organic farming activities in Turkey. With the development of organic agriculture, the number of academic studies on the subject has also increased. However, empirical studies in the organic agriculture literature are still less than theoretical studies. In particular, studies investigating what factors are effective in organic agricultural production are very few. The aim of this study is to determine the factors that are effective in organic agriculture production and to present policy recommendations on the subject. Within the scope of this purpose, organic agriculture production in 81 provinces of Turkey in the period of 2010-2019 was examined by panel data analysis. In the analysis using the PPML (Poisson Pseudo Maximum Likelihood) estimator, two different models were established. In these models, the number of farmers, agricultural land, Gross Domestic Product (GDP), population, the amount of electricity used in industry, and the effect of literacy rate on organic agricultural production were examined. According to the findings, it has been determined that the amount of electricity used in the industry affects organic agricultural production negatively, while other variables affect it positively. The effect of variables other than literacy rate and GDP on organic farming production was found to be statistically significant.

Keywords: *Organic Agriculture, Turkey, PPML*

1. INTRODUCTION

Depending on the global developments, the agricultural sector has started to include new roles besides its traditional functions. A new understanding has emerged called bioeconomy, which includes the production and consumption of plants and animals, their biological wastes and all sectoral systems based on the functions of these wastes. "These sectors and systems encompass land and marine ecosystems and the services they provide; all major production sectors that use and produce biological resources; food; feed; bio-based products; It covers all economic and industrial sectors that use biological resources and processes to produce energy and services" (Numanoğlu and İnce, 2020). Therefore, the agricultural sector has started to include new functions such as food safety, health and protection of natural resources.

With the recent technological developments, agricultural productivity has increased throughout the world. Although agricultural land per capita decreased, food consumption per capita per day increased. In general, agricultural production has increased in the world. However, because of climate change, political and economic crises, migration, and wars, the agricultural sector has suffered severe wounds all over the world. Because of these, both agricultural productivity decreases and food trade suffers as a result of countries trying to meet domestic demand primarily. In addition, even if agricultural production is adequate, individuals' access to these products is limited due to economic crises (FAO, 2021). All these factors lead individuals to sustainable agriculture and food systems. Especially when the

ecological balance lost because of wrong agricultural techniques is combined with global warming, it threatens sustainable food production. In order to cope with this threat, organic agriculture stands out as a system that aims to restore the lost balance in the ecological system, supports environmentally friendly agricultural production, and does not use chemical pesticides and fertilization systems in production. The aim of this system is to get the maximum agricultural yield without polluting the environment (Deniz, 2009).

Organic farming first started in Europe and the USA and spread to the world from there. The organic agriculture sector has been developing rapidly both in the world and in Turkey recently. This development is exacerbated by the increase in awareness of climate change, the desire to protect the environment, and the level of development. With gaining the importance of organic agriculture in the last period, several studies have been carried out in this field. In this study, it has been tried to create a holistic view of the factors affecting organic agriculture. The aim of the study is to determine the factors affecting organic agriculture in Turkey. For this purpose, it is thought that it will affect organic agriculture production for 81 provinces between 2010-2019; Two different models were estimated with the PPML (Poisson Pseudo Maximum Likelihood) estimator using the variables of the number of farmers producing organic agriculture, the size of the area where organic agriculture is produced, the gross domestic product, the total population, the amount of electricity used in the industry and the number of people who can read and write. The present study is unique in terms of considering organic agriculture as a whole, the period examined, and the analysis method. In the next part of the study, first, the theoretical background is presented and then the implementation part is given. In the last section, there is a discussion of the findings.

2. THEORETICAL BACKGROUND

The understanding of carrying out agricultural production in harmony with nature and without harming it firstly emerged in Germany in the 1920s. Germany, Switzerland, England, Denmark and the Netherlands started to make biodynamic agricultural production (a completely natural production system that takes care of ecological balances) in this period. The understanding of organic agriculture began to emerge after this period, and steps were taken, albeit small, in various European countries. In the 1950s-1960s, with the increase in the awareness of individuals on the production of healthy food that is compatible with nature, studies on this subject gained momentum. The increasing interest in ecology and the Oil Crisis in 1973 also increased the interest in organic agriculture. New ideas have emerged about sustainable development of agriculture such as the effective use of natural resources, protection of the environment, ensuring high efficiency, feed safety and organic, organic-biological, bio-dynamic methods (Shi-ming and Sauerborn, 2006).

Until the 1970s, organic farming practices around the world were made with the individual efforts of countries and these actions were relatively limited. In 1972, the International Federation of Organic Agriculture Movements (IFOAM) was established as a result of the desire to gather these practices worldwide. The aim of the organization can be defined as the widespread adoption of literally sustainable agriculture, value chains, and consumption in the light of organic farming principles. In this way, certain standards have been established worldwide in agricultural production (IFOAM, 2017). In the 1980s, it began to be emphasized, especially in Europe, that necessary steps should be taken before the environment is irreversibly polluted because of severe industrial production and improper agricultural practices. With the agricultural policies developed in this period, various developments were experienced in organic agriculture. Trade in organic agricultural with this increasing interest, products have also developed. With the increase in consumer demand, domestic demand has skyrocketed, especially in developed countries (İpek and Yaşar Çil, 2010).

Organic agriculture in Turkey started in 1986 for export. Production started in 1984-1985 when companies in Europe demanded organic products from Turkish companies. Firstly, raisins and dried figs were produced and exported by organic methods in the Aegean region. Later, the production spread to different regions and the products were diversified. Consultancy, inspection and certification services were provided to these applications by foreign companies. In 1992, the Ecological Agriculture Organization Association (ETO) was established in order to gather these activities in Turkey under one roof. In 2004, the Regulation on the Principles and Implementation of Organic Agriculture and the Organic Agriculture Law came into effect. Accordingly, various objectives such as re-establishing the deteriorated ecological balance, providing inputs to be used in organic agriculture, disseminating this method, improving demand and developing exports have been set. Demand and production for organic agriculture have increased rapidly in Turkey, especially as a result of the recent increase in awareness of the environment and healthy nutrition (Bakırcı, 2005).

Graph 1. Organic Area (Farmland) [ha]
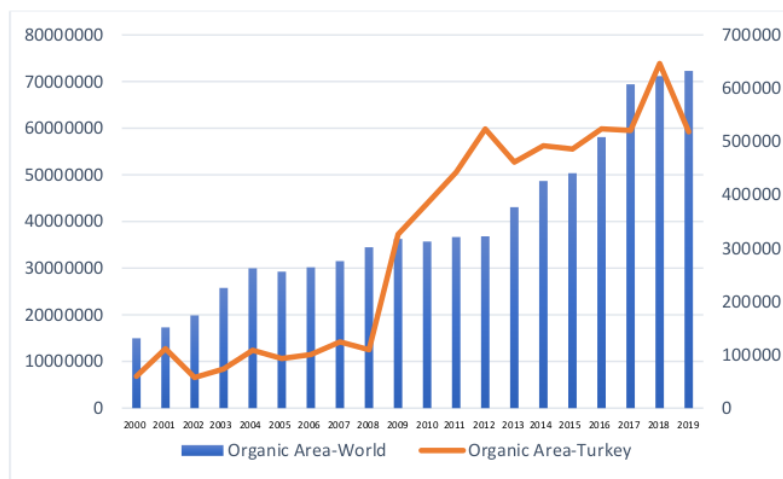
Source: FIBL Statistics

Graph 1 shows the development of organic agricultural lands in the 2000-2019 period. The axes are divided into two in order to observe the change in Turkey because of the size of the agricultural lands in the world is very large. The left axis shows the world and the right axis shows the total of the lands in Turkey. Accordingly, although the development in Turkey was limited until 2008, it has shown a rapid increase in parallel with the development in the world since this year. A similar graph can be drawn for the number of farmers engaged in organic farming. Graph 1 strikingly reveals the increasing importance of organic agriculture in Turkey. Today, organic farming activities are carried out in 81 provinces of Turkey. When the distribution of organic agricultural production by provinces is examined in Graph 2, it is seen that production generally comes to the fore in the eastern provinces. In the west, Aydın and Manisa provinces head the provinces where organic agriculture is carried out intensively, especially with the effect of climatic convenience. Particularly in small cities, which are open to agricultural development and where the industry is relatively limited in economic activities, organic agriculture is tried to be developed with the support of the state. In this way, efforts are made to reduce regional unemployment.

Graph 2. Distribution of Organic Agricultural Production by Provinces

Organic Agricultural Production 2019
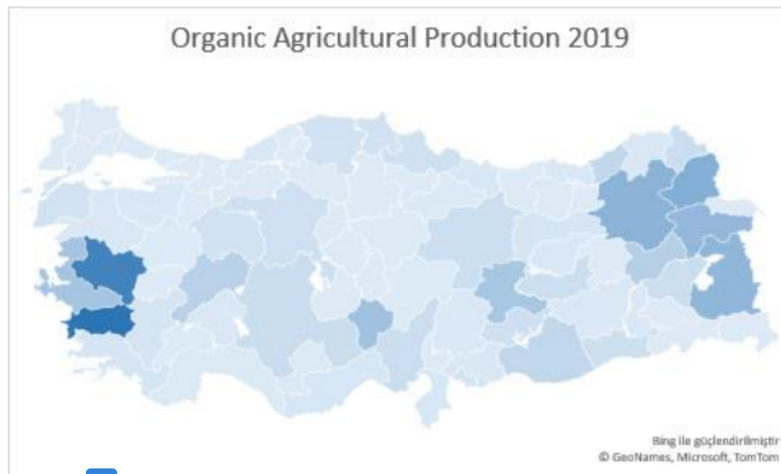
Source: Republic of Turkey Ministry of Agriculture and Forestry

The rapid increase in the importance given to organic agriculture in Turkey in the recent period has enabled the formation of an extensive literature in this field. When the literature on organic agriculture is examined, it has been seen that there are quite a lot of articles written on organic agriculture consumption in Turkey. However, empirical studies on the factors affecting the production of organic agriculture are very limited. Apart from this, there are also several theoretical studies in the literature (Keskin and Ören, 2008; İpek and Yaşar Çil, 2010; Kızılaslan and Olgun, 2012; Öztürk and İslam, 2014; Eryılmaz, Kılıç and Boz, 2019). In addition, some empirical studies have been conducted on a city or region in general, not Turkey (Acar, Dok and Kahveci Caner, 2009; Karabaş and Gürler, 2011; Kaya and Atsan, 2013; Çelik, 2019). In addition, in some of these studies, organic product production was examined not as a whole, but over certain product groups (Birinci and Er, 2006; Karadaş and Kızıloğlu, 2008; Özbağ, 2010). Empirical studies conducted throughout Turkey have remained quite limited (Merdan, 2018). In addition, there are also studies in which panel data analysis is conducted for country groups, including Turkey (Ateş, 2020). With this study, it is aimed to fill this gap in the literature by conducting an empirical study on organic agriculture to cover all provinces in Turkey.

3. IMPLEMENTATION

3.1.Data and Methodology

In this study, which was prepared to examine the factors affecting organic agriculture production in Turkey, data from 81 provinces were used in the period of 2010-2019. In this context, there are explanations of the variables used in Table 1. The variables used are those that are frequently used in the literature and that are thought to affect organic farming production.

Table 1. Variables Used in Analysis

Variable Name	Definition	Source
Prdct	Organic farming production amount	Republic of Turkey Ministry of Agriculture and Forestry

frm	Number of farmers engaged in organic farming	Republic of Turkey Ministry of Agriculture and Forestry
land	The size of the organic farming land	Republic of Turkey Ministry of Agriculture and Forestry
gdp	Gross domestic product	TurkStat
pop	Total population	TurkStat
elec	Amount of electricity used in industry (MWh)	TurkStat
lit	Number of people who can read and write-literacy rate	TurkStat

Factors affecting organic agriculture production in Turkey were estimated using the PPML (Poisson Pseudo Maximum Likelihood) estimator. The PPML estimator is generally used when there are zero values and heteroscedasticity in the data set (Bilici, 2017). It has been determined by Gomez-Herrera (2013) that there are deviations between various estimators in data sets with zero values and heterogeneity. In addition, with zero values in the dependent variable, deviations were determined between the variable being in linear form in the model and being in logarithmic form. For this reason, it is more appropriate to use the Poisson fixed effects estimator (Westerlund & Wilhelmson, 2011). In addition, Monte Carlo simulations have shown that the deviation of the PPML estimator is smaller than the EKK estimators and it performs better in small samples (Gül and Yerdelen Tatoğlu, 2019). In addition, the PPML estimator gives consistent results in this case, considering the problem of heteroscedasticity (Keskin, 2019).

3.2.Model

When the data set used in the analysis is examined, it has been determined that organic agriculture is not practiced every year in 81 provinces of Turkey, and organic agriculture has started in some provinces in the last few years. In the years when this situation was valid, the fact that the values of variables such as production amount, number of producers, production area were zero and the existence of heterogeneity according to provinces made it appropriate to use the PPML estimator in the analysis. In this study, analysis was performed using the PPML estimator with the assumption of fixed effects. Two different models were established within the scope of the analysis. The first of these models is more limited, and the second is the extensive model. The representation of the models in exponential form is as follows:

Limited Model;

$$Prdct_{ij} = \exp(\beta_0 + \beta_1 lfrm + \beta_2 lland + \beta_3 lgdp + \beta_4 lpop)\, u_{ij}$$

Extensive Model;

$$Prdct_{ij} = \exp(\beta_0 + \beta_1 lfirm + \beta_2 lland + \beta_3 lgdp + \beta_4 lpop + \beta_5 elec + \beta_6 lit)\, u_{ij}$$

The *exp (exponent)* in the model shows the exponential function and the variables starting with "*l*" are used in the form of *ln*. The analysis results of the limited model are given in Table 2.

Table 2. Limited Model Estimation Results

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf. Interval]	
lfrm	.1896284	.0399344	4.75	0.000	.1113584	.2678983
lland	.5964385	.0434496	13.73	0.000	.5112789	.6815982
lgdp	.063896	.071599	0.89	0.372	-.0764355	.2042274
lpop	.1305503	.04314	3.03	0.002	.0459974	.2151031
cons	1.503209	.9304007	1.62	0.106	-.3203425	3.326761

According to the model estimation result, the number of farmers, production area and population variables has a positive effect on organic agriculture. The coefficients of these variables were found to be statistically significant at the 1% significance level. The coefficient of the gross domestic product variable is statistically insignificant.

The analysis results of the extended model are given in Table 3.

Table 3. Extended Model Estimation Results

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf. Interval]	
lfrm	.1789712	.0400065	4.47	0.000	.1005599	.2573826
lland	.5948974	.0443422	13.42	0.000	.5079882	.6818065
lgdp	.1441438	.0815589	1.77	0.077	-.0157087	.3039964
lpop	.252796	.0686505	3.68	0.000	.1182435	.3873484
elec	-3.93e-08	1.49e-08	-2.65	0.008	-6.85e-08	-1.02e-08
lit	-6.29e-08	5.14e-08	-1.22	0.221	-1.64e-07	3.79e-08
cons	-.7567192	1.449856	-0.52	0.602	-3.598384	2.084946

Accordingly, the coefficients of the gross domestic product and literacy rate variables were found to be statistically insignificant at the 5% significance level. The coefficients of other variables are statistically significant. In parallel with the results obtained from the limited model, the number of farmers, production area and population variables affect organic agriculture positively. However, the amount of electricity used in the industry has a negative effect. The amount of electricity used in industry is commonly higher in high-income and economic activity areas where industry develops. Agricultural production in these cities is generally low. In these regions, the products obtained from agriculture are usually used as industrial raw materials. Therefore, it is expected that organic agriculture is low in such cities. In addition, the state-supported organic agriculture moves to the eastern provinces with

undeveloped industry also leads to this result. Although the literacy rate is meaningless, it has a supporting sign. As can be seen from Graph 2, the fact that organic farming activities are higher in some cities in the west of Turkey results in the fact that the relationship between population and organic farming production is in the same direction. The advantage of these cities is that they have favorable climatic conditions for organic farming. In addition, because of the general export of organic agricultural products, these cities become suitable for production due to their proximity to the foreign market. In this context, directing the production in the western provinces to the foreign market and the production in the small provinces in the east to the domestic market may increase production due to specialization and market segmentation.

4. DISCUSSION

Organic farming studies have a structure that constantly improves itself. As a result of the studies organized with the participation of all stakeholders in this process, the process that started with Organic 1.0 continued with Organic 2.0, and today the Organic 3.0 process has started. In this direction, it is aimed at raising awareness about organic agriculture all over the world and thus to grow organic agriculture. Accordingly, an environmental movement with high social participation was aimed by taking lessons from the mistakes made and eliminating the insufficiencies. Organic 3.0 principles are tried to be established by creating a balance between humans and nature (Marangoz and Kumcu, 2018). Turkey's following the Organic 3.0 process closely and arranging its systems accordingly will enable it to gain an advantage in this relatively new field.

The first organic agriculture production in Turkey started with the export of dried fruits such as raisins and figs in the 1980s and there are still areas open to development. Although organic agriculture is new in Turkey, it shows a rapid development. Informing the producers in this area will increase their profitability. The fact that the soil and water assets in Turkey are not polluted yet, the appropriate ecological balance and climatic conditions, provide an advantage in organic farming production. However, the fragmentation of agricultural lands increases the certificate costs of small-scale farmers. Smallholder producers may give up this system, as producers cannot enter the organic agriculture market without a certificate. At the same time, selling the goods produced in the transition period together with the conventional agricultural goods increases the costs in the transition period. For this reason, supporting small producers is important in the development of the organic agriculture sector (Ministry of Development, 2018). In the analysis presented in the present study, agricultural land is one of the most important variables affecting organic agriculture production in terms of coefficient size. The increase in the number of farmers and agricultural land in this area will also positively affect organic agriculture production. For this reason, it is vital for the development of the sector to solve the problems of farmers related to organic agriculture production and to encourage them in this field.

The low consumption of organic agriculture in the domestic market may be because of reasons such as the high prices of these products, the lack of knowledge of consumers about these products, and the limited variety of organic vegetables in shopping areas. However, the increase in the level of education, the increase in the sensitivity to the consumption of healthy products and the increase in the socio-economic factors of the consumers can direct individuals to the organic agriculture market. Despite this, the fact that organic agricultural products are mostly exported causes production to be shaped according to the demand from abroad (Demiryürek, 2011). Taking steps to develop the domestic market will also improve production in this area. In particular, raising awareness of individuals on environmental issues will support their orientation to organic agriculture. Although the literacy rate is found to be meaningless in the current analysis, there are a number of studies in the literature stating that education

positively affects organic agriculture (Erem Kaya and Atsan, 2013; Bahşi and Akça, 2019). The fact that the signs of industrialization and literacy turn out to be contrary to expectations is due to the concentration of the organic farming across provinces is practiced in Turkey, usually in underdeveloped rural areas. Sustainable agricultural policies have gained importance with the rapidly increasing population around the world. In the analysis made in the current study, population is the second variable that most affects organic agriculture. However, with the increase in production in this area, the price of these products will decrease and they will become economically accessible to a larger segment of the society. In the analysis made within the scope of the study, the income variable was found to be positive in a way that supports this situation.

The shortness of the data set is the biggest limitation in the analysis made within the scope of this study. In addition, the fact that production does not start at the same time in every city prevents the use of different estimation methods. In the ongoing studies, it is planned to examine how the development level of the industry in the cities affects the organic agriculture market and the effect of exports.

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Eşleşmeleri çıkar   Kapat