THE NEXUS OF CO2 EMISSION, POPULATION, AGRICULTURAL AREA SIZE, GDP AND ENERGY USE IN TURKEY

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Fresenius Environmental Bulletin

© by PSP Volume 27 – No. 10/2018 pages 6812-6823 Fresenius Environmental Bulletin

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ABSTRACT

Greenhouse gas effect is known as the main cause of global warming and climate change. There are many factors that cause greenhouse gases in the atmosphere. In this study, the relationship with CO_2 emissions of energy use, GDP, agricultural area size and population in Turkey was examined. The research has gained a more original character by investigating the effect of agriculture. In the study, time series analyses were used. The series included the years between 1995 and 2016. ADF, JCT, OLS, FMOLS, CCR and GCT tests were conducted. According to the results obtained, it was determined that the variables has cointegrated in the long run. Nevertheless, it can be said that both long-term and short-term energy use and population are effective factors on greenhouse gas emission. For this reason, it is important to increase investments in renewable energy sources. Individuals, on the other hand, will be able to make a positive contribution to this process by directing the applications to the environment, which will reduce environmental pressure in both consumption and daily life cycle. The measures to be taken related to his issue can be considered as a driving factor in some laws of government and in the action plans of the relevant ministries.

KEYWORDS:
CO_2 Emission, Agriculture, GDP, Energy Use, Population, Turkey.

INTRODUCTION

There are several definitions of the concept of development. However, in general sense, deve-lopment is defined as the changes carried out to increase production and national income per capita, to improve the value judgements of people in line with the world standards and to change the socio-cultural and economic structure [1]. Development is an ultimate goal of all countries. It refers to the holistic progress of a society including economic, social, environmental and even cultural aspects. All countries try to maximize social benefits by using their own internal dynamics. This is directly related to the level of development. Social benefit is a balance process taking all internal and external factors other than individualism into account. Societies carry out various production activities while maximizing the benefit. This production phenomenon is maintained despite a certain environmental cost regardless of its organization in the technical or economic aspects. In other words, production and its factors participating in the process owe a lot to the livable world. This debt is an environmental one and reveals the requirement of considering sustainable development approach in every country [2].

The sustainable development policies providing the formation of global economic and social development have become one of the priorities of the world in the 21st century. The concept of sustainability is involved in every policy today. The concept of "sustainability" was first used in the Bruntland Report drafted by the United Nations World Environment and Development Commission in 1987. The report mainly involved the sustainable development goals including poverty eradication, equal distribution of the benefit obtained from natural resources, population control and the development of environmental friendly technolo-gies. The report looks for solutions to the existing problems in line with these goals and refers to the concept of sustainability as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [3].

The development process that accelerated with the Industrial Revolution created a desire in people to consume more natural resources. In this process, the deterioration in resources that are considered to be unlimited led to the understanding that development cannot be sustainable without taking environment into consideration. The most important initiative of the development process is production the most important input of which is energy. Technological advances and increasing population brought in production increase while the world's demand in energy is increasing every day. Together with the energy demand that increased after the industrial revolution, countries constantly updated their energy policies for both meeting their own consumptions and getting a foothold in the power battles in the world. Countries now establish their competitive position to the extent of their ability to supply energy, which is the most important source of production. Therefore, nowadays, energy is one of the most important elements within the development policies.

The energy need in the world increases every day and this increase is influenced by the population increase as well as a change process with the demand aspect, i.e. the consequences brought by industrialization and the transformations in the pleasures and habits of people. The pressure on environment is also increasing every day as long as the energy demand required by these transformations is not supplied from renewable resources. The most important and problematic aspect is especially manifested by global warming. The concept of sustainability, which started to be uttered in some international meetings particularly in the 1970s and 1980s, is gradually integrated into more policies every day, which shows the significance attached by the international society on the consequences of the threat of global warming. The Paris Climate Agreement signed by 195 countries in 2016 [4] is one of the recent steps taken within the scope of international environmental awareness. This agreement includes measures to reduce release of greenhouse gases within the scope of the United Nations Framework Convention on Climate Change. The agreement was signed by 195 member countries and thus it is the most largely recognized agreement on climate change in the history of the world.

One of the most important causes of the increase in greenhouse gas emission (referred as CO2 equivalent), which causes global warming, is the energy demanded by the countries to realize economic growth. CO2 emission is among several contaminants causing climate change and it emerges by the burning of inputs used to obtain energy and it constitutes 58.8% of all greenhouse gases [5]. The increase of CO2 has been affected by the rapidly developing industrial sector after the 1970s and together with the associated environmental issues, predictions and analyses related to economic growth and use of clean energy started to develop [6].

In addition, the change in the field of agriculture, the increase in human population and the increasing use of energy needed for more growth are important factors that trigger global warming. Particularly, agricultural activities are defined to be affected by climate change as well as causing it. Soil cultivation, fertilizing, agricultural spraying and procedures in the product-food supply chain, the change of using agricultural fields, the use of energy in agriculture, the manure of raised animals and similar activities contribute to the carbon emission [7]. According to the estimations, agricultural activities are responsible for around 20% of the increasing greenhouse gases in the world [8], and this ratio was calculated to be 6,83% in Turkey [9].

There are many indicators showing the development level of a country. Until the 1970s, development and growth were evaluated together and the development was measured with the increase in national income. In general, it is defined as the economic growth based on industrialization. GDP, national income per capita and other economic indicators are accepted to be the numeric data that reflect the development in the best way. These indicators are the main indicators of economic growth rather than development and provide general information on the size of a country. However, the word size reminds of a quantitative superiority, nominal or reel.

The incidents that we describe as growth are the developments that have positive effects especially on economic indicators, and one of these developments is the increase in industrial production. The most important indicator of the growth in industrial production is the increase in energy demand while the most energy demand in Turkey is from the industrial sector [10]. The developments in the industrial sector have a positive effect on economic indicators whereas these developments will cause a certain cost on environment unless the share of renewable energy resources in the production increase in terms of energy usage. The relation between energy usage and CO2 emission is considered to be important in this regard.

The increase in total GDP contributed by the production level in a country will have a positive effect on income per capita. Therefore, when economic growth indicators are reviewed, income per capita is a significant variable as well as the energy usage. In terms of the relationship between economic growth and the environment, the Environmental Kuznets Curve (EKK), which is the adapted a version adapted specifically to Simon Kuznets' theory of economic growth and development, is of importance in the 1990s [11]. Accordingly, it is argued that environmental pollution and/or environmental damage will increase together with the economic growth and then decrease after a certain level of income [12, 13]. Developing countries may prevent environmental pollution by taking lessons from the history of the developed countries, using clean technologies in the growth process and taking the environment-income relations into consideration. Similarly, [14] stated that countries may reshape their development efforts in a manner to achieve environmental and economic gains together. This is called as “tunnelling” in the EKC process.

Another growth is the population increase and we observe different views in the history of economy. In the studies conducted with this purpose, a group of researchers concluded that population increase may be detrimental for economic growth while another group concluded that it may be useful. In the literature, the first group was called as “the pessimists” and the second group as “the optimists”. The basic ideas of the optimists are based on the views of Thomas Malthus on population. At the end of the 18th century, Malthus studied the relation between population increase and food items and suggested that the net influence of the population increase will be negative. In the course of time, it was observed that the predictions of pessimists on population didn't take place while the views of optimists stood out. According to the optimists, population increase may have a positive impact on growth by creating a valuable asset [15, 16, 17]. According to this view, creative human stock increases as population increases, thus new inventions and developments have positive impact on economic growth. This view was less effective until the mid-1980s and the idea that the population growth is "neutral", i.e. it will not affect economic growth positively or negatively, began to prevail [18]. Therefore, the modelling of present study took population variable into consideration by considering the interrelation between economic growth, CO2 and population.

The relation between agriculture and CO2 is important for Turkey with significant contribution to GDP. Turkey is within the top 10 countries in the world with respect to the value of its agricultural production [19]. There is a tendency of decrease in the agricultural fields in Turkey, which has an important potential with respect to the agricultural production value. Therefore, determining the relations between agricultural fields and CO2 emission is important for Turkey in seeing the effect of agriculture on environment.

Figure 1 includes the tendencies regarding the CO2 emission, population, agricultural area size, income per capita and energy use in Turkey between 1995-2016. When we examine the Graph 1, it can be said that the CO2 emission, population, income per capita and energy use have a tendency to increase while agricultural fields have a tendency to decrease.

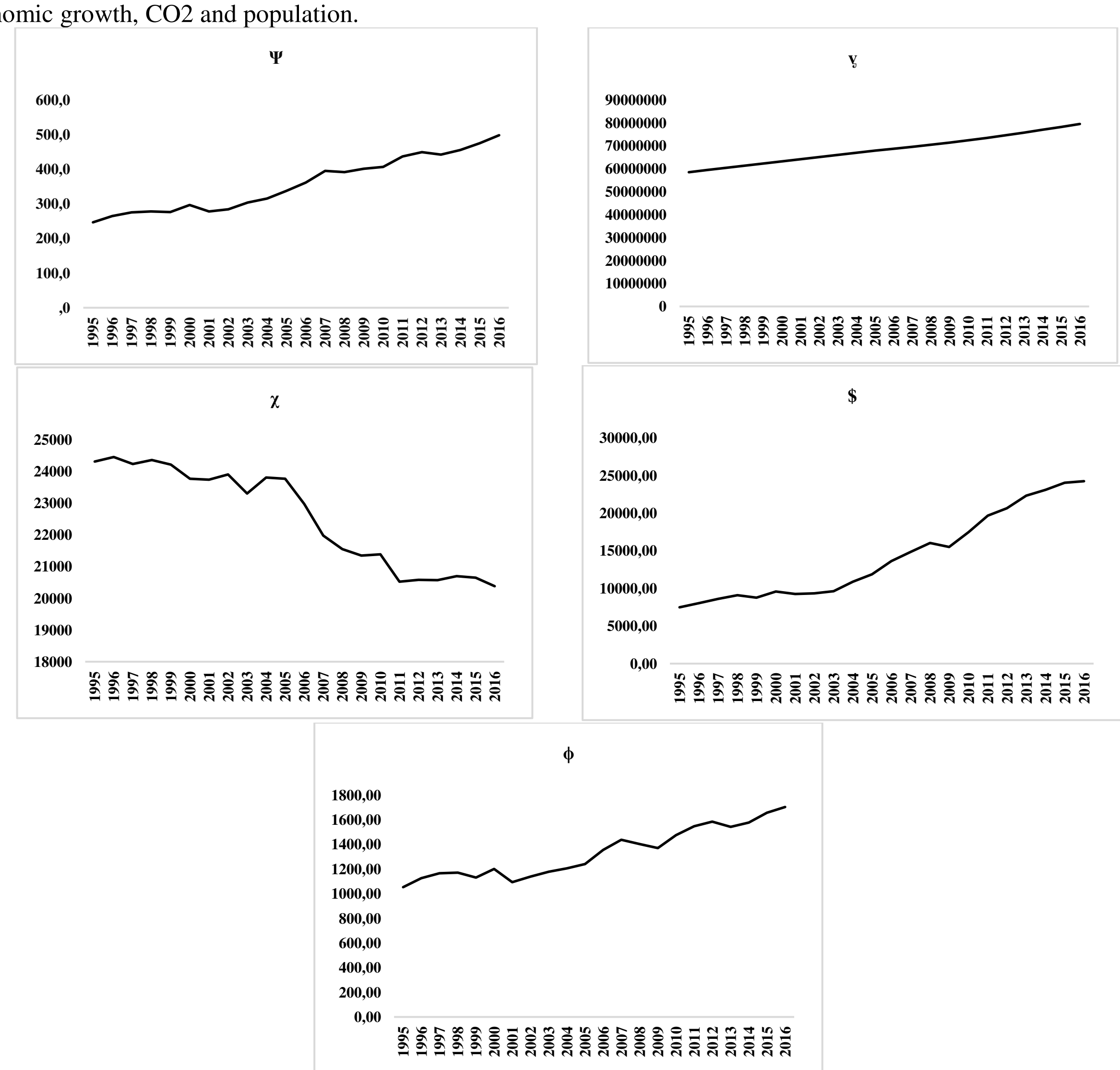

FIGURE 1
Trends of Ψ, ɣ, χ, $ and ϕ between 1995 and 2016 in Turkey

TABLE 1
Variables, symbols and data resources in the study

Variables	Symbol	Unit	Data Source
CO2	Ψ	Million tone	Turkstat
GDP	$	Per capita dollar ppp	Worldbank
Energy Use	ϕ	Per person petroleum equivalent kg	Turkstat
Agricultural area size	χ	Thousand hectares	Turkstat
Population	ɣ	Million	Worldbank

(ppp: Purchasing Power Parity)

Population, agricultural area size, GDP and energy use, which are stated to be effective on CO2 emission, have substantially changed in Turkey. In Turkey where there was an increase in growth and development efforts especially since the beginning of the 2000s, the CO2 level has also showed a noticeable increase along with the change in various parameters. When the changes in variables evaluated in the study are examined, the CO2 level increased by 101.98%, GDP increased by 224.01%, energy use increased by 61.79%, agricultural area size decreased by 16.17%, and population increased by 35.95% [20].

There are various studies both in the world [21, 22, 23, 24, 25, 26, 27, 28] and in Turkey [29, 30, 31, 5, 32, 33, 34, 35, 36, 37] on the relations of CO2 increase and energy use and different indicators of economic growth and on the effect of agriculture [38, 39, 40, 41, 42, 43, 44, 45] and population [46, 47, 48] on CO2 emission [49].

This study developed recommendations for policy makers by examining the relation between the change in the greenhouse gas emission, which is the most important factor of global warming (as a CO2 equivalent) and the change in population, GDP, energy use and agricultural fields in Turkey through a time-series analysis. Turkey achieved 52.111.042 $ agricultural income in 2017, which constitutes 6.1% of total GDP. However, there is a shortage of time-series studies in Turkey on agricultural fields and population. Therefore, this study intends to fill in this gap.

MATERIALS AND METHODS

The study covers the period between 1995 and 2016 for Turkey. The data resources and symbols on the CO_2 level, agricultural area size, GDP and energy use in Turkey during the concerned period are given in Table 1.

Time series of the variables were created through the data obtained. Full algorithmic form was used in the study. Functional approach between CO_2 level and other variables under the study can be expressed as follows:

$$\ln \Psi = f(\ln\$, \ln\phi, \ln\chi, \ln\gamma) \quad (1)$$

The functional relation was taken into consideration and the following econometric analyses were conducted in order to determine the long and short term relations of variables. In the literature, there are many studies using the following analyses and similar econometric tests to determine the factors affecting CO2 emission [50, 51, 52, 53, 54, 55, 56, 57, 58].

-Unit root test (ADF)

-Johensen Cointegration test

-Full Modified Ordinary Least Square (FMOLS)

-Ordinary Least Square Regression (OLS)

-Canonical Cointegrating Regression (CCR)

-Granger Causality Test

Unit root test. The unit root test was used in the study. Unit root test involves the stationarity studies. The results obtained from the series including the unit root may be biased. The regression between the variables can be dimensioned to be spurious regression. There are several previous studies conducted with the unit root test, and the assumptions of these studies are revealed [59, 60, 61, 62, 63, 64, 65, 66]. The relevant studies emphasize the importance of unit root test. This study used the ADF test statistics for the unit root test. The basic notation for the unit root test based on the ADF principles can be stated as follows:

$$\Delta X_t = \beta_0 + \beta_1 t + \beta_i X_{t-1} + \sum_{j=1}^{n} \theta_i \Delta X_{t-j} + e_t \quad (2)$$

In the Equation 2, β_0 refers to the constant term; t refers to the deterministic trend; n refers to the lag length and e_t refers to the stochastic term. ADF test statistic results were compared to the MacKinnon critical value and accepted/rejected according to the significance levels of 1%, 5% and 10% [67]. The lag lengths were determined by the automatic selection criterion which gave the lag with the lowest AIC/SIC value. The series that were made stationary were then tested with the Johensen Cointegration Test, OLS, FMOLS, CCR and Granger causality test.

Johensen Cointegration Test (JCT). Johensen Cointegration Test is an approach that reveals whether the series act together in the long term. Equation 3, 4 includes the notation developed by [68];

$$Y_t = \sum_{i=1}^{p} A_i Y_{t-i} + \beta X_t + e_t \quad (3)$$

In Equation 4, X_t and Y_t are stationary series at the I(1) level but not stationary at the I(0) level. Series can be brought to the level I(1) and the notation can be reinstated as follows:

$$\Delta Y_t = \pi Y_{t-1} + \sum_{i=1}^{p-1} \delta_i Y_{t-i} + \beta X_t + v_t \quad (4)$$

$$\Psi_{NT}^* = N^{-1} \sum_{i=1}^{N} \left[\sum_{t=1}^{T} (\$_t - \bar{\$}_i)^2\right]^{-1} \left[\sum_{t=1}^{T} (\$_t - \bar{\$}_i)\Psi_t^* - T\hat{\tau}_i\right] \quad (5)$$

$$\Psi_{NT}^* = N^{-1} \sum_{i=1}^{N} \left[\sum_{t=1}^{T} (\phi_t - \bar{\phi}_i)^2\right]^{-1} \left[\sum_{t=1}^{T} (\phi_t - \bar{\phi}_i)\Psi_t^* - T\hat{\tau}_i\right] \quad (6)$$

$$\Psi_{NT}^* = N^{-1} \sum_{i=1}^{N} \left[\sum_{t=1}^{T} (\chi_t - \bar{\chi}_i)^2\right]^{-1} \left[\sum_{t=1}^{T} (\chi_t - \bar{\chi}_i)\Psi_t^* - T\hat{\tau}_i\right] \quad (7)$$

$$\Psi_{NT}^* = N^{-1} \sum_{i=1}^{N} \left[\sum_{t=1}^{T} (\gamma_t - \bar{\gamma}_i)^2\right]^{-1} \left[\sum_{t=1}^{T} (\gamma_t - \bar{\gamma}_i)\Psi_t^* - T\hat{\tau}_i\right] \quad (8)$$

Here $\pi = \alpha\beta'$. α and β' refer to two matrices with the (kxr) dimension and (r) rank [69, 70]. α refers to the adaptation rate, β refers to the long range cointegration coefficients matrix and r refers to the rank of the matrix [71]. If the rank is equal to 1, it is concluded that there is 1 cointegration relation between the variables and if it is more than 1, then there is the cointegration relation equal to the value of the rank.

Ordinary Least Square (OLS). In the OLS method which is called as the normal regression analysis, the extent of partial effect in the dependent variable by the independent variables in the short term is determined. Equation 5 includes the notation on national income per capita according to population, energy use, agricultural area size and purchasing parity that are thought to be affect the CO_2 level for the regression suggested by [72].

$$\Psi_t = \beta_1\$_t + \beta_2\phi_t + \beta_3\chi_t + \beta_4\gamma_t + u_t \quad (9)$$

Here $\beta_{1,2,3,4}$ refer to the coefficients of independent variables while u_t refers to the stochastic term with white noise.

Full Modified Ordinary Least Square (FMOLS). The long range relations between the variables under the study can be revealed by the FMOLS test developed by [73, 74]. The FMOLS test which can verify the results obtained from the cointegration test has several advantages. It can fix the issues like autocorrelation and change in variance both between and within the dimensions. In this aspect, the constant term takes into account the presence of possible correlation between the differences of the error term and independent variables [75]. Here, the notation in Equation 5, 6, 7, 8 above can be used to carry out the necessary analysis assuming that the statistics t has a normal distribution.

Canonical Cointegrating Regression (CCR). CCR is another method used in the study to determine the coefficients. Developed by Park (1992), CCR uses the version of variables converted by the long range covariance matrix to eliminate the deviations in the least squares technique. The goal in this transformation is to eradicate asymptotical internality caused by the long range correlation [76]. In principle, it is quite similar to FMOLS. Only difference is that it uses the stationary transformations of data to be able to reduce the long term correlation between the cointegration equation and stochastic shocks [77].

Granger Causality Test (GCT). The test developed by [78] expresses the independent variable to be the cause of the dependent variable if the condition using the past values of the variable determined as independent is more predictable than the condition not using the same. Equation 10-11' includes the notation on the Granger Causality Test

$$Y_t = \mu_0 + \sum_{i=1}^{n} \mu_i Y_{t-i} + \sum_{i=1}^{n} \beta_i X_{t-i} + e_t \quad (10)$$

$$X_t = \Theta_0 + \sum_{i=1}^{k} \Theta_i X_{t-i} + \sum_{i=1}^{k} \pi_i Y_{t-i} + u_t \quad (11)$$

μ, β, Θ and π in Equation 10, 11' refers to parameters of variables, n and k refer to the lag lengths, e and u refer to error terms.

RESULTS AND DISCUSSION

In the study, before examining the CO2 level and the econometric analyses of the variables affecting it, the expression of descriptive statistics for all variables can be considered as a correct approach.

Descriptive statistics of the variables are presented in Table 2.

It can be said that the values of the variables examined, such as mean, median, std.dev., skewness, kurtosis and jarqua-bera are within the normal limits. After descriptive statistics, the correlation matrix was created to reveal whether the variables

TABLE 2
Descriptive Statistics of Variables

	Ψ	χ	ϕ	$	ɣ
Mean	357.6311	22570.68	1334.311	14271.22	68478123
Median	349.4321	23145.50	1297.422	12757.94	68333406
Maximum	498.0000	24457.00	1703.210	24243.92	79512426
Minimum	246.5534	20382.00	1052.700	7482.380	58486381
Std. Dev.	79.58365	1573.218	203.5260	5807.974	6309289.
Skewness	0.224011	-0.208177	0.332226	0.508008	0.113045
Kurtosis	1.610929	1.323223	1.706439	1.781073	1.915273
Jarque-Bera	1.952721	2.736187	1.938563	2.308233	1.125437
Probability	0.376680	0.254592	0.379355	0.315336	0.569658
Sum	7867.884	496555.0	29354.84	313966.9	1506518715
Observations	22	22	22	22	22

TABLE 3
Correlation Matrix of Variables

	Ψ	χ	ϕ	$	ɣ
Ψ	1.00				
χ	-0.97*	1.00			
ϕ	0.99*	-0.95*	1.00		
$	0.98*	-0.96*	0.98*	1.00	
ɣ	0.97*	-0.94*	0.95*	0.97*	1.00

* mark is mean that significant at 1% level

TABLE 4
Unit Root Test Results

Variables	ADF			
	Intercept		Trend and Intercept	
	Level	Δ	Level	Δ
Ψ	-0.3111	-4.6563*	-2.0915	-4.5431*
ϕ	-0.4019	-4.9493*	-2.3056	-4.9134*
$	-0.0307	-3.9834*	-1.7231	-3.8969**
ɣ	1.6401	-5.1073*	-2.1133	-4.9861*
χ	-0.1391	-4.1629*	-2.1740	-4.0500*
	Breakpoint Unit Root Test (Base on ADF Principle)			
Ψ	-2.9242	-5.0408*	-3.6532	-5.2904**
ϕ	-2.5460	-5,2271*	-3.0482	-5.1490**
$	-2.7433	-4.5572**	-3.4314	-5.9304*
ɣ	-2.0661	-5.3391*	-2.3412	-5.3519**
χ	-4.4238	5.0761*	-4.1844	-4.8244**

* and ** marks are mean that significant respectively at 1% and 5% level

were related to each other. The correlation matrix results are presented in Table 3.

When the correlation table of the variables examined was analyzed, it was determined that all variables were related to other variables at a significance level of 1%.

Having stationary time-series is important in econometric estimations. [79] showed that spurious regression problem may be experienced if one works with nonstationary time-series. Therefore, the stationary condition of the series was studied by using the Augmented Dickey Fuller (ADF) unit root test, which is a modified version of the Dickey-Fuller test and recommended by [80]. Table 4 shows the stationarity test results.

In the ADF test, it was concluded that all series had unit root or were not stationary when the unit root test was applied for the series. Therefore, it was concluded that the series became stationary or non-unit root when the first difference of the series was taken and the unit root test was re-applied. Therefore, it can be said that the integration level of all series is I(1) after the ADF unit root test. It is possible to establish a preliminary information that series that are stationary at the level of I(1) but not stationary at the level of I(0) are cointegrated in the long range [71]. A cointegration analysis was conducted to study the long-range relations based on this preliminary information. The results are given in Table 5.

When we look at Table 5, it is possible to see a long run relation between CO_2 emission, population, agricultural area size, energy use and income per capita. When we evaluate the results, the test statistics providing information about the long run relations between CO_2 emission, population, agricultural field, energy use and income per capita are found to be statistically significant.

In this study, the long range effects of the factors including CO_2 emission, population, agricultural area size, energy use and income per capita were quantitatively revealed and it can be said that the factors are in interaction with each other. However, it is not possible to interpret the direction and strength of

TABLE 5
Cointegration Test Results of the factors affecting the level Ψ between 1995 and 2016 years in Turkey

	Trace			Maximum Eigenvalue		
	Eigenvalue	Trace Statistic	0.05 Critical Value	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value
r=0*	0.9888	159.7296	69.8188*	0.9888	89.9343	33.8768*
r=1*	0.8648	69.7952	47.8561*	0.8648	40.0344	27.5843*
r=2	0.6158	29.7608	29.7970	0.6158	19.1328	21.1316
r=3	0.4015	10.6279	15.4947	0.4015	10.2678	14.2646
r=4	0.0178	0.3600	3.8414	0.0178	0.3600	3.84146

* mark is mean that significant at 1% level

TABLE 6
Short and long term effects of the factors affecting the level Ψ between 1995 and 2016 years in Turkey

Dependent Variable: Ψ	OLS		FMOLS		CCR (Canonical Cointegrating Regression)	
	Coff.	t-stat	Coff.	t-stat	Coff.	t-stat
ϕ	0.7659	3.8638*	0.8205	5.0926*	0.8726	3.6500*
$	0.0057	0.0448	-0.0231	-0.2282	-0.0489	-0.3551
ɣ	0.8780	3.2810*	0.8958	3.9980*	0.9246	4.0849*
χ	-0.3804	-1.2983	-0.3700	-1.5783	-0.3772	-1.5495
C	-11.7261	-2.2604**	-12.270	-2.6719**	-12.848	-2.9785*
Diagnostic Tests						
R-squared	0.99		0.99		0.99	
Jarqua-bera	4.4266		4.3013		4.4415	
Breusch-Godfrey LM Test	2.7797					
Breusch-Pagan-Godfrey	0.5728					

* and ** marks are mean that significant respectively at 1% and 5% level

this relation through the cointegration analysis. OLS and Full Modified OLS analyses were conducted to reveal the short and long range effects of the relation between CO_2 emission, population, agricultural area size, energy use and income per capita. Table 6 includes the relevant results.

When we look at Table 6, we observe a statistically same directional relation with the confidence limit of 95% between CO_2 emission, energy use and population in Turkey according to the results of OLS and Full Modified OLS. When we look at the interaction of CO_2 emission and energy use, it is observed that an increase of 1% in the energy use will increase the CO_2 emission by 0,82% and an increase of 1% will increase the CO_2 emission by 0,89%. When we reviewed the literature, we obtained similar results from the studies in Turkey. Accordingly, an increase of 1% in the energy use created an increase in the CO_2 emission by 1,03% [81] and by 1,46% [82] while [83] stated that an increase of 1% in the electricity usage will provide an increase of 0,36% in the CO_2 ratio. In a similar study, [84] predicted that an increase of 1% in the energy use and population intensity will provide an increase in the CO_2 ratio by 1,17% and 1,27% respectively.

The studies on population state that population is an important variable affecting the CO_2 emission. [85] determined that population is the most important variable explaining the CO_2 emission in Turkey followed by fossil fuel consumption, combustible renewable energy and waste energy consumption, gross domestic product and consumption of alternative and nuclear energy.

On the other hand, no statistically significant relation in the confidence limit of 95% was found between CO_2 emission, income per capita and agricultural area size. There are studies finding that there is no statistically significant relation between CO_2 and income per capita in Turkey [83, 5] which is attributed to various causes. The first one can be shown as the fact that the imbalance in income distribution in Turkey doesn't fully reflect the economic growth. In [3], it is noticed that the Gini Coefficient in Turkey varied between 0,391 and 0,428 between 2006 and 2016 [3]. The Gini coefficient was calculated to be 0,404 most recently in 2016 and indicates that the problems related to the unfair distribution of income in Turkey remain. The relevant problems show that the income per capita is not a good indicator reflecting development on its own. In addition, the analyses on growth in Turkey provided results showing that growth is not based on more production [85]. As a result, the problems related to the source of the growth figures and income distribution made the effect of income per capita on CO_2 emission statistically insignificant.

Another variable which is statistically insignificant for contributing to the CO_2 emission is the change in agricultural area size. There is a decrease of 16,17% in the agricultural area size in Turkey between 1995 and 2016. The negative directional coefficient of the agricultural area size variable coefficient in Table 6 shows that the increase in agricultural area size is decreasing the CO_2 emission. However this condition is not considered to be statistically significant. Under the circumstances of Turkey, the development of an environmental awareness in the input use in agriculture, prevalence of the use of environment friendly technologies and few numbers of activities to increase CO_2 emission in reducing agricultural fields may be effective.

TABLE 7
Granger Causality Test Results of the factors affecting the level Ψ between 1995 and 2016 years in Turkey

Hypothesis	F-stat
ϕ → Ψ	3.2800***
Ψ → ϕ	3.0085***
$→ Ψ	0.2060
Ψ →$	2.5443
ɣ → Ψ	2.6940***
Ψ → ɣ	7.1406*
χ → Ψ	1.7610
Ψ → χ	5.0203**
$→ ϕ	5.0884**
ϕ →$	1.1560
ɣ → ϕ	2.5014
ϕ → ɣ	3.4335***
χ → ϕ	0.3349
ϕ → χ	3.3967***
ɣ →$	1.6223
$→ ɣ	4.4947**
χ →$	0.0034
$→ χ	4.0815**
χ → ɣ	40.5527*
ɣ → χ	2.8276***

*, ** and *** marks are mean that significant respectively at 1% 5% and 10% level

The relation between the variables under the study and the direction of this relation were studied by using the Granger Causality Test. When we look at Table 7, we observe a one-way relation of causality of the CO_2 variable with the variable of agricultural field and a two-way relation of causality with the variables of population and energy use. Agricultural fields are not the cause of CO_2 emission in particular while the CO_2 emission is considered to be a cause in the change of agricultural fields. When the sector changes are examined together with growth, it can be said that the share of agricultural segment decreases and the share of the industrial and service segments increase in developed countries. Therefore, if we consider CO_2 emission to be an indicator of growth, it can be evaluated as the cause behind the decrease in agricultural fields. The lack of causality between the variables of income per capita and CO_2 can be attributed to the fact that the Turkish economy mostly follows a financial growth policy based on consumption. It can be said that there isn't an intense industrial economy that will directly affect the CO_2 level on its own, and that the existing industry is sensitive towards environmental issues.

CONCLUSION

As a result of this study which examined some parameters (income per capita, energy usage, population and agricultural area size) that are considered to be directly or indirectly related to economic growth affecting the CO_2 emission between 1995 and 2016 in Turkey, it was calculated that the CO_2 emission increased in 2006 by nearly 2 times compared to 1995, and during these 22 years the agricultural fields decreased by 16,17%, population increased by 35,95%, income per capita increase by 224,01% and energy usage increased by 61,79%. It was determined that population increase has a significant effect in addition to the increase in CO_2 emission in Turkey. On the other hand, the fact the population increase in Turkey contributes to the increase in CO_2 emission more than all variables both in the short and long range shows that the increase in CO_2 emission is affected not only by the economic growth indicators but also by the other policies. The fact that the effect of the variable of income per capita, which is significant for economic growth, is not statistically significant for the increase in CO_2 emission shows that an evaluation is necessary to determine whether growth in Turkey takes place on the basis of production or consumption.

When agriculture, which is one of the most controversial issues with respect to CO_2 emission, is considered for its contribution, we observe that the agricultural fields decrease from the statistical point of view. The effect of the decrease of agricultural fields on CO_2 emission was not found to be statistically significant.

In conclusion, Turkey committed to reduce its greenhouse emissions with the Paris Agreement for the first time in its history and declared that it will reduce its greenhouse emissions by 21% before 2030 according to the reference scenario. This figure reveals the emission reduction effect of the plan and policies intended by Turkey to be realized until 2030 in all segments of the economy (energy production, industry, agriculture, waste, buildings, transportation and forestry). The present study concluded that the energy consumption and population were respectively decisive in the CO_2 emission which has the biggest share among the greenhouse emission between 1995 and 2016. There are studies revealing a one-way relation of causality from energy consumption to real GDP [86], a positive relationship in the short term and a negative relationship in the long term between real GDP and energy consumption [87], a two-way relation of causality between energy consumption and real GDP [88], a negative relationship between income per capita and carbon emissions and a positive relationship between income per capita and energy consumption per capita [89], and a short term one-way relation of causality from economic growth and primary energy consumption to carbon emissions [5] in Turkey. Here, by taking into consideration Turkey's current dynamics, it can be said that Turkey has the potential to reduce the greenhouse emissions without negatively affecting its growth. It can also be said that the increase due to the relation of energy usage and CO_2 emission can be limited considering the fact that the share of the clean energy in energy usage will increase through the recent investments in the field of renewable energy usage and through the prospective policies.

Considering the relation of population increase and CO_2 release, the model in the study indicates the increase of environmental awareness in the population to be the most rational way for the control of CO_2 emission. At this point, it is essential for policy makers to keep the current status under control through legal and political arrangements. The measures to be taken in this aspect will create a significant effect in limiting CO_2 emission in Turkey. In the causality analysis applied, the causality from population to agricultural fields instead of to energy use and to income per capita can be attributed to the information that nearly 27% of the population in Turkey consists of agricultural population. At the same time, it indicates a problem with respect to the inexpedient use of the agricultural fields. Both environmental awareness and inexpedient use of the agriculture fields are elements that may be effective in the increase of CO_2 emission. In this regard, emission reduction policies included in the action plans of the Ministry of Agriculture and Forestry, Ministry of Environment and Urbanization, Ministry of Energy and other relevant institutions/organizations, and the policies on social consciousness should be sustained and implemented in a discipline.

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Received: **28.03.2018**
Accepted: **09.08.2018**

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