CONTRIBUTION OF LIVESTOCK TO CO_2 EMISSION IN D-8 (DEVELOPING-8) COUNTRIES: AN EMPIRICAL ANALYSE OF PANEL DATA

DOĞAN, H. G.[1*] – SAÇLI, Y.[2]

[1]*Department of Agricultural Economics, Agricultural Faculty, Kırşehir Ahi Evran University, Kırşehir, Turkey*

[2]*The Department of Strategy and Budget, Presidency of the Republic of Turkey, Ankara, Turkey*

*Corresponding author
e-mail: hg.dogan@ahievran.edu.tr

Abstract. Climate change makes itself perceivable day by day. Therefore, the determination of the factors that cause climate change and the effects of these are studied increasingly nowadays. Considering the global scale, it is seen as an effective way for countries to reduce the impacts of climate change and to act together in adaptation efforts. Therefore, regional and non-regional collaborations are important in this struggle. The aim of this study is to reveal the relationships between livestock activity and Carbon Dioxide (CO_2) emissions in Developing-8 (D-8) countries, an economic co-operation organization, with panel data analysis. In this study, the effect of the cattle, sheep and poultry stock of D-8 countries between 1990 and 2017 on CO_2 emissions was investigated with the Autoregressive Distributed Lag (ARDL) model. As a result, there was a statistically significant positive correlation between the stock number of cattle and poultry and the CO_2 emissions in general, although there was no statistically significant relationship with the breeding of sheep. The effect of animal husbandry activities on climate change is important because of their contribution to CO_2 emissions. In the processes involving materials such as enteric fermentation, animal originated fertilizer, animal waste, it is thought that the political/regulatory arrangements that will eliminate such factors can be made for producers in the micro-scale and for the agricultural sector in the macro scale.
Keywords: *climate change, livestock production, D-8 countries, ARDL model, CO_2 emission*

Introduction

Global warming due to climate change is at the top of today's most important problems. A lot of research has been done on the future effects of global warming (FAO, 2015; Riphah, 2015; Seneviratne et al., 2016; Özdemir et al., 2017; Prasad et al., 2017; Chena et al., 2018; Doğan and Kan, 2018; Iddrisu and Peker, 2018; Doğan and Kan, 2019; Qadir et al., 2019) and its effects are felt day by day. Many scenarios have been developed for this. In this regard, there is a common consensus for many countries around the world: the countries with the highest greenhouse gas emissions should have more duties. Scientists point out that, by the first quarter of the 21st century, the carbon dioxide content in the atmosphere increased by 40% and the methane gas content by 150% compared to the years when the industrial revolution began (Euronews, 2015). China and the United States are the most prominent countries in terms of greenhouse gas emissions, while they are followed by countries such as AB-27, India, Russia, Japan and Brazil (The World Bank, 2019a).

There are also studies on the impact of the sectors on greenhouse gas emissions as the main factor of global warming (Bayar and Bahrend; 1994; Pekin, 2006; FAO, 2015; Riphah, 2015; Doğan and Kan, 2018; Kanat and Keskin, 2018; EPA, 2019;

Peker et al.; 2019; PSU, 2019), and the impact of each sector is different. Agriculture is an important sector that impacts climate change, also being affected by itself, because it affects the global flow of greenhouse gases. Greenhouse gases such as CO_2, CH_4, and N_2O are counted among the causes of climate change as a result of agricultural activities (energy consumption, plant and animal production, fertilization, pesticide use, etc.) (Houghton, 2003; Akalın, 2014). Agricultural activities are reported to be responsible for about 20% of the growing greenhouse gases in the world (Pathak and Wasmann, 2007). The activities of agriculture, such as the destruction of forests to transform the agricultural field, also greatly increase greenhouse gas emissions. The destruction of forest lands is considered to be responsible for 10% to 30% of the carbon dioxide released into the atmosphere. Therefore, it is the second biggest source of greenhouse gas emissions into the atmosphere after fossil fuel combustion (Harvey et al., 2010). The second important greenhouse gas originating from agricultural activities is methane. Rice cultivation is blamed for more than 40% of global methane emissions. Farm animals account for 15% of global methane emissions. Ruminants (cattle, sheep, goats, camels, and buffalo) digest grass and cellulose. In this way, they release methane into the air. The world's cattle number accounts for about 75% of the methane emissions of total farm animals (IPCC, 2007). However, since methane gas life is considerably lower than that of CO2 gas, CO2 emissions are generally emphasized in research.

The measures to prevent global climate change, as well as, the adaptation strategies for possible adverse effects constitute the main framework of this struggle. In the world, each country is creating its own strategy against adverse effects of climate change, and these strategies sometimes turn into a common struggle with regional integrations or national integrations. The provision of governance collaboration in the fight against climate change (mitigation, adaptation, and resilience) is one of the most important phases (Peker et al., 2019). Therefore, in regional integrations based on economic co-operation, the issues of combating climate change need to be more involved and the increase of collaborations is necessary.

The D-8 organization (Developing 8), which was established to act as a partner in the global system based on economic cooperation, consists of 8 countries (Bangladesh, Indonesia, Iran, Malaysia, Egypt, Nigeria, Pakistan, Turkey). Its foundations were laid in October 1996 at the invitation of Prof. Dr. Necmettin Erbakan, the former Prime Minister of the Republic of Turkey, at the "Cooperation in Development Conference" organized in Istanbul with the participation of representatives of those countries. After a series of preparatory meetings following the Cooperation in Development Conference on October 22, 1996, the establishment of the D-8 was formally announced at "the Summit of the Heads of State and Government" organized in Istanbul on June 15, 1997 (Istanbul Declaration). The purpose of the D-8 is to increase trade and co-operation between the Member States. The aim of launching the D-8 initiative is to create and diversify new opportunities in trade relations between 8 countries representing a large economic potential, various sources, a wide population and geographical area, and to increase participation in the decision making process at international level, to provide better life conditions, to improve economic co-operation around concrete joint projects and to strengthen the situation of developing countries in the world economy. Agriculture and food safety, renewable energy resources, industry, transportation, tourism are some of the main issues that are expected to be cooperated (D-8 OEC, 2019a).

The D-8 has established a common platform for advocating the rights of developing countries against developed countries, especially in the World Trade Organization (WTO) decisions, with the goal of targeting more global partnerships than regional integration. In addition, this common platform has played an important role in protecting the rights of countries in determining the measures and responsibilities of the countries on the global CO_2 emissions causing climate change. For the first time, at the Malaysia-Kuala Lumpur Declaration in 2008, it was reported as follows: *"Recognizing the adverse impacts of global warming and climate change on development, we reaffirm our commitment to enhance cooperation in climate change negotiations following the Bali Roadmap to support the adaptation efforts of the developing countries, especially those of the least developed and the low-lying coastal countries and uphold the principle of common but differentiated responsibilities in mitigation of the emission of greenhouse gases"* (D-8 OEC, 2019b). In the 2012 Islamabad declaration, it was noted that the effects of climate change in sustainable and inclusive development should have also been considered (D-8 OEC, 2019c). The development of joint adaptation strategies against the impacts of climate change and need to be working to reduce the adverse effects, which may arise primarily from global warming, on the people of the D-8 countries were reported again in the 2017 Istanbul Declaration (D-8 OEC, 2019d).

It is clearly seen that climate change threatens human welfare and agricultural production, considering that nearly 2.5 billion people in developing countries earn their lives from agriculture. The D-8 countries constitute 13.94% of the world's agricultural production (465.7 billion $) (the World Bank, 2019b) according to 2017 data, and 6.20% of the world's CO_2 emissions according to 2014 data (The World Bank, 2019a). According to the data of 2016, the gross production value of beef is examined as $258,084,093 in Bangladesh, $2,636,059,545 in Egypt, $3,428,638,282 in Indonesia, $1,845,763,741 in Iran, $68,611,219 in Malaysia, $559,357,239 in Nigeria, $2,608,695,845, and also $6,217,254,585 in Turkey. The gross production value of mutton is $ 9,036,936 in Bangladesh, $490,525,023 in Egypt, $275,071,662 in Indonesia, $1,044,326,227 in Iran, $146,262 in Malaysia, $265,000,401 in Nigeria $328 274 105 in Pakistan and $2,173,555,064 in Turkey. Poultry gross production value is $228,811,476 in Bangladesh, $1,775,763,964 in Egypt, $ 6,918,959,386 in Indonesia, $8,275,937,537 in Iran, $280,193,375 in Malaysia, and $252,579,138 in Nigeria, $2,529,530,629 in Pakistan and also $3,943,021,371 in Turkey. Looking at the CO_2 emissions of the 8 countries that constitute the D-8, it is seen to be less than China, the United States, the EU-28 and India, which are countries and/or regional unions that are releasing the most CO_2 emissions in the world. Despite this, combating climate change continue to be a common share of global economic partnerships.

In this study, the effects of the animal stock numbers in D-8 countries on CO_2 emissions were investigated by using the panel data set, and for the D-8 meeting to be done thereafter, policy proposals have been attempted to develop measures for the prevention and adaptation of climate change.

Materials and methods

In the study, the relationship of CO_2 emission (kt) with cattle, sheep, and poultry stock numbers in D-8 countries was investigated. The variables and units are presented in *Table 1*.

Table 1. *Variables, abbreviations and units used in research*

Variable names	Symbols	Units	Data sources
Carbon dioxide emission	CO_2	kt	World Bank, FAO
Cattle stock	C	Head	World Bank, FAO
Sheep stock	S	Head	World Bank, FAO
Poultry stock	P	Head	World Bank, FAO

Some econometric models have been utilized with the help of panel data set in examining the variables and relations between countries. The research covers the years between 1990 and 2017. Eight countries, called D-8, constitute the research area. These countries are Bangladesh, Indonesia, Iran, Malaysia, Egypt, Nigeria, Pakistan, and Turkey. The research is based on two fundamental analyses. The data evaluated in full logarithmic form was analyzed by the unit root test and ARDL. Descriptive information for tests can be expressed as follows.

Unit root test (ADF)

The unit root tests have several fractions, which are proposed by researchers in the literature (Maddala and Wu, 1999; Kao and Chiang, 2000; Hadri, 2000; Choi, 2001; Levin et al., 2002; Im et al., 2003). This study uses Levin, Lin, Chu (LLC) and Im, Peseran, Shin (IPS) unit root tests based on the Augmented Dickey Fuller (ADF) test statistic. Basic equality for unit root tests based on ADF principles can be expressed as follows:

$$\Delta lnX_{it} = \beta_i lnX_{it-1} + \sum_{j=1}^{n} \theta_{ij} \Delta lnX_{it-j} + e_{it} \qquad \text{(Eq.1)}$$

Autoregressive distributed lag (ARDL)

In the literature, the Engle-Granger (1987) models based on error term and Johansen (1988) and Johansen and Jesilius (1990) models based on the system approach (Altıntaş, 2013) are often used in cointegration tests. However, in order for these methods to be valid, all variables must be stationary at level I(1) and not stationary at the level I(0) (Peseran et al., 2001). The ARDL boundary test approach allows for co-integration testing with non-stationary series at the same level (Pesaran and Shin, 1995; Pesaran et al., 2001). The advantage of the ARDL approach is that it is possible to test the cointegration without considering the degree of integration of variables. There are three important points to be considered in the method. I- The boundary test procedure is easy and, unlike multivariate co-integration methods of Johansen and Juselius (1990), it is possible to verify co-integration after lag lengths are determined. II- Unlike the co-integration techniques of Johansen and Juselius (1990), the boundary test procedure does not require preliminary testing of the variables included in the unit root test model. The boundary test can be applied, regardless of whether I (0) and I (1) or all of them are mutually co-integrated at the same level except when the series in the model is at the level I (2), I (0) and I (1). III-Boundary testing is very effective for small or limited sample size.

ARDL notations adapted to the research were expressed in *Equations 2–5:*

$$\Delta \ln CO2 = \beta_0 + \sum_{i=1}^{m} \beta_{1i} \Delta \ln CO2_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta \ln C_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta \ln S_{t-i} + \sum_{i=0}^{m} \beta_{4i} \Delta \ln P_{t-i}$$
$$+ a1 \ln CO2_{t-1} + a2 \ln C_{t-1} + a3 \ln S_{t-1} + a4 \ln P_{t-1} + u_t \tag{Eq.2}$$

$$\Delta \ln C = \beta_0 + \sum_{i=1}^{m} \beta_{1i} \Delta \ln C_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta \ln CO2_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta \ln S_{t-i} + \sum_{i=0}^{m} \beta_{4i} \Delta \ln P_{t-i}$$
$$+ a1 \ln CO2_{t-1} + a2 \ln C_{t-1} + a3 \ln S_{t-1} + a4 \ln P_{t-1} + u_t \tag{Eq.3}$$

$$\Delta \ln S = \beta_0 + \sum_{i=1}^{m} \beta_{1i} \Delta \ln S_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta \ln CO2_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta \ln C_{t-i} + \sum_{i=0}^{m} \beta_{4i} \Delta \ln P_{t-i}$$
$$+ a1 \ln CO2_{t-1} + a2 \ln C_{t-1} + a3 \ln S_{t-1} + a4 \ln P_{t-1} + u_t \tag{Eq.4}$$

$$\Delta \ln P = \beta_0 + \sum_{i=1}^{m} \beta_{1i} \Delta \ln P_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta \ln CO2_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta \ln S_{t-i} + \sum_{i=0}^{m} \beta_{4i} \Delta \ln C_{t-i}$$
$$+ a1 \ln CO2_{t-1} + a2 \ln C_{t-1} + a3 \ln S_{t-1} + a4 \ln P_{t-1} + u_t \tag{Eq.5}$$

In *Equations 2–5,* however, Δ refers to the difference processor, and m refers to the lag length. Information criteria such as AIC, SC, FPE, and HQ are utilized for determining the lag length. The lag length, which provides the smallest critical value, is determined as the model's lag length. Until reaching the model without autocorrelation, the process is resumed by passing the next lag value, for example, the first smallest value, the second smallest, etc. In Equations 2-3-4-5, H_0 hypothesis expressing that there is no co-integration between variables is formed as H_0: $a1 = a2 = a3 = a4$, the alternative hypothesis that mentions the existence of co-integration is formed as H_1: $a1 \neq a2 \neq a3 \neq a4$.

Results and discussion

Regional partnerships increase the capacity of countries to economically collaborate in the process of globalization, which is a great advantage for developing adaptability to global challenges. In these challenges, global climate change is the first of the most talked and debated issues nowadays. The factors that cause global climate change and the solution proposals against it require efforts to create an international policy outside of national policy creation. The struggle with this problem is only possible with collaboration (Peker et al., 2019).

The D-8 organization, which is an important step in regional, economic and social partnership, has an important potential in agriculture. In terms of total agricultural production, it produces 13.94% of the world's agricultural production according to 2017 data (465.7 billion $) (The World Bank, 2019b), constitutes the 8.75% of the world's bovine existence, 21.55% of chicken existence, 25.06% of goat existence, and 13.98% of sheep existence (FAOSTAT, 2019). As seen from *Figure 1,* Pakistan is the leading country for the cattle stock numbers between D-8 countries. Nigeria, Pakistan, Iran, and Bangladesh are the leading countries for the sheep stock numbers. Also, Indonesia and Iran are the leading countries for poultry stock numbers.
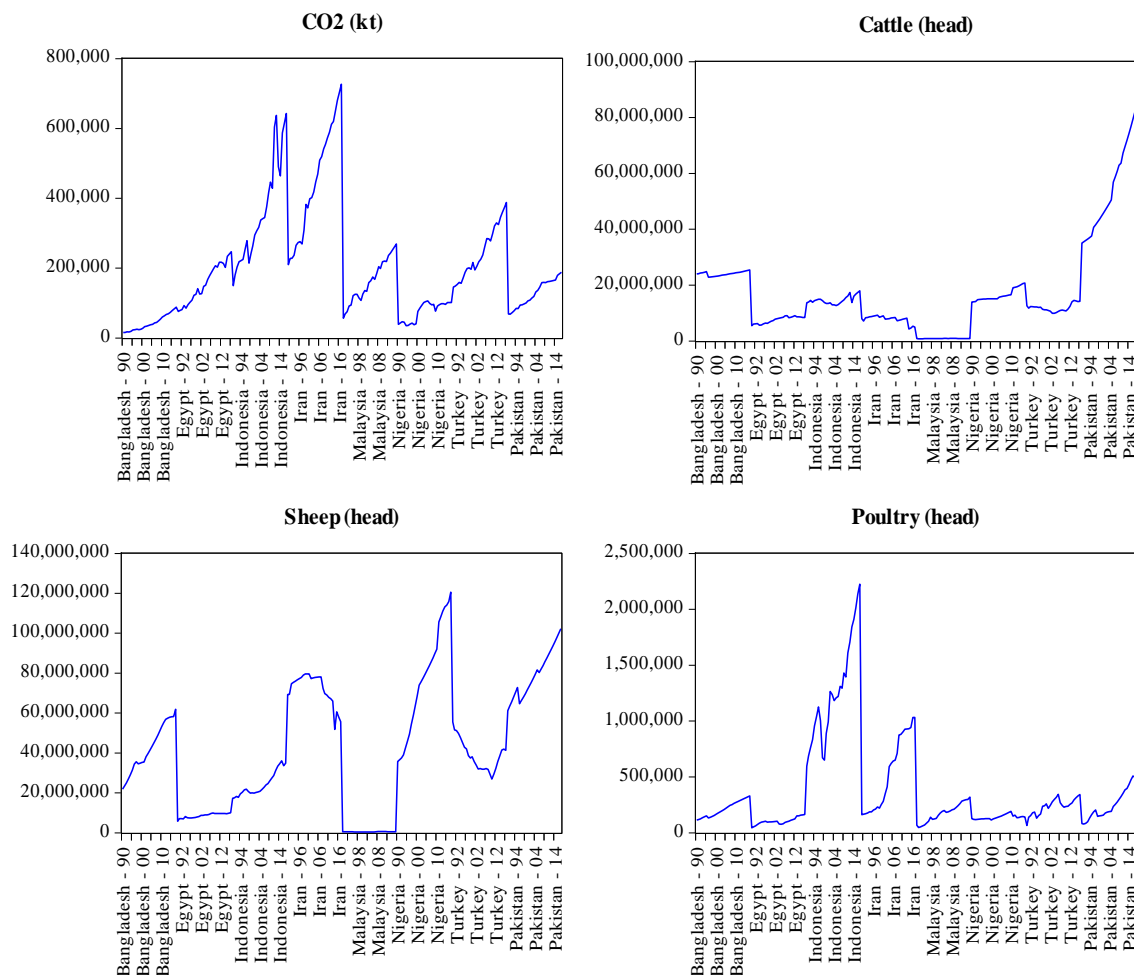
Figure 1. *CO₂ emission, cattle stock, sheep stock and poultry stock of D-8 countries by 1990-2017 years*

In econometric forecasts, the stationary of time series is important. Granger and Newbold (1974) showed that working with non-stationary time series might cause a false regression problem. In the study, if the results of the Levin, Lin, Chu, and Im, Peseran, Shin unit root test are examined, they can be seen as stationary in both Intercept and Intercept + Trend models. The unit root test results of the variables used in the study are given in *Table 2*.

Table 2. Unit root test results

Variables	Levin, Lin, Chu Test				Im, Peseran, Shin Test			
	Individual intercept		Individual intercept and trend		Individual intercept		Individual intercept and trend	
	Level	Dif.	Level	Dif.	Level	Dif.	Level	Dif.
lnCO₂	-2.4404*	-13.2348*	-2.1050**	-11.7832*	1.2650	-12.7269*	-2.2506**	-11.5971*
LnC	1.3652	-11.8788*	0.2041	-8.0473*	2.3058	-10.9181*	1.5564	-7.9102*
LnS	-1.8772**	6.4899*	0.0415	-5.0677*	1.3060	6.7918*	1.0787	-6.9924*
lnP	-0.8249	-7.3930*	1.5670	-1.5855**	1.1393	-9.6590*	0.1938	-6.6021*

*, **, *** are 1%, 5%, 10% significant, respectively

In this study, the long run effects of bovine, sheep and poultry stock factors on CO_2 emissions were quantitatively determined, and they could be said to be in interaction with each other. However, in order to interpret the direction and severity of these interactions, ARDL analysis was performed and the results were shown in *Table 3*. *Table 3* shows that the contribution of cattle and poultry to CO_2 emissions in the long run in D-8 countries were positive and statistically significant, whereas the contribution of sheep stock was positive but statistically insignificant at 95% confidence level.

Table 3. Results of ARDL estimators in a long and short run

Variable	Coefficient	Std. error	t-statistic
Long run equation			
Selected model: ARDL(4, 4, 4, 4)			
lnC	1.6359	0.1186	13.7932*
lnS	0.0976	0.0894	1.0915
lnP	1.2047	0.0499	24.1101*
Short run equation			
COINTEQ01	-0.02307	0.1433	-0.1609
D(LNCO2(-1))	-0.3779	0.1711	-2.2079**
D(LNCO2(-2))	-0.4184	0.1714	-2.4404**
D(LNCO2(-3))	-0.2962	0.1623	-1.8244***
D(LNC)	0.7301	0.8016	0.9108
D(LNC(-1))	-0.1592	1.0014	-0.1589
D(LNC(-2))	-0.9467	1.0094	-0.9378
D(LNC(-3))	-1.0718	0.7809	-1.3725
D(LNS)	-0.3897	0.5941	-0.6559
D(LNS(-1))	0.5907	0.4012	1.4723
D(LNS(-2))	-0.2341	0.4971	-0.4710
D(LNS(-3))	-0.2574	0.3911	-0.6580
D(LNP)	-0.5942	0.5123	-1.1598
D(LNP(-1))	-0.5277	0.3280	-1.6085
D(LNP(-2))	0.0977	0.2301	0.4246
D(LNP(-3))	0.0566	0.2277	0.2488
C	-0.3253	4.5388	-0.0716
Mean dependent var	0.0044	S.D. dependent var	0.0857
S.E. of regression	0.0628	Akaike info criterion	-2.5490
Sum squared resid	0.3362	Schwarz criterion	-0.4320
Log likelihood	424.49	Hannan-Quinn criterion	-1.6945

*,**,*** are 1%, 5%, 10% significant, respectively

In evaluating the emergence of this situation, it is necessary to consider firstly the relationship between animals and global warming. When animal husbandry activities are evaluated in terms of global warming, two kinds of effects, direct and indirect, occur. Methane, one of the most important causes of global warming, primarily creates greenhouse gas effects, while the CO_2 effect is second-degree important. The heat-capture capacity of methane in the atmosphere is 21 times higher than CO_2, and its life

is shorter than other gases (Naqvi and Sejian, 2011). Methane gas is emerging as a result of the storage of fertilizers of animals, especially ruminant animals, and related activities (Sherlock et al., 2002). Ruminants are defined by their structures with a special digestive system. In this way, ruminants are an important methane producer with the greenhouse gases they produce as a result of their comfortable digestion of low-quality cellulose-rich materials. In fact, animals produce very small amounts of methane individually. For example, a cattle produces approximately 80-110 kg of methane per year. At this point, however, the main reason for the responsibility of ruminants is their numbers worldwide rather than the amount of gas they produce. This situation results in a significant contribution to emissions (Koyuncu and Akgün, 2017). From here, the presence of animals itself directly contributes to global warming as a factor.

The indirect effect of animal stock on global warming is sourced from the need for energy in the production of animal foods that are a need for human. The energy requirement used in the feeding chain produces 10% of total CO_2 emissions. The most important source of the resulting CO_2 emissions is animal production and it is said to be equivalent to 9% of total emissions (Clarke, 2001). The source of the resulting emission is not directly the animal itself, but the CO_2 generated by the energy used in feed production, fertilizer processing, product processing, and transport has a significant share (Anonymous, 2012). According to the 2017 data, per capita CO2 levels in D-8 countries were 553.74 kg in Bangladesh, 2564.37 kg in Egypt, 2428.09 kg in Indonesia, 9006.33 kg in Iran, 8651, 53 kg in Malaysia, 532, 98 kg in Nigeria, in Turkey, and 905.88 kg in Pakistan (World Bank, 2019).

In the D-8 countries, because of the fact that sheep breeding is mostly based on pasture, less energy is consumed for the production of feed plants required for these animals than for other animal groups. This could lead to no statistically significant contribution of the sheep stock to the CO_2 emissions in the analysis. In addition, corn production from feed plants, which has a significant share in cattle and poultry production, requires a significant amount of nitrogenous fertilizer (HSUS, 2008). In response to this imperative, the nitrogenous soil pollutes water and air at a significant level. According to FAOSTAT data of 2017, D-8 countries are among the major corn producing countries in the world, especially Indonesian is sixth in corn production worldwide. Indonesia, Nigeria, Egypt, Turkey, and Pakistan, respectively, are among the first 22 countries in the production of corn. D-8 countries have 7.75% (15.3 million ha) of the world corn production area and realize 5.41% of production (61.4 million tons) (FAOSTAT, 2019).

Conclusion

The contribution of direct agricultural production to climate change is lower compared to other sectors, and it plays an important role to meet the basic needs of humanity. In the process of adaptation to climate change, it will be wrong to consider both the vegetable and animal part of the agricultural production separately and to make the planning in direction to that. The result of the study reveals that the indirect effects of livestock activity can be effective in CO_2 emissions as much as livestock numbers. Although the animal husbandry has a direct share in global warming, the role of unconscious input use in the production of feed crops, and the role of animal products processing industry, especially corn for animal feeding, are more important for climate change. Nowadays, it is emphasized that national country policies are not sufficient

alone and that it is more effective to act together in the struggle and adaptation of climate change. It is important that the D-8 countries, which have an important agricultural share in the world, should meet and act on common denominators in economic cooperation as well as climate change. In this context, working together not only in livestock but in all aspects of agriculture will have an impact on the development of more effective policies in terms of mitigation and adaptation of climate change impacts. Global climate change can be directly and indirectly influenced by the quality and quantity of feed given to animals, feeding strategies, seasonal availability of pastures, genetic studies, number of animals and animal health. Accordingly, some recommendations such as the correct setting of the sowing dates of the feed sources, the right practices for shelter air conditioning, the right approaches to pest and disease control (monitoring, crop rotation, diversity, etc.), the more efficient use of water, soil management and the selection of animals from the right breeds according to the region/conditions could be evaluated.

REFERENCES

[1]   Akalın, M. (2014): The climate change impacts on agriculture: adaptation and mitigation strategies for these impacts. – Journal of Hitit University Social Science 2: 351-357 (in Turkish).

[2]   Altıntaş, H. (2013): The relationship between oil prices, export and real exchange rate in turkey: bounds testing approach and analysis of dynamic causality. – International Management Journal of Economics and Business Administration 9(19): 1-30 (in Turkish).

[3]   Anonymous (2012): The Impact of Livestock Agriculture on Climate Change. – Agricultural Greenhouse Gas Research Centre, New Zealand.

[4]   Bayar, A. B., Bahrend, H. (1994): Global Environmental Problems. – Özkan Printing Press Matbaası, Ankara (in Turkish).

[5]   Chena, S., Zhi-Honga, J., Wei-Lina, C., Li, L., (2018): Changes in temperature extremes over China under 1.5 °C and 2 °C global warming targets. – Advances in Climate Change Research 9: 120-129.

[6]   Choi, I. (2001): Unit root tests for panel data. – J Int Money Financ 20: 249-72.

[7]   Clarke, J. (2001): Potential management practices and technologies to reduce nitrous oxide, methane and carbon dioxide emissions from New Zealand agriculture. – http://www.maf.govt.nz/mafnet/rural-nz/sustainable-resource-use/climate/green-house-gas-migration/ghg-mitigation.pdf.

[8]   D-8 OEC (D-8 Organisation for Economic Cooperation) (2019a): Brief history of D-8. – http://developing8.org/about-d-8/brief-history-of-d-8/.

[9]   D-8 OEC (D-8 Organisation for Economic Cooperation) (2019b): 2008-Kuala Lumpur-Malaysia   Declaration.   – http://developing8.org/image/DocumentandResouce/9026795.pdf.

[10]   D-8 OEC (D-8 Organisation for Economic Cooperation) (2019c): 2012-Islamabad-Pakistan Declaration. – http://developing8.org/report/islamabad-declaration/.

[11]   D-8 OEC (D-8 Organisation for Economic Cooperation) (2019c): 2017-Istanbul-Turkey Declaration. – http://developing8.org/report/istanbul-declaration-2017/.

[12]   Doğan, H. G., Kan, A. (2019). The effect of precipitation and temperature on wheat yield in Turkey: a panel FMOLS and panel VECM approach. – Environment, Development and Sustainability 21(1): 447-460.

[13]   Doğan, H. G., Kan, M., (2018): The nexus of CO2 emission, population, agricultural area size, GDP and energy use in Turkey. – Fresen. Environ. Bull. 27(10): 6812-6823.

[14] Engle, F., Granger, R., Clive, W. J. (1987): Cointegration and error correction: representation, estimation and testing. – Econometrica 55: 251-276.

[15] Euronews (2015): Green house gasses explained. – https://www.euronews.com/2015/06/26/green-house-gasses-explained.

[16] EPA (United States Environmental Protection Agency) (2019): Sources of greenhouse gas emissions. – https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

[17] FAO (2015): Estimating greenhouse gas emissions in agriculture. A manual to address data requirements for developing countries. – http://www.fao.org/3/a-i4260e.pdf.

[18] FAOSTAT (2019): Live animals data-2017. – http://www.fao.org/faostat/en/#data/QA.

[19] Hadri, K. (2000): Testing for stationarity in heterogeneous panel data. – Econometric Journal 3: 148-161.

[20] Harvey, A., Matthews, E., Sarma, D. (2010): The Global Methane Cycle. – NASA Goddard Institute for Space Studies. http://icp.giss.nasa.gov/education/methane/intro/cycle.html.

[21] Houghton, R. A. (2003): Why are estimates of the terrestrial carbon balance so different. – Global Change Biology 9: 500-509.

[22] Iddrisu, A. M., Peker, K. (2018): Assessment of technology for climate change adaptation in Sub-Saharan Africa. – J. Glob. Innov. Agric. Soc. Sci. 6(4): 101-114.

[23] Im, K. S., Pesaran, M. H., Shin, Y. (2003): Testing for unit roots in heterogeneous panels. – J Econom 115: 53-74.

[24] IPCC (2007): IPCC, fourth assessment report. Working Group III report "Mitigation of climate change". Chapter 8: Agriculture. – https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg3-chapter8-1.pdf.

[25] Johansen, S. (1988): Statistical analysis of cointegration vectors. – Journal of Economic Dynamics and Control 12(1): 231-54.

[26] Johansen, S., Juselıus, K. (1990): Maximum likelihood estimation and inference on cointegration with application to the demand for money. – Oxford Bulletin of Economics and Statistics 52: 169-210.

[27] Kanat, Z., Keskin, A. (2018): Studies on climate change in the world and current situation in Turkey. – Atatürk Univ., J. of the Agricultural Faculty 49(1): 67-78.

[28] Kao, C., Chiang, M. H. (2000): On the estimation and inference of a cointegrated regression in panel data. – Adv Econom 15: 179-222.

[29] Koyuncu, M., Akgün, H., (2017): Interaction between livestock and global climate change. – Journal of Agricultural Faculty of Uludag University 32(1): 151-164.

[30] Levin, A., Lin, C. F., Chu, C. (2002): Unit root tests in panel data: asymptotic and finite sample properties. – J Econom108: 1-24.

[31] Maddala, G. S., Wu, S. A. (1999): comparative study of unit root tests with panel data and a new simple test. – Oxf Bull Econ Stat 61: 631-52.

[32] Naqvi, S. M. K., Sejian, V. (2011): Global climate change: role of livestock. – Asian Journal of Agricultural Sciences 3: 19-25.

[33] Özdemir, F., Küçükçongar, M., Arısoy, R. Z., Öztürk, E., Önder, M., Kan, M., Kınacı, İ., Yılmaz, T., Yorgancılar, M., Şahin, M. (2017): Determination of Drought Perception and Socio-Economic Impact in Kop Region of Turkey. Project Report. – Turkish Republic Ministry of Food Agriculture and Livestock, Ministry of Development, KOP Regional Development Administration.

[34] Pathak, H., Wassmann, R. (2007): Introducing greenhouse gas mitigation as a development objective in rice-based agriculture: I. Generation of technical coefficients. – Agricultural Systems 94: 807-825.

[35] Peker, K., Kan, M., Nadeem, M. (2019): Corporate governance of climate change adaptation. – J. Glob. Innov. Agric. Soc. Sci. 7(1): 1-5.

[36] Pekin, M. A., (2006): Greenhouse gas emissions produced by transportation sector. – MSc. Thesis. Istanbul Technical University, Institute of Science and Technology, Istanbul.

[37] Pesaran, H., Shin, Y. (1995): An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. – In: Strom, S., Holly, A., Diamond, A. (eds.). Centennial Volume of Ranger Frisch. Cambridge University Press, Cambridge.

[38] Pesaran, H., Shin, Y., Smith, R. J. (2001): Bound testing approaches to the analysis of long run relationship. – Journal of Applied Econometrics 16(3): 289-326.

[39] PSU (The Pennsylvania State University) (2019): Current Emissions by Sector: Industry, Agriculture, and Forestry. – In: College of Earth and Mineral Sciences, The Pennsylvania State University E-Education (eds.) METEO 469: From Meteorology to Mitigation: Understanding Global Warming. https://www.e-education.psu.edu/meteo469/node/227.

[40] Prasad, P. V. V., Thomas, J. M. G., Narayanan, S. (2017): Global Warming Effects. – In: Thomas, B., Murray, B. G., Murphy, D. J. (eds.) Encyclopedia of Applied Plant Sciences. Second Ed. Academic Press, Amsterdam, pp: 289-299.

[41] Qadir, T., Akhtar, K., Ahmad, A., Shaoor, A., Saqib, M., Hussain, S., Rafiq, M. (2019): Wheat production under changing climate: consequences of environmental vulnerabilities on different abiotic and biotic stresses. – J. Glob. Innov. Agric. Soc. Sci. 7(1): 7-17.

[42] Riphah, U. S., (2015): Global warming: causes, effects and solutions. – Durreesamin Journal 1(4): 1-7.

[43] Seneviratne, S. I., Donat, M. G., Pitman, A. J. et al. (2016): Allowable CO_2 emissions based on regional and impact-related climate targets. – Nature 529(7587): 477e483.

[44] Sherlock, R. R., Sommer, S. G., Khan, R. Z., Wood, C. W., Guertal, E. A., Freney, J. R., Dawson, C. O., Cameron, K. C. (2002): Ammonia, methane and nitrous oxide emission from pig slurry applied to a pasture in New Zeeland. – Journal Environmental Quality 31: 1491-1501.

[45] The World Bank (2019a): 2014 year CO_2 emissions (kt) data. – https://data.worldbank.org/indicator/EN.ATM.CO2E.KT.

[46] The World Bank (2019b): 2017 year agriculture, forestry, and fishing, value added (current US$) data. – https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS.