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SCIENTIFIC PAPER

CARBON DIOXIDE EMISSION TRENDS AND ENVIRONMENTAL PROBLEMS IN CENTRAL EUROPE

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Abstract: *In this research, the effect of CO_2 emission was measured in two different land-use types (Crop and Grassland) in Central European and V4 countries. The primary aim of this study is to identify the significant output of CO_2 emissions from cropland and grassland. Secondary data collected from FAO (Food and Agriculture Organization of the United Nations) between 2010 and 2017. Mann-Whitney U test and odds ratio used to study the differences between the two country groups, and Principal Component Analysis was applied to create a performance map regarding the emission. A General Additive Panel model has analyzed the influence of area sizes and the regional differences on emissions. Results showed that the effect of grassland size is the primary factor in CO_2 emission. A significant difference can only be found between CEU and V4 countries regarding grassland size effect on CO_2 emission under grassland, which was rather small in the case of the V4 group but explained a larger part of the variance in case of CEU countries. The odds of having higher CO_2 from cropland to grassland was 2.43 times in the case of V4 compared to CEU countries.*

Keywords: *environment, carbon dioxide emission, climate change, greenhouse gas, land use*
JEL CLASSIFICATION: N54, O44, Q15, R11

INTRODUCTION

Global warming is driven overwhelmingly by carbon dioxide and other greenhouse gas emissions and is one of the world's biggest threats. The atmospheric GHG concentrations are a result of the net intensity of various drained organic soils and the decomposing of organic matters . Organic soils store around 600 gigatons of carbon globally (Yu, 2012). Besides, the biomass burning implies to natural or anthropogenic fires with organic matter combustion such as grassland, savanna, peatland, and agricultural crop residual. Most of the vigorous burning of biomass is carried out excessively on croplands (van der Werf et al., 2010). EU estimated the rise in biomass burning of 57 per cent to 110 per cent between 2010 and 2020 (Wagner et al., 2010). Many factors lead to ongoing growth in the combustion of biomass. A significant step of the European Union towards decreasing the consumption of fossil energy by increasing the usage of renewable energies, which will help to switch from the biomass burning (Fuller et al., 2013).

On the other hand, the Earth's total carbon content is approximately 0.8 X 1023 grams or 80 million petagrams (Pg), where 1 Pg is equivalent to 1015 g that represents 1 gigaton (GT) (Allison, 2016). Over the past 200 years, worldwide terrestrial carbon stocks like soils, plants, animals have received significant attention because they are known to be the largest source of CO_2 in the atmosphere (Houghton et al., 1983). The primary greenhouse gas to contribute to global warming is carbon dioxide (CO_2) (Pao & Tsai, 2011). This gas is produced in soils by roots, soil organisms and through soil respiration process and efflux, and emit to the environment. The estimated average of global CO_2 flux emission from soils that affects the ozone layer and the earth's climate based on extrapolations from biome land areas is (±S.D.) 68±4 PgC/year (Raich & Schlesinger, 1992).

But global agricultural production already has multiplied since 1970. At present, agriculture and land-use shifting are liable for 1/4 of human activities that are responsible for greenhouse gas emissions. (Bennetzen et al., 2016). On the other hand, crop productivity is linked to the atmospheric pollution of pesticides, CO_2 and other GHG gas emissions, whereas the soil organic matter loss can reduce the carbon sequestration potential of the environment (Stoate et al., 2001).

Generally, direct energy inputs such as diesel fuel, energy, solid fuels and other energy sources and indirect energy sources such as the agricultural manufacturing sector for the production and transportation of fertilizers, pesticides and equipment generate CO_2 (Küstermann et al., 2008). Carbon dioxide emissions add to the radiative driving of Earth's changing climate by raising the temperature of its atmosphere. Crop yield and production accounts for almost 50 per cent of human activities generates CH_4 emissions and approximately 70 per cent of anthropogenic N_2O emissions but the global warming potential of these two gases is comparatively intense, while CO_2 emissions surpass both CH_4 and N_2O. Over the past Century, CO_2 contributed about 65 per cent of the combined thermodynamic effects of perennial gases; respectively, CH_4 and N_2O have added about 20 and 5 per cent (Watson; et al., 1996).

A significant source of uncertainty in grasslands is the soil management effects on greenhouse gas emissions level. Temperate grasslands make up 20 per cent of Europe's land area with carbon. Carbon concentration occurs mainly underground in grassland ecosystems and the changes in land use can impact on soil organic carbon stocks such as the conversion of arable land to grassland and its management. (Soussana et al., 2004). The organic matter consists of both organic inputs and soil organic matter. Organic contaminants to the soil consist of debris above and below ground including dead leaves, fallen rotten fruits, tree's roots and branches that maintain tissue structure, crop residues, mulches, green and animal manures, fertilizer, animals dead body and waste (Allison, 2016). Those are responsible for producing gases and ultimately affect the environment. For sustaining the consistency of the soil and its future production efficiency, soil organic matter plays a crucial role. Over the years, nearly half of the world's fertile soils have consequently deteriorated in organic matter and surface content. Tillage is dominantly responsible for the declension of agricultural soil, that accelerates organic soil decomposition. This decomposition process reduces the soil's water retention and nutrients absorption ability, which minimizes the infiltration capacity of rainfall and contributes to increased soil consolidation and biodiversity loss. Such agricultural soils cannot leverage environmental resources such as freshwater, carbon sequestration and erosion management and pest control (Pisante; & Sà, 2012).

Over the past few decades, the EU has focused on the possible minimization of environmental pollution through organic cultivation system because it consumes lower energy for production from 10 to 70 % for a unit of land (G.J./ha) and from 15 to 45 % per yield (G.J./t) (Gomiero et al., 2008). However, organic cultivation requires more land than the conventional (Lansink, 2002) and the EU is the most active participant to CO_2 emission cuts under the Kyoto Protocol as the European countries carry out model initiatives in order to mitigate global warming (European Commission, 2020). On February 16 in 2005 the 37 most industrialized countries of the 146 nations joined under the Kyoto Protocol of the "United Nations Framework Convention on Climate Change" (UNFCCC) to minimize their GHG emissions and contributing to limit CO_2-equivalent emissions. The Kyoto Protocol allows reductions in emissions of 6 'greenhouse' gases including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulphur hexafluoride (SF6). This calculates the 'global warming potential' (GWP) indices for each gas (Reilly et al., 1999).

In this study, twelve European countries were selected to investigate the effects of the most toxic greenhouse gas and to understand the environmental influence and divergent views regarding CO_2 emission. Two different land types - cropland and grassland - have been involved in the research. The twelve countries are Austria, Belgium, Croatia, the Czech Republic, Germany, Hungary, Luxembourg, Netherland, Poland, Slovakia, Slovenia, and Switzerland and all have different obligations to reduce CO_2 emissions.

Apart from that most of the central European countries signed the Kyoto Protocol, the Visegrád (V4) group including the Czech Republic, Hungary, Poland and Slovakia was established to work together to develop geographically, socially and politically. They have a long shared common ground in tradition, culture, religion, and politics. In the European strategy for 2020 Visegrásd group countries focused on five key priorities and among them Climate change and energy objectives got significant attention to reduce greenhouse gas emissions by 20% compared to 1990 levels; to raise the share of renewables in the ultimate electricity usage to 20% and to increase energy efficiency by 20% (Káposzta & Nagy, 2015).

Green House Gas (GHG) emission from agriculture and forestry are the leading causes of affecting the environment. Especially land degradation, erosion, additional water consumption in cultivation, organic matter loss and greenhouse gas emissions (Virto et al., 2015). Particularly the integrated emission of CO_2 negatively affects both cropland and grassland of Central European and the V4 group (Imer et al., 2013). This study's primary purpose is to measure the CO_2 emission of 12 central European countries' cropland and grassland and the extent of influence on the environment that fuels global warming.

The subject of this paper to answer the question: how do carbon dioxide (CO_2) emissions affect the central European countries environment? To answer this question, the effect of CO_2 emission was evaluated from C stock changes in above and below-ground biomass pool, dead organic matter, fires and drainage of organic soils on cropland and grassland regarding Central European and V4 group.

The primary contributions are the identification of the environmental influence and the assessment of their feasibility. In the first section of the article, a major emphasis was placed on the literature review distinguishing the present research from past studies. Secondly, advanced methodology and data analysis techniques are described. Finally, a summary of the results with probable mitigation strategies, recommendations, an indication of future researches and new challenges are discussed.

MATERIALS AND METHODS

The investigation of the aggregate effect of land-based major greenhouse gas emissions was based on secondary data sources from the official database of the "Food and Agriculture Organization of the United Nations" (FAO). Relevant data for both country groups have been collected from FAO between 2010 and 2017 (FAOSTAT, n.d.) in order to quantify the land-based gases emitted by the Central European and the V4 group and to examine the country-specific effects for cropland and grassland in accordance with the Kyoto protocol and Europe 2020's greenhouse gas emissions reduction target. The areas are given in hectares and the amount of CO_2 is measured in Gigagram. The amount of CO_2 emissions under cropland and grassland was converted to tonnes and divided by areas, respectively, to measure emission production in tonnes per hectare. Principal Component Analysis (PCA) performed to create a performance map of the countries regarding the studied factors. The ratio of the total production from cropland and grassland also calculated for the two country groups. Based on this perspective, the odds ratio (OR) and its 95 per cent confidence intervals calculated according to Altman (Altman, 1997).

To measure the influence of area sizes (of cropland and grassland) and the regional differences on emissions, the ratio of variance estimated by the following General Additive Panel model (GAP):

$$\sqrt{y_{ij}} = \mu + \tau_i + B^{(1)}(x_{ij}^{(1)} - \bar{x}^{(1)}) + B^{(2)}(x_{ij}^{(2)} - \bar{x}^{(2)}) + \varepsilon_{ij}$$

where yij denotes the emission from CO_2 for the i-th country in the j-th $\bar{x}^{(1)}, \bar{x}^{(2)}$ year, denotes the global means for cropland and grassland areas, π_i measures the individual country differences, B is the parameter estimate for the given covariate and ε_{ij} is the unobserved error effect for the i-th country in the j-th year. The square root transformation of the dependent variable necessary satisfies the normality of the error terms. Statistically significant differences between the two country groups regarding the studied indicators have assessed by using the Mann–Whitney U test at a 10% significance level. R for Windows (version 4.0.0) software package was used for statistical data analysis.

RESULTS

The study design enabled to examine the ratio differences and comparative emission of Carbon dioxide in CEU and V4 country's cropland and grassland between 2010 to 2017. The statistics indicate not just the individual values but the average values over the whole period (Table 1). Among the Central European countries, Germany and Poland have the most substantial areas and emissions. Slovakia, Croatia, Luxembourg have lower areas and emissions in Gigagrams. The ratio between CO_2 emission under cropland and grassland was the lowest in the case of Slovenia, Austria and Netherlands and the highest in the case of Croatia and Slovakia (Table 1).

This studies explaining the changes in emissions based on land size. Slovenia, Hungary and Croatia are in the worst situation because of the highest CO_2 emission under grassland and cropland in tonnes/hectare (Table 1 and Figure 1). The Mann-Whitney rank test found significant differences between V4 and other Central European countries concerning the cropland area and emissions under cropland and grassland measured in tonnes per hectare. Visegrád group countries have a significantly larger size of cropland but relatively lower

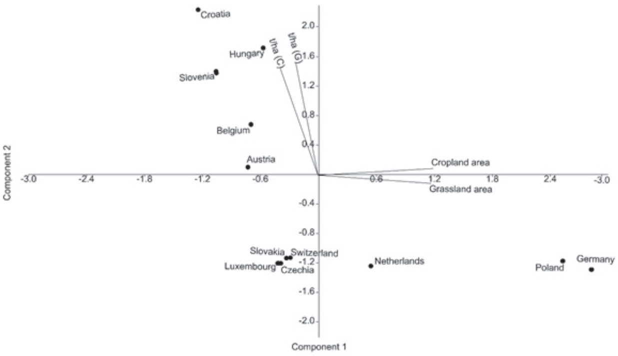
Table 1. Averages of the Examined Factors per Countries (2010-2017)

Country*	Grassland Area (hectare)	Cropland Area (hectare)	CO_2 emission under grassland (Gigagram)	CO_2 emission under cropland (Gigagram)	CO_2 emission under grassland (tonnes per hectare)	CO_2 emission under cropland (tonnes per hectare)
Austria	10101.50	2698.42	10.06	83.59	1.00	30.98
Belgium	3406.09	4568.17	11.91	148.86	3.50	32.59
Croatia	21.96	314.09	0.20	11.52	9.17	36.67
Czech Rep.*	*4326.76*	*6285.22*	*3.97*	*115.23*	*0.92*	*18.33*
Germany	597601.73	507528.45	550.78	9297.49	0.92	18.32
Hungary*	*30741.57*	*159987.52*	*251.29*	*5418.57*	*8.17*	*33.87*
Luxembourg	76.65	102.66	0.07	1.88	0.92	18.33
Netherland	207309.23	93288.48	190.59	1718.85	0.92	18.43
Poland*	*354789.26*	*691792.21*	*324.87*	*12660.99*	*0.92*	*18.30*
Slovakia*	*728.62*	*1661.50*	*0.67*	*30.46*	*0.92*	*18.33*
Slovenia	2367.99	3911.71	17.19	129.84	7.26	33.19
Switzerland	19368.07	14891.11	19.20	281.00	0.99	18.87
V4 average	97646.55	214931.61	145.20	4556.31	2.73	22.21
CEU average without V4	105031.65	78412.89	100.00	1459.13	3.08	25.92
CEU average	102569.95	123919.13	115.07	2491.52	2.97	24.68
Mann Whitney (p-value)	-1.39 (0.163)	-2.79 (0.005)	-0.931 (0.352)	-1.86 (0.063)	-3.79 (0.001)	-2.73 (0.006)

Source: authors' estimations. Notes: V4 countries indicated with* and italic style.

CO_2 emission under cropland and grassland if we consider emission in tonnes per hectare. This phenomenon can also be seen on the following performance map (Figure 1).

Figure 1. PCA Analysis of CO_2 emission by land type for Central European Countries.



C: Cropland; G: grassland; Source: authors' estimations.

There is a significant difference between the two ratios (cropland versus grassland) concerning country groups (Table 2). The odds of having higher CO_2 from cropland to grassland in the case of V4 countries is 2.43 (95 % CI: 1.88 - 3.14; $Z=6.78$; $p<0.001$) times much compared to the other Central European ones. The amount of CO_2 emission under the cropland area is significantly higher compared to grassland in the V4 group than in the Central EU. The high fluctuations also observed as individual countries have different ratios. Regarding weighted CO_2 emission 31% and 20% of CO_2 amount related to grassland in the case of Austria and the Netherlands, while 99 per cent originated from cropland in the case of Croatia, Slovakia and Hungary.

Table 2. The distribution of CO_2 Emissions (original and weighted by land area)

Country*	The original CO_2 emission (%)		Weighted CO_2 emission by land area (%)	
	Grassland	Cropland	Grassland	Cropland
Austria	11%	89%	31%	69%
Belgium	7%	93%	6%	94%
Croatia	2%	98%	1%	99%
The Czech Republic*	3%	97%	2%	98%
Germany	6%	94%	7%	93%
Hungary*	4%	96%	1%	99%
Luxembourg	4%	96%	3%	97%
Netherlands	10%	90%	20%	80%
Poland*	3%	97%	1%	99%
Slovakia*	2%	98%	1%	99%
Slovenia	12%	88%	7%	93%
Switzerland	6%	94%	8%	92%
V4 group	3%	97%	1%	99%
Central Europe without V4	7%	93%	10%	90%
Central Europe with V4	6%	94%	7%	93%

Source: authors' estimations. Notes: * V4 countries.

The effect of grassland size is the primary factor in CO_2 emission as 98-99% of the variance explained by this effect (Table 3).

The impact of grassland size on CO_2 emission under cropland is relatively smaller in the case of the V4 group and grassland size explains only 71.3 per cent of the variance of CO_2 emission under cropland compared to other CEU countries (98.2%). On the other hand, the cropland area explained a significantly higher amount of variance (28.6%) compared to the other CEU countries. Individual country differences contributed to a less explained ratio in the variance in the case of the V4 group but in the case of CEU countries, individual country differences were relatively higher with respect to CO_2 under grassland.

DISCUSSION

The present study focused on CO_2 emission proportions that vary based on country-specific land used. Research results are significantly coherent with Xiaofeng Xu (2008) who developed the biogeochemical model to estimate large-scale soil CO_2 fluxes and reported that the highest slope occurred in agricultural rice production and lowest temperate on grassland. Research result showed that grassland has a relatively higher impact on the environment than cropland.

Very few related studies have been carried out for Central European and V4 countries that affect CO_2 emission at cropland and grassland level by Dorota Wawrzyniak (2020), Jiandong Chen, Ping Wang, Lianbiao Cui, Shuo Huang and Malin Song (2018), Moutinho, Victor Madaleno, Mara Inglesi-Lotz, Roula Dogan and Eyup (2018), Madaleno and Moutinho (2017), Oertel, Cornelius Matschullat, Jörg Zurba, Kamal Zimmermann, Frank Erasmi and Stefan (2016). The majority of researchers put special emphasis on cropland rather than grassland that has a significant effect on the environment but our research has shown the opposite result. This paper explores this gap and encourages to further examine the factors influencing country-specific land-based CO_2 emission in Central Europe and the Visegarád countries.

Dorota Wawrzyniak's (2020) studies were based on data from 1993 to 2016 stating that Visegarád countries decreased their emissions by 20% achieving the Kyoto protocol and Europe 2020 target. Hungary has significantly reduced CO_2 emissions by 26% and 22% declined in the Czech Republic, 21% in Slovakia and Poland's large land size remains the largest emitter among the V4 group reducing the CO_2 emission by 18%.

In another study, O'Connor (2020) closely observed fossil-fuel and land-use change based on CO_2 emissions from 1751 to 2018 and identified the relationship between carbon dioxide (CO2) emissions and sink processes which are responsible for the climate change . Since the mid-1700s, CO_2 emissions have been increased by 370% for fossil-fuel combustion.

This study shows that grassland of both CEU and V4 countries is responsible for higher CO_2 emission as 98.2%

Table 3. Variance Analysis of the Land Type and Country Effects from the General Additive Panel Model*

Factor	Central Europe without V4			V4		
	Grassland	Cropland	Country	Grassland	Cropland	Country
CO_2 (Cropland)	98.2	1.8	0.1	***71.3***	***28.6***	0.1
CO_2 (Grassland)	98.3	0.1	***1.6***	99.8	0.1	0.1

Source: authors' estimations. Notes: *: all effects significant at 1% level.

and 71.3% of the variance of the combined CO_2 emission rates due to this factor (Table 3). The reason behind the increased emission is that the emission shifts were caused by the application of organic matter decomposition. Soil greenhouse gas (CO_2, CH_4, N_2O) flux directly affect the atmosphere by increasing emission (Yashiro et al., 2008). Besides, heterotrophic bacteria can oxidize the soil's carbon and extracting CO_2 that spreads into the environment. This respiratory cycle is one of the major fluxes of carbon (C) from the atmosphere to the terrestrial ecosystems (Schlesinger, 2011). Ideal soil respiration and organic decomposition depend entirely on abiotic factors such as soil humidity and temperature (Kirschbaum, 2004). As a result, the future climate will significantly change which correlates with the research result.

Besides, many factors are affecting this emission rate in selected central European countries. Among them, acidification of the soil mentionable and it's increased N supply decrease the thin base of the trees and turn the root area into upper layers of soil. Increased development above ground, which can be seen in many places throughout Europe. 25% of the total forested area of Poland, Slovakia, Czech Republic, and Germany had defoliation and severe damages on all trees (Matzner & Murach, 1995). Furthermore, many farmers tend to pick tropical deforestation activity for converting to the forest land into arable land which has adverse effects on the environment. However, deforestation can be critical in collective efforts to soothe the concentrations of greenhouse gas (GHG) at levels that prevent harmful intervention in the climate system (Santilli et al., 2005). These types of anthropogenic activities, such as changes to biophysical settings, biodiversity loss and unplanned usages of natural resources, had substantial influences on the global environmental system.

Soils carry the largest carbon source in terrestrial ecosystems, consisting of various materials with a wide range of various molecular structures including fresh organic matter (FOR), like litterfall, plant and leaf litter, soil litter, and root exudates and soil organic matter (SOM) (Blagodatskaya & Kuzyakov, 2008). The quality and texture of soil organic matter (SOM) are important factors that influence the mineralization of carbon (C) and nitrogen (N) under persistent soil moisture, but their impact on the mineralization of organic matter and the related biogenic gas like carbon dioxide (CO_2) vary during sequential dry and wet cycles (Harrison-Kirk et al., 2013).

The impact of temperature and the effects of the addition of fresh substrates on the decomposition of soil organic matter are based on two main elements, soil carbon dynamics under climate change and increasing CO_2 levels. Soil organic carbon composition of much more extremely complicated or low-quality carbon molecules that decompose quite slowly and is often referred to more sullen carbon pool. (Thiessen et al., 2013). Moreover, There remains a significant mystery as regards the extent to which increasing temperatures induce decomposition in Soil organic matter stores and provide positive input on global warming. The stocks of malleable and truculent substances are not comparable in most settings, with recalcitrant compounds becoming even more prevalent than readily biodegradable compounds (Davidson & Janssens, 2006). Subtle changes in Soil Organic Matter may drastically change the concentration of CO_2 in the atmosphere (Conant et al., 2011).

According to Rebecca Ryals and Silver's (2013) organic matter amendments, the carbon advantages of enhanced net primary productivity (NPP) can be compensated from a global warming viewpoint by reducing soil greenhouse gas emissions. Changes in organic matter maximize soil Carbon and nitrogen (N) concentrations and may significantly change the soil's environmental conditions including humidity, temperature and pH, thus raising potential carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) emissions. Amending grassland soils with organic waste greenhouse gas emissions can mitigate (GREGORICH et al., 2005). The results suggested complementary strategies including soil management, nitrification inhibitors and management of organic or inorganic fertilizers and directly influence the CO_2 gas emissions (Luo et al., 2010).

Also, climate change highly depends on the agriculture system, and it is the primary determinant of agriculture productivity but also fluctuates on latitude, altitude, and crop type (Adams et al., 1999). Eventually, temperature changes negatively affect overall food production and the environment. It has estimated that agricultural activities contribute approximately 30 per cent of the GHG emissions that cause anthropogenic climate change (Pete Smith & Gregory, 2013), and growth rates of the rain-fed area will be decreased by 15 per cent compared to the baseline (Rosegrant et al., 2009). However, organic cultivation increases 30 per cent of the higher richness of species like birds, insects, and plants than conventional cultivation systems, but 16% of them showed adverse biodiversity effects (Bengtsson et al., 2005).

In Europe, since the mid-1980s, policymakers, consumers, environmentalists, and farmers have focused considerable attention on organic cultivation (Stolze & Lampkin, 2009). Organic agriculture is a farming approach that represents the quality of the food and health, environmental preservation, livestock conservation, sustainable use of resources, and aims for social equality (Lampkin, 2017). According to the

Eurostat in 2018, organic farming extended to 13.4 million hectares of agriculture within the EU-28. It is 7.5 per cent of the EU-28 ‘s total agricultural land utilized as organic (Eurostat, 2020).

The organic cultivation system has a higher potentiality to climate resilience because it maintains healthy ecosystems with minimal negative impression on the environment. Thus, the cultivation of the crops agricultural GHG emissions can reduce by 20 per cent, where 10 per cent pointed reduction of energy demand (Adams et al., 1999). However, finding a way to minimize the influence of human activities on the environment changes is a growing concern (Azadi et al., 2011). Similar to this study conducted by Cristina Muñoz (Muñoz et al., 2010), suppression of CO_2 also observed from different points of view (Mikulčić et al., 2017), i.e., production cost, soils, crops, markets, and climate conditions.

This research has some unavoidable limitations. This study did not observe the risk of temperature sensitivities that evolve from CO_2 emission of cropland and grassland. The additional constraints of the research are that not only CO_2 but also other greenhouse gasses have the greater potential of global warming. Because other GHGs are created by microbial nitrification and denitrification in anoxic soil microsites and that can make a favourable environment unfavourable . (Kammann et al., 2008). The reason behind this phenomenon is that after the emission of CO_2, it increases the atmospheric concentration and remains on Earth for thousands of years. Moreover, it will take approximately 3.000 years to eradicate the current pool of CO_2 from the atmosphere in the absence of emissions from other sources (Schlesinger, 2015).

Climate-change management policy has been centralized in many European countries, including Hungary. The local interests, areas of expertise, and resources often remain dormant. This trend is incompatible with the principles and objectives of the relevant EU policies (Patkós et al., 2019). The climate-mitigation and renewable energy technologies, including biomass, lighting methane, wind, solar, geothermal, marine energy, hydropower, and energy waste, will be the long-term solutions (Dechezleprêtre et al., 2011).

The researchers, environmentalists and the policymaker concerned with the consequences of greenhouse gas (GHG) concentration in the atmosphere (Nyong et al., 2007) and can contribute to reducing the causes of global warming and bring resilience on climate change and protect the destruction of the ozone layer. CEU farmers need to understand the cultivation and environmental factors that are harming the atmosphere. However, CO_2 and N_2O mitigation practices not only support productivity but also help to cope with EU climate policy, Kyoto protocol and Europe 2020 strategy.

CONCLUSION

In nutshell, CO_2 is the core GHGs that connected with global warming. Measurement of carbon can be a crucial strategy to monitor and control CO_2 emissions in CEU. On the other hand, the CEU and Visegrád group have their own nationally defined goals and external difficulties emerging from geographical disparities. The purpose of this research was to see how much GHG emitting by the CEU and Visegrád countries and how they are coping with GHG emission-reducing strategies in meeting the target of Kyoto protocol and Europe 2020’s environmental goals. Results reflect the countries’ different level of GHG gas emission situations, making it harder to achieve cohesion.

Present analysis and policy discussion narrowed down the climate issue to a debate about CO_2 emissions from central European and Visegrád country’s cropland and grassland. In contrast, the Kyoto and Europe 2020 Agreements contained different climate policy issues including non-CO_2 greenhouse gases.

Emission results highlight the fact that Central European and V4 group countries’ cropland is responsible for more emission than emission from grassland, and therefore cropland is likely to have a more substantial influence on climate change. It is imperative to bring this issue to the forefront of biomass pool, dead organic matter, organic soils drainage to assess the collective impact to the environmental changes, and forthcoming steps should take to explore the potential mitigation and adaptation processes to fulfil and comply with the targets of Kyoto protocol and Europe 2020 strategy that need to be achieved by 2020.

Even though some mitigation strategies can adversely affect farming systems’ adaptive ability, most climate change adaptation options have a favourable impact on mitigation. For CEU countries appropriate adaptation measure applicable to lower the GHG emissions from their grassland and cropland, these are including (1) biomass can be used as a renewable energy source, which could easily replace fossil fuels from conventional cultivation systems (Urbaniec et al., 1384) . (2) The soil erosion mitigation strategies, (3) Nitrogen and phosphorus leaching control, (4) soil moisture preservation measures, (5) variety of crop rotations by choice of habitats or variations, (6) microclimate adaptation to mitigate extreme heat and provide insulation, (7) land utilization alteration including abandonment or expansion of the existing arable land, (8) Improving the efficiency of nitrogen use. (9) Improving the storage of soil carbon (P. Smith & Olesen, 2010), (10) Enhanced sequestration of carbon soil by reduced tillage, (11) Efficiency of fertilizer-N to improved crop utilization, (12) Utilization of chemical or natural nitrification inhibitors, (13) GHG emissions reductions by storing atmospheric Carbon (C) as soil organic matter (Muñoz et al., 2010), (14) increasing Switching from conventional farming system to the organic farming system.

Eventually, to mitigate outcomes of global warming by considering the adverse effects of CO_2 emissions, accurate measurement of emissions, and urgent action towards mitigating and controlling gasses is inevitable for climate resilience. Further research is necessary to clarify how these greenhouse gases play a role in mitigating the potential impacts of climate change.

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