ISSN 1822-8038 (online)
INTELEKTINĖ EKONOMIKA
INTELLECTUAL ECONOMICS
2020, No. 14(1), p. 161-183

RESPONSIBLE ENVIRONMENTAL MANAGEMENT AS A TOOL FOR ACHIEVING THE SUSTAINABILE DEVELOPMENT OF EUROPEAN COUNTRIES

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DOI: 10.13165/IE-20-14-1-10

Abstract: *The trend of the last decade is to achieve sustainable development of society. The reasons of the development of this tendency are the global processes of industrial growth, the level of consumption of products, urbanization, and the development of globalization processes, the formation of the impact of non-profit organizations in the fight against environmental problems. The problems of environmental responsibility are urgent for many researchers, as they represent a way to solve complex environmental and economic problems facing the representatives of modern business, society and the state. The article deals with the analysis of the environmental component of social responsibility and its impact on the sustainable development of European countries. The article focuses on prioritizing sustainable development goals, namely Partnership for Sustainable Development. The factors that most influence on the environmental sustainability of European countries (Lithuania, Hungary, Slovakia, France, and Ukraine) were analyzed. The correlation between GDP changes, populations and the level of environmental pollution has been proved. The definition of the concept of responsible consumption is considered and recommendations of reducing the level of influence of the agricultural sector on the environmental component were proposed. The necessity to increase environmental social responsibility in order to prevent a negative impact on the economy of European countries is substantiated.*

Keywords: *responsible consumption, ecological responsibility, sustainable development, globalization, environmental*

JEL Classification codes: *Q01, Q52, M14*

1. Introduction

The increasing importance of the country's development, at the present stage, enhances the interaction between society and nature – with the attraction and use of large quantities of raw materials, energy, and fuels – and influences the change of directions in the crucial role of natural resources and ecology through increasing human influence.

Increasingly, there is an exacerbation of the environmental problems of the world, which in turn affects the environment, resulting in the pollution of land, water, and air, the deterioration of public health, a reduction life expectancy, and an inequality of access to resources, which creates negative trends in the socio-economic development of each country. The consequence of such actions is a violation of the balance of the nature-economy-society balanced, that is, the global concept of sustainable development.

In accordance with the new Resolution "Transformation of Our World: The 2030 Agenda for Sustainability," 17 Sustainable Development Goals have been developed with 169 targets. A list of goals has been established. The set of objectives covers a wide range of areas as it addresses the interrelated elements of sustainable development: economic growth; social integration; and environmental protection. Sustainable Development Goals are spreading across the world, both in rich and poor areas. That is why the current conditions of development of the countries of the world demand from society a reduction in the consumption of resources, an increase in the use of alternative types of materials and renewable sources of energy, and the introduction of resource-efficient, low-waste, and cleaner technologies.

Summarizing these issues and their possible solutions in line with the Sustainable Development Goals, this study considers Objective 13: Take urgent action to tackle climate change and its implications, and Objective 17: Strengthen sustainable development and enhance the work of the Global Partnership Mechanisms. In the interest of sustainable development, it is an objective necessity to study the relationship between the ecological system and the sustainable development of the country's economy.

2. Literature review

Theoretical and practical aspects of environmental issues and the sustainable development of the economy were described in the works of such scientists as Hoffman (1998), Meadows, Randers, and Meadows (2007), Reimers (1990), and others. Analyses of environmental pollution were reflected in the articles of Golyan (2007), Burkinsky (2006), Khlobistov and Zharova (2010), and others.

Sustainable development has been explored by leading scholars such as Zgurovsky and Gwishiani (2008), Dolishniy, Melnyk, Rudenko and Lisovsky (2005), and others.

International institutions at the global level are studying the environmental component of sustainable development. These institutions include: the International Council for Science (ICSU, n.d.); the World Center for Geoinformatics and Sustainable Development (WDC); the Club of Rome (n.d.); the International Institute for Applied Systems Analysis (IIASA, n.d.); and the International Federation global problems.

Despite the considerable amount of scientific work devoted to the environmental problem and the sustainable development of the economy, it is necessary to study the relationship between them.

The aim of this study is to investigate the relationship between the state of the environment and the sustainable development of the economy.

3. Methodology

For this study an inductive approach was used, which involved the development of a theory as a result of the observation of data (Saunders, Lewis, and Thornhill 2009; Figure 1). A sample of subjects was studied for establishing the theory by working with quantitative data from France, Hungary, Lithuania, Poland, Slovakia, and Ukraine.

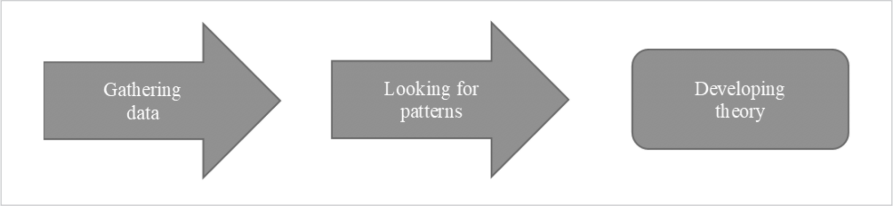


Figure 1. *Main steps in the inductive approach*

Source: Authors' compilation based on Saunders, Lewis, and Thornhill (2009)

For answering the research questions of the study, secondary data was used. Analyses of correlation between GDP, population, and pollutant emissions, as well as dependence of value added, pollutant emissions, and use of organic fertilizers, were performed based on the secondary data of World-Statistics and CITEPA for the abovementioned countries. World-Statistics provides data from international organizations, such as the World Bank, the United Nations, and Eurostat, while CITEPA is a Technical Reference Center for Air Pollution and Climate Change, reporting atmospheric emissions data.

A grounded theory approach (Strauss and Corbin 2008), involving the inductive building of theory, was adopted for data analysis. Potential bias in this method can arise from the researcher's worldview, and pre-understanding can also influence the achievement of "pure" grounded theory (Gummesson 2000). In this research, some level of pre-understanding was acknowledged and minimized through reflection.

4. Results and discussion

4. 1. Theoretical and practical aspects of the sustainable development process

Seventeen Global goals of Sustainable Development were documented in "Transforming our world: A 2030 agenda for sustainable development." The event was part of the 70th session of the UN General Assembly, held in New York in September 2015.

As a result of all consultations, taking into account national specificities, the first, third, fourth, sixth, eighth, ninth, and eleventh goals were identified as priority targets for the sustainable development for Ukraine and its regions. In general, this choice is typical of a transition country. It is worth pointing out that the environmental component was completely ignored when choosing targets, even though environmental issues are quite acute in some regions. Over four years, Ukraine has been focused on achieving the chosen goals, albeit slowly (UNDP to Ukraine 2016, 2018).

When explaining the impact of international projects on achieving the sustainable development goals, one can draw a comparison between such measures and benchmarking processes. This type of marketing aims to study the positive experience of leading companies and implement the results obtained in their work. International projects aim to achieve similar goals. Any international cooperation is accompanied by the acquisition of new experience and useful skills that are often used in economic, social, or environmental fields (Loginova 2016).

Ukraine, as a country with a transitional and rather volatile economy, should focus on such measures, and use opportunities to borrow foreign experience in full. In spite of this, the Sustainable Development Goal No. 17, entitled "Partnership for Sustainable Development," was not selected as a priority for the country.

It is necessary to understand the importance of Goal No. 17 in its entirety. Sustainable development partnerships in the form of international projects and communications will always influence other goals, giving the experience of more progressive countries to those less progressive in the areas of economic development, social issues, and environmental security. A potential international partnership can affect the development of all areas of sustainable development, and this is a significant advantage.

Despite the lack of prioritization of international projects, the process of regional experience exchange has been much more intensive since the harmonization of sustainable development goals. It is important to understand that without significant impact from international projects, such development is very limited and usually ends in national trends.

The definition of sustainable development characterizes it as the development of the present generation, which does not conflict with the interests of future generations. Its essence is to create the conditions for the lives of future generations so that they can meet their needs in full. Moreover, it is about providing resources and living standards which should be no worse than the current ones (Sustainable Business Magazine, n.d.).

By stepping up international cooperation, countries and regions are creating the same concept of sustainable development as was discussed in the 2015 document (i.e., development that is global in nature and is characterized by comprehensive international cooperation).

The Sustainable Development Trends, formed by the New York Summit four years ago, have already become a benchmark for most countries. Only the pace of activity that countries implement in achieving the Sustainable Development Goals differs. It is important to note that the result of international projects is not only the borrowed experience

of more developed countries, but also the generation of new solutions to existing global problems, which is certainly one of the key factors for sustainable development.

Among the goals of sustainable development, in terms of environmental security the most global from both the long-term perspective and in terms of current needs is Climate Action Goal No. 13. A great deal of research and publications are devoted to the impact of climate change on different countries and regions.

The Oxford Dictionary defines climate change as a change in global or regional climate patterns, in particular mid-to-late twentieth-century changes that are largely related to increasing levels of carbon dioxide in the atmosphere produced by fossil fuels (Hodulova 2017). From the point of view of the concept of sustainable development, climate change can be characterized as a disruption of natural weather cycles through human activity, which affects the planet as a whole and can lead to various consequences in different countries. In 2015, the research organization Our World in Data conducted a study on carbon dioxide emissions in the regions of our planet. It is worth noting that the chronology of the study covers the period from 1751 to the year of the analysis (Ritchie and Roser 2017).

The progressive increase in emissions began in the 1850s, when the Industrial Revolution from England was spreading to other countries in Europe and the United States. At that time, emissions did not even total one billion tons. In 100 years, this figure was six billion tons; it had increased by more than 6-fold. The graph in Figure 2 shows that, since the 1930s, carbon dioxide emissions have increased by approximately 1.5 times every 20 years, which is already a significant upward trend. The most significant centers of atmospheric pollution are the United States, Europe, and China. In addition, as a whole, the entire Asian region produces approximately 44% of the world's total carbon dioxide emissions (Figure 2; Ritchie and Roser 2017).

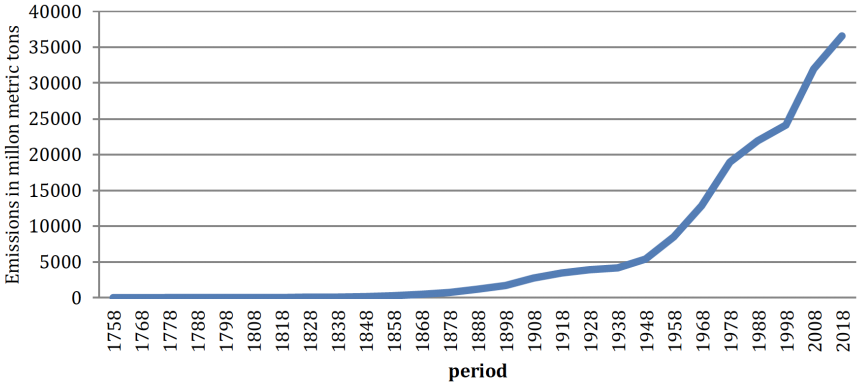


Figure 2. *Global emissions of carbon dioxide by world regions from 1758 to 2018*

Source: Authors' compilation based on Ritchie and Roser (2017)

Carbon dioxide emissions have been increasing at a very low rate in recent years, despite many environmental reduction programs. Such a qualitative suspension of carbon dioxide emissions gives us hope for further positive changes on this issue globally.

Given the anthropogenic nature of the vast majority of adverse climate change, it is crucial to give people a full and clear understanding of what is happening and what the consequences can be. In this case, the maximum effect on human perception can be achieved by having an understanding of the effects of climate change on human health.

The impact factors can be divided into 4 groups, depending on the nature of the causes and their potential consequences (Centers for Disease Control and Prevention, n.d.):

- Temperature rise (in particular extreme heat, which will manifest in heat and cardiovascular diseases, as well as the opposite situation which is accompanied by injuries and fatal cases of hypothermia);
- Sharper change in weather conditions (in particular air pollution, which will increase the incidence of respiratory diseases. Another consequence is the change in the ecology vector, which causes an increase in the incidence of malaria, rocky fever, and other insect-borne diseases);
- Sea level rise (in particular an increase in the number of allergens, which causes an increase in the frequency of respiratory allergy diseases. Another, equally significant consequence of the sea level rise is its impact on the quality of water, which is accompanied by an increase in the incidence of cholera, cryptosporidiosis, etc.);
- Increase in atmospheric carbon dioxide (increased atmospheric CO_2 content is largely due to lower nitrogen concentration in plants and lower nutrient content in crops if soil nitrogen level is suboptimal. As a result, the vast majority of people will be eating poorly, and the incidence of diarrheal disease will increase many times over. Another very negative consequence in this case is environmental degradation, which will cause migration to accelerate, which in turn will lead to conflict among citizens and other side effects; Centers for Disease Control and Prevention, n.d.).

It should be understood that in the context of one particular person, the above consequences may not be as significant as they may seem. But we have a population of 7.5 billion people on Earth, and it is on this scale that we should evaluate the possible negative consequences.

4. 2. Current issues of climate change which impact on European countries; development: a comparative analysis

The authors' research dedicated to the Sustainable Development Goals and the impact of climate change was explored in accordance with Climate Action Goal No. 13. The study was conducted on the basis of information from five European countries. All five countries are representatives of Europe, so this study demonstrates the different nature of climate change impacts across a single continent.

Weather anomalies recorded in Ukraine in recent years confirm negative climate change in the country. These changes involve increasing drought, increasing the dura-

tion of hot periods (the so-called heat waves), as well as the frequency and intensity of thunderstorms, hailstorms, and storms that have caused great harm to people living in a certain area. Climate change is also affecting Ukraine's export structure – agriculture will have to adapt to the new seasonality and the new rainfall regime. According to an almost general trend, there is extreme heat in the country, and the frequency of days with maximum summer temperatures of 35–40°C in Ukraine has almost doubled in the last few years.

Exploring the issue of climate change in France, it is worth noting that the country has become much warmer in the last ten years, and its ecology has changed as a result. The Giec study, conducted by an intergovernmental panel of climate change experts in March 2014, shows interesting results. At present, all regions of the world suffer from human-induced warming. In some countries, this is being reflected in the disappearance of plant and animal species, and the problem of a lack of drinking water is present in most African countries because of extreme heat. In France, however, there are problems with the migration of birds. In addition, the country sometimes introduces restrictions on water usage, which is a consequence of the reducing amount of this resource and the increasing of its need. France's rail network has also experienced negative climate change because of the sensitivity of the rails to heat damage (Idele 2017).

France's GHG emissions fell by around 11% between 1990 and 2018, but there are great differences between the sectors. For example, transport, housing, and waste increased by 12%, 11%, and 14% respectively. In this case, high growth rates were offset by reductions in emissions from industry (-40%), energy (-27%), and agriculture (-6%), as demonstrated in Figure 3 (Idele 2017; Georgieva 2019; World Data Atlas).

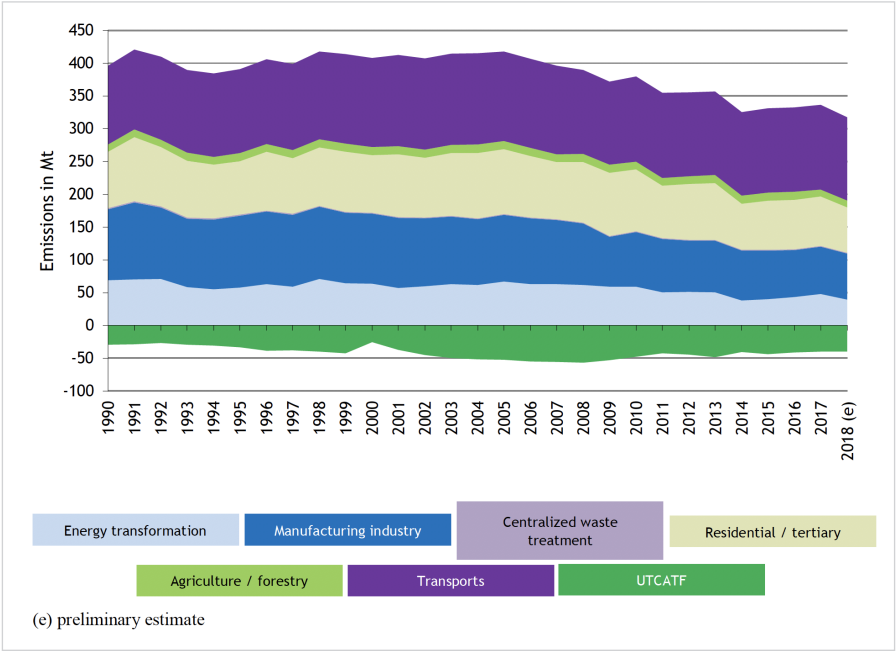


Figure 3. *Evolution of CO_2 emissions in air in mainland France since 1990*
Source: CITEPA/format SECTEN (April 2019)

Agriculture, where the lack of water will lead to higher prices for products, will be a great issue for Slovakia with increasing climate change. In Slovakia over the past 100 years, the average annual temperature has risen by 1.1°C.

As part of the new Greener Slovakia Environmental Strategy, the country has made a number of environmental decisions on specific problems of environmental safety. The strategy covers three of them, including water protection and biodiversity, climate change and air protection, and the green economy. In addition, the strategy proposes improvements in the protection of national parks and forests (by 2030, 75% of territorial national parks will face urgent conditions without human involvement). The strategy also envisages environmental public procurement, which is expected to increase by 70% by 2030. Another area of this strategy is environmental education, which should become an important part of formal education (Georgieva 2019).

"Dirty" vehicles generate around 90% of harmful emissions in Lithuania. Emissions from cars make up the largest share – 57%. Lithuania should reduce greenhouse gas emissions by 9% in the period of 2021–2030, while not exceeding the quota of 126.6 tons. If the country goes beyond the agreed limits, then it will have to cover this deficit with an appropriate amount in loans. According to forecasts, greenhouse gas emissions in 2021–2030 in Lithuania will reach 140 million tons. According to preliminary estimates,

covering the surplus will cost €348 million. Covering greenhouse gas emission quotas in the transport sector alone will require approximately €243 million, as transport is a major source of particulate matter and nitric oxide pollution in large cities. One of the main problems is that diesel vehicles emit significantly more of these pollutants than other types of fuel. Under a new bill, "vehicles with diesel pollution" will recognize vehicles with diesel engines whose carbon dioxide emissions exceed 115 grams per kilometer, as well as vehicles with petrol or gas engines whose carbon dioxide emissions exceed 130 grams per kilometer. For diesel, petrol, and gas engines exceeding the emission standards, a newly imposed tax will start from €80, €40, and €36 per year, respectively.

In Hungary, the PM 2.5 level is 19.4 micrograms per cubic meter, which is higher than the OECD average of 13.9 micrograms per cubic meter and well above the annual maximum of 10 micrograms per cubic meter set by the World Health Organization. PM 2.5, a fine particulate matter capable of reaching even the deepest part of the lung, is monitored in OECD countries, as these particles can be harmful to human health and shorten life spans.

Access to clean water is a fundamental factor in human well-being. Despite the significant progress OECD countries have made in reducing water pollution, improving the quality of freshwater is not always easy to determine. In Hungary, 77% of the population is satisfied with water quality, which is below the OECD average of 81%.

Therefore, a country's sustainable development can only be achieved by delimiting economic growth from the use of natural resources and environmental impact. This distinction can be explored by comparing the dynamics of economic growth with the use of natural resources.

The demarcation will be confirmed when growth rates or environmental impacts are lower than economic growth. But the real goal must be a complete demarcation when the environmental impact is stable or diminishing and the economy grows (BIO Intelligence Service, Institute for Social Ecology, and Sustainable Europe Research Institute 2012).

Decoupling (decoupling and delimitation are used as synonyms) is a separation of parameters. The EC Communication to the European Council and Parliament (European Commission 2011) identifies two types of delimitation: economic growth from resource use; and economic growth from environmental impact.

In one way or another, the theory and methodology of the concept have been used in a number of strategies and programming documents of the EU, the UN, and a number of countries around the world. In particular, the main documents are: the EU's "Thematic Strategy on the Sustainable Use of Natural Resources" (2005); "Roadmap to a Resource Efficient Europe" (2011); "Strategy for the Sustainable Development of the European Union – Europe 2020"; "Assessment of resource efficiency indicators and targets, Final report" (2012); "UN-UNEP Annual Report"; Organization for Economic Co-operation and Development (OECD); Global Environmental Forum Environment (Global Forum on Environment, focusing on sustainable materials management 2011); publications of the European Environment Agency; as well as a number of individual sustainable development strategies of EU countries, including Germany, Austria, France, Norway, Sweden, and others.

Differentiating between environmental impact and economic growth means two things:

1. The economy is growing faster than the rate of use of natural resources, but the absolute value of resources is used more;
2. The economy is growing, and resources are being used at the same or smaller levels.

These different degrees of delimitation are commonly referred to as relative and absolute delimitation. Similarly, decoupling environmental impact from economic growth means an economy growing at a faster rate than environmental impact (relative delimitation) or stabilizing or reducing environmental impact (absolute delimitation; European Commission 2011).

We compared the dynamics of the main indicators of economic growth and its impact on the environment in Ukraine, France, and Slovakia.

Figures 4, 5, 6, 7, and 8 show the dynamics of the economic growth indicator (GDP), the population, and the amount of pollutant emissions into the atmosphere in each country.

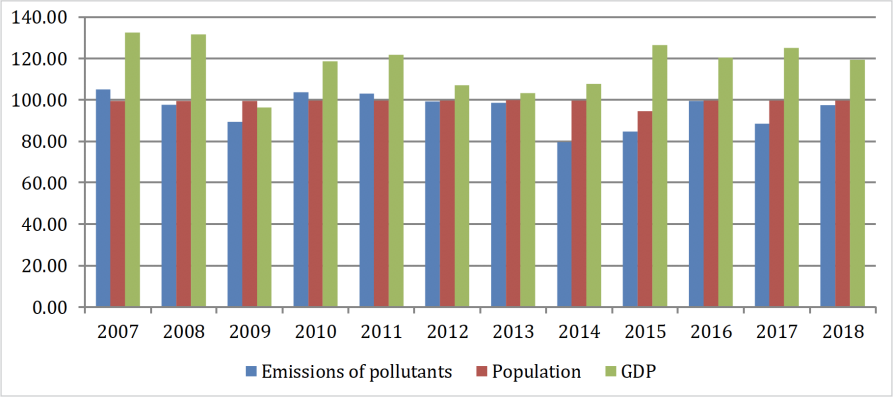


Figure 4. *Correlation between GDP, population, and pollutant emissions in Ukraine*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

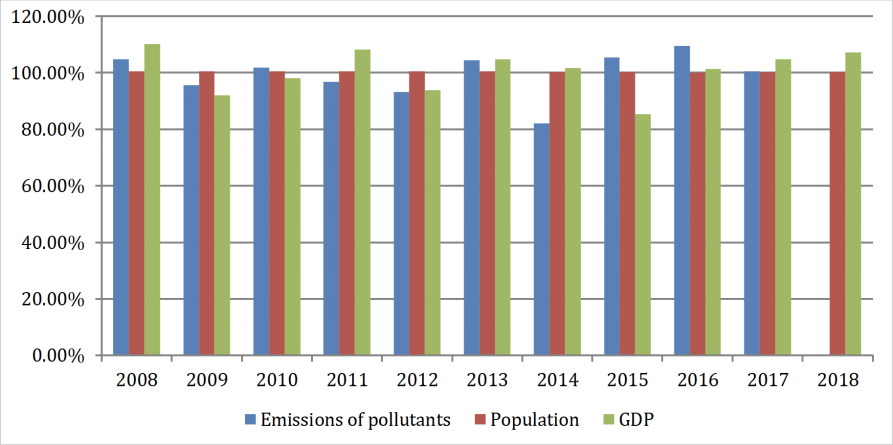


Figure 5. *Correlation between GDP, population, and pollutant emissions in France*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

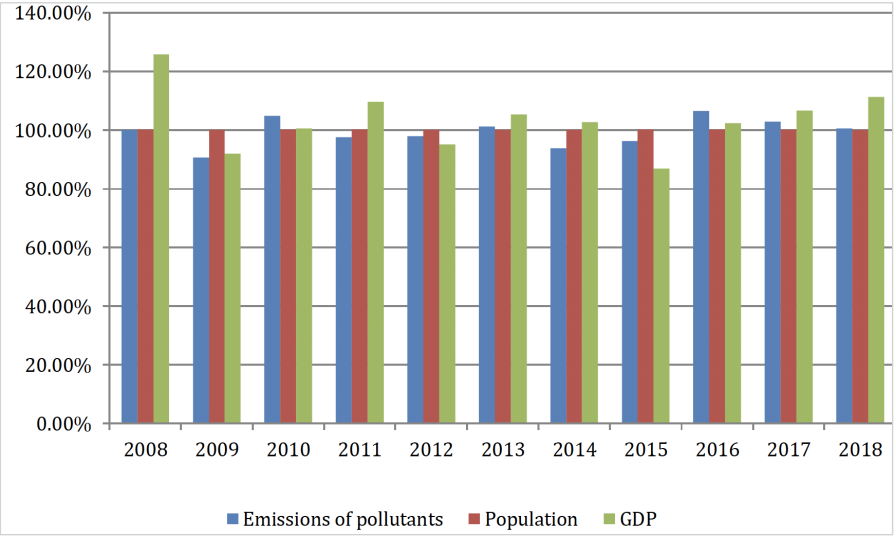


Figure 6. *Correlation between GDP, population, and pollutant emissions in Slovakia*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

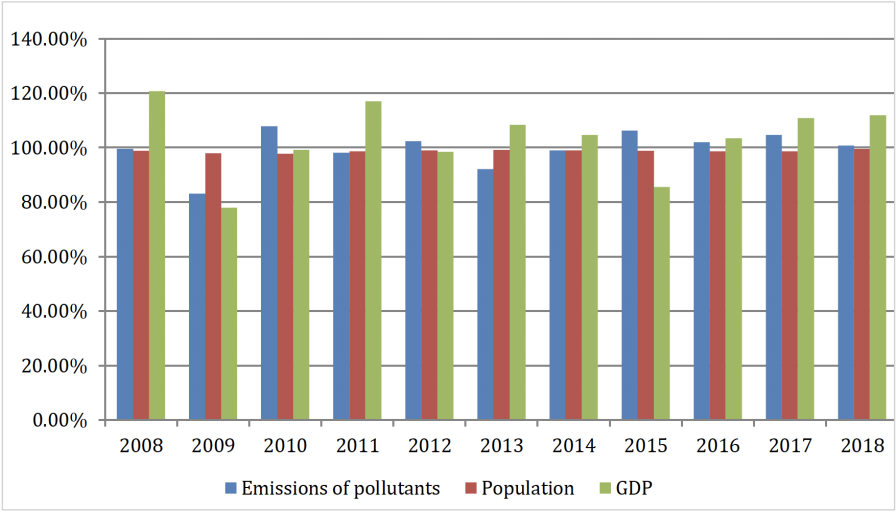


Figure 7. *Correlation between GDP, population, and pollutant emissions in Lithuania*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

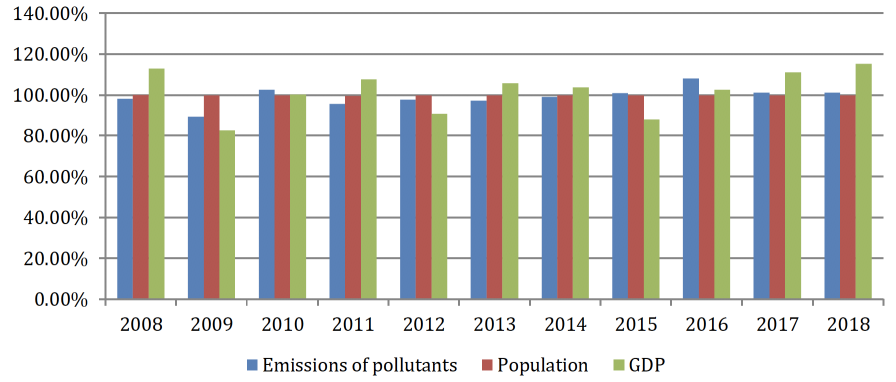


Figure 8. *Correlation between GDP, population, and pollutant emissions in Hungary*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

The analysis shows that GDP growth rates are much higher than similar emission figures but overall the emission trend remains positive, indicating a relative distinction between these indicators, although in some cases the opposite situation is observed in a relatively minor manner. Agriculture is one of the largest sources of greenhouse gas emissions, and the proper use of its potential can help to limit global warming to 2°C by the end of the century. OECD experts assessed the impact of agriculture on global warming and analyzed the policies of developed and developing countries on the subject.

Agriculture contributes to an increase in carbon dioxide emissions, an increase land use, and a decrease in CO_2 absorption mechanisms such as forests or organic soils. Direct and indirect land-related agricultural emissions are accounted for in the AFOLU (Agriculture, Forestry, and Other Land Use) sector. In total, emissions in the AFOLU sector include agricultural greenhouse gases (CO_2-free), net CO_2 emissions from agricultural soils, and net CO_2 emissions from deforestation and other land uses (FOLU).

Agriculture is a major source of greenhouse gas emissions. It releases large quantities of carbon dioxide through the burning of biomass, mainly in areas of deforestation and grassland.

Agriculture is also responsible for up to half of all methane emissions. Though it persists for a shorter time in the atmosphere, methane is approximately 20 times more powerful than carbon dioxide in its warming action and is therefore a major short-term contributor to global warming. Current annual anthropogenic emissions are around 540 million tones, and are growing by around 5% per year (CITEPA 1990; Batini 2019a).

Livestock alone accounts for approximately one quarter of methane emissions, by way of gut fermentation and the decay of excreta. As livestock numbers grow, and as livestock rearing becomes increasingly industrial, the production of manure is projected to rise by approximately 60% by 2030. Methane emissions from livestock are likely to increase by the same proportion.

Irrigated rice farming is the other main agricultural source of methane, accounting for approximately one fifth of total anthropogenic emissions. The area used for irrigated rice is projected to increase by approximately 10% by 2030. However, emissions may increase more slowly because an increasing amount of rice will be grown with better controlled irrigation and nutrient management, and rice varieties which emit less methane may be used.

Agriculture is a key source of another important greenhouse gas: nitrous oxide. This is generated by natural processes, but is boosted by leaching, by the volatilization and runoff of nitrogen fertilizers, and by the breakdown of crop residues and animal wastes. Livestock accounts for approximately half of all anthropogenic emissions. Annual nitrous oxide emissions from agriculture are projected to grow by 50% by 2030.

Farming can also be a sink for carbon. However, it is generally believed that soils, like other biological sinks (e.g., vegetation), have an inherent upper limit for storage. The total amount that can be stored is crop and location-specific, and the rate of sequestration declines after a few years of growth before eventually reaching this limit. In 1997–1999, an estimated 590 to 1,180 million tonnes of carbon were locked up in cropland soils alone, in the form of soil organic matter from crop residues and manure. Projections of increased crop production imply that by 2030 this total could rise by 50%.

Other changes could boost the total even further. If only 2 million of the current 126 million ha of saline soils were restored each year, they could account for an extra 13 million tonnes of carbon annually. In developed countries, land that is permanently set-aside can sequester large amounts of carbon if it is left unmanaged, or reforested.

Depending on agroclimatic conditions, NT/CA can lock up 0.1 to 1 tonne of carbon per ha per year, in addition to cutting carbon dioxide emissions by over 50 percent

through the reduced use of fossil fuel in plowing. The growth potential for NT/CA is considerable. If another 150 million ha of rainfed cropland is converted to NT/CA by 2030 and the average sequestration rate on land managed in this way is 0.2 to 0.4 tonne per ha per year, a further 30 to 60 million tonnes of carbon could be soaked up annually during the first few years after conversion.

Should any of these practices be discontinued, the sequestered carbon would be released over a period of a few years. Agricultural carbon sinks of this kind are needed to "buy time" in which to cope with carbon dioxide emissions at source (Batini 2019b).

Greenhouse gas emissions from the livestock sector make up 18% of all human-related emissions. This is larger than the entire transport sector of the planet (Figure 9).

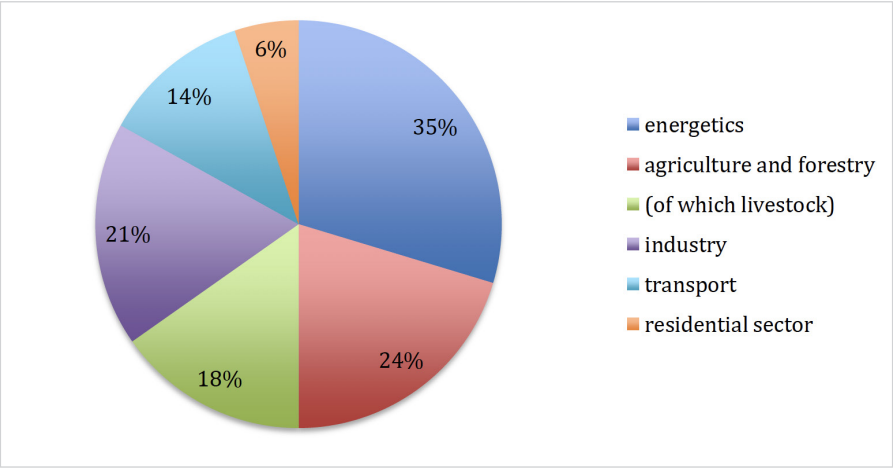


Figure 9. *The average value of atmospheric emissions in 2018*

Source: Authors' compilation based on Chatham House and CITEPA data (2020)

Industrial livestock is a source of three greenhouse gases: methane, nitrogen dioxide, and carbon dioxide. According to Chatham House, animal husbandry emits 39% of all methane and 65% of all nitrogen dioxide. Methane is produced during animal digestion and by the large amount of manure that accumulates on farms.

This sector is causing carbon dioxide emissions whilst the rainforests of Brazil and Southeast Asia are being destroyed in search of new pastures. Forests are also cleared into fields for growing animal feed.

The greenhouse gas emissions are extremely large: the world's 20 largest meat and dairy companies produce more greenhouse gases than all of Germany. Industrial livestock facilities cause enormous damage to the environment. Their emissions lead to the formation of atmospheric aerosol and acid rain, increasing the concentrations of greenhouse gases.

For meat and dairy production, a quarter of all industrial water is used annually, making AIC the largest consumer of water in the world. The vast majority of this water, due to the lack of treatment plants, returns to the environment in the form of liquid manure, suspensions, and sewage.

The Food and Agriculture Organization (FAO) report said that the environment is also contaminated with nitrates, substances, and pathogens that reduce oxygen, heavy metals, antibiotics, hormones, and residues of other medicines. Water contamination also occurs through the use of pesticides when growing feed. According to the FAO, in recent years in many countries, including Ukraine, there has been a significant increase of 50% in pesticide use.

Groundwater is also polluted. In the United States, of the 1,600 wells near farms 34% were contaminated with nitrates, with 10% exceeding normal levels. Another cause of water pollution is antibiotics, half of which are used in livestock.

Thus, it is possible to generalize the impact of the agro-complex in environmental pollution (Figure 10)

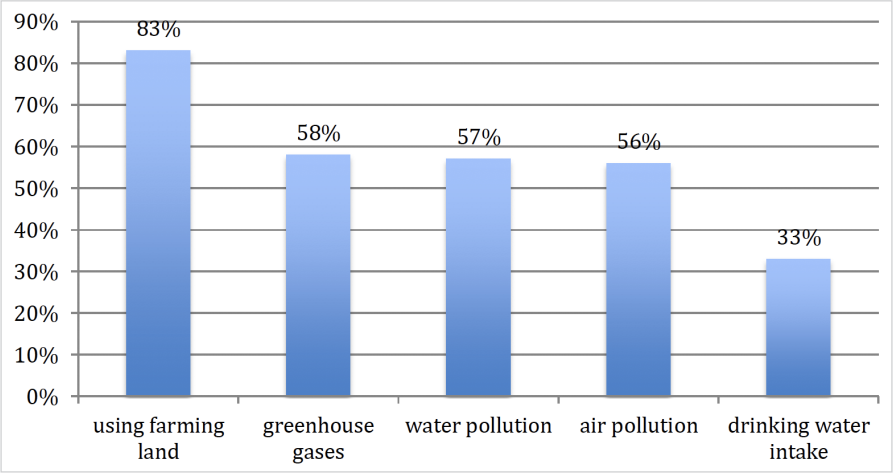


Figure 10. *The impact of the agro-complex in environmental pollution in 2018*

Source: Authors' compilation based on CITEPA and FAO data (2020)

As the world's population grows and the number of people consuming animal products grows, it will be more difficult to achieve climate change targets.

Helen Harvatt of Harvard University estimates that if action is not taken, then by 2030 livestock alone could account for 37% of the allowable emissions to keep warming below 2°C, and 49% if the goal is to limit warming 1.5°C. Besides the fact that the agri-food sector has a direct impact on climate change, it consumes large amounts of the planet's resources, in particular about half of the world's lands that are not covered by ice and deserts, and three quarters of its fresh water. Agriculture depletes these resources

due to the systematic emission of pollutants such as pesticides, synthetic fertilizers, and manure; discharges of genetically modified organisms and their deposits in surface and ground waters; loss of topsoil; as well as the salinization and waterlogging of irrigated lands. It has been established that the applied agricultural methods cause soil degradation at rates more than 100 times higher than the rates at which new soils are formed. Agriculture is also the main cause of the current mass extinction of species on Earth, according to the United Nations Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2019).

Worst of all, existing food systems have not met expectations for providing humanity with food. While a third of all food produced goes to more than 70 billion animals that are annually farmed only on land, in 2018 over 820 million people worldwide were starving, according to FAO. At the same time, 650 million people were classified as obese and approximately 2 billion overweight due to eating too much of the wrong types of food.

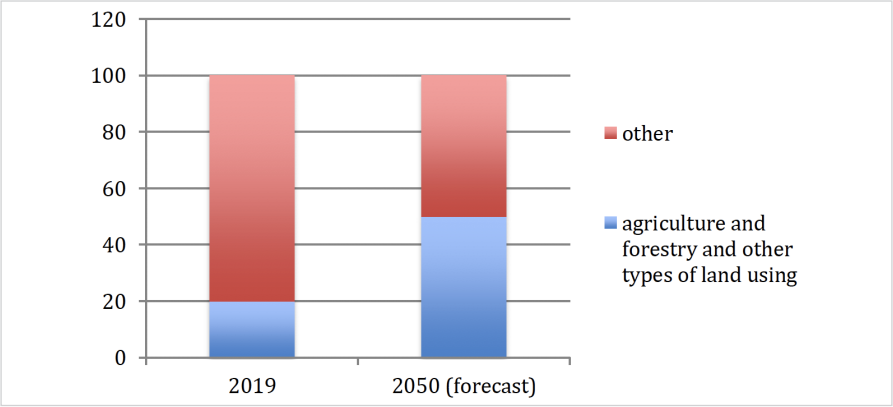
Making food systems sustainable for a growing world population is technologically possible, but this requires an in-depth review of production and consumption – namely, the Great Food Transformations. In the supply area, three changes are needed.

Firstly, the global production and consumption of red meat (especially beef) and dairy products should be reduced by about 50% by replacing them with vegetable proteins. The adoption of urgent measures by the three leading producers of beef – the USA, Brazil, and the European Union – and dairy products – the USA, India, and China – is of the utmost importance (IPCC 2019).

Secondly, a large-scale transition is required from traditional monocultural agriculture to practices that promote biodiversity, such as organic farming and the combination of farming with livestock, sustainable soil cultivation, and ecosystem restoration. Denmark and the Netherlands were among the first countries to announce bold plans for the transition to organic agriculture. Soil restoration using regenerative farming methods (for example, planting cover and perennial crops and stopping monoculture cultivation) will help to keep up to 60 tons of carbon per acre in the soil and green spaces, and thus reduce carbon dioxide emissions into the atmosphere. As one leading soil scientist, Rattan Lell of Ohio State University, calculated: "an increase in carbon content in the soils of the planet by only 2 percent can compensate for 100 percent of all greenhouse gas emissions." Regenerative mariculture will help both to absorb carbon and restore ecosystems. According to the World Bank, breeding algae and mollusks in the oceans in an area equivalent to 5% of US territorial waters would allow the production of protein equivalent to 2.3 trillion hamburgers, and absorb an amount of carbon equal to the emissions of 20 million cars. Mariculture covering less than 10% of the world's oceans would help to absorb all of the carbon produced in a year on the planet, and produce enough biofuels to meet the world's energy needs, according to Tim Flannery of the University of Melbourne (Harwatt 2018; Hedenus, Persson, and Sprei 2016).

Thirdly, an integral part of limiting climate change will be improving land use – for example, in the form of forest planting and reducing deforestation, as pristine forests absorb twice as much carbon as monoculture plantings. The proposed Covenant, in addition to the Paris Agreement (Global Deal on Nature Conservation), aims to ensure

that by 2030, 30% of the Earth is formally protected and another 20% are considered stabilization zones to limit global temperature increases to less than 1.5°C. Provided that these three changes are large-scale and coordinated, in combination they can drastically reduce emissions, increase carbon sequestration from arable land, free up land for crops and forests, stop the loss of biodiversity and pollinators, and restore global fresh water reserves. Changes in supply and land use should be accompanied by changes in diets and a shift to increasingly diverse plant-based products, such as coarse grains, legumes, and vegetables, as well as nuts and seeds. A study published in 2018 in *Nature* magazine concluded that if slightly more meat and dairy products would benefit malnourished people, then the average citizen of the world should eat them 50% less according to the catchy rule: "breakfast or lunch without animal products." Mostly plant-based diets are crucial not only for the planet (Figure 11), but also for people, because they reduce the risk of cancer, cardiovascular disease, type 2 diabetes, and obesity.



Note. Excluding greenhouse gases from food and non-food transformations.

Figure 11. *Share of greenhouse gases from the agri-food sector*

Source: Intergovernmental Panel on Climate Change (2019); Willet et al. (2019)

Thus, by 2050 the share of greenhouse gas emissions from the agri-food sector is expected to increase to half of total emissions compared with one quarter at present. (Percentage of greenhouse gases from agriculture, fisheries, and land use in total greenhouse gases).

Therefore, it is precisely due to the increase in agricultural exports that the exploitation of land is increasing, which requires the use of organic fertilizers – themselves also factors of soil and air pollution. The authors conducted a study on agriculture based on the value added, the amount of pollutant emissions, and the use of organic fertilizers in Ukraine, Hungary, Slovakia, France, and Lithuania, presented in Figures 12–16.

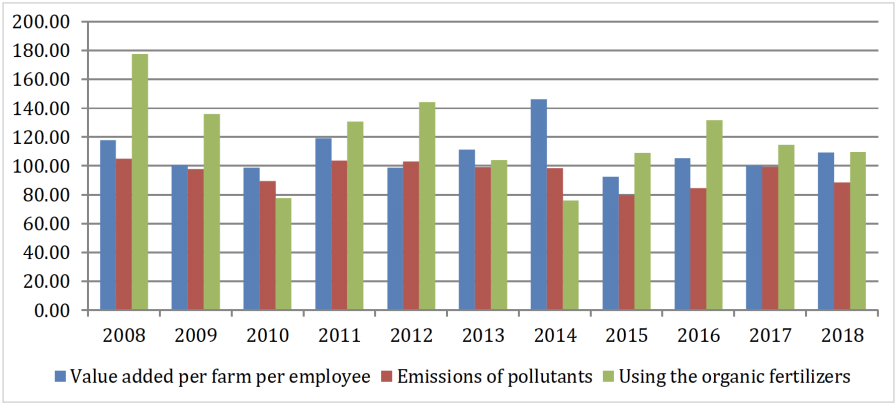


Figure 12. *Dependence of value added, pollutant emissions, and use of organic fertilizers in Ukraine (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA (2020)

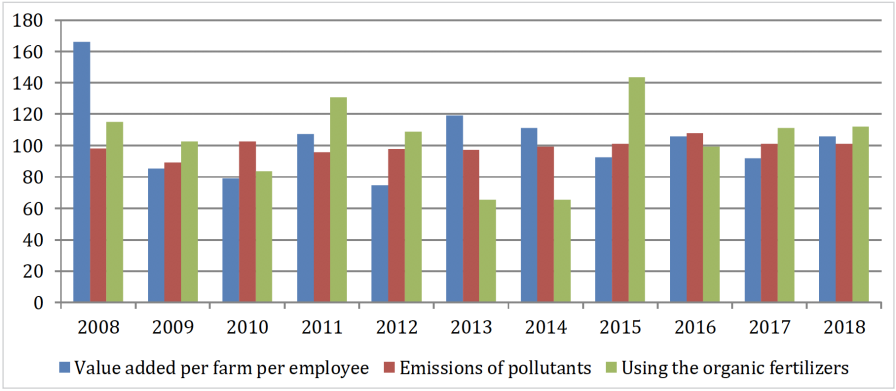


Figure 13. *Dependence of value added, pollutant emissions, and use of organic fertilizers in Hungary (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA data (2020)

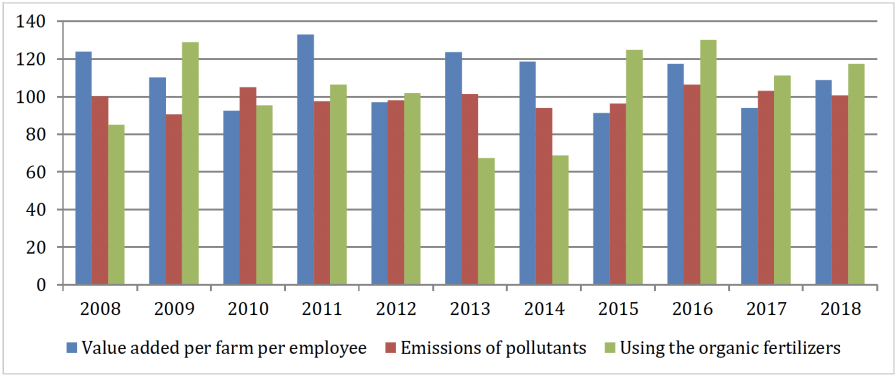


Figure 14. *Dependence of value added, pollutant emissions, and use of organic fertilizers in Slovakia (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA data (2020)

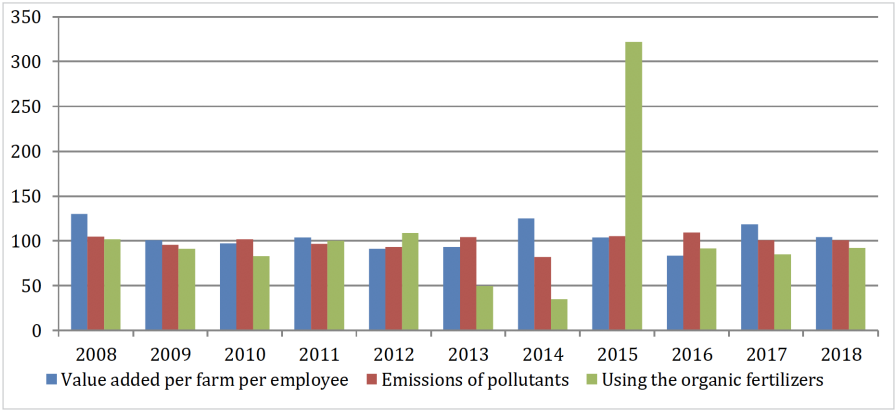


Figure 15. *Dependence of value added, pollutant emissions, and use of organic fertilizers in France (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA data (2020)

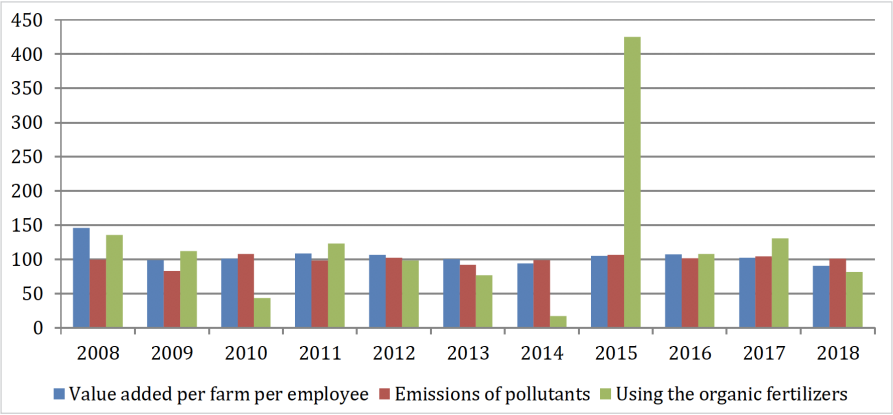


Figure 16. *Dependence of value added, pollutant emissions, and use of organic fertilizers in Lithuania (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA data (2020)

Thus, it is observed that the use of organic fertilizers in most cases affects the added value of agriculture and worsens the climatic conditions of countries. This further reflects the efficiency of land use, which tends to decrease without reducing the use of fertilizers and demarcation of indicators. However, there is a reduction in the differences between indicators, so we can note a positive correlation between them, again demonstrating that the processes of land analysis for certain components of fertilizers make it possible to reduce pollution and the inefficient use of land resources.

5. Conclusion

Sustainable development of the economy and the population growth of the country can be ensured by reducing the negative impact of entrepreneurial activity on nature and reducing the level of nature and resource intensity of the economy. Movement along the trajectory of sustainable development is impossible when the intensity of use of natural resources and the amount of pollution per unit of output are increasing. Achieving decoupling requires significant changes in government policy, an increase in the pace of scientific and technological progress, and structural changes in the economy. The key role in these processes should be played by the modernization and gradual replacement of the obsolete fixed assets of industry with advanced technologies, the widespread use of cleaner production, the introduction of resource-saving, low- and non-waste technologies, and other innovations.

Summarizing the experience of the four countries on the effects of climate change and how to address them, there are several factors that can improve the environmental situation and its impact on anthropogenic factors at the global level:

- Construction of green infrastructure;

- Increasing the amount of low emission transport;
- Flood protection;
- Gradual increases in garbage collection fee;
- Improving energy efficiency;
- Improving public awareness of energy projects and energy;
- Introducing environmental education into formal education;
- Ensuring effective control of logging;
- Control of water consumption;
- Increasing responsible consumption;
- Analysis of the chemical composition of land resources, etc.

Regarding solutions, the day-to-day reduction of agricultural pollution is proposed to be achieved by reducing meat consumption. Brigitte Alarcon, sustainable food policy officer at WWF, noted that: "We can cut a quarter of our climate emissions from the European food supply chain by eating more pulses, fruit and vegetables and by reducing our meat consumption. National governments should improve food education to encourage healthy eating habits and environmental sustainability as a first step."

However, in most countries – such as Ukraine, Hungary, and Poland – the opposite is the case. According to the Eurostat, the FAO, and CITEPA, in ten years the consumption of meat has increased by 15% to 3.2 million tonnes. The consumption of poultry meat increased the most. The second direction for improvement is to use waste as an energy resource. Livestock waste requires special conditions for its disposal. Unfortunately, companies do not always approach this in good faith, but at the same time the great potential of this waste for renewable energy remains.

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