THE INTERACTION BETWEEN AGRICULTURAL AND ENVIRONMENTAL SUSTAINABILITY IN LITHUANIA: A REVIEW

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Annotation

This paper discusses the interactions between agricultural activities and environmental sustainability in Lithuania. This study focuses on two research problems: what is the interaction of agricultural activities for environmental sustainability; and what are preference sets of measures for environmental protection in agriculture. Literature review regarding trends in agriculture to the environment shows the relationship with negative affects. The interactions between agricultural activities and the environment are expressed as a negative impact in the fact for the too-high use of fertilization of nitrogen and phosphorus causes eutrophication of groundwater and terrestrial ecosystems. Overuse of irrigation causes salinization of the soil and the destruction of freshwater ecosystems. Chemical inputs expressed by the use of pesticides cause the loss of biodiversity. Irresponsible use of mechanized machinery has an effect on climate air pollutants and greenhouse gas emissions. Therefore, it is very important to apply a set of measures for environmental protection to agricultural activities. The results of the paper are useful for further research for „European Green Deal" energy development.

Key words: Agricultural Activities, Environment Sustainability, Interactions.

Introduction

Relevance of the research. Sustainable environment is one of the most important commitments made by the EU and all its Member States under the Paris Agreement. In line with this commitment, EU countries have agreed to make it a reality by 2050. The EU would be the first climate-neutral economy and society. The transition to a climate-neutral economy is becoming a priority for the EU. It is planned to reduce emissions of greenhouse gas by 2030 from the current 40 to 55 percent compared to 1990 levels.

A greenhouse gas (or GHG for short) is any gas in the atmosphere which absorbs and re-emits heat, and thereby keeps the planet's atmosphere warmer than it otherwise would be. The main GHGs in the Earth's atmosphere are water vapour, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and ozone (Brander, 2012). To achieve the target of reducing EU emissions by at least 40% by 2030, the sectors covered by the EU ETS will need to reduce their emissions by 43% compared to 2005. This means that the overall number of emission allowances will decline at a faster pace than before: from 2021 onwards by 2,2% annually instead of 1,74%. This is equivalent to an additional emissions reduction of around 556 million tonnes between 2020 and 2030. Around 6,3 billion euro allowances, worth as much as 160 billion euro, are expected to be allocated for free to companies between 2021 and 2030 (European Council, 2019).

In the 2020 year in Lithuania, 20,2 million tons of greenhouse gases were emitted into the atmosphere. It is about 1 % less than 2019 levels. The transport (30,4%) and energy (28,1%) sectors accounted for the largest emissions. In third place - agriculture (22,1%), fewer emissions of greenhouse gases in the industrial (15,3%) and waste (4,1%) sectors (Konstantinavičiūtė et al., 2022).

The reduction in GHG emissions in the agricultural sector depends mainly on the use of fertilizers on arable land and the number of livestock. It is, therefore, necessary to promote sustainable farming, crop rotation, increase perennial grassland, increase soil fertility, apply innovative manure management technologies, apply biogas production, improve the accounting and transparency of synthetic fertilizers used, promote their conversion to organic, change the composition of animal feed to reduce methane (CH4) and nitrous oxide (N2O) emissions, organize education and awareness-raising for farmers, review subsidies and tax incentives and other measures (Ministry of Environment of the Republic of Lithuania et al., 2020).

The long-term goal for the agricultural sector set out in the Sustainable Development Strategy is to create a cost-effective and competitive industry based on environmentally friendly farming. Agriculture sector should develop ecological farms, produce high quality certified agriculture and food products that conserve natural resources. The main long-term challenges for the agricultural sector are: 1. Intensify the production of organic crop and livestock products; achieve a certified ecological production area of at least 10% of all farmland by 2020; 2.To promote the efficient development of biofuel production: biofuels should replace at least 15% of the fuel used for transport. (Ministry of Environment of the Republic of Lithuania et al., 2020).

In implementing the priorities of the European Green Deal, the Lithuanian government has drawn up a program of six projects: A circular and climate-neutral economy; Sustainable and accessible cities; Protection and sustainable use of natural capital; Society as a transformer of the Green Deal (coordinated by the Ministry of Environment); Green energy (coordinated by the Ministry of Energy); Agricultural, aquaculture and food production systems (coordinated by the Ministry of Agriculture) (Ministry of Environment of the Republic of Lithuania, 2022).

Lithuania is committed to reducing 9% greenhouse gas emissions by 2030. A large part of GHG emissions must be reduced in agriculture. The most important way to increase farms' resilience to climate change will be to optimize and restructure their economies. The planned tasks are: 1. To reduce the negative impact of climate change on agriculture; 2. To stop soil degradation, to renew drainage systems; 3. Implement effective risk management measures. 4. To foster sustainable agri-environmental protection; 5. Achieve a breakthrough in organic farming (Ministry of Agriculture of the Republic of Lithuania, 2019).

According to the 2021-2023 strategic plan of the Ministry of Agriculture, it is planned to implement one of the four strategic goals is to be formed and implemented a rational policy of agriculture, food and rural development. The aim is to promote the production of competitive products, modernization of the country's agriculture and food industry, employment in rural areas, support the income of rural workers, ensure the representation of the sector in EU institutions, diplomatic representatives, dissemination of information (Ministry of Agriculture of the Republic of Lithuania, 2021).

Research goal: is to provide an overview of the interaction between agricultural activities and environmental sustainability by focusing on the agriculture–environment nexus.

Research objectives:

1. To analysis the major agricultural activities and their effects on environmental sustainability.
2. To determine a preference set of measures for environmental protection in agriculture.

Research methods: The analysis shall be carried out using methods of comparison, analysis and representation of graphing data, general scientific methods of generalization and synthesis. Statistical data from Eurostat, the Lithuanian Department of Statistics and normative data provided in the directives of the European Commission were used in the research.

Literature Review

The literature review of the nexus between agriculture and the environment disclosed various situations how agricultural activities have an impact on different sources of on environment. Jialing Yu and Jian Wu, 2018 look for answers about relationships between policies for agriculture and the environment: how the policy system affects the agriculture–environment nexus, and what is the future picture for sustainability and food security in China. They confirm that technology and institutional innovation in China should emphasize more integrated sustainable development considering the agriculture–environment nexus, instead of setting incoherent and sometimes incompatible policy goals for each separate side. Ibrahim and Shirazi, 2021 in the study explore the energy-water-environment nexus and how can leverage this to transition to a circular economic (CE). The results showed the nexus between the mobility, electricity, agriculture and water supply system needs consideration for optimal policy outcome for the CE in Qatar. Also, need to embark on public awareness on moving away from linear economic to the circular economic paradigm and developing a comprehensive policy on circular economic. Ikram et al., 2020 investigate complex, country-level relationships between ISO 14001 certification, renewable energy consumption, access to electricity, agriculture, and CO2 emissions within the South Asian Association for Regional Cooperation (SAARC) countries. Results revealed that among all SAARC countries, India has substantial CO2 emission issues. They also find reductions in emissions from renewable energy consumption and the adoption of ISO 14001 certification in these countries. Iqbal Khan et al., 2018 analyses the nexus between agriculture value-added, coal electricity, hydroelectricity, renewable energy, forest area, vegetable area and greenhouse gas (GHG) emission in Pakistan. They discovered the government should increase the agriculture value-added, renewable energy, vegetable and forest area because all these variables could off-set the GHG emission increase due to coal

electricity and hydroelectricity. Venghaus et al., 2019 evaluated the current state of integrated policy design in the EU, a review of European energy, water, and agricultural policies was conducted. The analysis revealed that the respective sectoral policy sets are historically grown based on differing sets of formal and informal rules and processes, thus making policy integration among the sectors, let alone within the nexus, a highly challenging task. Adedoyin et al., 2020 evaluated the relationship between agro-economic performance, the Real Gross Domestic Product (GDP), Total natural rent, urbanization and environmental degradation vis-à-vis (Carbon dioxide emissions) in a carbon function. Results showed that agricultural value-added reduces emissions in sub-Saharan Africa while urbanization and natural resource rent both increases CO2 emissions in the long run. Toor et al., 2020 evaluated the impact of global climate change on agricultural major crops production. Climate is the primary determinant of agricultural productivity. The conclusion is climate change has a relationship with agriculture in one or another way. Here are also indirect emitters such as land-use change; leaching of fertilizers; use of fossil fuels for mechanization; transport and agrochemical and fertilizer production that have adverse impacts on Agriculture due to climatic variations.

Jemmali et al., 2021 studied the food-water poverty nexus was investigated against climate changes and agriculture sustainability in Middle East and North Africa (MENA) countries. To alleviate food-water poverty levels, it is crucial to prompt agricultural productivity without damaging the environment. It is found that less developed countries in the region are the most exposed to climate changes and severe water and food insecurity.

Al-Shayaa et al., 2021 identify the attitudes of farmers towards agriculture and the environment in Al-Ghat area of Saudi Arabia. The study suggested the need for new awareness and orientation programs to educate farmers and extension workers, highlighting the environment-friendly agricultural practices. Yeni, Teoman, 2020 presented the environmental performance of agriculture in Turkey and evaluated the agri-environmental support instruments. They discovered that Turkey's agriculture is far from sustainable. It is problem with legislative changes, amounts of support falling short of the cost of a green transition in agriculture, lack of knowledge and training activities regarding environment-friendly agricultural methods, and lack of effective organization of agricultural producers. Hasler et al., 2015 indicated that the demand for energy and raw materials grows, agriculture is under greater pressure. As a result, the environmental impact of the agricultural sector has increased significantly in recent decades. Konstantinavičiūtė et al., 2020 analysed greenhouse gas (GHG) emissions from agriculture sector in Lithuania include: methane (CH4) emissions from enteric fermentation of domestic livestock; CH4 and nitrous oxide (N2O) (direct and indirect) emissions from manure management; direct and indirect N2O emissions from managed soils; carbon dioxide (CO2) emissions from soil liming and application of urea. The results of GHG emissions from agriculture sector by sources during the period 2010-2020, CO2 eq. (Carbon dioxide equivalent) are provided in the 1 table below.

Table 1

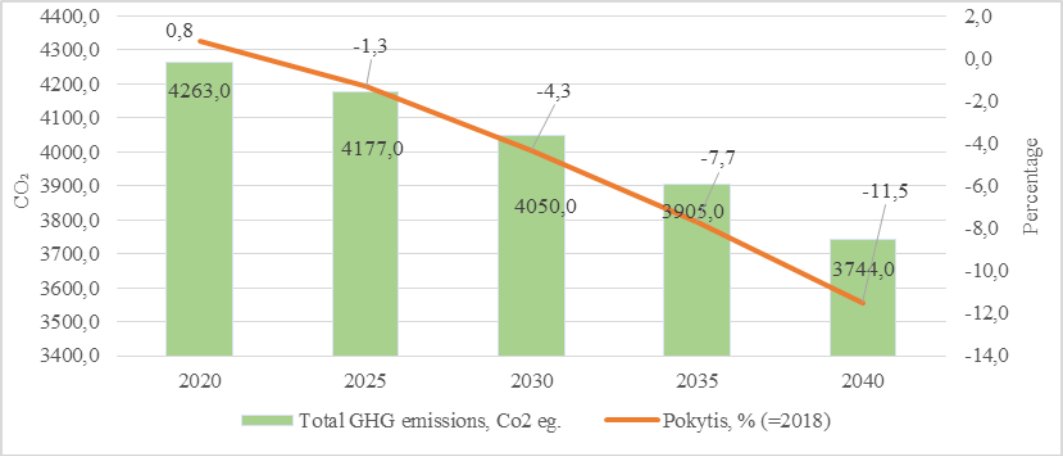
GHG emissions from agriculture sector by sources, CO2 eq.

Year	Enteric fermen-tation	Manure managment			Agricultural soils		Liming	Urea applica tion	Total
		Direct		Indirect	Direct	Indirect			
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	CO_2	CO_2	CO_2 eg.
2010	1649,9	293,5	100,3	99,3	1656,9	334,7	6,29	15,77	4156,7
2015	1634,3	285,9	108	99,2	1956,5	416,6	19,25	17,98	4537,7
2020	1445,4	231,6	95,7	84,1	2121,5	449,6	7,02	15,94	4450,9
Δ 2020-2010, %	**-12,4**	**-21,1**	**-4,6**	**-15,3**	**28,0**	**34,3**	**11,6**	**1,1**	**7,1**

Source: formed by the authors on the basis of publications of the Konstantinavičiūtė et al., 2022

GHG emissions projections for agriculture sector are provided for five subsectors: enteric fermentation, manure management, agricultural soils and CO2 emissions from liming and urea. The largest source of GHG emissions is agricultural soils, particularly indirect soils emissions (34,3%).

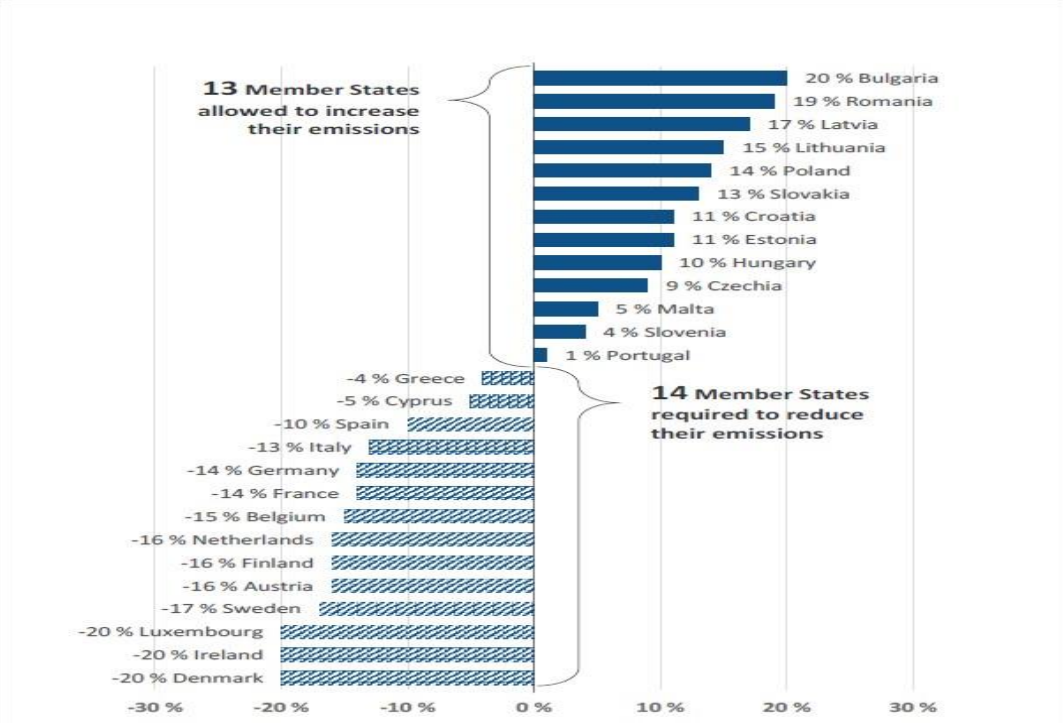
Figure 1 below presents aggregated GHG emissions of projected period from agriculture sector.



1 Fig. GHG emissions of projected period from agriculture sector.
Source: formed by the authors on the basis of publications of the Konstantinavičiūtė et al.,2022

Compared to 2018 emissions from agriculture sector will decrease by 1,3 % in 2025 and by 11,5 % in 2040. The main components of the environment that are adversely affected by farming are air, water, soil, natural resources and biodiversity. Knowing the components makes it easier to stop and reduce the negative effects of farming. In order to solve the problem of climate change, agricultural activities must be ecologically sound by: a) promoting ecological pest management by reducing the use of pesticides; b) integrating soil fertility management to reduce the use of chemical fertilizers; c) aiming for biodiversity and growing several crops; d) reduce erosion, water depletion and soil and water protection.

Lithuania still has a reserve in GHG emissions. At EU level an additional 25 percentage point reduction will be needed in the current decade to achieve the 55% reduction target. The challenges at Member State level vary a lot (Figure 2).



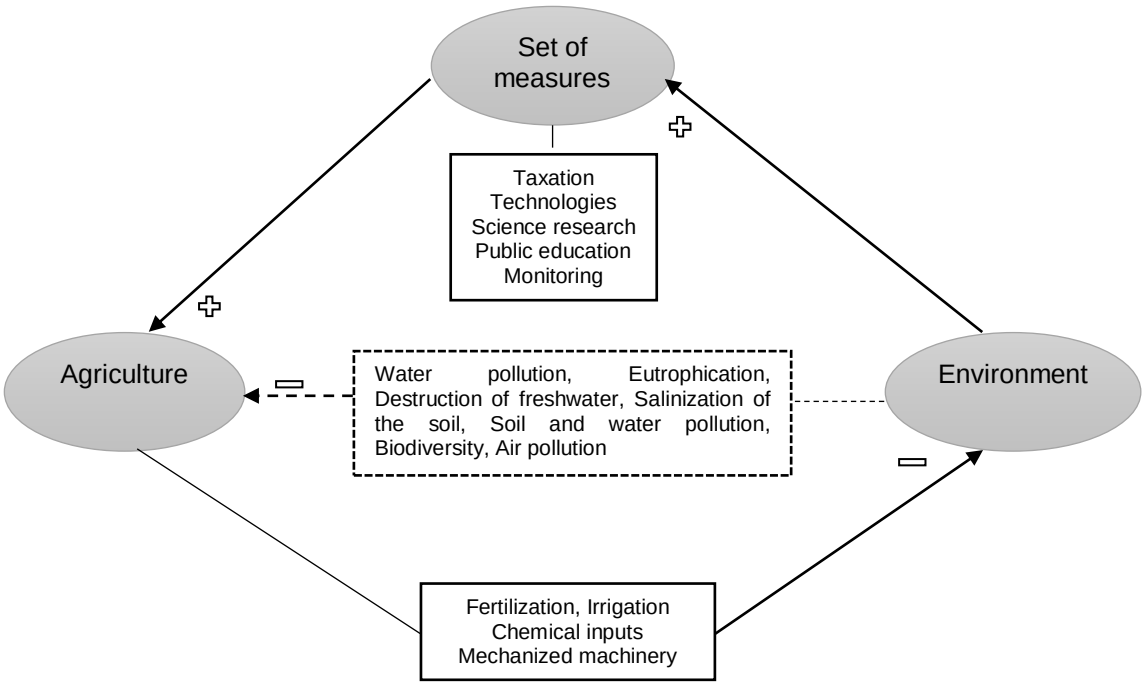
2 Fig. The 2020 Member State targets under effort sharing legislation, compared to 2005 emissions
Source: European Court of Auditors, 2021

The results of the analysis (Figure 2) indicate the reduction that has been made to achieve the 2020 target. Lithuania is one of 13 out of the 27 EU Member States, where the 2020 targets under the Effort Sharing legislation (including agriculture) have been more than achieved and these Member States have even space for increasing their GHG emissions.

The literature review revealed various results of relationships between agriculture and environmental nexus. The most important fact we can notice is common policy systems and to educate on public awareness on moving away from linear economic to the circular economic, which integrated sustainable development. The Sustainable Development Goals (SDGs) were set in 2015 by the international community as part of the UN 2030 Agenda for Sustainable Development through which countries of the world collectively pledged to eradicate poverty, find sustainable and inclusive development solutions, ensure everyone's human rights, and generally make sure that no one is left behind by 2030. The EU made a positive and constructive contribution to the development of the 2030 Agenda. It is committed to implement the SDGs in all our policies and encourage EU countries in doing the same.

Methodology

After analyzing the works of scientists, we present evidence from the literature to support the framework, that is how agriculture affects the environment through four agricultural activities: fertilization, irrigation, chemical inputs, and mechanized machinery. The following discusses the nexus between agricultural activities and environmental sustainability (Figure 3). The model shows three directions structure. Every direction affects another one. Agriculture has important effects on factors within this system, driving interactions as well as being impacted by them. The main activities of agriculture affect environmental pollution from the utilization of fertilization, irrigation, chemical inputs and mechanized machinery. Fertilization affects the environment from the utilization of excess nitrogen and phosphorus. Over -fertilization affects pollution of water and eutrophication. Irrigation is a major factor in agricultural intensification. But irrigation is affected to the environment for overuse of water resources. It has a negative effect on destruction of freshwater and salinization of the soil. Chemical inputs affect the environment from the utilization of pesticides. The intensive use of chemical inputs such as pesticides affects soil and water pollution and especially biodiversity. Mechanized machinery is affected environmental by emissions of air pollutants and greenhouse gas emissions. It has an effect on climate change and air pollution. All this has a negative impact not only on the environment but also on human health.



3 Fig. The nexus between agricultural activities and environmental sustainability
Sources: formed by the author on the basis of publications of the Jialing Yu, Jian Wu, 2018; Venghaus et al., 2019; Konstantinavičiūtė et al., 2020; Yeni, Teoman, 2020; Al-Shayaa et al., 2021; Jemmali et al., 2021

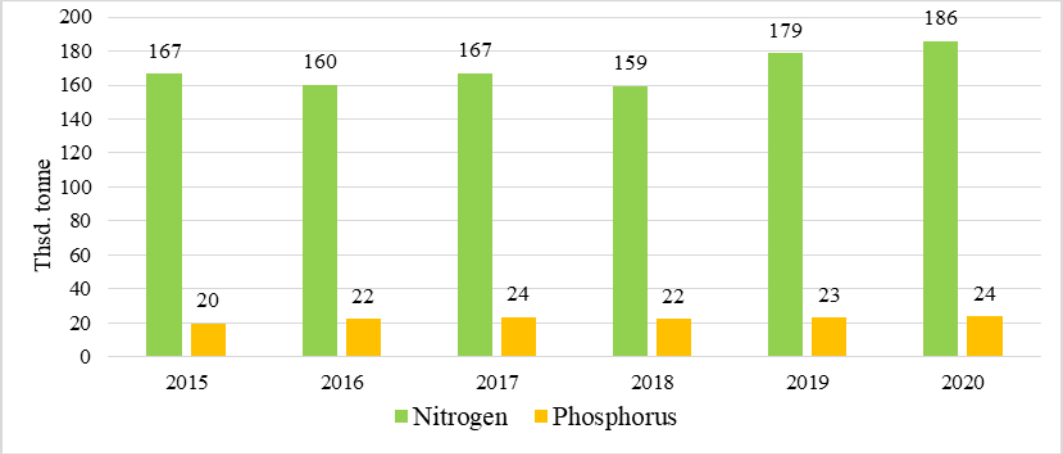
The negative effects of agriculture on the environment due to the increase in the growing demand for energy and food, such as tillage and the use of inputs, have not yet been well studied. The challenge is to incorporate insights from across research sectors (including ecology, climate science, and economics) to gain a better understanding of the role of the agriculture and environment in this complex system. One of the most effective methods for studying the environmental impact of agricultural activities is the lifecycle method. However, this

method is not applied in this paper's research. Arrows indicate a connection between variables, with a (+) signifying a generally positive effect and (-) a generally negative effect.

In order to control the negative effects of agricultural activities, it is necessary to take intervention measures to reduce environmental pollution due to the development of agricultural activities. At present, agricultural activities are encouraged to increase the efficiency of agricultural activities due to the potential of energy resources and the increased demand for food products. It is, therefore, necessary to encourage and motivate by intervention measures to switch from traditional agriculture to sustainable farming. The proposed set of interventions acts as feedback to the development of sustainable agricultural activities and the reduction of environmental pollution.

Analysis of the Results

In order to research the interactions between agriculture and the environment based was built a model. We focus to disclose what are trends and changes in fertilization, irrigation, chemical inputs and mechanized machinery in the agriculture of Lithuania during the period 2014-2020 years. High use of nitrogen fertilizers causes eutrophication of aquatic and terrestrial ecosystems. If more phosphorus fertilizers are used than the plants consume, eutrophication of groundwater and freshwater occurs. According to Coleman, Crossley, 2003, intensive use of mineral fertilizers changes the composition of soil microorganisms, the soil becomes acidic. The concentration of heavy metals in acidic soils increases, and these metals also enter the human body through plants and the cattle that feed on them. This pollution occurs when rain-washed mineral fertilizers enter surface waters. Excessive water pollution with these organic compounds can lead to eutrophication (swamping) of lakes and rivers and disturb the balance of aquatic ecosystems. Dynamics of mineral fertilizer consumption in Lithuania during the period 2015-2020 are shown in Figure 4.

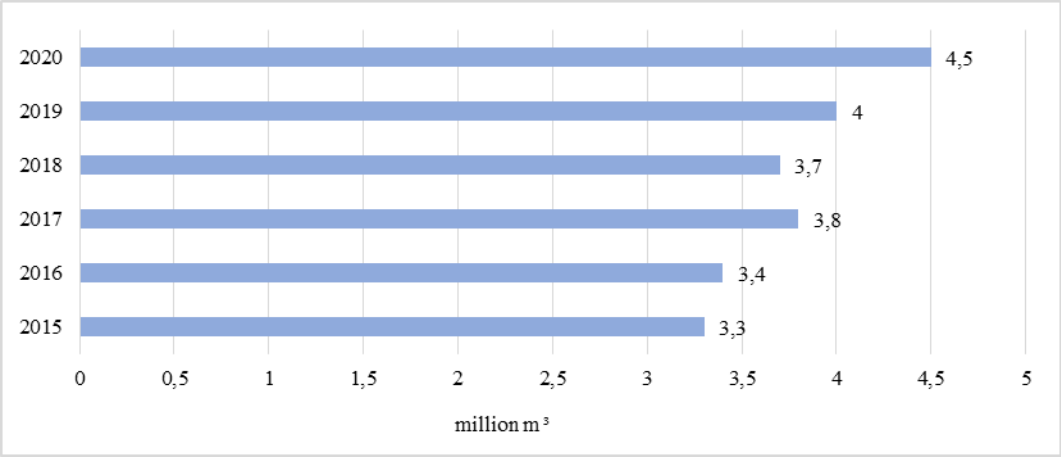


4 Fig. Estimated mineral fertilizer consumption by agriculture (thsd. tonne), 2015-2020 in Lithuania

Source: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental_indicator_-_mineral_fertiliser_consumption

Nitrogen consumption was the most important fertilizer in Lithuania over the previous decade. Since 2015 the nitrogen consumption has been fluctuating with the smallest total amount of 167 thsd. tonne in 2015 and the largest portion of 186 thsd. tonne in 2020. Total phosphorus consumption in 2015 amounted to 20 thsd. tonne and in 2020 – 24 thsd. tonne. It can be noticed, that the mineral fertilizer consumption by agriculture during the period 2015-2020 was increased by about 11,4 % nitrogen and about 20 % phosphorus. Mineral fertilizers, such as nitrogen and phosphorus, are widely used in agriculture to optimize production. They are important nutrients that are absorbed from the soil by plants for their growth. A surplus of nitrogen and phosphorus can, however, lead to environmental pollution like eutrophication of surface water. Therefore, it is important to reduce excessive use of mineral fertilizers.

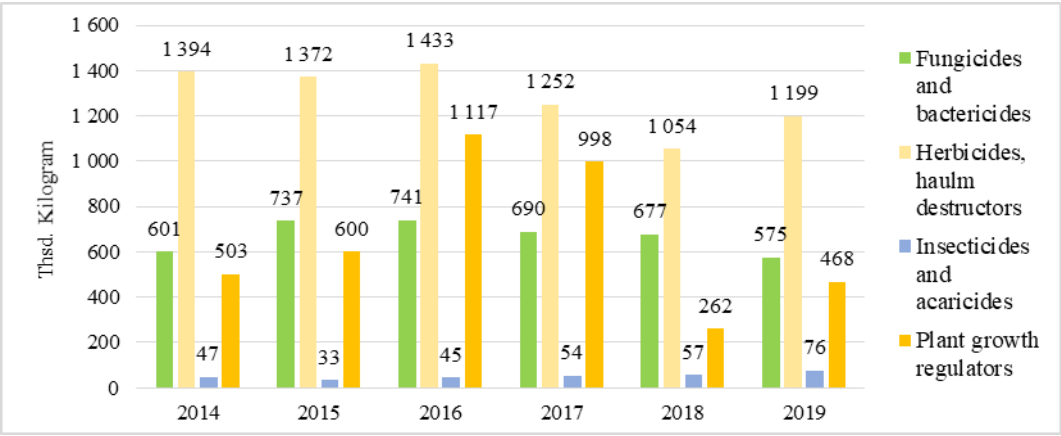
Another problem with the use of natural resources related to agriculture is the irrational use of freshwater. The agricultural sector is a major user of freshwater resources. The irrational use of freshwater contributes not only to the depletion of these resources but also to the salinization of the soil and the destruction of freshwater ecosystems. Overfishing can lead to lower groundwater levels, saline water infiltration, and loss of wetlands. Dynamics of water consumption in agriculture of Lithuania during the period 2015-2020 are shown in Figure 5.



5 Fig. Water consumption in agriculture, million m³, 2015-2020 in Lithuania
Source: https://osp.stat.gov.lt/lietuvos-aplinka-zemes-ukis-ir-energetika-2021/aplinka/vanduo

Consumption of water during the period 2015-2020 increased by 36 %. The highest total water consumption in 2020 amounted to 4,5 million m³. The results of the dynamic indicate that water consumption is growing every year with the smallest portion of 3,0 % in 2015 and the largest portion of 12,5 % in 2020. Agricultural production depends on water availability. Irrigation offers multiple benefits to farmers, such as increased crop viability, yield and quality. Irrigation water comes from streams, rivers and lakes (surface water bodies), wells (groundwater bodies), rainwater collection and reclaimed wastewater. Agriculture affects both water quality (e.g. through diffuse pollution from fertilisers or pesticides) and water quantity (European court of auditors, 2021). However, overuse of water resources is destructive to fresh water and salinization of the soil.

The greatest impact on soil and water pollution in agriculture is caused by chemical inputs. In most countries, pesticides are mainly used for agricultural purposes. Pesticides reduce the damage caused by pests and diseases, but at the same time have a negative impact on the environment. Pesticides can be toxic not only to humans and fauna, but also to contaminate water bodies, groundwater and soil with hazardous pollutants. Pesticides are dangerous to humans not only when working with them but also when they enter food. Pesticides are associated with effects on biodiversity and human health. The loss of biodiversity is related to the decrease in the area of natural grasslands, as only certain plant and animal species are common in those grasslands. The use of pesticides can be reduced by changing agricultural crop production technologies, improving pesticide application techniques and technologies, replacing old preparations with more effective ones, using lower rates, using pesticides only when there is a real economic need. Dynamics of sales pesticides are shown in Figure 6.

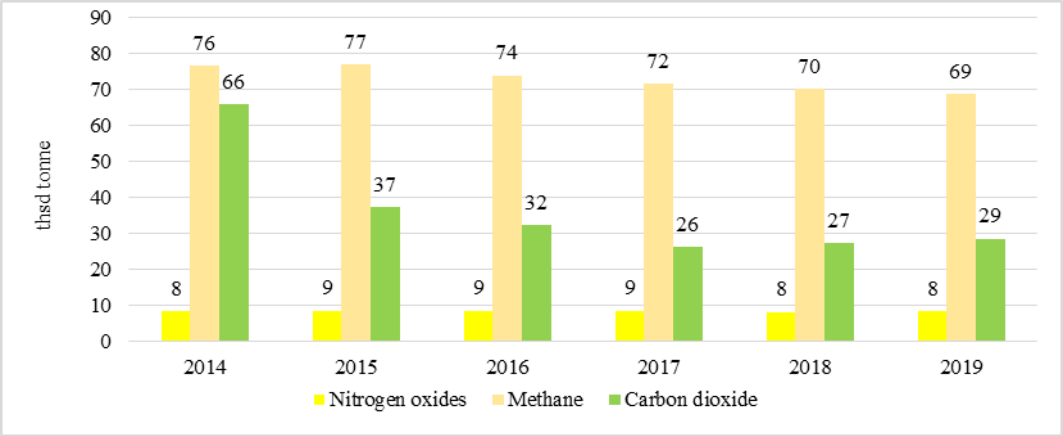


6 Fig. Sale of pesticides (thsd. kilogram), 2014 -2019 in Lithuania.
Source: https://ec.europa.eu/eurostat/databrowser/view/aei_fm_salpest09/default/table?lang=en

Herbicides consumption was the most significant pesticide of sale in Lithuania with the total amount of 1394 thsd. kilogram in 2014 and the total amount of 1199 thsd. kilogram in

2019. Consumption of herbicides during the period 2014-2019 decreased by 14 %. It can be noticed, that the sale of pesticides during the period 2014-2019 was decreased by about 4 % fungicides, plant growth regulators - 7 %. However, insecticides were increased by 62 %.

Mechanized agriculture is the process of using agricultural machinery to mechanize the work of agriculture, greatly increasing farm worker productivity. The use of machinery has made it possible to increase agricultural productivity and improve yields and the supply of food. However, agriculture, as an energy user, contributes to the depletion of non-renewable energy resources and to global warming through energy-related emissions. The use of transport in soil preparation, sowing, fertilization, pesticide spraying, harvesting, incineration of residues is linked to climate change and increased air pollution. Dynamics of emissions of air pollutants in agriculture during the period 2014-2019 are shown in Figure 7.



7 Fig. Emissions of air pollutants in agriculture (thsd. tonne), 2014-2019 in Lithuania
Source: https://ec.europa.eu/eurostat/databrowser/view/ENV_AIR_GGE__custom_2837721 /default/table?lang=en

Nitrogen oxide emissions in 2019 remained at the same level of 8 thsd. tonne as in 2014. The emissions of methane decreased by 9 % and carbon dioxide decreased by 56 %. It can be noticed, that the biggest decrease was carbon dioxide pollution. Summarizing the results of the study, it is important to note that in order to reduce air pollution and, at the same time, global warming, it is necessary to promote and motivate the healthy benefits of green energy.

The reorientation of agriculture towards sustainable farming is one of the priorities in mitigating climate change. The aim is to apply measures that focus on resource-efficient agriculture and increase the added value of agricultural production. The scientific literature recommends the use of these environmental measures in agriculture (Table 2).

Table 2

Preference set of measures for environmental protection in agriculture

	Descriptions of measures
Pollution taxation	Pollution taxation is considered to be the most effective way to reduce pollution, but this opportunity is still not sufficiently used in Lithuania.
Advanced technologies and science research	It is important for Lithuania to focus these funds on those activities where GHG emissions could be reduced the most, but it is also necessary to manage the risks of transition. The changes of climate change should be implemented on the basis of science, technology, calculations and the socio-economic consequences of decisions.
Public education	Sustainable agricultural activities require the public to be informed about the nature of the various pollutants and the way in which they affect the environment.
Monitoring	Agricultural production intensification is having a negative impact on climate change, biodiversity, water, air and soil quality. Therefore, monitoring the use of land resources can ensure the country's energy and raw material independence, high quality of life and restore the balance of nature.

Sources: *Environment Council, 2017; Finger at el., 2019; LR Ministry of Environment et al., 2020; Ministry of Agriculture of the Republic of Lithuania, 2021; Al-Shayaa et al., 2021.*

The main measures to be taken to regulate agricultural pollution are pollution taxation, advanced technologies and science research, public education and monitoring. These interventions expect to reduce environmental pollution and climate change. Therefore, needs to promote researchers' ideas to do more studies about the effects of measures of environmental protection on reducing the environmental pollution.

Pollution taxation. The most important European‘s policy tool in the fight against climate change is the EU Emissions Trading Scheme (EU ETS). EU Emissions trading system is one of the key instruments for reducing greenhouse gas emissions (Kilpys et al., 2017). This tax depends on the amount of CO2 generated. The quantity of allowances is limited by the quota set at EU level, and operators are allocated part of their allowances free of charge and the missing part must be auctioned. The review will contribute to the EU's goal of reducing emissions by at least 40% by 2030, as committed under the Paris Agreement on Climate Change (Environment Council, 2017). In the European Union, only about 45% generated CO2 emissions are taxed in this way. In 2017, the EU ETS covered only about 30%. Lithuanian GHG emissions (International Monetary Fund, 2019). For this reason, some EU countries also apply CO2 taxes. There is still no such separate tax in Lithuania. Also, Lithuania is taxed the least in the EU. However, Lithuania is committed to reducing GHG emissions in non-ETS sectors by 9% by 2030 compared to 2005 levels (European Environment Agency, 2020).

Advanced technologies and science research. Investments in the creation and development of clean energy technologies could not only help Lithuania solve the problems of climate change, but also help the country's economy to rise in the value chain. Improvements in the technical infrastructure and the legal framework can expand access to precision farming and thereby its overall societal benefits. Investment support for implementation of climate-friendly farming methods in farms (investment into energy-saving and GHG emission reducing equipment and technologies) (Finger et al., 2019).

Public education. Investment in education and in environmentally friendly research and experimental development has not only a high economic impact but also a positive impact on the climate. Public education and awareness-raising by encouraging the reduction of electricity consumption during periods of extreme weather (especially during heat waves), saving and eliminating unnecessary needs (Kilpys et al., 2017). Also, it is imperative to gauge the level of awareness of the farmers on the agricultural practices causing environmental issue in order to devise new agricultural extension programs. Sharing knowledge with farmers about environmentally friendly activities. Improve farmers' knowledge on how to use advanced agricultural technologies and farming solutions to reduce GHG emissions (Ministry of Environment of the Republic of Lithuania et al., 2020; Al-Shayaa et al., 2021).

Monitoring of agricultural activities. The Ministry of Agriculture of the Republic of Lithuania is developing a monitoring methodology that promotes favorable farming. It is planned to: • develop and approve an action plan and monitoring methodology for sustainable soil use; • to develop a methodology for the preparation of fertilization plans, to establish the mandatory preparation of fertilization plans (with organic and mineral fertilizers) and to control their implementation, and to develop and start implementing incentive measures to contribute to the goal of reducing the use of mineral fertilizers by 5% by 2024 compared to 2020; • supporting sustainable tillage and crop production practices to increase soil carbon sequestration; • support measures to create biodiversity-rich landscape elements that prevent soil erosion, with a view to achieving 4% by 2024 use of agricultural land to diversify the landscape, etc. (Ministry of Agriculture of the Republic of Lithuania, 2021).

Conclusions

This study focused on a review of the interactions between agricultural activities and environmental sustainability. As regards the environmental aspect, the analysis results showed that the effect of the agriculture sector on the environment should analyze by four agricultural activities: fertilization, irrigation, chemical inputs, and mechanized machinery. The results of data show that nitrogen and phosphorus consumption during the period 2015-2020 was increased by about 11,4 % nitrogen and about 20 % phosphorus. This negative effect on environmental sustainability is expressed in the fact for the high use of nitrogen fertilizers causes eutrophication of aquatic and terrestrial ecosystems and the high use of phosphorus fertilizers causes eutrophication of groundwater and freshwater occurs. Consumption of water during the period 2015-2020 increased by 36 %. The overuse of freshwater causes affects the salinization of the soil and the destruction of the freshwater ecosystem. Despite the fact that the consumption of herbicides during the period 2014-2019 decreased by 14 % and at the same time was decreased by about 4 % fungicides, plant growth regulators - 7 %. However, insecticides were increased by 62 %. Chemical inputs expressed by the use of pesticides cause the loss of biodiversity. Mechanized machinery is expressed by consumption of nitrogen oxide,

emissions of methane and carbon dioxide. Results show that Nitrogen oxide emissions stayed stable at 8 thsd. tonne in the 2019 year. The emission of methane was decreased by 9 % and carbon dioxide was decreased by 56 %. Mechanized machinery is related to the changes in climate conditions to decrease air pollutants and greenhouse gas emissions.

Environmental measures play an important role in the synergies between agriculture and environmental sustainability. Environmental taxes are one of the most effective economic instruments for reducing pollution and tackling climate change. The other one is advanced technologies and scientific research. It is a tool that should cover the spectrum of research and innovation. This would contribute to the development of organic agriculture and a sustainable environment. Public education is applied to discussions about the nature of the various pollutants and the way in which they affect the environment, to increase the motivation to engage in organic agricultural practices, to introduce them to sustainable business conditions. Monitoring is a set of provisions that must clearly and transparently monitor the interaction between agriculture and the environment.

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