IMPACT OF INTENSIVE AGRICULTURAL PRODUCTION ON THE ENVIRONMENT[1]

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Abstract

Today, intensive agricultural production is presented as a key production system for maintaining global food security, but at the same time it brings with it numerous challenges that affect the environment. This paper will analyze the impact of intensive agriculture on the environment, investigating how these processes can have different effects on ecosystems. The positive and negative impacts of technological progress will be analyzed. In which aspects of water and air pollution, loss of biodiversity and climate change will be included. Also, aspects of enabling increased productivity and food security for the world's population, more efficient use of resources, as well as the possibility of producing higher yields on smaller areas. This paper will also present a set of measures that directly affect the reduction of the negative impact of intensive agriculture, enabling the sustainability of agricultural production.

Key words: *intensive agriculture, environment, climate change.*

Introduction

Agriculture, as one of the most important branches of the global economic system, faces the challenges of balancing between the increase in food production, which is necessary for the growing world population, and the preservation of the environment. Improvement in agriculture and food production technology are critical for increasing yields and efficiency to meet food security requirements.

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Intensive agricultural production, with its ability to increase yields and use resources efficiently, simultaneously brings with it a number of negative impacts on the environment (Kughur, et al., 2015). Therefore, the field of intensive agriculture is a topic of discussion at different levels, although it is considered crucial in securing food for the global population, its effects on the environment are considered very questionable.

Positive aspects such as increased productivity (Janković et al. 2020), more efficient use of resources and maintenance of food security for the future, represent fundamental support for intensive

Agriculture. On the other hand, air and water pollution, loss of biodiversity and finally climate change are just some of the negative aspects that must be considered.

Based on the mentioned aspects of intensive agriculture, this analysis investigates the impacts of intensive agriculture on the environment, analyzes negative and positive aspects and looks at potential trends and measures for sustainable food production in the future. This approach aims to achieve a balance between growing food needs and preserving the environment for future generations.

Negative impact

Air pollution

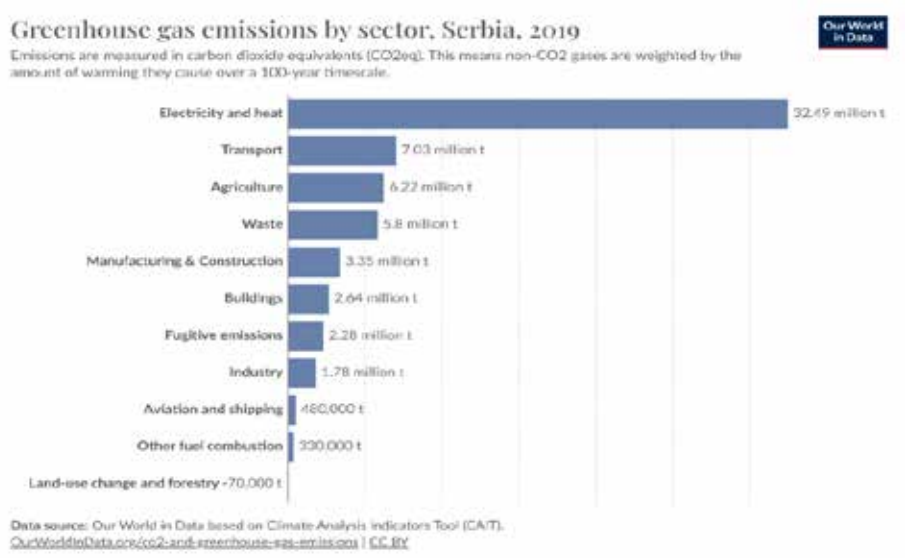
Daily use of agricultural machinery in intensive agricultural production plays a significant role in air pollution. The use of tractors, harvesters and other agricultural machinery during all agricultural operations consumes large amounts of fossil fuels. Burning these fossil fuels releases various chemical compounds (oxides as well as organic compounds). Further evaporation of organic compounds leads to the appearance of the greenhouse effect. Greenhouse gas (GHG) emissions are largely associated with agricultural production. Carbon dioxide (CO_2) is one of the most common greenhouse gases (Yoro & Daramola, 2020). This group of gases also includes nitrogen suboxide (N_2O) and methane (CH_4) (Pao et al., 2015).

CO_2 is known as the base of various environmental problems such as global warming, the occurrence of extreme weather conditions and the rise of sea levels. (Lin & Xu, 2018; Chamberlain et al., 2016). The reason why the emission of CO_2 is the subject of various scientific research is the fact that

the concentration of CO_2 has increased by 40% since 1750. IPCC, I. (2014). At the global level in recent years, China has been presented as a country that needs a quick reaction to reduce CO_2 emissions because there has been a rapid increase in CO_2 concentration. In this country, the agricultural sector has for some time been shown to be the main sector that has led to an increase in CO_2 emissions (Dogan et al., 2016). The increase within this sector was largely contributed by the mechanization of the agricultural industry (Xu, & Lin, 2017).

What represents a serious threat to the Republic of Serbia is that, based on the analysis of CO_2 emissions by sector, agriculture is in the third position in terms of CO_2 emissions (33.49 million t), after the production of electricity and heat (7.03 million t) and transport (6.22 million t)(Fig. 1).

Figures 1. *CO_2 emissions in 2019 by sector, Republic of Serbia.*



Source: https://ourworldindata.org/co2/country/serbia

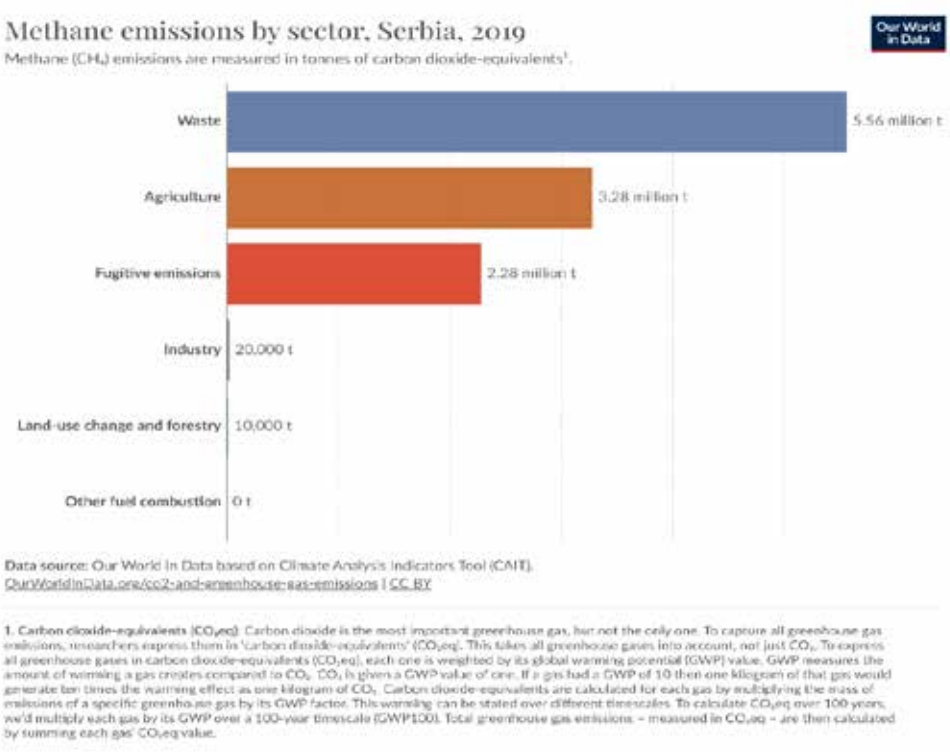
If this dramatic increase in CO_2 emissions continues, without adequate measures, it is predicted that the consequences will result in global warming as well as serious climate changes.

Emission of CH_4 methane from the agricultural sector is often associated with various processes and activities, and the largest amounts of methane are produced as a product during the process of manure manipulation and storage.

(De Corato, 2020; Čustović et al. 2015). Today's farms often do not have adequate conditions for waste management. According to the methane emission, the agriculture sector (3.28 million t) at the end of 2019 was in second place according to the methane emission based on the sector of the Republic of Serbia (Fig. 2).

What can also contribute to methane emissions are various activities during tillage. The use of tractors and other machinery for soil cultivation can create specific anaerobic conditions (without the presence of oxygen). Such conditions make the work of microorganisms easier in the decomposition of organic matter. This causes the emission of metals from the soil.

Figure 2. Methane emissions by sector for 2019 in the Republic of Serbia

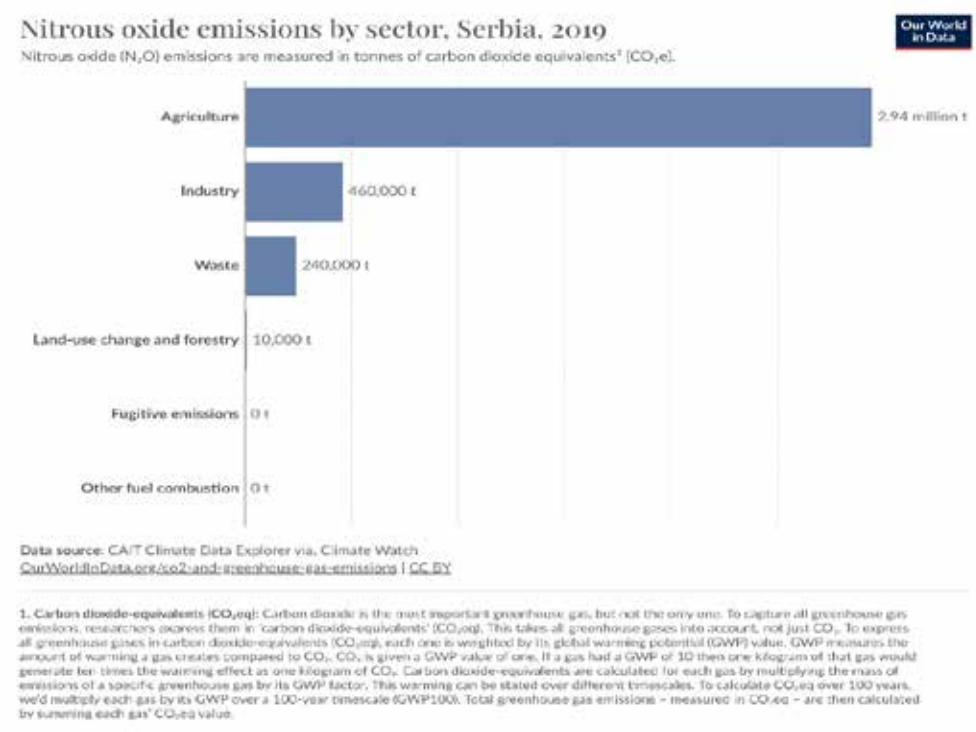


Source:https://ourworldindata.org/grapher/methane-emissions-by-sector?time=latest&country=~SRB

Agricultural production increasingly requires monitoring of the effects that remain after the finished production processes. As already mentioned, intensive agricultural production requires the use of large amounts of fertilizers and

chemicals in order to achieve high yields (Kovačević, et al., 2011). Therefore, intensive agricultural production can leave a serious environmental problem by increasing another greenhouse gas emission, i.e. by increasing N2O (nitrogen suboxide) emissions. In the Republic of Serbia, according to data from 2019, the agricultural sector (2.9 million t) is in first place in terms of nitrogen oxide emissions (Fig. 3).

Figure 3. Emission of N2O by sectors of the Republic of Serbia, 2019



Source:https://ourworldindata.org/co2/country/serbia#nitrous-oxide-how-much-does-the-average-person-emit-where-do-emissions-come-from

Water pollution

Water pollution from agriculture is a serious environmental problem worldwide (Evans et al., 2019), including the Republic of Serbia. The main sources of water pollution are industrial and municipal waters, which are largely untreated. Agriculture also has a big impact on pollution. Water is also polluted by intensive agricultural production, which in today's conditions requires the application of high doses of mineral fertilizers and pesticides. Excessive

amounts of these substances seep into the underground water and thus can end up in lakes, streams or rivers, which causes water pollution. Water pollution is most often caused by fertilizers that contain nitrogen and phosphorus. This process can lead to a decrease in water quality, endangering aquatic life and reducing biodiversity.

The negative effect of intensive agricultural production for the environment are particularly visible in rural areas. The reason for this is the fact that these areas are the main places for food production. The use of agrotechnical measures - pesticides, fertilizers and salt - puts water conservation at risk. Only 10-15% of applied pesticides (Đorđević, 2018) reach the target pests, and the rest end up in environmental elements (air, water and soil) (Roljević Nikolić & Paraušić 2019) and never reach the target surface (Sedlar et al., 2018).

Loss of biodiversity

Biodiversity loss due to agricultural production is present to a large extent. Therefore, one of the most important problems we face in the 21st century is the loss of biological diversity, especially in conditions of intensive agricultural production (Šeremešić at el., 2017). Agricultural production in the Republic of Serbia is distinguished by large monoculture areas, which are focused on the cultivation of certain crops (corn, wheat or sunflower). This is the reason for the change in diversity in the plant world. This practice can have a negative impact on local biodiversity (Hendershot et al., 2020). Also, the use of agrochemical substances can cause poisoning and death of many beneficial organisms, such as bees, other insects and birds, which directly affects biodiversity. Intensive land cultivation can lead to soil erosion (Chamizo, 2017), which has the effect of reducing soil fertility and destroying habitats for various organisms, including microorganisms, plants and animals.

Climate changes

All previously mentioned negative impacts lead to global climate change. The phenomenon of climate change today represents one of the most important and very complex problems faced by the growing human population. Climate change is a constant process on earth, but in recent times, roughly the last 100 years, the pace of these changes has increased dramatically. (Arora, 2019).

For the most part, the impact on climate change is reflected through the emission of gases with the greenhouse effect, the deformation and change of land use, the intensive use of pesticides and fertilizers.

The consequences of these activities, if there are no changes in production, will result in an increase in extreme weather conditions, such as droughts, floods and unpredictable changes during different seasons of the year (Nikolić Popadić, 2023). Which will affect both the yields of agricultural production and livestock production

Positive effects

Intensive agriculture, despite all the criticism related to negative impacts, can have several positive aspects regarding resource efficiency and sustainable agriculture (Mkonda, 2021). The main advantage of intensive agriculture is the increase in yield per unit area. The introduction of modern systems such as vertical farms, hydroponic systems or buildings with protected space (greenhouses or greenhouses) (Marina & Grujić Vučkovski, 2022) enables adequate optimization of land use.

Today's modern systems used in agriculture require large sums of money. Therefore, their application in systems of intensive agriculture is the most profitable and most frequently applied. Through the use of precision technology (like sensors for detecting various changes) irrigation system, more precise dosing of all resources is possible (fertilizer, pesticides and water) which can affect losses and unnecessary consumption of these resources (Oparnica et al, 2019).

An intensive production system with proper management and strict adherence to appropriate practices can ensure food safety. Given that intensive agriculture provides adequate means for food production, which would satisfy the needs of an ever-growing population.

Incorporating sustainable methods into the framework of intensive agriculture creates an opportunity to achieve a balance between increased productivity and conservation of natural resources. Sustainable practices within intensive agriculture can be key in meeting global food demands while ensuring long-term sustainability for future generations.

Recommended measures for the improvement of intensive agriculture

Intensive agricultural production has achieved certain goals, but several key measures can be found that could improve existing systems:

- Use of Precision Technologies: The application of sensors, UAV technology, GPS signals, certain software varies depending on many factors. In many developed countries, the application of precision agriculture is quite high, while in other parts of the world, especially in smaller farms or in less developed areas, this application can be limited.
- Vertical production and hydroponic systems: The development of innovative systems such as vertical farms, hydroponic systems and aeroponics helps to intensify production in a smaller space, reducing the impact on the environment and increasing efficiency.
- Robotics and Automation: The use of robots and automated systems in agriculture can significantly improve efficiency, reduce the need for manual labor and precisely manage processes such as sowing, mowing and harvesting.
- Sustainable Water Management: This primarily refers to the processing of waste water, but in combination with the use of modern irrigation systems. This combination reduces the total water consumption in agriculture. (Rosa et al., 2020). Also, the implementation of sensors for measuring moisture levels enables continuous monitoring of soil conditions and dosing of water according to the individual needs of the plant.
- Use of alternative pesticides: The development of environmentally friendly chemical agents and alternative methods for pest control can reduce the use of harmful pesticides, reducing the harmful impact on the environment (Bonanomi et al., 2020).

These recommended measures cover various fields, from precision agriculture, agrochemistry, water management to robotics. Which promotes sustainable practice and better use of resources in the system of intensive agriculture. Also, the application of these technological strategies is crucial for preserving the environment, increasing productivity and reducing the negative impacts of intensive agriculture.

Conclusion

Intensive agriculture has a complex range of impacts on the environment. Negative aspects, such as pollution and loss of biodiversity as well as climate change, require urgent changes and regulations in order to slow down and reduce their harmful effects as soon as possible.

The future of intensive agriculture will be reflected in the application of sustainable practices and technological innovations aimed at producing a sufficient amount of food, but at the same time preserving the environment. This will include the implementation of precision agriculture systems, the introduction of sustainable strategies to reduce negative impacts on the environment, and regulations that encourage environmentally friendly practices.

Through this approach, we can expect to achieve a balance between food production and environmental protection, ensuring the sustainability of agriculture and meeting the needs of future generations. Sustainable food production will be a major issue in solving the challenge of global food security.

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