Technologies for ensuring environmental safety of agricultural production

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Abstract. In the modern world, the problem of environmental safety is becoming increasingly pressing, especially in the context of agriculture, where its impact on the environment is felt especially acutely. This article presents an analysis of these problems and proposes innovative approaches to solve them. The focus is on precision agriculture, which involves the use of advanced technologies such as the use of drones and sensors to optimize farming processes. The use of smart farming based on data analysis using neural networks and artificial intelligence is considered, which allows for more efficient use of resources and reduces the negative impact on the environment. Control of pests and diseases of crops is also an important aspect. The article discusses modern methods of combating them, including the use of biological products and other organic means of protection. These aspects help reduce exposure to pesticides and minimize negative environmental impacts. The article emphasizes the importance of using modern technologies in agriculture to ensure environmental safety and sustainable development of rural areas.

1 Introduction

Currently, environmental safety issues are becoming very relevant and significant in all areas of industry, including agriculture. Agricultural production plays a key role in ensuring food security and meeting the needs of the population, however, the active development of this sector of the economy can have a negative impact on the environment. The problem of sustainability of agricultural systems is also relevant. This is due to the fact that it is necessary to develop technologies that do not have a negative or harmful effect on raw materials, as well as on human health, are affordable and effective for farmers and increase production productivity. This scientific work will examine the main problems of environmental safety of agricultural production and a set of measures that can solve these problems or reduce their negative impact on the environment and humans.

Agriculture is constantly in need of new areas to increase planting volumes and create new pastures. This type of human activity occupies a leading position in causing harm to the environment when compared with other types of industry. Approximately 30-35% of

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greenhouse gases come from agriculture. Irrigation of fields consumes approximately 70% of global water consumption [1,2].

Ecological safety of agricultural production is ensuring sustainable development of agriculture, in which negative environmental impacts areminimized, biodiversity is preserved and product safety for consumers is ensured.

To ensure environmental safety in agriculture, it is necessary to apply methods and technologies that reduce the use of chemical fertilizers and pesticides, optimize the use of water resources, reduce soil and water pollution, and contribute to the preservation of soil fertility and biodiversity.

In addition, it is important to monitor compliance with environmental standards at all stages of agricultural production, from seed selection and tillage to storage and transportation of finished products.

Agriculture is of key importance for ensuring the food security of the population, therefore it is important to strive to improve the environmental safety of this sector in order to preserve the health of people and the environment of our planet.

2 Problems of environmental safety in agriculture

There is a significant increase in agricultural productivity due to the use of fertilizers, irrigation water, agricultural machinery, and plant protection products [3]. All of the above aspects are interrelated and have a certain negative impact on the further active development of agriculture, and can also harm human health. For example, plant nutrients are harmful when they enter ground and surface waters.

Aquatic plants feed on these substances and clog irrigation and drainage structures, thereby increasing maintenance costs and reducing productivity. Nitrates and nitrites that accumulate in groundwater are harmful to the health of livestock and humans. It is also worth mentioning that the causative agents of many infectious diseases are brought not only naturally (water and soil), but are also spread by machines that move contaminated soil or the remains of diseased plants to uninfected fields. Inappropriate use of chemicals in fields can have a negative impact on the environment, for example, the use of heptachlor (no longer used as a herbicide) to control alfalfa weevil resulted in soil contamination that negatively affected the chemical composition of hay, which caused dairy cows to ate this hay, producing milk containing heptachlor [4].

Residues of heptachlor have been found in all environmental components. This substance mainly affects the liver and central nervous system, but certain effects on the reproductive, hematopoietic, immune and renal systems can also be observed [5].

One of the important negative phenomena of illiterate agriculture is eutrophication - active algal blooms. Increases in mineral and organic matter in water bodies, which reduces the dissolved oxygen content in the water. An environment favorable for aquatic plants is created, but the development of aquatic organisms is suppressed. Eutrophication harms aquatic life and pollutes drinking water [6,7].

It is worth mentioning that human activities actively reflect and accelerate natural processes, such as soil erosion. Soil erosion is a wide range of processes that have different properties and span every continent on the planet. The content of organic and nutrient substances in the soil may decrease, the structure will be disrupted, and the water-holding capacity may also decrease. Field equipment can also negatively affect the condition of the soil. It can compact the soil due to which it deprives it of oxygen, increases surface runoff, and also reduces the rate of infiltration. General signs of soil degradation are compaction, waterlogging, and an increase in pH values in a negative direction for plants. Reducing the volume of soil microorganisms, which negatively affects the development of plants, and can also have a huge impact on the metabolism in the environment. In Russia, 1.5-2 million

hectares of land are degraded annually, which means the loss of 1.5 billion tons of soil layer rich in humus. [7-8,12].

One of the important negative aspects of agriculture is the large release of carbon dioxide, nitrous oxide and methane into the environment, which affects not only agricultural production, but also climate change in general.

Agriculture has a major impact on the hydrosphere, the main methods of this phenomenon lies in changes in land use, soil properties, water flow patterns and impacts on its quality. Contamination of surface and groundwater is associated with outdated agricultural practices. Modification of natural landscapes for agricultural purposes can change the infiltration capacity of soils, affecting groundwater recharge. Large volumes of use of fertilizers, pesticides, herbicides and other plant protection products; traditional irrigation methods include: surface and capillary irrigation, sprinkling. These irrigation methods have a number of disadvantages, namely soil salinization with the drip method. Soil salinity is a serious problem that needs to be addressed, and it also applies to soil erosion if the problem is not addressed in a timely manner. This is a process by which the salt content increases to levels that are harmful to plants and can kill them. These agricultural activities have a negative impact on the water-holding capacity of the soil, as well as on the cycle of nutrients and the movement of pollutants [9-11].

Some of the problems were listed that are caused by outdated methods used in agriculture or illiterate use of agricultural technologies. The negative impact of the agro-industrial complex on the environment is an old, but relevant and important problem that requires a modern approach to solution. This set of measures that can solve this problem or reduce the negative impact on the environment is called sustainable agriculture. These measures use modern developments for more effective introduction and development of the agro-industrial complex. Agriculture plays an important role in the development of many environmental processes, so it is important to use technologies that minimally affect these processes without losing productivity and quality.

3 Application of digital technologies in solving environmental problems in the agro-industrial complex

The solution to the above environmental problems is the use of modern digital technologies. The most promising method is the use of precision agriculture, which is based on the use of sensors, drones, GPS navigation, monitoring of yields, and the condition of crops. This set of technologies, together with intelligent farming, can reduce the negative impact of agriculture on the environment. If precision farming helps to monitor equipment and various sensors that can monitor anything, for example, the condition of the soil, water in reclamation ditches, the condition of animals, etc. then the agricultural Internet of things makes it possible to connect all devices (sensors, drones, etc.) to collect information in real time. Intelligent farming uses neural networks and artificial intelligence to analyze all received data and optimize the necessary processes in each farm individually. Based on world experience and the experience of domestic farms, we can say that the use of modern technologies makes it possible to create optimal soil-agrotechnical, territorial and organizational conditions.

The use of differentiated application of mineral fertilizers, insecticides, herbicides, fungicides, nematicides, rodenticides, growth regulators and other necessary chemical products will not only save money on all of the above plant protection products, but will also allow them to be applied precisely only where it is really necessary. This will help increase the volume of high-quality harvest, as well as reduce the excessive chemical impact on the soil, which can, with proper agrotechnological treatment, help resist soil erosion and water pollution. Also, with the help of the Internet of Things, it is possible to increase the efficiency of irrigation processes, minimize the volume of water and reduce its losses.

The use of digital technologies in the agricultural sector not only helps to increase the profitability of farms, but also reduces their impact on the environment. Crop growth is optimized, the use of water and chemicals is reduced, the amount of greenhouse gases released by agricultural activities is reduced, and the use of natural resources is reduced and their use becomes more rational.

In addition to the use of digital technologies, the use of analogues as fertilizers and plant protection products is being considered. A replacement or addition to mineral fertilizers are organic fertilizers. They can be considered as something that can improve the condition of the soil by inducing humus formation. The introduced organic substances, for example, humus, vermicompost, compost, green manure, etc., are maximally used by the soil biota, as well as by agricultural crops. As a replacement for plant protection products, the use of biological products created from organic sources is considered, which can be considered not as harmful and dangerous to the environment as conventional drugs, since they act as a result of a specific biological reaction.

4 What problems exist with the introduction of digital technologies?

The introduction of digital technologies has a number of problems. Lack of a large digital infrastructure for manufacturers, no synchronous and timely exchange of information between enterprises. This reflects the fact that the formation of joint agriculture is not taking place. This economic model helps to shape the more active development of digital trade, which has a positive impact on the formation of sustainable production sovereignty of the country. Without the use of digital infrastructure, successful development of agriculture does not occur.

The problem of slow Internet or its absence in a number of territories is urgent. This problem hinders the development of geographic information systems. For the period from 2018 to 2019, information systems about agricultural land were created in 50 constituent entities of the Russian Federation. However, according to Rosstat, only 20% of these lands are provided with 3G Internet; in the rest it is completely absent.

Digitalization and automation of many processes suggests that highly qualified personnel are needed for successful development and high-quality work in the future. Nowadays, a small percentage of graduates of agricultural universities work in their specialty, which is why the influx of new specialists is less than the number of those who retired. Farms and large enterprises lure highly qualified specialists from each other, since there are very few of them. It is often easier and cheaper for farms or companies to train specialists for further work.

The most basic and main problem why many domestic firms do not want to use digital technologies in their work is the risk of technical failures or system failures. In addition to the risks of failures or breakdowns of complex sensor systems, the fact that the payback and repair of such equipment is quite expensive, which may put off some farmers, also plays a big role. In general, promoting environmental safety in agriculture requires a holistic approach that balances productivity through environmental conservation and takes into account the long-term sustainability of food production systems. Collaboration among farmers, policy makers, researchers and consumers is necessary to effectively address these issues.

5 Conclusion

This paper examined modern technologies aimed at ensuring environmental safety in agricultural production. The study revealed that the use of innovative methods and means plays a key role in minimizing the negative impact of agricultural activities on the environment.

The transition to sustainable agricultural technologies, such as organic farming, the introduction of agroecological methods of crop and livestock management, as well as the use of biological means to protect plants and animals from diseases and pests, help reduce the level of pollution of soil, water and air.

In addition, an important aspect of ensuring environmental sustainability in agriculture is raising awareness of agricultural producers about environmental issues and introducing educational programs and consultations aimed at introducing environmentally sustainable production methods.

In conclusion, it can be argued that the development and implementation of technologies to ensure environmental safety in agriculture not only contributes to the preservation of the environment, but also improves the quality of products, ensuring healthy nutrition and well-being for the population. Further research and practical activities in this area are important for the formation of sustainable agriculture and maintaining the ecological balance of our planet.

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