The influence of environmental factors on the development of agricultural production

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Abstract. Improving the environmental friendliness of agricultural production is a paramount task that needs to be addressed in the near future. As a result of production activities, an agricultural enterprise affects the environment and in most cases this impact is detrimental. Pollution of water and atmospheric basins, reduction of soil fertility is the result of inefficient production activities, the consequences of which will not be long in coming and will turn into a tragedy for the agricultural sector. The deterioration of the quality of soil, water and atmosphere will negatively affect future crops, and failure to comply with the requirements for land reclamation will lead to depletion of fertile soils. Therefore, taking into account the influence of environmental factors on the development of agricultural production is relevant and in demand.

1. Introduction
Agricultural production is a key sector of the modern economy. The health and well-being of citizens depends on the level of its development. Improving the quality of food products has a positive effect on the life expectancy of the population, its ability to labor and creative detail, the growth of the quality of life and satisfaction. As of the beginning of 2022, about 25% of the population of the Russian Federation lives in rural areas participates directly or indirectly in the production of agricultural products.

The growth and development of agricultural production is associated with the development of rural areas and the formation of an effective infrastructure, thanks to which rural work would be perceived as a vocation and have all the qualities of a prestigious activity among the younger generation. The development of a diverse rural infrastructure would reduce the outflow of young professionals to the cities, thereby increasing employment in agriculture and, accordingly, increasing the volume of agricultural production.
The process of agricultural production is influenced by such factors as the composition and quality of labor resources, the availability of a scientific base, the volume of material and financial resources, the management system and production technology, as well as the system of natural, climatic and environmental factors that determine the conditions for the metabolism of crops and the ecosystem as a whole [1].

2. Materials and methods
The purpose of the study is to assess the state of environmental conditions for agricultural production in the Krasnodar Territory. The information base for the analysis is statistical collections of the Federal State Statistics Service and reports of the Federal Service for State Registration of Cadastre and Cartography. The research methodology is based on the scientific works of modern scientists [2-3; 6; 8], who study the problems of environmental safety, as well as the influence of environmental factors on the functioning and development of agricultural production.

The formation of the agricultural sector should be carried out taking into account the influence of environmental factors on the environment, since ignoring them can lead to an increase in technogenic impacts [4]. Modern agricultural production is a multi-link system that, in the course of its activity, affects all components of the natural environment. The irrational use of natural resources, ignoring the requirements of environmental protection in the process of agricultural production, weak state environmental protection activities, as well as the low level of human culture jeopardize environmental safety [5; 7]. Practice has shown that the majority of agricultural producers operating in conditions of a shortage of financial and material resources ignored the issues of environmental interaction, which led to pollution and depletion of land and water bodies [9-10].

Because of insufficient attention to the environment on the part of agricultural producers, there is a deterioration in the quality of the main means of production - agricultural land, and violations of the exploitation process have led to the loss of their soil fertility and depletion [11-12].

The Krasnodar Territory is a leader among the regions in the production of agricultural products. Favorable weather and soil conditions make it possible to produce a full range of agricultural products. As of January 1, 2022, more than 14.5 million tons of grain and leguminous products were produced in the region, including 10.1 million tons of wheat, 7.3 million tons of sugar beet, more than 1 million tons of sunflower, 350 and 703 thousand tons of potatoes and vegetables, respectively. Animal husbandry is developing rapidly, so in 2021, 456.8 thousand tons of livestock and poultry were received in live weight, more than 1.3 million tons of milk and more than 1.3 billion eggs. The main producers of agricultural products are specialized agricultural enterprises, which account for more than 54% of crop production and more than 65% of animal husbandry.

The development of agricultural production slows down not only organizational and production factors, but also environmental ones. According to the report “On the availability of land and their redistribution by categories, lands and forms of ownership” approved by the head of the department of the federal service for state registration of cadastre and cartography in the Krasnodar Territory, for the period from 2010 to 2020, 46.4 thousand hectares of agricultural land, including 35.3 thousand hectares of arable land (table 1).

The growth and development of agricultural production is impossible without taking into account the factors affecting the production process. A special role belongs to the factors influencing soil indicators - humus content and water-physical characteristics. One of the ways to improve soil indicators is the implementation of reclamation soil protection and environmental protection measures. In the Krasnodar Territory, the share of reclaimed land in the total area of agricultural land in 2020 was 8.6%. About 208 thousand hectares of arable land received a good assessment of the state of irrigated lands, and more than 42 thousand hectares or 8.0% - unsatisfactory. Land reclamation, as an environmental factor, helps to increase soil fertility, crop growth, ensure sustainable farming and reduce the impact of soil and climatic conditions on the agricultural production process.
Table 1. Dynamics of development of agricultural land in the Krasnodar Territory.

| Indicator                                           | 2010      | 2015      | 2020      |
|-----------------------------------------------------|-----------|-----------|-----------|
| Area of agricultural land, thousand ha              | 4245.7    | 4224.6    | 4199.3    |
| including arable land                               | 3753.3    | 3737.8    | 3718      |
| perennial plantations                               | 98.6      | 94.5      | 90.3      |
| hayfields                                           | 51.5      | 51.4      | 52.3      |
| pastures                                            | 342.3     | 340.9     | 338.7     |
| Area of retired agricultural land, thousand ha       |           | 21.1      | 25.3      |
| including arable land                               |           | 15.5      | 19.8      |
| Share of reclaimed land in the total area of         | 8.5       | 8.5       | 8.6       |
| agricultural land, %                                 |           |           |           |
| including arable land                               | 8.0       | 8.0       | 8.0       |
| Share of unsatisfactorily irrigated lands in the total area of reclaimed lands, % | 12.1 | 11.5 | 11.0 |
| including arable land                               | 11.9      | 11.2      | 10.6      |

The analysis showed that the following negative phenomena are widespread in the region, leading to a reduction in soil fertility, and hence to a reduction in gross yields: wind and water erosion, a decrease in the humus content in the soil, salinization and leaching (figure 1). There is a slight reduction in the areas of degrading lands, mainly due to their withdrawal from production (disposal). The share of deflationary lands in 2020 reached 28%, which is primarily due to the weak system of anti-erosion land development, as well as the use of traditional crop cultivation systems, and the insufficient level of introduction of no-tillage technologies.

Another environmental factor that has a negative impact on soil fertility is its leaching. So for the period from 2010 to 2020 more than 713 thousand hectares of agricultural land in the Krasnodar Territory are subject to this type of degradation. The leaching of alkali and alkaline earth metals, as well as mineral particles and soil colloids outside the root system of crops reduces the nutritional value of the soil by 10-15%. One of the causes of leaching is improper irrigation.

There is a slight reduction in acid soils from 161.5 thousand hectares in 2010 to 159.6 thousand hectares in 2020, their share is about 5%. Reducing the content of salt harmful to agricultural plants is possible through chemical reclamation, which will remove substances such as hydrogen, aluminum, and sodium from the root layer. Currently, there are the following methods of chemical reclamation:
liming, gypsuming and acidification of soils, as well as the introduction of organic and mineral fertilizers, which increase the nutrient regime of irrigated soils and increase fertility.

Water is the main resource of agricultural production. Its pollution is the main reason for the incomplete realization of the biological potential of agricultural crops. The waters of the Black and Azov Seas, rivers and estuaries, lakes and reservoirs, as well as channels of economic systems form the water potential of the Krasnodar Territory. The area of river and sea basins in the Krasnodar Territory is more than 57 and 451 thousand square kilometers, respectively, the length of river drains reaches 38 thousand km. Current (operational) costs for the collection and treatment of wastewater are incurred annually. In 2020, the amount of expenses amounted to 4598.8 thousand rubles or 27% of the total costs directed to environmental activities.

3. Results and discussion

Most managers of agricultural organizations do not take into account the negative factors affecting the state of the environment and soil fertility in the results of their activities. This ignoring will result in significant financial costs in the future, as well as a long time period needed to restore fertility and create a favorable ecological system.

The volume of damage caused to the system of agriculture, expressed in the reduction of soil fertility as a result of the activities of agricultural production, is constantly increasing and in recent years is equal to the volume of agricultural production. In this regard, the question of determining the optimal structure of agricultural production and the introduction of science-based crop rotations adapted to specific natural and climatic conditions is particularly acute. The Krasnodar Territory, based on land and climate assessment, is divided into 7 natural and economic zones with 19 subzones. Agricultural production should be carried out in accordance with this zoning, in order to minimize the difference between the consumption of nutrients by crops from the soil and the application of organic and mineral fertilizers to the soil.

The development of agricultural production is manifested in an increase in crop yields, which directly depends on the level of soil fertility. Therefore, the development and implementation of measures aimed at regulating the biological processes occurring in the soil will make it possible to achieve the full realization of the biological potential of agricultural crops. The complex of agrotechnical and reclamation measures should include the selection of the species and varietal composition of agricultural crops, their optimal combination and alternation, the use of modern soil cultivation technologies, the application of mineral fertilizers taking into account the nutritional regimes of soils, the application of organic fertilizers in order to increase soil humus, maintaining the required level soil moisture, the implementation of measures to protect soil from wind and water erosion, the observance of science-based crop rotations.

The implementation of the proposed measures will improve the water-physical properties of the soil, its fertility and, as a result, crop yields (figure 2). The considered measures make it possible to increase the yield of agricultural crops up to 40% and obtain an additional agro-reclamation effect, which will allow solving certain environmental and economic problems aimed at creating favorable conditions for the cultivation of agricultural crops, as well as increasing soil fertility and forming a sustainable environmental paradigm.

4. Conclusions

Agricultural products are the result of agricultural production, during which the impact on the state of the environment is carried out, in most cases it is expressed in the form of negative externalities. The use of traditional (dump) tillage systems, an increase in the number of used agricultural machines and units, an increase in the application of fertilizers per unit area and plant protection products directly and indirectly affect the pollution of agricultural land, water and air basins. It should be noted that in agricultural production all sectors are interconnected, therefore, negative impacts in one sector will affect the results of activities in another. The depletion of agricultural land at present will affect the process of agricultural production in the future, agricultural land completely or partially withdrawn...
from circulation should be replaced with fertile ones, but this is not always possible, or these activities will require significant financial, labor and material resources.

**Figure 2.** Effect (yield growth) from the implementation of measures aimed at increasing soil fertility.

The state of natural conditions today in the Krasnodar Territory can be described as favorable, however, neglect of environmental factors affecting the process of agricultural production can lead to the degradation of agriculture in the future. The strategy for the sustainable development of agricultural production involves farming with the maximum use of resource potential, ensuring the constant renewal of soil fertility, purification of water and atmosphere, and the formation of a safe ecosystem. The introduction of modern intensive technologies for the cultivation of agricultural land, the replacement of chemical means of weed control and plant protection with biological ones, regular monitoring of the state of environmental factors will allow to obtain an additional increase in yield, provide the population with high-quality environmentally friendly food, thereby increasing the food security of the state.

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