Rational use of natural resources and environmental protection in agriculture

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Abstract. The article presents the indicators of the development of the agro-industrial complex of the Volgograd region, the achievements in the provision of agricultural products to the population, both in our region and the entire Russian Federation, are noted. One of the water bodies is considered, located on the territory of the Volgo-Akhtuba floodplain natural park, in the zone of agricultural landscapes, the resources of which are used by farmers for irrigating cultivated crops. The data of hydrological surveys of JSC "Volgovodproekt" carried out on the territory of the natural park have been studied. The main negative factors of agro-industrial production with an increase in irrigated areas and their impact on water bodies are analyzed. The hydrochemical indicators of the water quality of the Akhtuba River were investigated and the integral indicators of water quality were calculated. It was revealed that the use of the combinatorial index of water pollution is a priority for assessing water quality.

1. Introduction

The agro-industrial complex today is a powerful anthropogenic factor affecting all components of the environment. The negative impact of agricultural production has reached a critical level in some regions of our country. The determining factor in obtaining a guaranteed yield in agriculture is the condition of the soil and, which is important, the availability of moisture, especially for arid zones, such as, for example, the Volgograd region. The study of the impact of agricultural production on the environment is a relevant study to identify the causes of negative impact on the environment and achieve environmental safety in economic activities.

In accordance with the state program for providing food to the inhabitants of the Russian Federation, the Volgograd Region occupies one of the leading places in the production of agricultural products. Most of the land in our region is agricultural. The most productive soils are located in the northern part of the Volgograd region; to the south they are less suitable for agriculture. In general, in the region, arable soils occupy a little over 70%, pastures occupy about 28%, but perennial plantations occupy a low share in the structure of farmland. According to the data of previous studies, the soils of the Volgograd region are mainly represented by chestnut, floodplain, and solonetzes [1]. It is well known that our region is a zone of risky farming, but despite the arid climate and unproductive soils, the agrarians produced in 2019 agricultural products worth more than 120 billion rubles. In the Volgograd region there are regions that are leaders in the production of grain, sunflower, vegetable products. In the field of agro-industrial production, since 2014, a course has been taken to develop land reclamation, since for the Volgograd region this is the key to obtaining a guaranteed harvest of...
agricultural products. However, in this regard, one cannot but take into account the fact that the areas of irrigated land are constantly growing and the impact on the environment is increasing.

The basis for theoretical analysis and research of the impact of agricultural enterprises on a water body is empirical research carried out by specialized organizations with the involvement of accredited laboratories. When conducting an integral assessment of water quality using data obtained in the course of studies of the state of water resources of the Akhtuba River by Volgovodproekt JSC, it is necessary to find out which of the indicators is the most objective [2-3].

2. Materials and methods

As a material for analyzing the impact of an agricultural enterprise on such a component of the environment as water resources, stock, reference data, information from engineering surveys were used, one of the most attractive for farmers in the Volgograd region is the irrigated floodplain soils of the Volga-Akhtubinskaya floodplain. When writing the article, we used such methods as analysis of scientific literature, stock and cartographic materials of field research, and engineering surveys of design documentation for the construction of irrigation systems in the Volgograd region [4-5].

3. Results

On the territory of the Volga-Akhtubinskaya floodplain natural park in the zone of agricultural landscapes, it is allowed to conduct agriculture using environmentally friendly methods. The floodplain soils and the microclimate of this territory are of great interest to farmers. Most of the agricultural enterprises located on the territory of the Sredneakhtubinsky and Leninsky districts of the Volgograd region use water for irrigation from the Akhtuba River, the largest "arm" of the Volga River. The uniqueness of the hydrology of the natural park is the presence of many eriks, lakes, channels. During the spring flood, the Akhtuba River is hydraulically connected to the Gnilaya and Osinki eriks through the Pakhotny erik, forming a single water body, which is most interesting for studying the water quality of this object.

Agricultural crops are irrigated through an irrigation system with a floating station taking water directly from the Akhtuba River. To restore soil fertility, under the control of the leadership of the relevant authorities of the Volgograd region, calculated doses of fertilizers are introduced, and pesticides permitted for the protected area are also used for pest control. It is not excluded that the formation of "top water" on irrigated soils, and the discharge of groundwater in the warm season occurs in the Akhtuba River. Therefore, there is a possibility of migration of pollutants (pesticides, nitrogen group, oil products, etc.) entering the groundwater during the production of agricultural products into the Akhtuba River. The results of the analysis of water from the Akhtuba River are presented in table 1. Volgovodproekt JSC by certified laboratories in accordance with GOST 31861-2012 carried out the assessment of the water quality of water bodies that are exposed to agricultural enterprises.

According to the conducted research, the water quality in the Akhtuba River is assessed as unsatisfactory. Excessive maximum permissible concentration (MPC) for fishery purposes was recorded, namely: COD, total iron, oil products, copper, and zinc. Samples of groundwater and bottom sediments showed that their condition is satisfactory and no excess of MPC was found.

Having the results of the chemical composition of the Akhtuba river water, it is possible to generalize and interpret this information in order to obtain a comprehensive assessment of the quality of natural water and the degree of pollution of the water body. To calculate the indices of water pollution, we use marker substances that have been studied and determined in table 1, we also take into account the general indicators of water quality - BOD5, COD, suspended solids, MPC are taken for water bodies of fishery significance, as the most stringent in terms of compliance. When using calculation methods in accordance with RD 52.24.643-2002, for each ingredient, based on actual concentrations, we calculate the multiplicity points of the MPC excess (Ki) and the frequency of occurrence of Hi excess, as well as the total estimated Bi score for the Akhtuba River, the calculations are summarized in table 2.
Table 1. Water pollution indices.

| Indicator name       | Concentration, mg/dm³ | MPC, mg/dm³ | MPC r/h, mg/dm³ |
|----------------------|-----------------------|-------------|-----------------|
| pH                   | 7,5                   | -           | -               |
| BOD₅                 | 2,0                   | No more than 4 | 2,0             |
| COD                  | 31,7                  | No more than 30 | -               |
| Suspended substances | 15                    | -           | -               |
| Chlorides            | 104,7                 | < 500       | 100             |
| Ammonia nitrogen     | 71                    | < 350       | 300             |
| Nitrates             | 0,01                  | 1,5         | 0,4             |
| Nitrite              | 0,18                  | -           | 40              |
| Iron total           | 0,021                 | -           | 0,08            |
| Petroleum products   | 0,2                   | 0,3         | 0,1             |
| Phenols              | 0,082                 | 0,3         | 0,05            |
| Surfactant           | 0,0001                | 0,1         | 0,001           |
| Copper               | 0,001                 | 0,05        | 0,05            |
| Zinc                 | 0,008                 | 1,0         | 0,005           |
| Nickel               | 0,024                 | 1,0         | 0,005           |
| Cadmium              | -                     | 0,02        | 0,01            |
| Lead                 | 0,00005               | 0,01        | 0,01            |
| Mercury              | -                     | 0,01        | 0,01            |
| Arsenic              | 0,00005               | 0,0005      | 0,0001          |
| Pesticides (by DDT)  | 0,001                 | 0,01        | 0,01            |
|                      | 0,0001                | 0,1         | 0,1             |

Table 2. Points of the frequency of exceeding the MPC, the frequency of occurrence of exceeding, as well as the total estimated score for the Akhtuba River.

| Indicator name       | Concentration, mg/dm³ | MPC, mg/dm³ | Ki   | Bi   | WPI  |
|----------------------|-----------------------|-------------|------|------|------|
| BOD₅                 | 7,5                   | 2,0         | 1,0  | 17,0 | 0,125|
| COD                  | 2,0                   | 30          | 1,1  | 18,7 | -    |
| Suspended substances | 31,7                  | incremental to background | 1,0  | 17,0 | -    |
| Chlorides            | 15                    | 300         | 0,2  | 3,4  | -    |
| Nitrates             | 104,7                 | 40          | 0,005| 0,1  | 0,001|
| Nitrite              | 71                    | 0,08        | 0,3  | 5,1  | 0,038|
| Petroleum products   | 0,01                  | 0,05        | 0,1  | 1,7  | 0,013|
| Phenols              | 0,18                  | 0,001       | 0,1  | 1,7  | 0,013|
| Surfactant           | 0,021                 | 0,05        | 0,02 | 0,3  | 0,003|
| Arsenic              | 0,2                   | 0,01        | 0,1  | 1,7  | 0,013|
| Pesticides (by DDT)  | 0,082                 | 0,1         | 0,0001| 0,0  | 0,00001|

Σ92 0,4

As a theoretical study of the impact of the production activity of an agricultural enterprise on the quality of water in the river, we took the main (marker) pollutants that can be formed as a result of production activities and cause pollution of the aquatic environment: oil products, pesticides, phenol, surfactants, arsenic, nitrates, nitrites, chlorides.

4. Discussion
Modern technical means make it possible to determine the presence of pollutants of any composition in natural waters, and it is generally known that their content should not exceed the MPC. The results
of the integral assessment of water quality in reservoirs presented in the article are used for hydrochemical monitoring. The frequency of occurrence of exceeding the MPC is determined by the ratio of the amount of substances that have a value greater than the MPC to the sum of all registered substances, expressed as a percentage, and for the Akhtuba River, this value is 17%. The sum of the estimated points Bi shows that the value of the CIP (combinatorial index of pollution) characterizes the water as “dirty”, but the indicator of the WPI, according to the marker indicators, on the contrary, shows that the water is clean. In the studies of Zhanabergenova D.R. shows the shortcomings of determining only WPI by a number of marker indicators when assessing the quality of water in the Surskoe reservoir of the Penza region, since many indicators of pollutants are not included in the accounting area and can form unsafe compounds. The results of the work of G.A. Lazareva on the study of the waters of the Verkhnevolzhsky reservoir located in the Tver region also show the priority of using the combinatorial index of water pollution in hydrochemical studies [6-9].

The results of calculating the WPI values showed the permissible level of impact for the production activities of agricultural enterprises, but in this case, only the presence of several specific pollutants is taken into account. Nevertheless, taking into account the indicators of the combinatorial pollution index (CPI), measures should be taken to reduce the negative impact of the agricultural sector on the water bodies of the Volga-Akhtubinskaya floodplain [10].

5. Conclusion

As a result of a theoretical study using the data of laboratory indicators of water bodies of the Volgo-Akhtubinskaya floodplain natural park, it was possible to show that when conducting hydrochemical monitoring, the combinatorial pollution index is the most effective integral indicator for assessing the quality of water condition, since the frequency of exceeding the maximum permissible concentration of all pollutants is taken into account present in the reservoir.

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