Ecologization of Water Use as a Factor of Sustainable Development of the Central Black Earth Region

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Abstract. The purpose of the work is to identify the factors, features and problems of water use in the Central Black Earth Region. The Central Black Earth Region is characterized by long-term degradation of water resources, irrational water use, a low level of water purification, a high degree of pollution of water bodies, which requires a deep analysis of factors and trends in the development of the area's natural resources. To achieve this goal, comparative, structural, statistical and analytical research methods were used. The information provided in the open official publications of the state statistics of the country and regions was used, in particular, the State Report "On the state and use of water resources of the Russian Federation in 2018" and reports on the state and protection of the environment of the Central Black Earth Region in 2018. In the course of the work, the data is systematized, structured, analyzed and summarized. The quality of water resources in the Central Black Earth Region is affected by the deterioration of the natural environment, including destruction of soils, a decrease in forest cover, and water and air pollution. Analysis of the development of water use shows us the complex ecological situation with the water resources of the region, characterized by a decrease in their volume. There are no rivers and reservoirs with "roughly clean" water in the Central Black Earth Region, water bodies of the 3rd category prevail, and there are even reservoirs of the 4th category of pollution. The water regime is deteriorating, fauna and flora are degrading. Taking into account the trends and features of modern nature management, on the basis of our work, we can conclude that the most effective direction of greening water use in the Central Black Earth Region is to reduce water consumption, purification of all types of runoff, optimization and afforestation of water protection zones.

1. Introduction
The definition and features of the concept of sustainable development (SD) are well known. The main importance in it was attached to the optimal use of natural resources, capable of ensuring the preservation of nature. Gradually, the concept of SD in the works of scientists has changed in favour of the socio-economic component, which is understandable, because of the complexity of the concept of socio-economic development. Currently, a number of main aspects of the study of the development of socio-economic and ecological systems can be identified. Among the first of them, the development of socio-economic-ecological systems should be noted as a solution to the problems (J. March, G. Simon). When you define a problem, you need to choose the goal and tasks of its implementation, determine the resources, stages, performers and activities, and also calculate the structure of actions to optimize the selected solution and feedbacks. For water use, it is not difficult to identify problems, but it is difficult to find the necessary resources [10].

When assessing development as an optimization of business management, the emphasis in water use should be shifted to greening production during the operation of enterprises. In this case, the role of business in economic development is dominant in comparison with governing bodies. R. Beauregard calls it "the main direction in practice of developing of the local economy", Marris - "the corporatist paradigm." Understanding of development as creating a "growth machine - a coalition of government bodies with the labor union, businessmen" allows joint efforts to achieve the desired result in water use. In order to realise this systemic approach, it is necessary to optimize the resources of the economic
system of water use (water, labor and money) to turn into a gross regional product [11]. The development as a preservation of the natural and social environment or an ecological model also has different interpretations: co-evolution of development (Blair and Premus), “development from below” (Nelson), the theory of social networks (Bates). One of the main characteristics uniting the works of these scientists is the demystification of economic growth and respect for the right of society to its habitat (including clean water and reservoirs). The Central Black Earth Region is characterized by degradation of the natural and social environment, caused by the irrational use of soil resources, fires, deforestation and non-restoration of forests, water and air pollution, and a noticeable narrowing of social infrastructure. It can also be noted that some scientists understand economic development as the release of human potential, as a result of leadership (Wyel, Teitz, Gilot), as a search for social justice. In any case, the achievement of optimal (rational) nature management requires taking into account all these metaphors of socio-economic development [5].

In our opinion, sustainable socio-economic development should be understood as a socio-economic development that ensures the full preservation of the natural environment [8].

The area is currently characterized by an excessively high anthropogenic and, moreover, irrational load on natural geosystems. Too high share of arable land (almost 62% of the area at present), small area and economic use of water protection zones, ploughing of the floodplain (several years ago, the farmers in the Verkhnemamonsky District of the Voronezh Region ploughed the Don floodplain) have an extremely negative effect on the state of water resources. All main components of the natural environment of the Central Black Earth Region are under an excessive pressure, deteriorating structurally and decreasing in territorial aspects. A significant general degradation of nature causes a crisis and catastrophic state of most water bodies, which explains the necessity to transition to expanded reproduction of natural resources - a simple conservation of nature is no longer enough. Therefore, it seems relevant to us to assess the level of anthropogenic use of one of the main natural components - water resources. In our opinion, the improving of the ecological state of water bodies is one of the main directions of optimizing the natural environment of the Central Black Earth Region. The purpose of the work is to identify the factors, characteristics and problems of water use in the Central Black Earth Region. The Central Black Earth Region is characterized by a long-term degradation of water resources, irrational water use, a low level of water purification, a high degree of water pollution, which require a deep analysis of the factors and trends in the development of natural resources in the area.

2. Research materials and methods
To achieve this goal, comparative, structural, statistical and analytical research methods were used. The information provided in the open official publications of the state statistics of the country and regions was used, in particular, the State Report "On the state and use of water resources of the Russian Federation in 2018" and reports on the state and protection of the environment of the Central Black Earth Region in 2018. In the course of the work, the data is systematized, structured, analyzed and summarized. The quality of water resources in the Central Black Earth Region is affected by the degradation of the natural environment, caused by the irrational use of soil resources, fires, deforestation and non-restoration of forests, water and air pollution.

The Central Black Earth Region is distinguished by a high degree of use of the territory, which led to the significant changes in the natural environment. There are practically no fully preserved landscapes in the region. Water resources play a special role for the development of the economy and the population's living, the availability of which determines the urban and rural settlement of the region. It is no coincidence that almost all urban and many rural settlements (RS) are located along river banks. At present, when the river network has noticeably decreased, many RSs are located near ponds and reservoirs.

A man, mastering the planet, from ancient times settled near water sources. The same pattern is typical for urban and rural settlements of the Chernozem Region. Voronezh arose along the bank of the river of the same name, Lipetsk - at the river Lipovka, Tambov grew up on the Tsna, Kursk is located near the Tuskari and Kur rivers, and the Vezelka and the Severiskiy Donets rivers flow through Belgorod. At the same time, the development of a significant part of the territory of the Central Black Region is limited by water reserves. Water is needed to satisfy domestic needs, industrial water supply, irrigation of fields, for recreation of the population. The quality and comfort of people's lives is
determined not only by the state of social infrastructure, but largely depends on the natural environment, ecological situation, and the presence of forests. At the same time, one of the most important factors in choosing a place of residence is the availability of water bodies and the quality of drinking water.

The most difficult situation in the area's natural resources is determined not only by modern anthropogenesis. In the second half of the 19th century, the high density of the rural population contributed to an ultra-high share of ploughing (about 80% of the Central Black Earth Region, while forests were almost completely cut down), the area of hayfields and pastures sharply decreased, and the water protection zones were subjected to such a dense technogenesis that they almost disappeared. Arable lands often came out practically to the banks of the rivers. Even now, sometimes agricultural fields are located at a distance of 20-30 meters from the river bed. The area of forests in the Central Black Earth Region over the years of the development of the territory has decreased from 5 million hectares (about 30% of the area) to 1.451 million hectares - 8.7% [1]. Deforestation caused a reduction of small rivers by about twice and significant soil erosion (over 1/3 of the territory).

3. Results and discussion

Water resources, which concentrate the main elements of technogenesis, are under the greatest pressure in the Central Black Earth Region. At present, with the exception of a number of ponds and reservoirs, water bodies are already little used in economic activities, including recreational ones. Surface waters are mainly used in technological processes for cooling units or for steam production by enterprises of the energy, chemical industry and metallurgy. Most surface water bodies are of little use for utilities, irrigation and full-fledged fish farming. It should be noted that the Central Black Earth Region is characterized by a very low water supply - 30.6 km³ of water from 4260.3 km³ of the country or 0.72% [1], therefore the rational use of water resources is very important. The population of the district is 7181 thousand people (2019) or 4.89% of the population of the Russian Federation. The area of the district is 166.78 thousand square km, which is 0.97% of the country's territory. One square kilometer of the territory in the Central Black Earth Region accounts for 179 thousand m³ of water per year. The average simultaneous volume of water resources (5.43 km³) determines a very low level of water availability - 32.6 thousand m³ of water per 1 km² of the territory, which is almost seven times lower than the average for the Russian Federation. The provision of water resources per person in the Central Black Earth Region (642 m³ / person) is lower than the national average, and in the southern regions it is even lower. Water areas in the total area of the region account for 2.1% (352.8 thousand hectares).

The regime of surface waters and the reserves of water resources of the Central Chernozem Region obey to general laws, among which the main ones are the regime and the amount of atmospheric precipitation and underlying rocks. Both of these main factors are unfavourable for the surface waters of the region. The average annual moisture coefficient (MC), equal to the ratio of the amount of precipitation to evaporation, ranges from 1.08 in the northwest of the Kursk Region to 0.8 in the southern regions of the Voronezh and Belgorod Regions. At the same time, in some years the MC value is less than 0.5, and in some years (2010 and possibly in 2020) even lower than 0.3. The main rocks that make up the territory of the region - chalk and limestone, also reduce the reserves of surface water due to the development of karst processes.

Due to the decrease of the average annual precipitation layer from 640 mm in the northwest to 420 mm in the southeast, the volume of surface runoff, respectively, decreases in this direction. On average, for the Central Black Earth Region (including the Oryol Region), the average annual runoff layer is 105 mm per year, and the Central Black Region - 99.9 mm (from 76 mm in the Voronezh Region to 128 mm in the Kursk Region).

The largest runoff layer is typical for the basins of the Tim, Ksheh, Olym, Krasivaya Mecha rivers, and its lowest values are observed in the southeast: in the basins of the Chernaya Kalitva, Bityug, Elan, Savala, Krusha, where this indicator is 60–40 mm. The average annual runoff on the territory of the region decreases from the northwest to the southeast from 170 to 40 mm (more than 4 times) [8]. The total local flow of all subjects of the Central Black Earth Region, which is formed in the river network of the region, reaches 16.7 km³, which is about 0.4% of the country's indicator. The largest runoff is observed in the longest area of the Voronezh Region, where the river Don with its largest tributaries flows.
According to the state report "On the state and use of water resources of the Russian Federation in 2018", the total volume of water resources of the Central Black Earth Region was 30.6 km³.

**Figure 1.** Distribution of water resources by regions of the Central Black Earth Region, total - km³, per person - thousand m³ [Built by [1]]

A very low supply of water resources per person is observed in the southern Belgorod Region. The general indicator of water availability per person in the Voronezh Region is the highest in the Central Black Earth Region due to the flow of the largest rivers Don and Khoper in the region, despite the high aridity of the climate in the southern part. It is even higher compared to more northern Lipetsk Region.

The distribution of surface waters of the Central Black Earth Region is the result of precipitation and underlying rocks, by relief and tectonics, as well as anthropogenic activity (reservoirs and ponds). Recent tectonic movements have contributed to a decrease in the number of rivers and a reduction in their length. Due to the uplift of the territory upper reaches of many rivers have become dry, which reduced their total water content. The total number of rivers with a length of more than 10 km in the region reached 941 units with a total length of 27497 km, and in the early 2000s there were only 5157 rivers and watercourses, and their length was 44153 km. The density of the district's river network (0.23 km / km² in the Central Black Region on average) ranges from 0.14 km / km² in the Belgorod Region to 0.27 km / km² in the Tambov Region. The rivers of the Central Black Earth Region (as well as other regions of the southern half of the European part of the country) belong to the basins of the Azov, Black and Caspian Seas. The main rivers for the region are the rivers of the Azov Sea basin with the Don and its largest tributaries - the Severskii Donets, Voronezh, Khoper, Bityug and others, see table 1.

| Name         | Where flows | Length | Square of basin, km² | Runoff volume, million m³ |
|--------------|-------------|--------|---------------------|---------------------------|
| Don          | Azov Sea    | 1870   | 421700              | 27700                     |
| Oka          | Volga       | 1500   | 5621                | 425                       |
| Psel         | Dnepr       | 806    | 3353                | 176                       |
| Seim         | Desna       | 748    | 11146               | 775                       |
| Don          | 1050        | 3560   |                     | 236                       |
| Tihaya Sosna | Don         | 151    | 3190                | 134                       |
| Vorskla      | Dnepr       | 494    | 2650                | 232                       |
| Khoper       | Don         | 979    | 61100               | 4608                      |
| Voronezh     | Don         | 368    | 21600               | 388                       |
| Tsna         | Moksha      | 446    | 4454                | 351                       |
| Lesnoy Tambov| Tsna        | 70     | 1610                | 112                       |
| Vorona       | Khoper      | 454    | 6939                | 269                       |
| Savala       | Khoper      | 285    | 4090                | 125                       |
| Bityug       | Don         | 379    | 8800                | 179                       |

The Desna, Vorskla, flowing towards the Dnepr, belong to the Black Sea basin. The Oka and Tsna carry their waters to the Caspian Sea. More than 70% of their annual runoff occurs during the
spring flood. Almost all rivers (with the exception of the Don) originate on the territory of the region, they are shallow, especially in summer, and are of no significant importance either in terms of transport or energy. But the economic importance of these rivers for a rather arid region is great. They are sources of watering and irrigation of lands, water supply for enterprises and settlements. The largest rivers (the Don, Tsna, Severskiy Donets, Seim) used to be for shipping. At present, only large reservoirs and adjacent river beds can remain in this capacity on the territory of the district. Not a single river in the Central Black Earth Region, including the Don, is now navigable. In 2020, a water ecological disaster broke out in the area: the water level dropped below the minimum in recent decades, many water bodies completely dried up, especially ponds and lakes up to 2 meters deep. Such a large river as the Bityug turned into a discontinuous chain of lakes, and in some places completely dried up. For a long time there have been recreation centers and children's summer camps along the banks of many rivers. Currently, their recreational value has decreased due to the growing pollution.

For the water bodies of the Central Black Earth Region, the following general dependence is characterized: small rivers, lakes and ponds are usually cleaner than medium and large water bodies for pollution by metals, chemicals, oil products, but their biological state is worse.

In general, there are no rivers and reservoirs in the region with rough quality water of the 1st pollution category of the specific combinatorial water pollution index (SCWPI) up to 1.0, as well as 4 "b" and 4 "g" categories "very dirty" (SCWPI from 8 up to 11) and 5th category "extremely dirty" water (SCWPI over 11). There is not a single more or less large water body in the region, which would be fully related to the 2nd category - "slightly polluted" (SCWPI is 1-2). At the same time, a number of rivers, especially at the exit from reserves or large forest tracts (the Seim river, the Reut river in the Kursk region, the Usman river, the Khoper river in the Voronezh region, the Lesnoy Voronezh river in the Tambov region and others) were characterized as "slightly polluted". The Voronezh and Don rivers in 2018, when the highest water content regime was observed over the past 20 years due to heavy rainfall floods, in some places also belonged to the 2nd class of water pollution (the Voronezh river near the village of Pisarevka, the river Don near the village of Belogorye, etc.). Most rivers are characterized by the prevalence of 3 and 3 "a" pollution categories. According to several criteria, the water quality in them does not meet the requirements established for a water body of fishery importance.

The values of the SCWPI range in the rivers of the Central Black Earth Region mainly from 2.1 to 2.9, which correspond to categories 3 and 3 "a" "polluted". The 3 "b" class "very polluted" water in 2018 included the places of the Tuskar River, the Svapa River, the Psel River, the Tsna River, the Severskiy Donets River, the Oskol River - SCWPI from 3 to 4 units. Moreover, the waters of the Psel River near the city of Oboyan in 2018 had a pollution class 4 "dirty" [3], as well as the waters of the river Tsna from Tambov to Morshansk [1]. The Severskiy Donets River in the Belgorod Region, which is a tributary of the river Don, has an indicator of SCWPI 4.53, which provides a water quality category - 4 "a" "dirty" SCWPI from 4 to 6.

The largest excess of the MPC in 2018 in the Central Black Earth Region (22 times) was observed for copper compounds (the Tuskar River in the Kursk Region). But for the rest of the main pollutants, there is usually a significant excess of the MPC for the content of manganese, total iron, nitrites, phenols, COD, organic substances, ammonium nitrogen. The dissolved oxygen content ranges mainly from 5 mg / dm³ to 13 mg / dm³. To a certain extent, the general level of pollution can be revealed by the example of the Don, where variation in pollution are less than in other rivers due to the larger volume of water, see Fig. 2.

Figure 2. The main pollutants in the MPC of r. Don near Lebedyan, ed. [Built by 3]
Snow feeding of the rivers of the region accounts for 60-80% of the volume of incoming water, ground water is 15-20%, and rainfall - 5-10%, therefore it is very important to preserve part of the runoff to reduce the spring flood and increase the water level in the summer low-water period [6]. At the same time, failure to comply with technical and environmental requirements during the construction of hydro technical structures (HTS) only worsens the environmental situation. In many municipalities, there are almost no rivers left at all, see Fig. 3.

A necessary factor of the normal functioning of the economy is the presence of lakes, ponds and reservoirs. Due to the insufficient density of the rivers, they are very important for the Central Black Earth Region in summer. There are more than 2 thousand lakes here, and there are about 8 thousand ponds and reservoirs (active and dried up) [2].

Figure 3. The share of rivers and ponds in the land area of the MD and UD of the Voronezh Region, %. [Built on 9]

The lakes of the Chernozem Region are divided into three main types: floodplain, karst and subsidence-suffusion. Floodplain lakes (oxbow lakes) are found quite often in the floodplain of the Don (Pogonovo, Stepnoe, Takhtarka), Khoper (Yurmishche, Ilmen, Orlovskoe), Voronezh (Andreevskoe, Bogoroditskoe), Bityug, Seim, Vorona, Tsna and other rivers. The largest lake in the Tambov Region, Ramza (an oxbow lake 2.5 km long, 10 m wide, 250 hectares in area and up to 2 m deep) is located in the floodplain of the river Vorona. Shallow karst (up to 2 meters) lakes are widespread, mainly in limestone rocks in the north of the Central Russian Upland. Western shallow lakes are located on the watersheds in the southern steppe part of the Central Black Earth Region, while, unlike ponds, their basins are filled with water throughout summer. There are no large lakes with large reserves of water in the Central Black Earth Region. Therefore, their importance for economic activity is not great.

The ecological state of the lakes differs little from the rivers. So Lake Zhirovo (a hydrological natural monument) is characterized by rather serious pollution. This is a shallow body of water (area 20 hectares, length is slightly more than 1 km, width is 10-100 m) is located near the confluence of the r. Voronezh in the r. Don. Usually lake waters are classified as class 3 ("polluted water"). At the same time, in the high-water year 2018, there was a decrease in the concentration of copper from 2.2 MPC to 1.3 MPC, the value of the SCWPI decreased from 2.281 in 2017 to 1.428 in 2018, respectively, the water quality class changed from 3 ("polluted") to 2 ("Slightly polluted") [3]. Bacteriological analysis of water shows that the waters of the lake Zhirovo does not match the requirements of Appendix 1 of SaNPIN 2.1.5.980-2000 for the content of common colymphic and thermotolerant bacteria [3]. A quantitative chemical analysis of the bottom sediments of the lake shows that the content of all heavy metals in the bottom samples is set below the MPC of soils, but higher than the background values: plumbum - 1.7 times, zinc - 3.42 times, nickel - 1.67 times, manganese - 6.53 times, and the content of hydrogen sulfide exceeds background values by 6 times, ammonium nitrogen - 1.71 times [3].

Ponds and reservoirs of the Central Black Earth Region are of much greater importance for economic activity than lakes. Ponds include man-made reservoirs with a water volume of up to 1 million m³. Such objects in the Central Black Earth Region account for 4% of the local runoff, their volume is
about 0.45 km², and the water surface area reaches 270 km². The volume of water in ponds and reservoirs significantly (2-2.5 times) exceeds the volume of water in rivers during low-water periods.

Favourable geomorphological conditions exist for the construction of ponds and reservoirs: the territory is indented with a large number of gullies and small permanent and temporary river streams. At the same time, the underlying rocks, as well as the small resources of snow water in recent years, have limited the possibilities for the construction of new ponds in the southern part of the region. Currently, there is no new construction of ponds in the Central Black Earth Region, and as their service life is from 25 to 50 years, many of them have degraded. These reservoirs are widely used in the economy, especially for fish farming (silver carp, grass carp, carp, common carp, crucian carp) and for watering livestock. Among the 12 main types of ponds in the region, artificial fish-breeding reservoirs currently prevail. The ponds and reservoirs of the Central Black Earth Region together retain up to 15-20% of the total runoff of the district, as well as 30-40% of the spring and 70-80% of the storm runoff in the territories where they are located.

In the Voronezh region, there are over 2,000 previously built ponds with a water volume of 112.4 million m³, with a water surface area of 63.9 km², but currently most of them are in a dry state. In terms of water volume, artificial objects of the Voronezh Region are distributed as follows: the volume of more than 10 million m³ has 2 reservoirs, 5-10 million m³ - 4 reservoirs, 1-5 million m³ - 200 reservoirs, 0.5-1 million m³ - 190 reservoirs, 0.1-0.5 million m³ - 430 ponds, less than 0.1 million m³ - 1725 ponds.

In the Lipetsk Region, about 2,000 ponds were built with a total normal water volume of 100 million m³. In the 80s, over 450 artificial reservoirs were created in the Belgorod Region, including two large reservoirs, one of which with an area of a water surface of 275 hectares is located in the Rakityansky District (Soldatskoye), the other in the Chernyansky District (Morkvinskoye). In the Central Black Earth Region, a network of small ponds is predominantly developed, so 988 reservoirs of this type in the Belgorod Region (more than 70% or 692 ponds) were up to 2 hectares. In general, there are 1101 artificial objects in this area, of which the largest are the Belgorod and Staroskolskoye reservoirs (see Table 2), as well as the Mayorskoye reservoir on the river Uraevo (volume of 8 million m³) and Korchanskoye reservoir (6.8 million m³). Moreover, there are 73 units of ponds and reservoirs with a volume from 1 to 5 million m³, 51 units from 0.5 to 1 million m³, 67 units from 0.2 to 0.5 million m³, up to 0.2 million m³ - 631 units [3]. In the Tambov Region, there are about 900 ponds and reservoirs with a maximum water volume of 534.5 million m³ [1]. The existing and fairly large water bodies are decreasing in the region. So, even in relatively favourable 2017-2018 years in terms of total water content in the Kursk Region, two dozen artificial reservoirs have disappeared, including 6 reservoirs. At the beginning of 2019, there were only about 490 ponds, reservoirs, and wastewater reservoirs in it. Their total water reserves are 788 million m³. Reservoirs make up 31% or 150 units, including 4 reservoirs with a water volume of over 30 million m³ [1].

| Ponds       | Water volume with the least retaining level | Water volume with normal retaining level | Water volume with the highest retaining level | Useful capacity | Average annual runoff, million cubic meters |
|-------------|---------------------------------------------|------------------------------------------|----------------------------------------------|----------------|---------------------------------------------|
| Belgorod    | 7.88                                        | 76                                       | 76                                           | 68.12          | 234.9                                       |
| Voronezh    | 5.95                                        | 204                                      | 357.5                                        | 198.05         | 2507                                        |
| Kursk       | 2.8                                         | 8.9                                      | 11                                           | 6.1            | 43                                          |
| Matryskoe   | 33.46                                       | 119.31                                   | -                                            | 85.85          | 467                                         |
| Mikhailovskoe | 2.34                                      | 41.1                                     | 63.11                                        | 38.76          | 153                                         |
| Stary Oskolskoe | 19                                     | 87.1                                     | 270                                          | 68.1           | 200                                         |
| Tambov      | -                                           | 92                                       | -                                            | 88             | -                                           |

In the Central Black Earth Region, shallow water depths up to 1.5 m (2/3 of all ponds) and ponds up to 3 meters deep (1/5) prevail. Most of them dry up in August. In 2020, almost all of them lost water. Deep (up to 4.5 meters) ponds account for about 10%, and very deep (over 4.5 meters) - only 1-
2% of such water bodies in the region [8]. In the conditions of the onset of dry hot summer seasons in the Central Black Region, the technical requirements for the construction of ponds should be more strict. Currently, the main sources of water supply are reservoirs.

The Voronezh reservoir, 35 km long, with a volume of 199.3 million m³, with a total water area of 70 km² and with an average annual water discharge of 70.3 m³/s, is the largest reservoir of the Central Black Region of fisheries importance. Its water for technological needs is used by: Voronezh Regional Generation TPP-1, Heating Networking Company, PJSC "VASO", CJSC "Voronezh Tire Plant". The reservoir receives water from the city's enterprises, as well as unorganized discharges with melt and storm water. The construction and filling of the reservoir with water was accompanied by gross violations of the necessary environmental requirements. The lack of cleaning of the channel and the floodplain of the river Voronezh has especially affected the degradation of the reservoir from soil deposits that had to be completely removed. This would significantly reduce sludge formation. At the same time, insufficiently cleaned wastewater and storm water enter the reservoir. According to the observation results, the water of the Voronezh reservoir changes within the framework of 3 and 4 quality categories: 3 ("polluted"), 3 "a" ("polluted"), 3 "b" ("very polluted"), 4 "a" ("dirty") [3]. The Belgorod reservoir is characterized by the same problems, but it is even dirtier. In it, of some places, there is currently a category of water quality 4 "b", in 2018, categories 3 "b" and 4 "a" prevailed; the water quality of category 4 "b" was also in 2015, 2017 [3]. In all reservoirs, including the Belgorod one, in summer there is an abundant bloom of blue-green algae, which affects the indicator of dissolved oxygen. To improve the ecological state of the Voronezh reservoir, fry of herbivorous fish species were introduced in 2018, which can prevent the development of blue-green algae in the reservoir. It should also be noted that the death of fauna and flora has been observed in almost all large water bodies over the past three years. The normal training level (NTL) of the Belgorod reservoir coincides with the maximum retaining level (MRL), which makes it a potentially hazardous technogenic object.

Most lakes, ponds and reservoirs are also in critical or crisis conditions. In recent years, there has been no construction of new HS in the region, but a major overhaul of the existing ones is required, which requires tens of billions of rubles in investments in the Central Black Earth Region. So in the Belgorod Region, only the overhaul of the hydroelectric facilities of 6 ponds in 2016 cost the budget of 35 million rubles (near the villages of Krasny Oktyabr, Zhukovo, Kiselevo, khutor Tserkovny, settlement Komsomolsky, st. Solovey) [8].

In connection with the pollution of surface water for water supply to the population for drinking and household purposes, groundwater is of great importance. In the Central Black Earth Region, they occur in several horizons and at different depths. On watersheds, groundwater occurs at a greater depth than on the slopes and bottoms of gullies. It is no coincidence that many rural settlements in the region are confined to gullies and river valleys, where water can be obtained using ordinary wells. The flow rate of wells and sources is small: several litres or tens of litres per second, rarely 100-150 litres per second. Groundwater in the Voronezh Region occurs in the north of the region in neogene and quaternary rocks, and in the rest of the territory the main aquifer is the Upper Cretaceous, the waters of which are contained in the chalk-marl strata. In the Belgorod Region, three aquifers are of great importance: Paleogene, Upper Cretaceous and Devonian. At present, due to the large withdrawal of water, groundwater reserves of the Central Black Earth Region must be replenished artificially using filter ponds. Groundwater resources as a whole for the Central Chernozem Region are 23.973 thousand m³/day, the average module is 2142.9 m³/day per km², groundwater reserves - 5423.9 thousand m³/day, the degree of exploration of resources is 22.6%, the degree of resource development is 9.3%, the degree of development of reserves is 30.8%. The largest reserves and levels of exploration and development of resources are observed in the Belgorod Region, where they are most needed. In general, the region's groundwater resources are relatively small, which requires their careful use. On the territory of the Central Black Earth Region in 2018, economic entities extracted 1 226.9 million m³ of water from natural sources for various needs, including 439.8 million m³ from surface water bodies, 774.1 m³ from underground aquifers (see fig. 4).
The main sources for industrial water supply are surface waters; rivers and reservoirs. The underground sources are used for household purposes. The quality of drinking water according to sanitary and chemical standards in water samples from underground sources is constantly deteriorating, which is due, on the one hand, to natural factors (increased content of iron, manganese, boron, salts in the water), and on the other hand, to the growing anthropogenic pollution of groundwater, insufficient water purification, deterioration of water supply networks. The largest volumes of surface water are taken to feed the cooling ponds of the Kursk and Voronezh NPPs. In 2018 from the r. Seim took 63.3 million m³ of water with an annual volume of river flow in this place of 828 million m³, which is 7.6% of the flow. Water is advantageously used to cool NPP equipment. During water intake, large losses are observed during transportation (in the Lipetsk Region in 2018 - 28.10 million m³ or 14.6%) [9]. Water losses in the Tambov Region in 2018 amounted to 9.67 million m³, or 8.9% of the total volume of groundwater withdrawn. Leaks and unaccounted water consumption in the water supply systems of the Kursk Region make up more than 40%, and in a number of cities in the region they reach 60% (in the Russian Federation, the share of water losses is a maximum of 25% of the total intake volume). Losses of water in water supply networks are on average 9% (as in the Central Black Earth Region) of the total volume of water supply to the network. The total water intake in the Voronezh Region was 405.5 million m³ in 2018, and water losses exceeded 26.1 million m³. The use of water in 2018 from groundwater bodies for household and drinking needs amounted to 126.4 million m³, for production needs 220.7 million m³, for irrigation - 9.4 million m³. In general, in 2018, 1076 million m³ of water was used in the district, while 315 million m³ of insufficiently cleaned wastewater was discharged into surface water bodies. There is no discharge into groundwater bodies on the territory of the Central Black Earth Region (apart from a small discharge in the Tambov Region - 0.20 million m³).

The big problem is the low degree of water purification. So in the Tambov Region in 2018 the volume of contaminated and insufficiently cleaned wastewater amounted to 85.5% of the total volume of water used, and in the Lipetsk Region - 85.9%, despite the fact that the last one has 52 biological and mechanical cleaning facilities. At the same time, only 4.6% of the volume of discharged wastewater are normatively cleaned [9]. In the Voronezh Region, according to the official data, the volume of insufficiently cleaned wastewater reached 118.8 million m³ per year in 2018, but the total mass of pollutants that entered the water bodies of the Voronezh Region along with wastewater was 114,439 tons !!! [3]. The total capacity of cleaning facilities in 2018 amounted to 348.43 million m³/year, which is generally insufficient. But the main problem is the low quality of outdated cleaning facilities, most...
of which were put into operation in the 60s and 70s. In 2009, the first modern complex of biological wastewater cleaning of 15 facilities at OJSC Voronezhsintezkauchuk was put into operation in Voronezh, instead of the previous mechanical cleaning, which required more than 800 million rubles. This project was financed by «Sibur Holdings», but even this complex is far from providing utilization of the full volume of wastewater of SK.

4. Conclusion
A radical change in the water use strategy is required. There is an urgent need for comprehensive cleaning of all types of wastewater, especially the creation of a storm sewer cleaning system. The problems of large reservoirs are largely due to the lack of cleaning of melt water and storm runoff. In the Voronezh Region, the main pollutants contained in the water of reservoirs in concentrations exceeding the MPC are suspended solids and chemical oxygen consumption. Large reservoirs, such as the Voronezh "sea", need to be reduced by backfilling the most silted shallow waters and deepening the main part, river beds and ponds need to be cleaned and their water protection zones expanded. Due to its poor quality, it is already impossible to use the water of most reservoirs for economic purposes, but in the future, the deterioration of the quality of groundwater, which is growing every year, will impact its purification. According to the calculations of American scientists using the example of New York, purification of all types of wastewater is the most economically profitable way to improve the quality of groundwater and surface water. Moreover, the optimization of water protection zones and the creation of storm water purification ponds does not require large investments, and a complete ecological rehabilitation and river cleaning requires several million or even tens of millions of rubles per 1 km of the channel [7]. In 2016, cleaning and ecological rehabilitation of the river Zhigalka were carried out in Tambov, the river Psel in the city of Obloyan and other rivers [8]. The residents received magnificent recreational areas, and the rivers themselves became more full-flowing, but the costs amounted to several million rubles per 1 km of the channel. For environmental rehabilitation of 9.52 km of the river Voronezh in Lipetsk in 2018 spent 54.870.8 thousand rubles, 30.6 million rubles were spent on cleaning 5.65 km of the Stanovaya Ryasa River in the city of Chaplygin [1]. The urgent need for widespread wastewater cleaning, especially domestic and stormwater, which is underdeveloped in the region. It is no coincidence that in most water bodies of the Central Black Earth Region the main pollutants are suspended solids (dry residue is hundreds of thousands of tons per year) and chemical oxygen consumption [4]. Dirty water is typical not only for water bodies of large cities, but also for surface waters near rural settlements. In Russia (in contrast to European countries), household and agricultural wastewater is almost not cleaned in rural areas, which worsens the quality of water in open reservoirs and groundwater, and leads to an increase in the incidence of diseases of the population. The total single length of street sewerage networks in most rural areas of the CCR is only a few kilometers, and storm sewerage systems are generally absent. So in the Kursk Region, out of 2.8 thousand settlements, centralized sewerage systems operate only in 68 cities and large RS (2.4%), while there are only 46 outdated sewage cleaning plants (SCP) for the cleaning of domestic wastewater. In recent years, the situation with the cleaning of municipal water in the Belgorod Region has noticeably improved, where the sewage system of block type ENVI-PUR is being introduced for the cleaning of wastewater of detached buildings, the construction and reconstruction of the SCP in almost all more or less large settlements within the program "Provision of affordable and comfortable housing and utilities for residents of the Belgorod Region for 2014-2020." At the same time, on the territory of the region, there are sewage cleaning plants in a dilapidated state in Belovskoe, Tomarovka, Bykovka, Livenka and others. Due to its low quality, it is currently impossible to use the water of most reservoirs, therefore, groundwater is mainly used, but in the future, with current trends in water use, an unacceptable quality of groundwater can be expected.

The state of forest resources in the Central Black Earth Region also does not allow to achieve a sustainable state of nature, including the conservation of water resources. It is deforestation in the Central Black Earth Region that causes too short spring floods, pollution and river shallowing. At present, the water quality and the state of water bodies are extremely poor for the region, ecosystems die, rivers, lakes, ponds and even reservoirs disappear, which requires a radical change in the water use strategy of the Russian Federation. The problem of preserving water resources can be completely solved only in a comprehensive manner by reducing water consumption, cleaning all types of wastewater,
increasing the share of circulating water supply, optimizing and afforestation of water protection zones, which requires significant financial investments. Tax policy currently does not meet the objectives of achieving a sustainable state of the natural environment. Taxes, fees and payments for the use and pollution of natural resources in the Central Black Earth Region do not even reach 1 billion rubles a year. It is necessary to spend tens of billions of rubles a year to improve water use. The economic mechanism in water use is inefficient due to low prices for water from surface sources. It is necessary to create an economic mechanism for sustainable water use that would be effective in the coming years.

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