

Diagnosics of nature management problems at the regional level

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Диагностика проблем природопользования на региональном уровне

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Аннотация: В статье проведен территориальный анализ природопользования в Приволжском федеральном округе (ПФО) по видам ресурсопользования. Проведено ранжирование регионов Приволжского федерального округа по показателям, отражающим воздействие региона на окружающую среду, инвестиции и затраты на охрану окружающей среды. Выявлено, что регионы, лидирующие по показателям воздействия, имеют наибольшие затраты на охрану, что позволяет сделать вывод о том, что высокие показатели инвестиции в охрану окружающей среды отражают «признание» регионами сложившихся проблем и необходимость их решения, и эти инвестиции направлены на решение конкретных задач природопользования. На основе специфики хозяйственной деятельности и отраслевой направленности регионов, а также с учетом результатов статистического анализа, ранжирования, применения проблемного и системного подходов, ГИС-технологий в исследовании проведена типология регионов ПФО и выделены типы природопользования. Подобные комплексные исследования процесса регионального природопользования позволяют дифференцировать проблемы в области охраны окружающей среды, подойти к пониманию рационального природопользования в Приволжском федеральном округе и направлений его организации с учетом территориальной специфики.

Ключевые слова: ресурсопользование, окружающая среда, ранжирование регионов, показатели воздействия, инвестиции, территориальная дифференциация, проблемы, типы природопользования, рациональное природопользование

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DIAGNOSTICS OF NATURE MANAGEMENT PROBLEMS AT THE REGIONAL LEVEL

IRINA ANATOLYEVNA SEMINA^a

RESEARCH ARTICLE

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Abstract: The article provides a territorial analysis for the use of natural resources in the Volga Federal District (VFD) by types of resource use. The authors ranked the regions of the Volga Federal District according to the indicators reflecting the region's impact on the environment, investments, and expenditures on environmental protection. The article demonstrates that the regions leading in the impact indicators have the highest expenditures for nature protection, which suggests that these regions «recognize» the existing problems and the need to solve them, considering that these investments aimed at solving specific problems of natural resource management. Based on the specifics of economic activity and industry orientation of the regions, given the results of statistical analysis, ranking, application of the problem and systematic approaches, and GIS-technology, the study conducted a typology of the VFD regions and identified types of nature management. Such comprehensive studies of the process of regional nature management allow us to differentiate problems in the field of environmental protection and to understand the rational use of natural resources in the Volga Federal District and the directions of its organization, considering the territorial specifics.

Keywords: resource use, environment, region ranking, impact indicators, investments, territorial differentiation, problems, types of nature management, rational nature management

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Introduction

The need to reconsider the existing approaches to regulating the processes of natural resource use and the search for new solutions is clear and relevant today.

The environmental management issue has some research aspects. The geo-ecological aspect focuses on the problems of landscape anthropogenic change and reduction of its sustainability. The socio-economic aspect identifies social, demographic, economic, and technological factors and consequences of environmental degradation. The resource aspect includes problems related to resource depletion and pollution. The process of resource management serves as a link between nature and people, ecology and economy (Fig. 1). It is a regulated process aiming to ensure environmental safety and sustainable (balanced) development. This issue is clearly stated and defined in the national project «Ecology».

Analysis of the environmental management in the Volga Federal District by types of resource use

The authors conducted a territorial analysis of environmental management in the Volga Federal District by types of resource use. The Volga Federal District (VFD) is one of the leaders in terms of the country's industrial production, which is why geo-ecological issues require increased public attention due to the emergence of negative trends, the consequences of which affect not only the environment but also social and economic development, in particular, the investment attractiveness of the region.

According to Rosstat and the Federal Service for Supervision of Natural Resources, the Volga Federal District ranks last among the top three districts in terms of water pollution from stationary sources in 2019 and 2020, second only to the Urals and Siberian Federal Districts [Statistics, 2020].

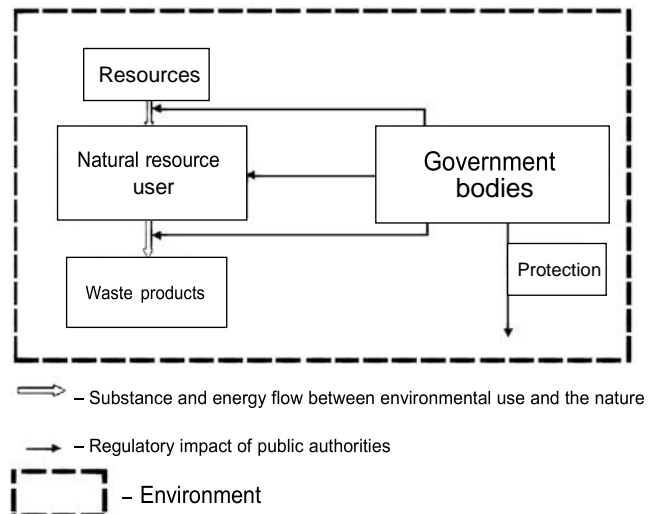
The Republic of Tatarstan, the Ulyanovsk region, and the Samara and Saratov regions stand out significantly in terms of river flow resources among the regions of the district. Most of all, the water use in the district is for industrial and domestic needs. Therefore, in regions with a powerful production complex, the water intake will be more significant. The Perm Krai is the leader in freshwater intake from natural sources; the Sara-

tov and Orenburg regions are also prominent in this indicator. Tatarstan, Bashkortostan, Samara, and Nizhny Novgorod regions have the highest water intake. The minimum water intake is registered in the Republic of Mordovia [On the state and protection of the environment..., 2021; Statistics, 2020].

The analysis of water use and water discharge shows that the regions with maximum water use and water discharge do not coincide. Perm Krai and Orenburg regions have the highest values for the use of freshwater, while the Samara and Nizhny Novgorod regions and the Republic of Tatarstan lead in terms of water discharges, which indicates the existence of current water pollution and other unresolved problems (Fig. 2, 3).

If we consider 2020, we should mention a significant increase in the collection of pollutants in water resources. This fact can be attributed to the

Figure 1. The scheme of interaction between the environment, natural resource users and government bodies

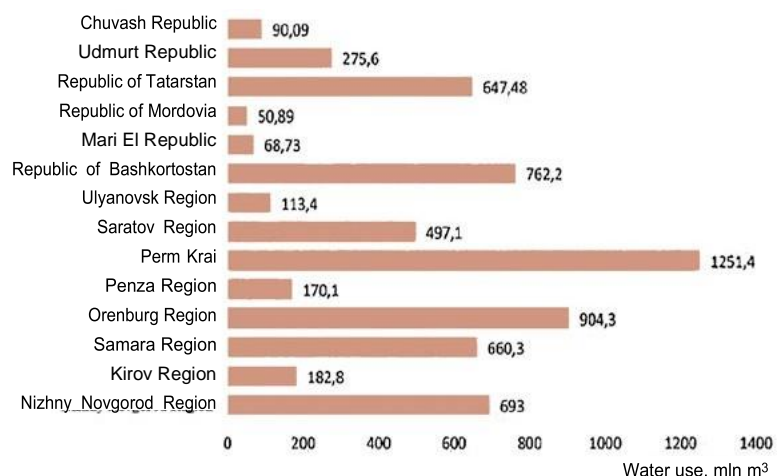


water conservation measures taken. However, not all regions were able to improve their indicators. For example, in the Orenburg region, there has been a sharp decrease in the number of substances captured in water, while the volume of emissions to water resources has remained the same [On the state and protection of the environment..., 2021; Statistics, 2020].

The analysis of forest use has shown that there are changes in the forest lands of regions in the Volga Federal District. From 2010 to 2019 the area of forests [On the state and protection of the environment..., 2021] has increased and soft-leaved and coniferous tree species prevail in the structure of forest areas. In the age structure of forests in the Volga Federal District, there is a significant percentage of aged forests, which indicates the problems in the forestry and wood industry of the district. All regions of the Volga Federal District have aged forests, but they predominate in Perm Krai, Kirov, and Nizhny Novgorod regions, as well as the Republic of Bashkortostan.

Forest conservation and protection are necessary for wood use. In 2019, the forest fund of the Republic of Mordovia registered the maximum area of forests traversed by fires per

Figure 2. Freshwater use in the Volga Federal District regions, 2019 [On the state and protection of the environment..., 2021]



case of fire. The highest flammability in forestry was noted in the forest stands of Temnikovskiy and Kovylkinskiy districts of the republic.

The analysis of atmospheric emissions from the Volga Federal District has shown that emissions from mobile sources dominate compared to stationary emissions. Gross emissions across the district increased from 2010 and then declined significantly from 2018 to 2019, as well as emissions from mobile sources. That can be explained by the political and financial situation on the world stage and the related economic situation in the country.

In the context of the subjects of the Volga Federal District, we can distinguish economically developed regions with a powerful industrial potential, where emissions from stationary sources are the highest (Fig. 4, 5).

These are the republics of Bashkortostan, Tatarstan, the Orenburg region, and the Perm Krai. The highest volume of emissions from mobile sources is registered in the Saratov region. The most favorable situation with atmospheric pollution is in the Chuvash Republic, Penza, and Ulyanovsk regions.

We can point out several cities in the Volga Federal District that have improved their environmental situation between 2010 and 2019, such as Perm, Solikamsk, Berezniki, Izhevsk, Nizhnekamsk, Mednogorsk, Saransk, Orenburg, and Balakovo. However, there are cities where the situation has only become worse – Samara, Ulyanovsk, Orsk, Salavat, and Kuvandyk (Fig. 6).

Analysis of the structure of air emissions from stationary sources shows that principal air pollutants in the Volga Federal District were maximum for HC (hydrocarbon), which is especially characteristic of the Orenburg Region, the republics of Bashkortostan and Udmurtia [On the state and protection of the environment..., 2021; Statistics, 2020].

Production waste generation is most common in the industrially developed and more populated subjects – the Orenburg Region, the Perm Krai, and the Republic of Bashkortostan (Fig. 7). In the Volga Federal District, industrial waste disposal prevails at the facilities belonging to the enterprises.

From 2011 to 2019, this indicator decreased, which is explained by the stabilization of production in the VFD regions and the consistent partial solution of the waste problem due to the modernization of production facilities.

Figure 3. Water discharges in the Volga Federal District regions, 2019 [On the state and protection of the environment..., 2021]

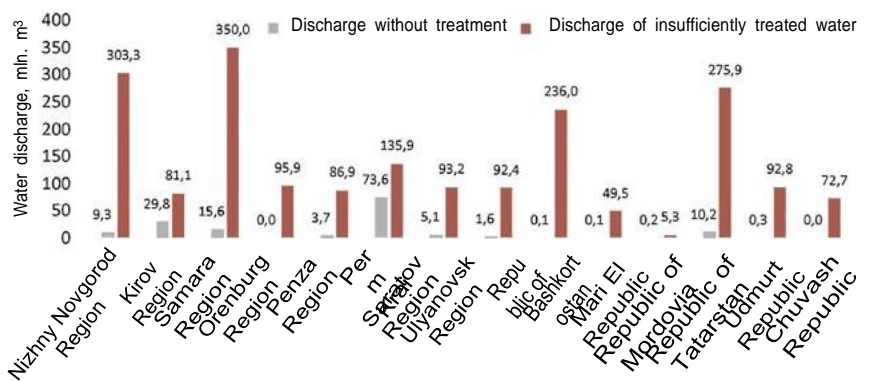


Figure 4. The volume of air pollutant emissions in the Volga Federal District from 2010 to 2019 [On the state and protection of the environment..., 2021]

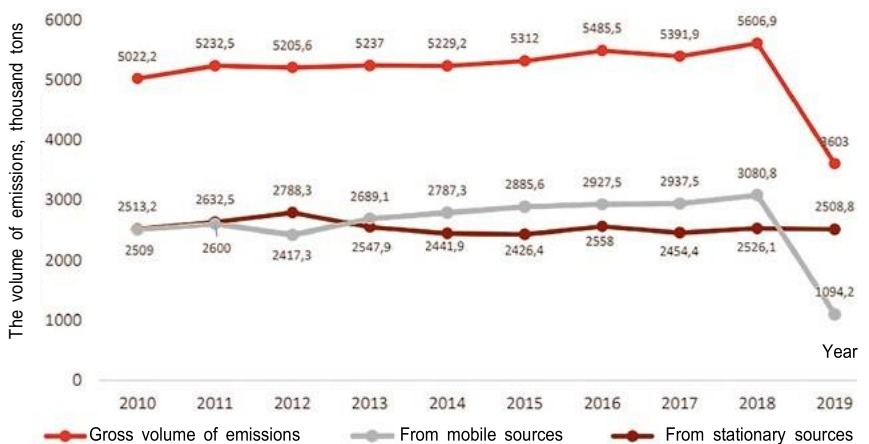
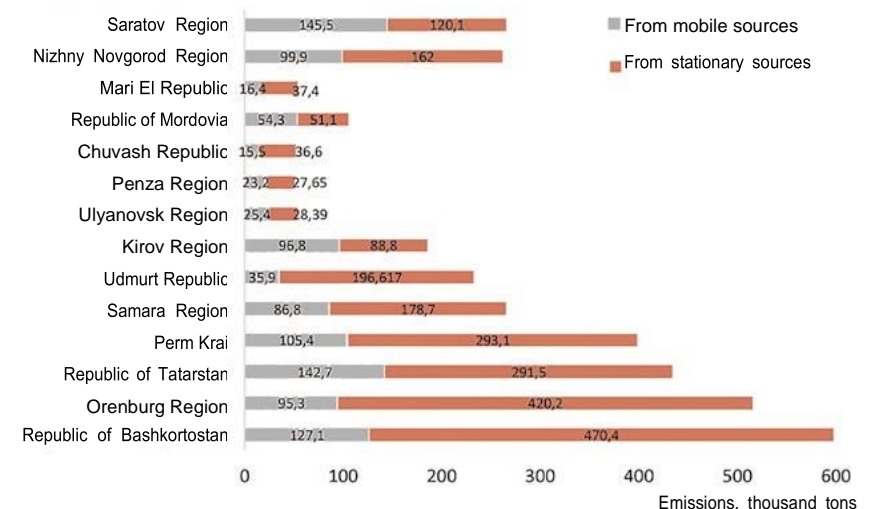


Figure 5. Quantitative indicator of atmospheric pollution in the Volga Federal District regions, 2019 [On the state and protection of the environment..., 2021]



The analysis shows that the problem of rational environmental management in the Volga Federal District regions takes place in various sectors and spheres of economic activity [Logiнова, Semina, Folomeikina, 2018; Semina, Nosonov, Kulikov,

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2017]. It is associated with the active use of water, forest, soil, and mineral resources [On the state and protection of the environment..., 2021; Statistics, 2020], which leads to pollution of water and air basins, resource depletion, and production and consumption of waste formation. Most of the regions of the Volga Federal District have resource use problems that require deeper understanding and solutions [Loginova, Semina, Folomeikina, 2018; National project "Ecology", 2022].

Regional differentiation of environmental impact and protection in the Volga Federal District

The authors ranked the regions of the Volga Federal District according to the indicators that reflect the impact of the region on the environment, investments, and costs for environmental protection [On the state and protection of the environment..., 2021]. **Table** shows the ranking results.

Each group of indicators shows a sum of points, where the *minimum score reflects the more critical situation* in the region for the analyzed indicators. The score equates to the region's place in each indicator. The lowest score is 8 (Perm Krai for impact indicators and the Republic of Mordovia for investments and expenditures on environmental protection), the highest scores are 46 (Chuvash Republic) and 54 (Republic of Tatarstan).

Figure 8 shows the graph with scores for each group of environmental management and «economic compensation» indicators, i.e., investments and costs for environmental protection. This correlation of final scores allows us to understand the existing problems and the opportunities to solve them. If the environmental management problem is not significant, the cost of its solution may not be considerable.

However, the republics of Tatarstan and Bashkortostan, being in the average

position in terms of urgency of environmental problems (in our case, the score was 23 and 22, respectively), show the maximum investment and costs for environmental protection in the VFD, which may indicate a more flexible mechanism of environmental management in these regions. At the same time, the Perm Krai has the most problems with natural resources management but, in terms of «economic compensation», stands only 4th in the district.

Figure 6. Air pollution levels in cities of the Volga Federal District [On the state and protection of the environment..., 2021]

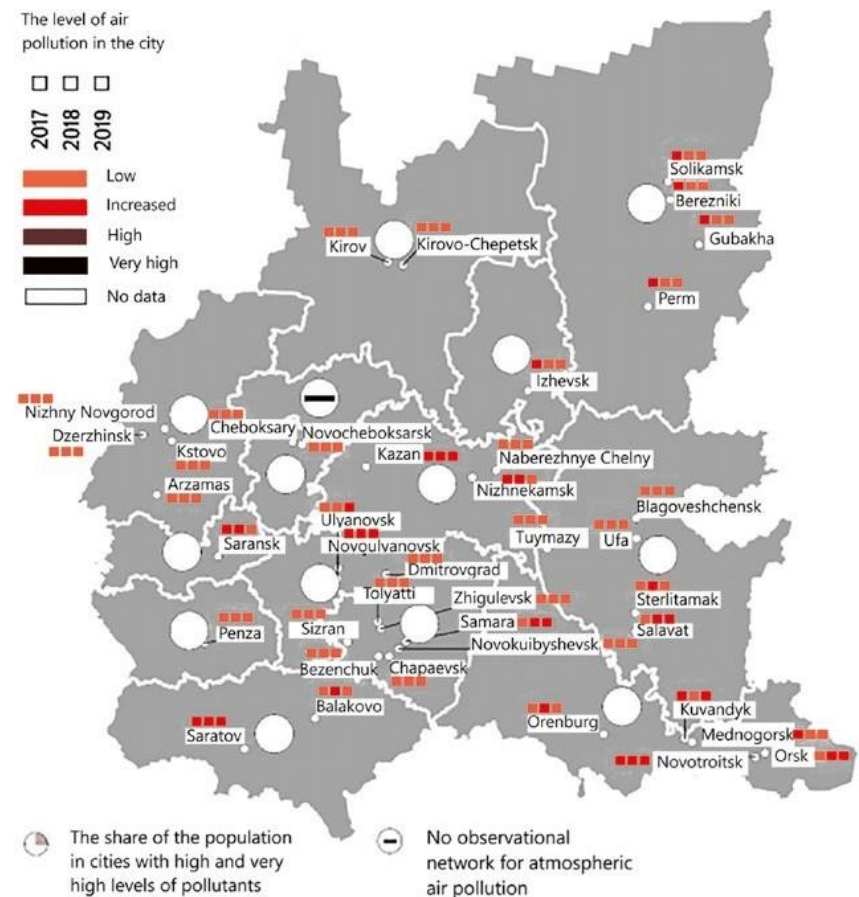
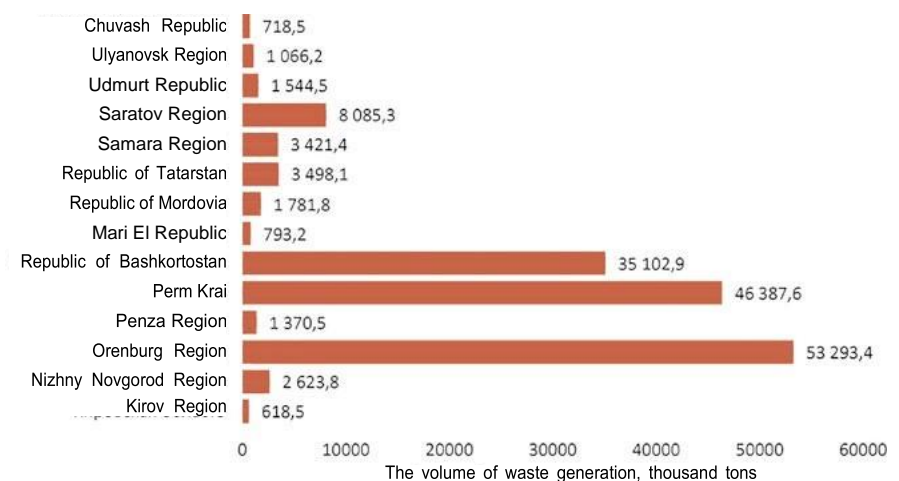


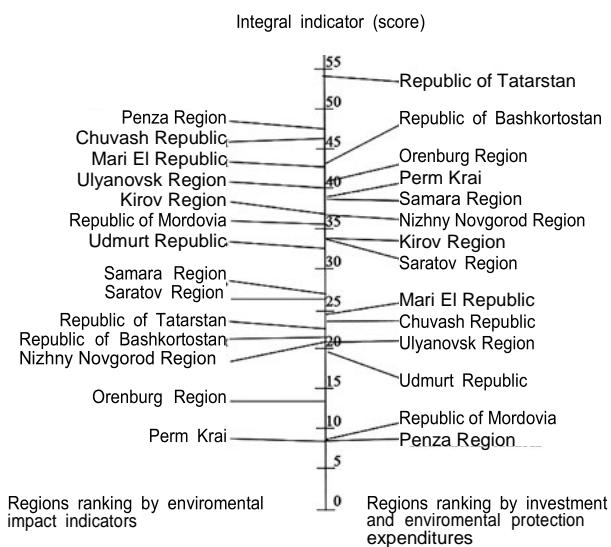
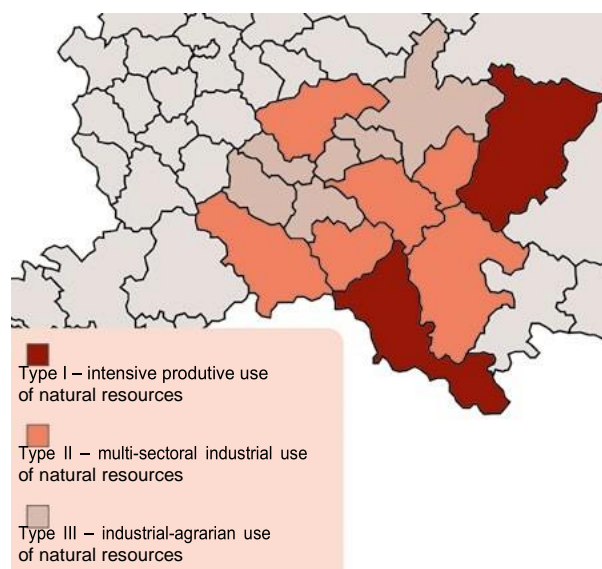
Figure 7. Generating production and consumption waste in the Volga Federal District regions, 2019 [National project "Ecology", 2022]



The Republic of Mordovia and the Penza region are the least invested in environmental protection in the Volga Federal District. These regions do not have a significant impact on the environment compared to other regions, but, as our study showed, if we ignore the existing environmental problems of water pollution, air pollution, forest management, production and consumption waste generation, it can lead to irrational nature management and a negative impact on public health.

Table. VFD region ranking by indicators of environmental management and protection, 2019

The subject of the Russian Federation	Group of indicators showing the impact on the environment				Total score	Group of indicators showing investments and expenditures on environmental protection				Total score
	The volume of pollutant emissions from mobile and stationary sources	Discharge of polluted wastewater	Generated production and consumption waste	The total area of dead forest plantings		Investments in air protection	Investments in the protection and rational use of water resources	The current costs of forest reproduction and reforestation	Environmental protection expenditures (total)	
Republic of Bashkortostan	1	5	3	13	22	9	13	8	13	43
Mari El Republic	12	13	12	5	42	1	7	13	3	24
Republic of Mordovia	10	14	8	3	35	2	1	3	2	8
Republic of Tatarstan	3	4	5	11	23	14	14	12	14	54
Udmurt Republic	8	10	9	6	32	4	5	4	6	19
Chuvash Republic	11	12	13	10	46	6	2	11	4	23
Perm Krai	4	1	2	1	8	7	6	14	11	38
Kirov Region	9	6	14	7	36	11	11	5	7	34
Nizhny Novgorod Region	7	3	7	4	21	8	12	6	10	36
Orenburg Region	2	8	1	2	13	12	10	10	9	41
Penza Region	14	11	10	12	47	3	3	1	1	8
Samara Region	5	2	6	14	27	13	4	9	12	38
Saratov Region	6	7	4	9	26	10	9	7	8	34
Ulyanovsk Region	13	9	11	8	40	5	8	2	5	20

Figure 8. Graph of the Volga Federal District regions' position according to the scale of the integral index of environmental management and protection**Figure 9. Types of resource use in the regions of the Volga Federal District, 2019**

Results and conclusions

The specifics of economic activity and industry orientation of the Volga Federal District regions, as well as the results of statistical analysis, ranking (Table, Fig. 8), application of the problem and system approaches [Vanieva, 2018; Loginova, Semina, Folomeikina, 2018], and GIS technology in the study, allowed us to identify the type of environmental management in the regions of Volga Federal District (Fig. 9).

There are three types of resource use in the regions of the district (Fig. 9). *The first type of regions* is characterized by intensive productive natural resource use and includes Perm Krai and the Orenburg industrial regions. According to all indicators of natural resource use, their environmental impact in the district is maximum and intensive.

The second type of multi-sectoral productive nature management also belongs to the industrial regions as well as with developed agricultural production. These are the Nizhny Novgorod, Saratov and Samara regions, the republics of Bashkortostan, Tatarstan, and Udmurtia. Except for Udmurtia, these regions make significant expenditures on environmental protection and take significant efforts to address environmental issues.

The third type of regions of industrial-agrarian environmental management consists of the Kirov, Ulyanovsk, and Penza regions and the republics of Chuvashia, Mordovia, and Mari El. They do not have the same impact on the environment in the district as the regions of the first and second types, but we can find all the identified environmental management problems

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there. Investments and costs for environmental protection in the district are also minimal, which, on the one hand, is logical; at the same time, the existing problems are particularly severe, which require their solution through economic methods of environmental management, including the adoption of environmental protection programs.

The typology of Volga Federal District regions according to the types of environmental resource use allowed us to differentiate the modern process of environmental management in the district and to come to an understanding of the rational use of natural resources in the VFD and the directions of its organization, given the territorial specifics.

Based on the results, we can assume that only a few sub-

jects of the Volga Federal District region are ready to become a platform for attracting investment. At the moment, we can call the Republic of Tatarstan a leader in investment attractiveness among all regions of the Volga Federal District. Despite the many industrial complexes, Tatarstan manages to control the ecological situation in the region. And this fact demonstrates the efficiency of measures in the field of environmental management. Prospects for further research lie in the search for regions where nature management practices are already established so we can apply them to subjects with unfavorable environmental conditions. That will attract new investors and improve the socio-economic situation in the Volga Federal District, as well as rationalize the use of natural resources in the regions of the district.

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