Ecological and economic aspects of the waste management reform: the experience of the Rostov region

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Abstract. The problems of the household garbage and industrial wastes utilization are currently central in the regions with a high concentration of population and production. This region in the South of Russia is the Rostov region. The industrial specialization of economy, intensive agriculture, the saturation of infrastructure facilities and high with a predominance of cities are the factors, causing the waste production and consumption large volumes formation in the Rostov region. Since 2018 the process of reforming the waste disposal system has been carried out in the Rostov region, as well as in other regions of Russia. Instead of landfills, where production and consumption wastes were simply stored and buried, the innovative technical and ecological chain, allowing the processing of garbage and recycling of waste, is being created in the region. The waste management reform involves the creation of 8 inter-municipal ecological waste-treatment complexes in the Rostov region, including solid household waste landfills, waste sorting plants, waste transfer stations and other infrastructure facilities for the waste management. At the same time, this reform faces a number of organizational, managerial, engineering, economic, environmental and socio-psychological problems. The essence and problems of the waste disposal system reform in the Rostov region, the reasons and possible ways of the decision the general assessment of efficiency of the developed scheme of utilization of waste a way of the solution of a problem of accumulation and removal of garbage in the region are considered in this article.

Introduction

Waste management includes a system of actions to eliminate their negative impact on society and the environmental state. It consists of the use of waste at certain stages of the technological cycle for their separation and disinfection, storage and disposal and necessarily involves the recycling of products and materials that have already finished their lifetime [1]. This problem is particularly relevant in the regions with a significant concentration of population and a high level of urbanization, since the development of production and consumption there leads the significant masses of waste accumulation, which causes enormous geo-ecological, economic and social damage. By contaminating all geospheres, waste has a negative impact on human health, disrupts the natural course of natural processes, changes the structural components of the landscape. Therefore, the efficient waste management, including a system of measures for their disposal, is a determining factor in the sustainable development of the society.
Analysis of Recent Achievements and Publications
Efficient disposal of production and consumption wastes is a multidimensional problem. It is studied by experts in various fields of activity - environmentalists, physicians, engineers, economists, lawyers. Ecological and economic aspects of the waste management in production and consumption fields are considered by a number of domestic scientists (Yu.M. Potashnikov [1], M.D. Kharlamov, A.I. Kurbatova [2], L.N. Gubanov [3], S.G. Sheina [4, 5] and others) and foreign authors (D.N Pellow, A. Weinberg, A. Schnaiberg [6], R. Bendery [7]). The interdisciplinary approach presented in these works combines the views of ecologists with an assessment of the economic efficiency of the measures taken to develop the waste management system, allowing not only to increase public attention to this problem, but also to synthesize opportunities to eliminate the negative effects of the garbage annual growth.

The Purpose and Objectives of the Work
Despite the similarity of causes and main aspects of manifestation in the countries of the world, the problem of accumulation and waste recycling has spatial specificity. One of the regions in which this problem is acutely urgent is the Rostov region. The region is an industrially developed territory with a high concentration of population and production. In recent years, the regional administration has been making significant efforts to create an innovative system for utilization of the industrial and consumer waste generated in the region localities. However, as the authors’ analysis shows, this garbage collection and disposal system reform faces some serious problems and difficulties, which slow down its progress and reduce the possibilities for implementation. The objectives of this study are to identify and characterize the spatial characteristics of the industrial and consumer waste disposal problem in the Rostov region, assess the reform of the waste management system aimed at effectively solving this problem, identify and analyze problems and prospects for this reform implementation, its environmental significance and economic feasibility.

Main Material
Due to the location of numerous industrial enterprises and intensive agriculture in a relatively compact territory of Rostov region, the environment is experiencing significant anthropogenic pressure here. For the region the problem that has arisen in the sphere of handling household and the industrial waste generated by numerous enterprises is considered and the population is relevant. This problem is expressed in the annual increase in the number of produced garbage volumes, the creation of unauthorized places for its storage in the form of landfills and dumps, the exhaustion of garbage disposal facilities, pollution by soil, water bodies, air, and natural landscapes.

In the beginning of 2016 643 waste disposal facilities, of which 415 are operational and 228 are mothballed (decommissioned) were located in the region [8]. By the middle of 2018, according to the regional waste cadaster, 268 unauthorized waste disposal sites were monitored on the territory of the Rostov region. However, according to the unofficial data, the number of waste disposal sites in the region occupies more than 525 landfills [9]. Such a large number of unauthorized dumps significantly complicates the ecological situation in the region, waste is carried by wind and birds in the surrounding areas and burning of garbage increases the incidence of the population.

The system of production and consumption waste management, which existed in the Rostov region, proved to be inconsistent. However, all the collected garbage was taken out of the settlements and dumped in landfills or, at best, buried in garbage dumps. At the same time, there was practically no sorting of waste, the removal of the most valuable or, conversely, extremely toxic and dangerous fractions from them, and even more their recycling. There are also organizational and technical problems of garbage collection – container sites are not located in some rural municipalities, waste storage sites in rural settlements do not meet sanitary standards and environmental requirements, and the garbage collection schedule as the consumers of this service is systematically violated (especially in the sector of private low-rise buildings of municipalities) and waste collection organizations [10].
As a result, the settlements and areas of the region are overgrown with landfills, occupying large areas, and the garbage is not disposed.

The waste volume produced in the Rostov region is directly correlated with the level of the regional economy development. It is economic activity and concentration of population are the two determining factors directly determining the amount of environmental pollution, including the generation of garbage. From 3 to 6 billion tons of production and consumption wastes are generated annually in the region (Table 1), which, on average, ranges from 0.75 to 1.5 tons of garbage per year for each resident of the region [7]. Geographically, the largest amount of waste (about 1/3 of their total volume) is generated in the administrative center of region – Rostov-on-Don city. Being the largest city in the South of Russia, with the population exceeding 1.1 million people, Rostov-on-Don forms about 1/3 of municipal waste of the Rostov region [11].

Table 1. Facilities for disposal of production and consumption waste on territory of Rostov region, 2012-2017

| Year          | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---------------|------|------|------|------|------|------|
| Amount of generated wastes of production and consumption, million tons | 4.1  | 3.2  | 6.2  | 4.3  | 4.0  | 4.2  |
| Amount of utilized production and consumption wastes, million tons | 1.2  | 2.2  | 2.5  | 1.1  | 0.8  | 1.4  |
| The share of recycled and neutralized waste production and consumption in the total amount of waste generated, % | 37.0 | 75.0 | 46.8 | 34.7 | 46.7 | 40.7 |
| The volume of generated waste production and consumption per capita, kg on person | 951.4 | 754.1 | 1467.9 | 1001.4 | 941.5 | 998.4 |

* Calculated and compiled according to the data of the Ministry of Natural Resources and Ecology of Rostov Region [8] and the Territorial Body of the Federal State Statistics Service of Russia in the Rostov Region [11].

The largest contribution to the problem of formation and accumulation of production and consumption wastes in the Rostov region is accounted for by the industrial sector - thermal electric power, mining, agriculture and manufacturing industry - they provide in total more than 80% of all waste [8, 10]. It should be noted that the types and hazard class of waste generated in individual industries, although different, require particular attention to the most toxic wastes of IV and V hazard classes.

Thus, the situation in the field of the production and consumption waste management on the territory of the Rostov region is characterized by continuing environmental pollution due to the accumulation of the garbage large volumes with the insufficient level of utilization and the practical absence of the waste treatment system. As a result of the system advanced management methods analysis of the garbage utilization used in the regions of the Russian Federation and the countries of the European Union, an innovative variant of the system development for handling industrial and household waste has been adopted for the Rostov region. It was reflected in the developed new territorial waste management scheme for the Rostov region [12]. According to this scheme, the construction of 8 inter-municipal ecological waste processing complexes - IEWPC (Figure 1) is envisaged in the region (Figure 1):
The Myasnikovsky IEWPC is defined by the number 1.

Each inter-municipal waste processing complex (IEWPC) will include a landfill, waste handling and waste sorting complexes, production sites for the secondary material resources processing. Waste sorting complexes will be located on the territory of the landfills and waste transfer complexes. In 2017, the construction of Volgodonsk and Krasnosulinsky IEWPC began, in the second quarter of 2018 the creation of Morozovsky and Salsky complexes began, and at the end of 2018 the rest of IEWPC will start the operation. All eight IEWPC will be built exclusively at the investors’ expenses. The total investment in all eight complexes will be at least 7.5 billion rubles. Commissioning of all IEWPC is planned for the end of 2019.

However, the conceived waste recycling reform in the Rostov region has problems in its implementation. This is due to the several reasons. Thus, in particular, the norm of waste accumulation, which for the population is 8 liters of garbage per day per family member [13]. At the same time, on the basis of the generated waste established volume, the tariffs for garbage collection for both the population and enterprises also increased. In such a situation, many enterprises and firms did not enter into contracts for the garbage collection with the servicing organizations, transporting it independently to unauthorized landfills or throwing out in residential neighborhoods, thereby causing dissatisfaction of population living there. Thus, according to the information of Ministry of Housing and Communal Services of Rostov region at the beginning of 2019 about 50% of all enterprises and firms in the region signed contracts for garbage collection with the regional operators. In distant areas of the northern and northeastern periphery of the Rostov region, there are several hundred settlements where the garbage trucks of the regional waste collection operators do not reach because of the poor quality of roads in the villages. The residents of these rural settlements are still dumping garbage into ravines, expanding the area of unauthorized landfills. But the delay in engineering arrangement of the majority of IEWPC remains the main problem. The territories for their creation were allocated as early as 2017-2018, but the necessary measures for the formation of the necessary infrastructure for the disposal of garbage were not carried out on time. As a result, the regional operators are still forced to take the garbage to the operating landfills for waste collection, most of which will be closed in the near future due to excessive occupancy, which will further cause the problem of garbage disposal.
Summary
Analysis of the problem of the waste disposal in the Rostov region showed its substantial relevance and severity of manifestation. The constant increase in the number of places of its accumulation creates a significant burden on the environment of the region, deteriorating the health of population, the living quality standards, causes public concern. In order to effectively address the problem of the waste management in the region, a new territorial waste management scheme has been developed and implemented, on the basis of which a system of 8 inter-municipal IEWPCs is being created, the functioning of which will be associated with deep processing of garbage. This will require the population to master the technology of separate waste collection, and the investors and IEWPC operators will need to equip the appropriate engineering and environmental infrastructure and comply with strict standards for the waste disposal.

The model of waste utilization based on rationally located in the territory of the region, IERP will contribute, in our opinion, to bringing the problem of storing waste in a civilized framework based on modern technologies for its collection, sorting and recycling. At the same time, the reform of the system for utilization of production and consumption wastes in Rostov region faced a number of difficulties with organizational, managerial, financial, economic, engineering and technical reasons. In general, they are reduced to the delay in the arrangement of the IEWPC with the necessary engineering and environmental infrastructure necessary for the recycling of garbage.

In resolving this situation, we can distinguish two approaches. A radical approach is to suspend the further course of the reform until the full construction of IEWPC while freezing the increased tariffs for waste disposal under the new scheme. However, in our opinion, it is more expedient to speed up work on creating IEWPC on the basis of regional and federal finances. This will allow IEWPC to be commissioned during the established time periods, which will allow building an efficient recycling rational chain, bringing the degree of recycling to 90% and dumping only 10% of waste only in a decontaminated form. In turn, this will not only improve the environmental situation in the region, but will also bring a number of economic effects and will contribute to improving the life quality of the population.

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