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The Problem of Managing Municipal Solid Waste in The Context of a Sharing Economy

Karanashev A.[1], Sinyuk T.[2], Panfilova E.[2]

[1] *Doctor of Economic Sciences, Full Professor Kabardino-Balkarian State University, Department of Economics and Management in Tourism, Socio-humanitarian Institute (RUSSIA)*
[2] *Candidate of Economic Sciences, Associate Professor Rostov State University of Economics (RUSSIA)*

kanzor77@mail.ru, t_sinyuk@mail.ru, venize@mail.ru

Abstract

The article deals with the problems of making and making decisions in the field of municipal solid waste management at the municipal level. The combination of systemic problems of management and financing are of importance as a result of the implementation of the reform of MSW in the Russian Federation. The study reflects the set of operational problems of the municipal organization, economic and mathematical substantiated resource constraints that impede the implementation of operational activities and the algorithm for developing and making management decisions at the level of the municipality.

Keywords: Waste management system, continual improvement, Solid Waste Management, Sustainable waste management

1. INTRODUCTION

Urbanization has a significant impact on the ecological and evolutionary processes of socio – economic development [2] Therefore, sustainable development of economies is impossible without “clean development” [16] Modern trends in the functioning of the urban economy lead to overpopulation and, consequently, to an ever-increasing problem of management of solid municipal waste, in 2016, only 12% of all solid waste was disposed of. According to the World Bank by 2050. solid waste is expected to grow by 70% at 3.6 billion tons of garbage per year, whereas as of 2016, this figure was estimated at 2.01 billion tons. [14]

The progressive growth of solid waste is a pressing environmental issue for both developed and developing countries. At the same time, the share of developing countries accounts for a significant proportion of pollution by solid municipal waste, which reduces the quality of living space, both at the local, national, and global level [15]

A study on the management of municipal solid waste in China showed that it is the growth of population, economic development and increase in the expenditures of residents are the main factors affecting the volume and composition of garbage [1]

The problem of management of municipal solid waste, associated primarily with the lack of an effective mechanism for organization and control, which in turn leads to the formation of illegal places for the accumulation and storage of waste, noted in Slovenia and Croatia. [2] The emergence of a significant number of illegal landfills for storing garbage causes significant problems in socio-economic terms, and in consequence affects the health of the population and the functioning of the ecosystem as a whole.

In Italy, technological solutions and a scenario approach based on the reuse of MSW for energy production are used to solve the problem of management of MSW [8]

Scientists from Jordan [9] also state the problems of growing solid waste exponentially, expressing fears of excessive pollution of natural resources and the environment.

According to [17], information asymmetry and the growing awareness of the local population about the harm of unutilized municipal solid waste contributes to the ecological behaviour of individuals. The study [18] emphasizes that public awareness of the dangers of municipal solid waste itself is not yet a guarantee of the manifestation of the ecological clean behaviour of the population. So Sadhan Kumar

Ghosh [5] identifies the weakness of institutional initiatives and the lack of public awareness as key factors in the inefficiency of municipal solid waste management.

In Indonesia, the search for solutions to the problems of MSW management is conducted in the field of formation of a waste management system based on management programs that are prescriptive - top-down [3]. Muliawaty, L. [3] argues that the formation and implementation of an effective state policy for the management of municipal solid waste is not possible without the participation of the community as the main waste producer. An identical point of view is characteristic of the Indian community.

We also note that the Russian Federation is following this path with the new reform of the management of the MSW from 2019 [7].

In the work [19] it is noted that at the local level, in case of solid pollution, three problems are the most important: first, the increase in solid waste, second, the change in the quality of solid waste; thirdly, the process of transporting the collected waste and its disposal.

Our position is also close to the above, because without the support of the population, without forming a culture of collecting and sorting garbage from the population, there is a significant threat to the ineffectiveness of implementing the state policy of managing the MSW or delaying its implementation, which will lead to the need for additional funding. Thus, the purpose of this study is defined as the study of the Russian practice of municipal solid waste management in the context of the reform of MSW from 01/01/2019.

2. METHODOLOGY

The Russian Federation is in the initial path of reforming the municipal solid waste management system. The main regulations of the MSW reform are enshrined in the Federal Law No. 89 «On Production and Consumption Waste», as amended on January 1, 2019 [7]. The changes made are not currently being implemented in all the constituent entities of the Russian Federation, since some regions and cities of federal significance have been deferred (Moscow, St. Petersburg, Sevastopol). It should be noted that the implementation of this reform is difficult and has many negative consequences, which, on the one hand, is justified by the lack of readiness of local executive authorities to assume this level of responsibility and the lack of effective mechanisms for implementing “garbage reform” at the municipal level. In Figure 1 we present a set of system management problems of effective management of MSW arising at the lower level - at the level of the municipality and organization.

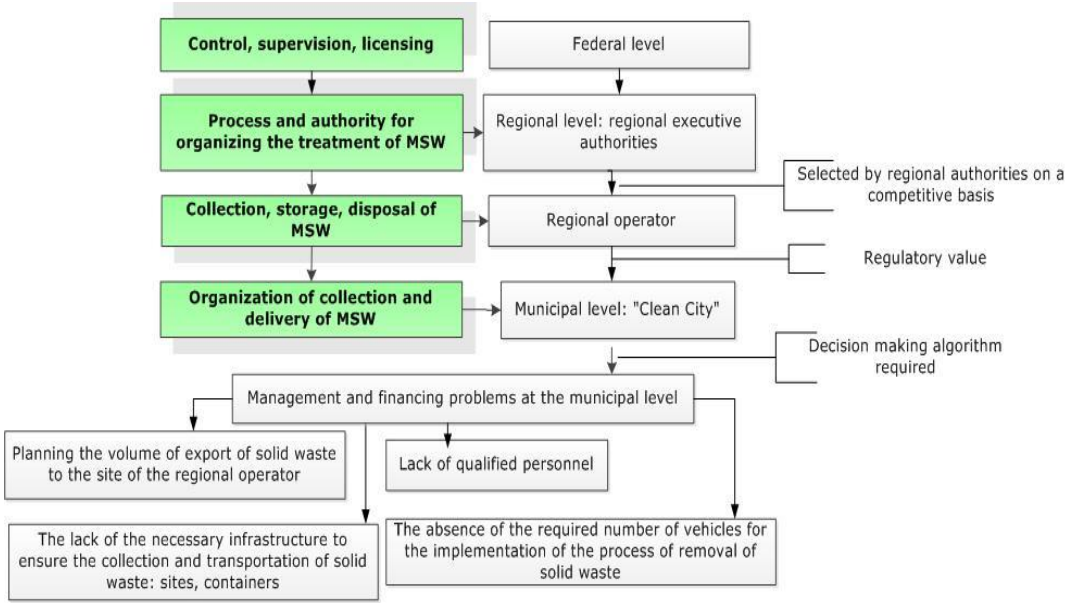

Fig. 1 Systemic problems of management of MSW at the level of a municipality (municipal organization) arising in the process of implementing the reform of MSW 2019 in the RF

Source: Author

From Fig. 1 it can be seen that the direct executor in the field of collection and transportation of MSW - a municipal organization - is not currently able to effectively accomplish the tasks, since on the one hand it does not have sufficient production resources, and on the other hand it needs a significant amount additional funding. The practical implementation of the tasks requires the managers of the municipality to make informed management decisions based on planning and forecasting the export of MSW based on the normative value of MSW volumes per 1 citizen living in a rural or urban area assigned by the regional operator. This task brings to the fore the relevance of the existence of an algorithm for the development and adoption of managerial decisions at the level of the municipality. This algorithm is presented in the following sequence of steps:

Step 1 - collecting the necessary initial information for 5-7 periods (Fig. 2);

Step 2 - using the methods of economic and mathematical modeling, trend models are built, and the most qualitative and reliable model is selected (Fig. 3);

Step 3 - based on the trend model, the forecast values of the resulting feature are calculated (Table 1);

Step 4 - the established standard value of export of MSW per 1 inhabitant is determined based on regional regulations;

Step 5 - calculation of the forecast value of the organization's revenue considering the standard tariff of the regional operator and the forecast volume of export of MSW is made (Fig. 4);

Step 6 - further, it is advisable to determine the ability to export the planned volume of MSW by available vehicles and give an estimate of the need for additional vehicles (garbage trucks), taking into account the schedule of flights (Fig. 5);

Step 7 - the required number of vehicles is determined for the implementation of operational tasks in full and an assessment of the financial costs of their purchase is given;

Step 8 - identification of sources of financing;

Step 9 - the definition and calculation of additional areas of attracting cash flows into the organization and increasing its level of profitability.

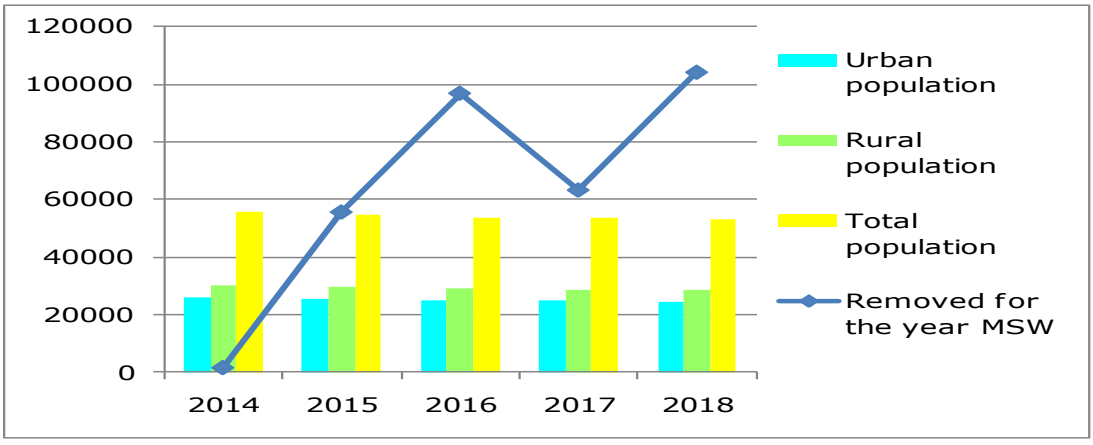

Fig. 2. Dynamics of the initial indicators for the formation of a dataset for the purpose of forecasting and planning the results of operational activities at the municipal level, considering the 2019 of municipal solid waste reform

Source: Author

Consider this issue on the example of PJSC "Clean City" Zernogradsky district of the Rostov region. Fig. 2 provides information on the volumes of MSW in the Zernogradsky municipal district [11]. According to the municipal statistics on 01.01. In 2018, the population of Zernogradsk district is 53,119 people [10]. Based on the data presented in Figure 2, it can be concluded that, on average, in Zernogradsky district there is 1.96 cubic meters exported of municipal solid waste per 1 inhabitant. Since there are no official statistical data for 2018 at the time of this document, it is possible to determine the volume of exported MSW in 2018 based on the average value calculation. Thus, the estimated value of exported of municipal solid waste in 2018 is 103, 97 thousand cubic meters.

Next, we present the predicted values for the population and the volume of municipal solid waste removed during the year (thousand cubic meters). We predict population size using trend models (Fig. 3). The forecast period is 3 years. A second-order polynomial was chosen as a function for the prediction, the materiality and reliability of the model was tested using a coefficient of determination, the value of which is 98.78%.

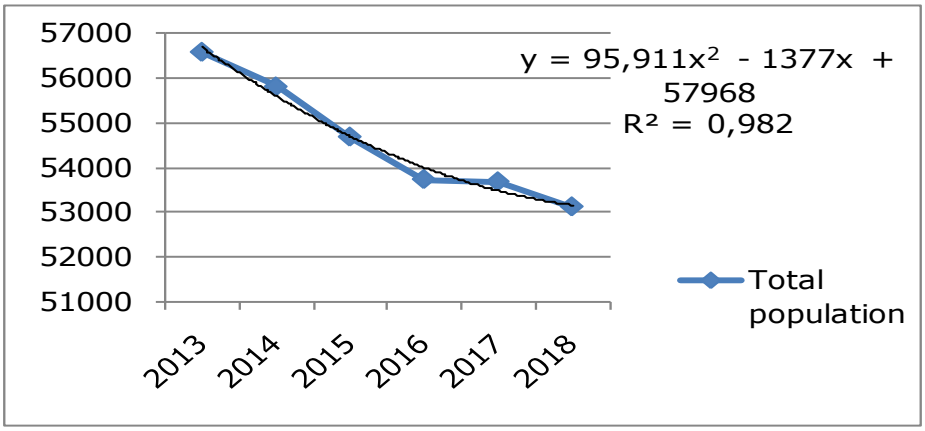

Fig. 3 Polynomial function of the indicator "Population" for Zernogradsk district
Source: Author

The results of the forecast of the population and volumes exported for the year of MSW are presented in table 1.

Table 1 Forecasting of the population and volumes of MSW exported during the year in the Zernogradsky municipal district, thousands of cubic meters

Period	Population, man	Waste for the year MSW, thousand cubic meters.
2013	56589	326,50
2014	55812	1,51
2015	54686	55,47
2016	53733	96,70
2017	53681	63,10
2018	53119	103,97
2019	**52856,09**	**103,45**
2020	**52744,98**	**103,23**
2021	**52777,70**	**103,30**
2022	**52954,26**	**103,64**

Source: Author

In accordance with Decree No. 85/127 of December 20, 201 “On Establishing a Unified Tariff for the Service of the Regional Operator for Solid Municipal Waste Management LLC EcoCenter” (TIN 3444177534) in the area of activity of the Salsk Intermunicipal Ecological Recycling Complex for 2019 [12] A single tariff was set for the service of a regional operator for municipal solid waste management, EcoCenter LLC (TIN 3444177534), which was used further in the calculations.

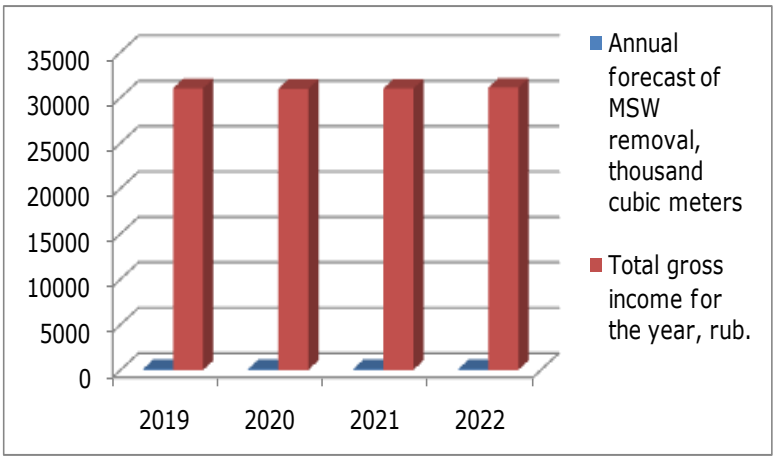

Fig. 4. Calculation of forecast values from operational activities at the municipal level

Source: Author

For our organization, the calculation of the planned number of flights was made based on the minimum and maximum possible number of flights per day, considering the compression ratio, which was adopted at the level of 1.2 points. The calculations are presented based on the planned number of flights 3 minimum - 4 maximum - Fig. 5.

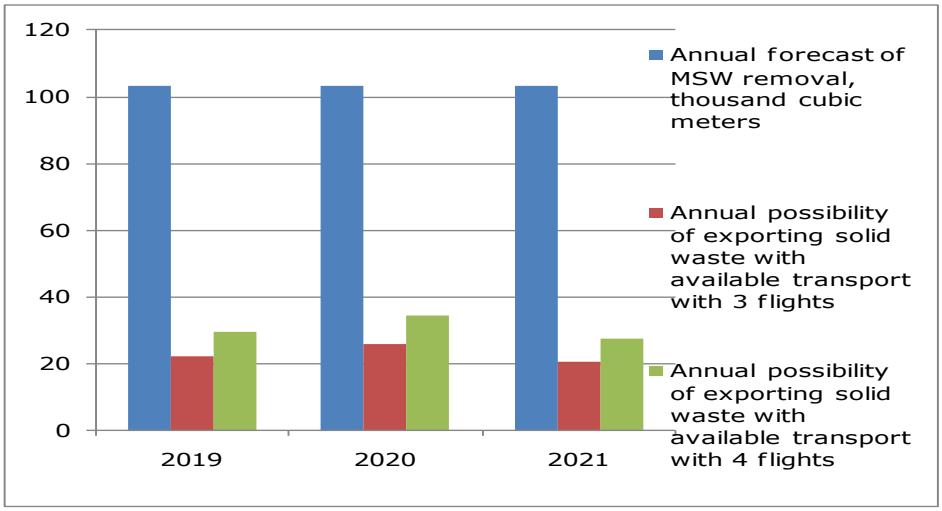

Fig. 5. The ratio of annual demand and the ability to solve operational problems at the level of the municipality

Source: Author

The figure shows that the organization does not have the capacity of existing production resources and requires the purchase of additional vehicles in an amount of from 3 to 7 units, depending on the compression ratio and flight schedule. In order to fully implement the tasks, set for the export of MSW in the assigned territory of the organization, it will be necessary to purchase additionally from 4 to 7 vehicles, the average market value is 1.7 million rubles, total costs - from 7 million rubles. up to 11.3 million rubles. Depends on the choice of vehicle type, the number of flights per day and the implementation of the compression ratio. Plyaskina N.I., Kharitonov V.N. [6] note that the most effective management methods of MSW are associated with the recycling process and alternative methods of MSW recycling, which in turn implies conducting separate collection of garbage, organizing relevant container sites. The organization of container sites as a task is delegated to the municipal level, which also leads to the need to determine the amount of funding in this area and search for sources of funding. The most common way to manage MSW in the Russian Federation and EU countries is the method of disposal of MSW. Other types of MSW management include incineration, pyrolysis, bioremediation and biogas plants, composting, recycling and SLFs [4] If we consider the implementation of the pyrolysis processing of MSW, we should note a number of

difficult moments, namely the high cost of pyrolysis stations, the complexity and danger of implementing the pyrolysis processing of MSW, the need to solve new management tasks related to solving the issues of pyrolysis products and the overall assessment of the pyrolysis station profitability. Thus, the effective implementation of management decisions in the collection, processing, storage and disposal of MSW at the municipal level requires substantial amounts of funding, as well as high-level specialists who can make financial and economic calculations in the planning and forecasting of volumes of MSW exported.

3. RESULTS

As a result of the study, the following conclusions were made. First, the implementation of the process of collection and disposal of MSW in the Russian Federation is characterized by deficiencies and lack of infrastructure infrastructure at the regional and municipal level, insufficient development and validity of tariff formation for export of MSW, problems in the formation of regulatory values for MSW export for rural and urban areas. Secondly, the problems listed at the tactical level have led to the difficulty of implementing operational tasks. As a result, the municipal organizations directly responsible for the performance of this function in the Russian Federation are organizations called “Clean City”, faced with a set of systemic problems in the field of organization, planning and financing of both their operational and strategic activities. Thirdly, in the framework of this study, a decision-making algorithm for management of MSW at the municipal level has been proposed, which will at the initial stage determine the existing resource potential of the organization and identify the necessary project initiatives for solving operational problems in the context of reforming the municipal solid waste management system.

4. CONCLUSION

Insufficient coherence of actions on the part of state authorities and the population, the lack of effective management methods for municipal solid waste, problems of financing projects for the storage, processing and disposal of MSW are a pressing problem not only for the Russian Federation, but also for other countries (Jordan [9], Slovenia and Croatia [2], Indonesia [3], Italy [8], India [5], etc.). It should be noted that pollution with solid municipal waste in rural areas is of relevance since it is the rural area that is the “receiving” side of the garbage dump because of the rapid processes of urbanization and urban growth. [20]. At the same time, the management of municipal solid industrial and medical waste is of importance. Currently, this issue has not found an effective solution. In this context, the proposed algorithm can be improved and refined to meet the specificity of municipal solid waste and from the position of the need to address design initiatives in operational activities.

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