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Regional Specifics of Municipal Solid Waste Management in Arctic Regions of the Russian Federation*

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Abstract. The article analyzes the regional specifics of solid municipal waste management in the Arctic zone of the Russian Federation. The relevance of the topic is determined by the need to analyze the regional specifics of solid municipal waste management within the framework of the federal project "Integrated System of Solid Municipal Waste Management", included in the national project "Ecology". First of all, this request will allow us to achieve the most effective management decisions in the field of regulatory regulation and the introduction of mechanisms for economic regulation of MSW management activities, as well as to contribute the creation of an effective management system, and the development of infrastructure for MSW management. The statistical analysis of formation indicators, processing and utilization of MSW waste in the structure by region is presented in this paper. The factors determining the specificity of MSW handling in the Arctic regions are defined. The expert survey made it possible to identify the main problems of implementing the garbage reform in the Arctic in general and in inner regions in particular. The main methods in this study were: semi-formal telephone interviews with representatives of environmental organizations and associations (18 informants), as well as collecting and analysis of statistical indicators of the MSW handling in the Arctic regions.

Keywords: *Arctic zone of the Russian Federation, ecology, municipal solid waste (MSW) management, scheme of territorial waste management, separate waste collection.*

Introduction

The ecological state of the Arctic zone territories of the Russian Federation is increasingly becoming the object of close managerial and research attention. In terms of environmental pollution sources, the main environmental damage to the territories of the Russian Arctic is caused by the activities of industrial enterprises, most of which continue to use aggressive technologies in the production process. In addition to the indicated environmental damage from industrial impact, the problems of waste generated as a result of consumption are becoming more and more acute.

The urgency of the problems of solid municipal waste (MSW) formation and disposal in the Arctic zone of the Russian Federation has not lost its force over the past three decades. The restructuring of the industrial sector, the loss of affordable models of cyclical production and processing of materials have significantly negatively affected the state of the environment in the region. The lack of a waste management system has led to uncontrolled accumulation of wastes at landfills and unauthorized dumps that do not meet environmental requirements. The continuous

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increase in the MSW volume (both in absolute terms and per capita), the complication of waste composition, which includes an increasing number of environmentally hazardous components, have led to the actualization and revision of traditional ways of MSW management at all levels.

At the moment, the issues of MSW management are identified at the highest management level as one of the main environmental problems of the Arctic zone of the Russian Federation ¹. Thus, according to the State Report "On the State and Protection of the Environment of the Russian Federation" submitted by the Ministry of Natural Resources and Ecology of the Russian Federation, the Arctic zone of the Russian Federation is recognized as the most sensitive to environmental pollution region of Russia. "The issue of anthropogenic impact on the natural environment in the Arctic zone of the Russian Federation is very acute due to the high vulnerability of geosystems and the low restorability of the region-specific landscapes" ².

Despite the recognition of the anthropogenic pressure problem and its consequences for the Arctic territories, the economic significance and potential of the Russian Arctic (primarily in the extractive, processing and transport sectors focused on carbon) are recognized as priority tasks of national policy ³, which raise the risks associated with increased amount of waste, including municipal waste.

Taking into account the strategic plans for socio-economic development of regions of the Russian Arctic, the problem of generation of consumption waste in the form of MSW requires a more detailed study: not only in terms of assessment of environmental damage from MSW or analysis of possible utilization options, but also from the point of view of studying the factors that determine the specificity of MSW management in the Russian Arctic.

Theoretical and methodological frame

The theoretical and methodological frame of this article is represented by two levels of work. The first is the general groundworks on the environmental aspects of life of Russian society; the second is the studies of various aspects of MSW management in the Russian Arctic.

The potential for research the ecological paradigm as an element of culture of Russian society was laid in the works of O.N. Yanitsky, L.G. Titarenko [1, 2, 3, 4]. The issues of environmental policy, conflicts and peculiarities of environmental organizations functioning are highlighted in the works of I.A. Khaliy; O.V. Aksenova, N. Levchenko, V.B. Golbrach [5, 6, 7, 8, 9, 10]. The problems of

¹ The report of the head of Rosprirodnadzor V.V. Kirillov at the international forum "The Arctic: Present and Future". URL: <https://rpn.gov.ru/search/?q=%D0%B4%D0%BE%D0%BA%D0%BB%D0%B0%D0%B4> (accessed 01 August 2020).

² State report "On the State and Protection of the Environment of the Russian Federation in 2018". URL: https://www.mnr.gov.ru/docs/o_sostoyanii_i_ob_okhrane_okruzhayushchey_sredy_rossiyskoy_federatsii/gosudarstvennyy_doklad_o_sostoyanii_i_ob_okhrane_okruzhayushchey_sredy_rossiyskoy_federatsii_v_2018/ (accessed 01 August 2020).

³ This proposition is reflected in regulatory documents, such as: "The strategy for the development of the Arctic zone of the Russian Federation and ensuring national security for the period up to 2020 (approved by the President of the Russian Federation on February 20, 2013)" and Resolution of the Government of the Russian Federation no. 366 of April 21, 2014 "On the State program of the Russian Federation "Social and economic development of the Arctic zone of the Russian Federation for the period up to 2020".

environmental awareness and behavior, in particular in waste management practices, are highlighted in the works of Yu.V. Ermolaeva, O. P. Ermolaeva [11, 12, 13].

With regard to research on the problems of MSW management in the Arctic, it is necessary to note the complexity of their coverage. Thus, the analysis of the statutory regulation of MSW in the Russian Arctic is presented in the works of S.A. Bogolyubov, I.O. Krasnova [14], I.A. Ignat'eva [15], V.A. Makov [16], I.A. Mizin [17]. Issues of handling (management) and features of territorial waste management schemes in the Russian Arctic are discussed in the studies of P.F. Agakhan'yants, A. Yu. Lomtev [18], S.A. Astaf'ev [19, 20], S.O. Kuz'mina, Yu.V. Anishchenko [21], V.A. Mar'ev [22] Yu.I. Sokolov [23]. The impact of MSW on the ecological situation in the Arctic regions is considered by O.V. Grigor'eva, M.O. Ivanets [24], V.I. Grebenets, V.A. Tolmanov, Yu.I. Sokolov [25]. The attitude of the Arctic region inhabitants to environmental threats and their impact on the population health are analyzed in the works of E.S. Klyukina [26, 27].

Despite the existing groundwork, the problem of MSW management requires an integrated approach and in-depth research, including the opinions of local participation agents, which makes it possible to identify the main obstacles to its effective solution, since the "degree" of environmental stress in the studied territories reaches its ultimate value due to different circumstances.

Research methods

This article is carried out within the framework of the RFBR grant and is one of the stages of work solving the problem of researching the opinion of the expert community in the regions of the Russian Arctic with regard to the problem of MSW management. This stage is the precursor to a series of representative surveys that the team of authors is going to conduct during 2020–2021 in the Russian Arctic regions, specifically in the Murmansk and Arkhangelsk regions, the Republic of Karelia and the Nenets Autonomous Okrug.

The main research method was a semi-formalized survey with environmental activists, whose profiles and communities are represented on the VKontakte network⁴ and have a larger (in comparison with other communities within the regions) number of subscribers. The number of interviewed experts was 18 informants (from the Murmansk region, the Arkhangelsk region, the Republic of Karelia, the Republic of Komi, the Republic of Yakutia (Sakha)).

Methods of statistical collection and processing of information were an important part of the work. The main sources were the following: official statistical database of the UISIS; annual reports of regional ministries of the Russian Arctic on the state and protection of the environment; formal inquiries to the Baltic-Arctic Interregional Administration of Rosprirodnadzor, regional schemes of territorial waste management.

⁴ The choice of this network was based on the popularity rating of the website in the Russian-speaking segment of the audience. URL: Global Internet Statistics for 2020 — Digital report on the state of digital technologies in the world and in Russia (web-canape.ru) (accessed 01 August 2020).

Statistical indicators of the formation, processing and utilization of MSW in the structure by regions of the Russian Arctic

According to Federal Law 89-FZ⁵, solid municipal waste is defined as waste generated in residential premises during consumption by individuals, as well as goods that have lost their consumption properties in the process of their use by individuals in residential premises in order to satisfy personal and domestic needs. Solid municipal waste also includes waste generated in the course of the activities of legal entities, individual entrepreneurs and similar in composition to waste generated in residential premises in the process of consumption by individuals.

To understand the scale of the MSW management problem, it is necessary to refer to the statistical indicators; the data are presented in Table 1.

Table 1

Indicators of MSW formation in the structure by regions of the Russian Arctic⁶

Subjects of the Russian Federation	MSW formation 2019, thousand tons	The resident population of the Russian Arctic territories, thousand people	MSW in kg per 1 inhabitant
Murmansk region	277 .4	741 .4	374 .2
Yamalo-Nenets Autonomous Okrug	241 .3	541 .4	445 .7
Arkhangelsk region	102 .8	605 .6	169 .8
Republic of Karelia	45 .5	113 .7	399 .8
Komi Republic	27 .7	74 .7	371 .4
Chukotka Autonomous Okrug	19 .2	19 .2	387 .1
Republic of Sakha (Yakutia)	17 .2	59 .4	289 .2
Krasnoyarsk region	15 .7	216 .9	463 .4
Nenets Autonomous Okrug	15 .6	43 .8	356 .2

The data in Table 1 indicate that the largest volume of MSW formation is in the Murmansk region (32.7%) and the Yamalo-Nenets Autonomous Okrug (28.5%). The smallest volume of MSW formation (up to 5%) is in the Nenets Autonomous Okrug (1.8%), in the Arctic territories of the

⁵ Federal'nyy zakon "Ob otkhodakh proizvodstva i potrebleniya" ot 24.06.1998 N 89-FZ. [Federal Law "On Production and Consumption Wastes" dated 24.06.1998 no. 89-FZ]. URL: http://www.consultant.ru/document/cons_doc_LAW_19109/ (accessed 01 August 2020).

⁶ Data source for the regions of the Russian Arctic — Source: Annual report on the protection and state of the environment in 2019 in the Murmansk, Arkhangelsk regions, the Nenets Autonomous Okrug, the Republic of Karelia, the Yamalo-Nenets Autonomous Okrug, the Komi Republic, Krasnoyarsk Territory and the Republic of Yakutia (Sakha), Chukotka Autonomous Okrug. For a number of regions where reports are not publicly available or regions that include Arctic territories, data were collected on the basis of formal inquiries to the Baltic-Arctic Interregional Administration of Rosprirodnadzor. Resident population — UISIS data. Formation of 1 kg of MSW per 1 inhabitant is calculated by the authors on the grounds of the volume of MSW per year (thousand tons) in the Arctic region or the Arctic territory per total number of residents.

Krasnoyarsk Territory (1.9%), the Republic of Sakha (Yakutia) (2.0%), the Chukotka Autonomous Okrug (2.3%) and the Komi Republic (3.3%). In the context of the average indicator of MSW amount in kg per 1 inhabitant of the Arctic regions, it can be stated that the data do not exceed the mean values for Russia as a whole — 400–500 kg per person per year. It is probably worth mentioning the lowest level of MSW formation in the Arkhangelsk region with the approximate amount of 170 kg per inhabitant per year.

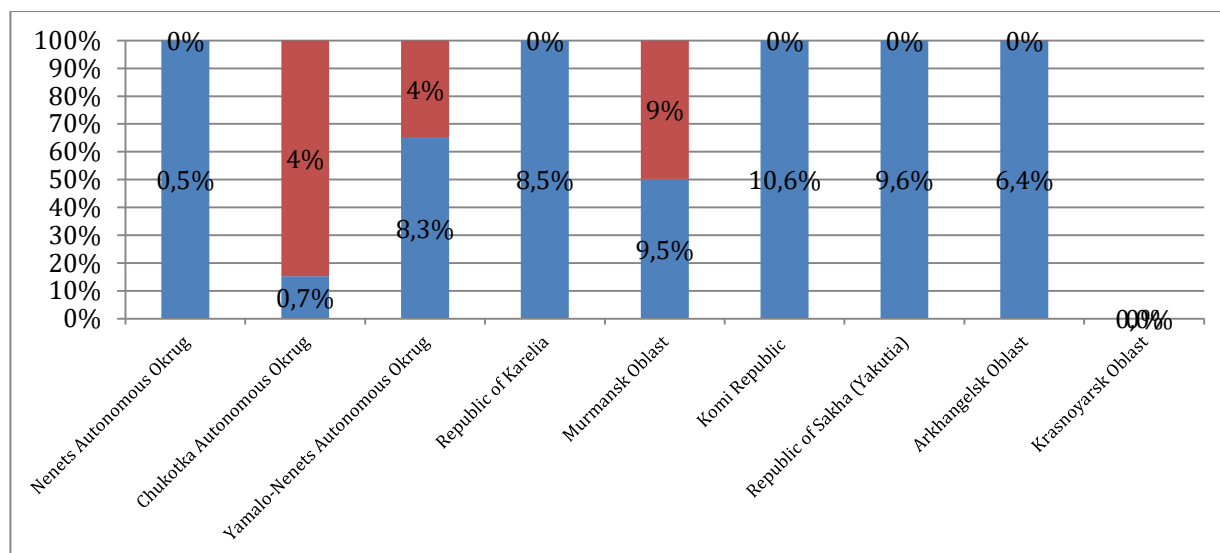


Fig. 1. Indicators of MSW processing and utilization in the structure by regions of the Russian Arctic, 2019 ⁷.

Figure 1 shows data on the processing and utilization of MSW in the structure for the Arctic regions. Concerning the MSW processing, it should be noted that this indicator does not exceed 10.0%. Regarding to the MSW utilization, it is possible to state that it is lacking in most of the northern territories. MSW utilization work is insignificantly carried out in the Murmansk region, where 9.0% of the total waste volume is utilized, in Chukotka and Yamalo-Nenets Autonomous Okrugs with 4.0% each.

A serious problem and one of the administrative tasks in the field of MSW management is the reduction of wastes placement facilities, primarily those formed unauthorizedly or those that have lost compliance with the SanPiN standards. Table 2 provides the current statistical information on the MSW placement facilities in the regions of the Russian Arctic.

Table 2

The number of sanctioned and unauthorized MSW placement facilities in the structure by regions, 2020 ⁸

AZRF region	Number of MSW placement facilities included in the SRWDS ⁹	Number of unauthorized dumps
Republic of Sakha (Yakutia)	260	329

⁷ Annual reports on protection and state of environment by the subjects of the Russian Arctic, 2019.

⁸ Annual reports on protection and state of environment by the subjects of the Russian Arctic, 2019. Official responses to formal inquiries to the Baltic-Arctic Interregional Administration of Rosprirodnadzor.

⁹ State register of waste disposal sites. URL: https://clevereco.ru/groro/respublika-karelija?sort=order_date&page=5 (accessed 01 August 2020).

Yamalo-Nenets Autonomous Okrug	145	350
Murmansk Oblast	78	147
Arkhangelsk Oblast	46	51
Nenets Autonomous Okrug	36	244
Republic of Karelia (Arctic territories)	30	10
Krasnoyarsk Territory (Arctic territories)	18	43
Chukotka Autonomous Okrug	12	44
Komi Republic	11	335

The problem of dumps in the northern regions is urgent for the population due to the fact that the majority of unauthorized landfills are formed within cities and rural settlements. The increase of waste volumes is becoming the subject of active discussion in the regional media, on the social networks profiles and among environmental activists more and more often.

According to the National Atlas of the Arctic, the Murmansk Region and the Republic of Sakha (Yakutia) have the highest total anthropogenic load in recent years; average anthropogenic load is in Arkhangelsk Region, Yamalo-Nenets Autonomous Okrug, Komi Republic and Krasnoyarsk Territory (Taimyr Dolgan-Nenets Okrug); the lowest level is in the Nenets Autonomous Okrug and Chukotka Autonomous Okrug¹⁰.

Factors determining the specifics of MSW management in the regions of the Russian Arctic

The main factors determining the specifics of MSW management in the Russian Arctic are:

Natural and climatic factors. The low average annual temperature, the presence of perennial frozen soils in most areas, the absence of fertile soils in the required volumes, which are recommended to be used for layer-by-layer waste isolation [29, Ulanova Z.A.] require implementation of special approaches to MSW management in the Far North.

Territorial factor. It should be noted that the regions of the Russian Arctic are territories that are difficult to compare in terms of a number of parameters (size of territories, density, remoteness, logistic accessibility). For example, the Arctic territories of the Krasnoyarsk Kray, the Chukotka Autonomous Okrug, the Nenets and Yamalo-Nenets Autonomous Okrug have a less favorable location than the Murmansk, Arkhangelsk regions, the Komi Republic and the Republic of Karelia: due to the lack of roads, the only possible ways to get to remote settlements and other regions — by water or air. Of course, this imposes serious restrictions on the possibility of MSW removing and processing, and what is possible to implement in one part of the Russian Arctic turns out to be difficult to achieve in another. An example is the legislative limitation of the terms of MSW accumulation at storage sites, which are limited to a period of 11 months. It is not possible to meet with these requirements in the Nenets Autonomous Okrug. The administration of the Nenets Autonomous Okrug has sent appeals to the Ministry of Construction, the Ministry of Natural Resources and the Ministry of Transport with an initiative to increase this period up to 36 months in those settlements where the number of residents is less than one and a half thousand and there are no roads.

¹⁰ Natsional'nyy atlas Arktiki [National Atlas of the Arctic]. Moscow, Roskartografiya, 2017. 75 p.

The problem of waste management in remote areas within the Arctic regions is crucial and actively discussed. In accordance with the Federal Law of 24.06.1998 No. 89-FZ¹¹ "On Production and Consumption Waste" as amended in 2014, all regions of the Arctic zone of the Russian Federation have developed territorial waste management schemes (TWMS). Researchers Agakhanyants P.F., Lomteva A.Yu., Primak E.A., Vyucheyskaya D.S., analyzing territorial waste management schemes in the Arctic regions, focus on the problems of MSW management in remote areas [18]. Thus, the MSW transportation and utilization are the most complex cases in the Nenets and Chukotka Autonomous Okrugs, in the Arctic territories of the Krasnoyarsk Kray, the Sakha Republic and the Komi Republic. The intraregional transit of MSW is significantly complicated for these regions; separate decentralized zones of regional operators are being created throughout these territories. In this regard, the questions of profitability and investment attractiveness of such technological zones remain open. The experience of the Chukotka Autonomous Okrug is noteworthy: its territory is divided into technological zones, and each of them is maintained by one of the 24 regional operators.

In TWMS of remoted areas of Murmansk, Arkhangelsk regions and the Arctic territories of the Republic of Karelia, MSW management is also a point of vulnerability. In fact, responsibility for the MSW management in these regions is shifted from the regional operator to the population, who is offered to separate, incinerate and compost waste by their own [18, Agakhanyants P.F. et al., p. 52]. However, there is no specific description of the separate collection system, which certainly creates the prerequisites for unauthorized dumps.

Ecological and economic factor. The main stake in the MSW management practice in all regions of the Russian Arctic is made on waste sorting complexes and further dumping of waste, which causes misunderstanding among the environmental community, since, with all the relevance and managerial attention to the topic, the implementation of the reform does not contribute to the effective collection and sorting of waste.

So, according to the Greenpeace report, which presented data on cities of AZRF with a population of 160 thousand people, access to stationary containers for separate waste (presented in the report) is as follows:

Table 3

Ranking of cities in terms of the residents' accessibility to separate waste collection, 2018–2019¹²

Place in the Greenpeace ranking, 2019	AZRF city	Residents' accessibility to separate waste collection in 2019, %	Residents' accessibility to separate waste collection in 2018, %
52	Noyabrsk	41	37
69	Syktyvkar	21	16
78	Severodvinsk	14	34
95	Arkhangelsk	8	34

¹¹ Federal'nyy zakon "Ob otkhodakh proizvodstva i potrebleniya" ot 24.06.1998 N 89-FZ [Federal Law "On Production and Consumption Waste" of June 24, 1998 no. 89-FZ]. URL: http://www.consultant.ru/document/cons_doc_LAW_19109/ (accessed 01 August 2020).

¹² Rating of the availability of separate waste collection in large cities of the Russian Federation. URL: greenpeace.ru/blogs/2020/03/12/rejting-greenpeace-kazhdyj-tretij-zhitel-krupnogo-goroda-rossii-imeet-dostup-k-razdelnomu-sboru/ (accessed 01 August 2020).

148	Murmansk	0	30
152	Norilsk	0	0
163	Yakutsk	0	0

As follows from the table 3, the situation in regional centers in terms of the residents' accessibility to the local separate waste collection is complex and ambiguous. Noyabrsk city, Yamalo-Nenets Autonomous Okrug, has positive dynamics in the rating and takes the highest line of the table. Severodvinsk, Arkhangelsk and Murmansk cities dropped by several positions in the ranking during the year. According to a Greenpeace report, there is no access to separate waste collection in such cities as Norilsk and Yakutsk. But it is worth noting that a drop in the rating and a zero value do not mean a lack of sorting in the regions.

The territorial schemes of all AZRF regions presuppose separate waste collection (SWC) in future, but this task is currently poorly implemented. It is worth mentioning that the SWC experience for large cities has been implemented in all regions of the Russian Arctic. In the Arkhangelsk region, for example, a two-container system of separate waste collection, implemented by AMPK LLC, has been operating for several years in large cities (Arkhangelsk, Novodvinsk, Severodvinsk). The territorial waste management scheme of the Arkhangelsk region contains a target indicator according to which a separate waste collection is planned to be implemented in 10 settlements with the largest population and a high level of infrastructure development. According to environmental experts, this approach to the MSW collection will make it possible to recycle up to 60% of waste, which is recognized as a good indicator, equated to the European experience.

After the commissioning of a waste sorting complex in the Murmansk region in 2019, separate containers for collecting plastic and glass (sold by ORKO-Invest LLC) disappeared from the territory of Murmansk city. Today, separate waste collection in large cities of the region is an exclusive initiative of environmental organizations, associations and a small part of the population.

Separate waste collection is not carried out in the Chukotka Autonomous Okrug. The main reasons for this are the insignificant amount of waste (the population of the ChAO is about 49 thousand people) and the lack of economic practicability, as well as the harsh climatic conditions (the duration of winters is 8–9 months), the inability to deliver wastes to the burial sites due to the lack of roads, the absence of processing plants and the high cost of exporting recyclable materials to other regions. It should be noted that the Chukotka Autonomous Okrug is in the most difficult situation in the Russian Arctic: the situation with landfills for solid municipal waste disposal has reached a critical point in the region, so, according to the report of the Accounts Chamber of the Russian Federation, the landfills will be completely filled in the next 7 years¹³.

¹³ Otchet o rezul'tatakh ekspertno-analiticheskogo meropriyatiya «Monitoring khoda realizatsii meropriyatiy natsional'nogo proekta «Ekologiya», v tom chisle svoevremennosti ikh finansovogo obespecheniya, dostizheniya tseyey i zadach, kontrol'nykh tochek, a takzhe kachestva upravleniya» (s rassmotreniem promezhutochnogo otcheta na zasedanii Kollegii Schetnoy palaty Rossiyskoy Federatsii) [Report on the results of the expert and analytical event "Monitoring of the activities implementation of the national project "Ecology", including the timeliness of their financial support, achievement of goals and objectives, control points, as well as the quality of management" (with consideration of the interim report at a meeting of the Board of the Accounts Chamber of the Russian Federation)]. URL: <https://ach.gov.ru/upload/iblock/697/6974665033576448bae98baa0e9626e4.pdf> (accessed 01 August 2020).

As the informants noted, the declared objectives of the national project “Ecology”, which implicate a progressive approach to waste management and have a goal of reducing unauthorized dumps and maximizing recycling resources, correlate poorly with their implementation. According to experts, the possible volume of secondary resources obtained at waste sorting stations does not exceed 18%¹⁴, which cannot be considered effective. And the subproject “Integrated MSW Management System” does not contain the necessary incentives and measures for the separate collection of waste and its recycling.

Table 4 contains information on the number of organizations involved in the collection, utilization and recycling in the regions of the Russian Arctic.

Table 4

*Organizations collecting, utilizing and processing recyclable materials in the structure of the Russian Arctic regions, 2020*¹⁵

AZRF region	Number of organizations involved in collection and utilization	Number of organizations involved in recycling
Arkhangelsk Oblast	20	1
Komi Republic	18	0
Yamalo-Nenets Autonomous Okrug	15	1
Murmansk Oblast	14	0
Krasnoyarsk Krai (Arctic territories)	13	0
Nenets Autonomous Okrug	8	0
Republic of Sakha (Yakutia)	6	2
Republic of Karelia (Arctic territories)	4	0
Chukotka Autonomous Okrug	-	-

The presented data indicate a weak development of the market for recyclable materials in the territories of the Russian Arctic. Processing plants are located only in three regions of the AZRF (Arkhangelsk Region, Yamalo-Nenets Autonomous Okrug and the Republic of Sakha (Yakutia)).

In order to fully understand the reasons for the inefficiency of the waste reform implementation in the regions of the Russian Arctic, we conducted semi-formalized interviews with representatives of the environmental community of the AZRF regions. Summarizing the data obtained, we received the following opinions of the informants.

1. Territorial waste management schemes. All survey participants are unanimous in their understanding of the discrepancy between the documents and the northern regional specifics. The attitude towards the tasks and the main idea is unambiguously positive, but not towards the methods of the implementation. The most critical respondents were the residents of the Arkhangelsk region, who, in addition to their high level of competence, indicated their own participation in public hearings and the proposals introduction (about 1300). All the respondents consider the existing schemes to be pilot projects that require serious improvements, in particular on the mechanisms of separate waste collection and the problems of remote settlements. The main ob-

¹⁴ The experts called different percentages with the range from 10% to 18% (the maximum mention is used in the text).

¹⁵ Compiled by the authors, based on work with open data of Internet resources.

stacle, according to public opinion, is the adherence of the regional authorities to the formal principle of development and implementation of the document just for *“a tick at the top”*; the measures taken do not contribute to a qualitative solution of the problem of MSW formation and utilization. The main expectation of the informants is a dialogue with decision-makers on the creation of a clear system of MSW management, where optimal conditions are created, legally and financially, for everyone: from a consumer and a regional operator to a processor-producer. Today, most interviewees believe that such conditions do not exist, and that the authorities are not ready for a meaningful dialogue.

2. Waste recycling. The lack of support from the regional authorities is unanimously considered by the informants as the main obstacle to the development of the recycling market. The involvement of the business community in the processing or production of goods from recyclable materials is not possible without public-private partnerships. Support in form of special tax regime or other forms of assistance are identified as key expectations. The second reason is the economic unattractiveness and long-term profitability of projects. Companies engaged in or experienced in the production of goods from recyclable materials see the benefit only in production volumes that can be sold within the region. In this case, the remoteness of the AZRF regions is a factor of economic disadvantage due to logistics costs. It is also worth mentioning that, despite the positive experience of SWC introducing in the cities of the Russian Arctic, this process remains the merit of environmental organizations and the personal (economically unattractive) initiative of individual entrepreneurs. According to the informants, the production of recyclable materials in the Russian Arctic is *“absolutely adventurous”*.

3. Environmental consciousness of population. It is difficult to solve the MSW problems without massive public involvement in the SWC practices. The opinions of informants in this parameter were not unanimous even within the same region. About 60% of the respondents admitted that population was ready to sort wastes and indicated the lack of the necessary infrastructure for SWC, suggesting significant financial support for this process from regional and municipal authorities, which do not have such opportunities. Another part of the expert community was more critical of environmental consciousness and public awareness. First of all, this referred to the reluctance of most people to get involved in waste sorting for a number of reasons: firstly, because of difficulties with the storage and accumulation of a certain type of sortable waste; secondly, the absence or remoteness of necessary infrastructure for separate collection; thirdly, the vulnerability of motivation to sorting waste. So, as an example, the situation with the January holidays in Arkhangelsk was cited, where the local garbage cans were overfilled with consumer waste while the public holidays and, in order not to dump garbage next to those cans, citizens threw unsorted garbage in containers for SWC. Informants from Yakutsk indicated that SWC practices should be introduced gradually and should start little by little, namely *“with batteries and tops”*; based on their own experience, they pointed out that the level of population consciousness in the field of SWC and understanding of waste fractions is still at an extremely low level. The informants also

noted that young people from primary school children up to 35 years old are more involved in SWC processes than senior citizens.

4. Work of regional operators. Regional operators are organizations that are responsible for the entire MSW cycle, including collection, transportation, processing, utilization, decontamination and disposal of wastes in specially designated locations. Regional operator service is paid by the owner of solid municipal waste: the population — flat owners in apartment buildings and owners of private households, legal entities and individual entrepreneurs.

The activities of regional operators in the AZRF regions are not easy. This is especially true for remote regions of the Russian Arctic. As mentioned above, there are 24 regional operators in the Chukotka Autonomous Okrug (10 organizations: 5 are enterprises of housing and utilities infrastructure with organizational and legal form of a municipal enterprise and a municipal unitary enterprise, and 5 are limited liability companies), 4 regional operators in the Republic of Yakutia (Sakha) (3 of them are limited liability companies, 1 is a state unitary enterprise), in the Nenets Autonomous Okrug there are 2 operators (municipal enterprise and municipal unitary enterprise), Arctic territories of the Krasnoyarsk Krai has 2 operators. The activities of regional operators in the above-mentioned territories are complicated by the lack of necessary infrastructure, which contributes to the economic justification of tariffs. Most of the operators are state-owned unitary enterprises. These regions are not very attractive for investors and the choice of regional operators remains a serious problem. For example, a regional operator for the northern zone of the Krasnoyarsk Krai (Turukhansk District) has not yet been chosen.

According to the reform, in order to become a regional operator companies had to go through a tender procedure, the main idea of the document was the competitive nature of the auction, where a decrease in the price of services reduces the tariff for citizens. This plan did not take into account the specifics of work in the Far North, which was economically unattractive for a regional operator. The consequences had the opposite effect: companies with no work experience and dubious reputations entered the market. Informants noted the example of the Arkhangelsk region, where EcoIntegrator company entered into a concession agreement with the regional administration and received a 10-year contract for removal and disposal of waste for a total amount of 28.3 billion rubles due to uncompetitive bidding. This company was established a year before the auction with one employee and an authorized capital of 10 thousand rubles. A similar situation is in the Chukotka Autonomous Okrug with the company RTK LLC: the lack of experience and competition allowed the organization to conclude a contract worth almost 137 million rubles. Karelia and Yakutia (Sakha) also have problems with choosing and work of regional operators.

The economic justification of tariffs by regional operators is also a complex issue for their activities. The highest rates are in the Chukotka Autonomous Okrug: waste transportation is the most expensive there. It should be added that payment discipline in most regions of the Russian Arctic is very high, the leaders are the Murmansk region, the Chukotka Autonomous Okrug, the

Republic of Karelia and Yakutia (Sakha). The average indicator for the Russian Federation is 50%, in the above designated regions (except for the Republic of Yakutia (Sakha)), it exceeds 80%.

All the informants of the study were recruited from the VKontakte social network. As the analysis of the network activity¹⁶ of local environmental organizations has shown, the topic of waste management is one of the most mentioned in the environmental agenda of the regions. Analysis of environmental organizations in all regions of the Russian Arctic has revealed three types of communities or profiles: regional public environmental organizations, initiative groups for MSW collection and territories cleaning up and activists with protest potential. The population network activity in the field of environmental issues is especially gaining strength in recent years, representing a special form of oppositional political participation [10, Gol'braykh V.B.]. For example, the most active protesters are groups of the Arkhangelsk region. This is related to the attempt to build a waste disposal facility at the Shies station, which caused a wave of indignation and resistance from the population of the Arkhangelsk region. There were network groups accumulating protest potential, such as "Pure Urdoma — Reload", "Pure Yarensk", "We are against the landfill in the Lenskiy district", "We are against the landfill on Shies!"

The topic of MSW management is crucial for a number of local associations that carry out educational activities among the population and the business community on the topic of separate waste collection and recycling. Such associations differ from classical environmental NPOs in a number of parameters: firstly, most of them do not have a long history of existence (usually 2–3 years) and they are not affiliated with any large regional or global environmental organizations; secondly, they have project-based nature of activity: most of associations do not have an organizational form, but are volunteer meetings of caring people; thirdly, they have only educational activities for organizing master classes, open lessons, eco-weeks and separate collection of waste and its delivery to recycling enterprises (mostly located in other regions); fourthly, such associations do not initiate dialogues with relevant authorities.

The most popular environmental organizations and associations of the Russian Arctic regions, either specializing or having one of the relevant topics "MSW management", are presented in the table below.

Table 5

Network representation of environmental organizations and associations in the regions of the Russian Arctic
17,18

AZRF region	Organizations and associations specializing only in the MSW problem	Organizations and associations having MSW problem on the agenda
Arkhangelsk Oblast	ECC	Environmental Movement 42

¹⁶ To search for environmental organizations and movements in the regions of the Russian Arctic, the program vk.barkov.net (<https://vk.barkov.net>) was used, which allows to identify thematic pages of groups and personalities, as well as to analyze the content of the wall in social networks.

¹⁷ Compiled by the authors based on the data analysis of the VK network and interviews.

¹⁸ The table does not include regional branches of all-Russian organizations; in this case, the selection was made specifically for local movements.

		Biarmia Green owl Pure North 29 Pomorie is not a dump
Murmansk Oblast	Pure Arctic	Nature and youth "Bellona-Murmansk"
Nenets Autonomous Okrug		Eco-Development Fund of the NAO
Yamalo-Nenets Autonomous Okrug	YANAO project "Future of the Arctic"	Ecology of Yamal
Chukotka Autonomous Okrug		Youth Support Fund
Republic of Sakha (Yakutia)	Separate Collection Yakutsk	Center for work with volunteers of the Republic of Sakha (Yaku- tia)
Arctic territories of the Republic of Kare- lia		Green wave
Komi Republic	Separate waste collection — Komi Re- public ECO_TIME_COMI	Pechora Rescue Committee
Arctic territories of the Krasnoyarsk Kray		Factory of kindness

In our opinion, local associations are most involved in the problem “from the inside” and represent its scale, shortcomings and possible solutions in a more vivid way.

Conclusion

Nevertheless, the conducted research has revealed a certain potential for further immersion in the problem and the necessity of its verification. In particular, it is a representative survey of the population in the field of environmental and economic practices that are implemented in the AZRF regions and possibility of their comparison and more detailed forecasting of volume of MSW formation and utilization. Research hypotheses that require further clarification appeared in the course of communication with informants, for example: whether such indicators as age groups, place of residence (urban (large / small city) / rural area) and the degree of population rootedness correlate with the level of their ecological culture.

The study has several unequivocal conclusions:

- Russian legislation does not fully take into account the climatic and territorial specificities of the AZRF regions in the field of waste management;
- The distance of remote communities and the remoteness of the regions themselves are a major obstacle to the waste management implementation, which reduces significantly the investment attractiveness of the MSW processing and recycling projects;
- Further development of the main idea and tasks of the Federal project “Ecology” is impossible without implementation of special conditions for the business community, ready to develop the recyclable materials market, and introduction of a separate waste collection system;
- There is a necessity of clear regional coordination in matters of substantiation of the best technologies in waste management;

- Serious managerial attention is required by the absence of a system which will make it possible to build a clear MSW management scheme, with maximum interests' observance of the agents influencing the MSW problem in the Russian Arctic;
- The environmental agenda of local activists is the evidence of active work with the public in the field of separate waste collection necessity, but this potential, which is realized exclusively as an initiative "from below", is not seriously supported by the regional authorities, and the stake on waste sorting complexes destroys the potential from the population.

Taking into account the complexity of the waste reform implementation, the Ministry of Natural Resources and Environment of the Russian Federation has developed a "road map" for the introduction of separate waste collection in the territory of the Russian Federation. The document establishes the procedure of tax incentives application to maximize the extraction of secondary resources from waste and their subsequent involvement in economic circulation, contains recommendations for changing building regulations: for example, abandoning garbage disposers in apartment buildings. An important note is the introduction of the "secondary resources" concept into the legislation. At the moment, the document is being negotiated.

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