Pol. J. Environ. Stud. Vol. 32, No. 4 (2023), 3267-3280
DOI: *10.15244/pjoes/161666* ONLINE PUBLICATION DATE: 2023-04-21

Original Research

Comparative Legal Aspects of Waste Management Policies

Vasilios Papastamoulis[1]*, Alexey Koryakov[2], Sergei Pavlikov[3], Lubov Vorona-Slivinskaya[4]

[1]School of Engineering, Design and Built Environments, Western Sydney University, Penrith, Australia
[2]Department of Management and Innovations, Financial University under the Government of the Russian Federation, Moscow, Russian Federation
[3]Department of Legal Regulation of Economic Activity of the Faculty of Law, Financial University under the Government of the Russian Federation, Moscow, Russian Federation
[4]Department at the University of Construction Technology, Saint Petersburg State University of Architecture and Civil Engineering (SPbGASU), Saint Petersburg, Russian Federation

Received: 9 November 2022
Accepted: 25 February 2023

Abstract

Today's world trends in the field of rapid population growth and urbanization have led to uncontrolled waste accumulation. The development of industrial activities in developing countries has increased the amount of waste generated from economic activities, which has led to environmental problems due to the complexity of waste management. The purpose of the study is to consider and update the knowledge on the practical application of national waste management strategies and plans in developed countries (United States, Japan, Australia, European Union countries), states with economies in transition (Russian and Kazakhstani cases), and developing countries (Asia and South America cases). The conceptual method was used to analyze the nature of complete and partial waste disposal and utilization as forms of waste management as well as for practical application of certain forms of waste management in different states. Knowledge about the practical aspects of the implementation of national waste management strategies and plans in various states was updated and systematized, the advantages and disadvantages of certain waste management forms were revealed. The paper provides an opportunity to systematize world experience regarding innovations in the field of waste recycling and how it can be applied in countries with different levels of development.

Keywords: complete waste disposal, developed states, developing states, partial waste disposal, recycling, states with economies in transition

*e-mail: vaspapastamoulis@yahoo.com

Introduction

The concept of 'waste' has quite a broad meaning as it can be presented in various physical states, most often as a solid or liquid. The majority of wastes these days, including household, medical, industrial, etc., are classified as solids regardless of their actual belonging to them [1]. As a rule, solid waste involves various kinds of food products, household items, goods, industrial materials and products, etc., which have lost their consumer qualities during operation and, as a rule, are not subject to further use [2]. At the United Nations (UN) level, waste is defined as materials that are not primary and not subject to use, which results in their disposition. Simultaneously, it is indicated that these do not include, firstly, recyclable and reused materials, and secondly, the materials in various physical states that have polluting properties, and also directly enter the water or air environment [3].

There are different classifications of waste in the scientific literature. First, as already mentioned, waste can be divided into solid, liquid or gaseous waste in accordance with its physical state. By the method of waste generation, there is industrial waste and consumer waste. By the sphere of waste generation, industrial, household and agricultural waste types are distinguished. By the criterion of waste origin, the latter are divided into organic waste, chemical waste, mineral waste and the so-called municipal waste [4,5]. According to the United Nations, there are such types of waste as agricultural waste, fishing waste, and forestry waste, mining waste, industrial waste, which is divided into hazardous and non-hazardous; waste of various kinds of systems of electricity, gas supply, air conditioning, as well as steam generation; construction waste; other types of waste from various economic activities; municipal waste; household waste [3, 6].

The presence of numerous problems associated with the generation of waste in the process of various activities creates a number of difficulties. For example, economies in transition and developing countries are concerned not only about the issue of waste recycling and waste processing before final disposal, but also about the storage of waste before its disposal, which is problematic due to the limited waste processing industry. In addition, there are frequent cases of detection in people living near garbage accumulations of a number of diseases, such as oncological diseases (cancer of the brain, lungs, etc.), congenital anomalies in children, and the potential risk of skin, nervous and musculoskeletal system diseases [7, 8]. These negative consequences of the spread of waste require states to get involved and take the responsibility for waste management in order to normalize public welfare. The term waste management is more inherent in Western countries, but it is actively used in the scientific literature of many other countries [9]. There are three main methods of waste disposal: complete disposal, partial disposal and utilization. In the first case, waste is stored in a special isolated place until it is completely disposed. Partial disposal involves waste fragment separation in order to obtain secondary raw materials, the rest can be destroyed. Utilization implies the full use of waste by separating secondary raw materials, combustible components, and organic substances with the further destruction of waste residues with the release of energy or steam [10].

Waste management should be described as organized activities for handling various types of waste [9, 11] the purpose of such measures is to prevent negative impacts on the environment and human health [12, 13]. The relevance of the implementation of an effective waste management system is monitored in developed countries, economies in transition, and developing states. It should be noted that this classification of states was introduced by the International Monetary Fund [14]. Developed countries are characterized by a market economy and advanced potential in the world market, so that, due to their status, they are able to ensure population well-being. The developed countries include most Western European states (for example, Germany, France, Great Britain, etc.), Canada, the USA, Israel, Japan, South Africa, New Zealand and Australia. The economies in transition are the countries of Eastern Europe and former Soviet Union republics (including the Russian Federation, the Republic of Kazakhstan, Georgia, Ukraine and a number of others), as well as Albania, Vietnam, China, Mongolia. Developing countries also include states with high per capita income (the United Arab Emirates), average per capita income (Tunisia) and the least developed countries (Congo) [14, 15]. The effectiveness and success of national waste management strategies differ across the groups of states.

These strategies and plans are being more efficiently implemented in developed countries, as evidenced, among other things, by the experience of the member states of the European Union. For example, the mass use of waste landfills has been abandoned in Germany since 2005; to this day, only a small number of them continue to operate with certain restrictions. In parallel, most of the waste there is subject to specific treatment, which allows the recycled waste to be reused. The latest systems for sorting, processing and cleaning waste in Switzerland make it possible to profit from recyclable waste (including by extracting particles of gold and silver from waste). Sweden, being a leading state in the field of waste management, has introduced a dual system, according to which, some waste is recycled and reused while the rest is incinerated as a result of sorting in order to obtain energy [16, 17]. In the Russian Federation, in turn, only half of the total amount of waste can be recycled (due to the limited production capacity) and the rest is stored in landfill sites [16, 18]. This issue is even more relevant for developing countries [5].

For example, due to the nonexistence of or limited transfer stations or other relevant infrastructure, in many

lesser developed countries, wastes are transported for ultimate disposal in water bodies, dumpsites or streets, which causes irreversible environmental damage [19]. This is typical for countries with a sharp rise in the level of industrial production, such as Pakistan, India, China, Vietnam, and some countries in the Middle East. For developing countries, some garbage collection methods should be singled out separately, which can be called familiar, but already outdated for more developed ones. The prevalent collection methods in the lesser developed and developing countries are road-side collection (e.g. Nepal) and door-to-door collection by community-based organizations (e.g. Sri Lanka and Vietnam) [20]. Sustainable Development Goals (SDG) assistance has not yet brought the expected positive effects, and the most relevant reason for the stagnation in waste management (including plastic common in poor countries) is the banal lack of comprehensive strategies for collecting, transporting, sorting and managing waste [21].

The issue of applying the experience of full and partial burial and disposal of waste in different countries should be approached individually, having studied the specifics of countries separately. Important components are the geographical location of the country, the level of its development, the structure of the economy, the current state of the necessary infrastructure capable of driving programmatic change in the industry [22]. Only by comparing similar indicators of two or more countries, it is possible to build a strategy, whether the experience of using full and partial disposal and disposal of waste is suitable for one country in relation to another or not. A good support for the mutual exchange of experience can be countries located in a common economic or cultural space. For example, such regions include the European Union, the countries of the former USSR, the Arab countries, the ASEAN countries [23]. Already in each individual aspect, it is possible to determine which part of the experience will be most valuable in a particular area, so that it is successfully implemented and brings the necessary benefits.

Based on the mentioned factors, the motivation for this research is the need to update and systematize current knowledge on national strategies and plans for the management of various types of waste. Consequently, the purpose of the study is to analyze and update the knowledge gained about the practical aspects of the implementation of national waste management strategies and plans. To achieve this goal, the following intermediate objectives have been set: 1) analysis of national waste management strategies and plans implemented in developed countries; 2) analysis of national waste management strategies and plans implemented in economies in transition; 3) analysis of national waste management strategies and plans implemented in developing countries; 4) comparative analysis of national waste management strategies and plans in the context of these three groups of states.

Research Methodology

This study examined the practical aspects of the implementation of national waste management strategies and plans by various groups of states (namely, developed, developing and those with economies in transition). Within the framework of the investigation, the following issues were considered: 1) the advantages and disadvantages of the three main waste management methods, namely, complete waste disposal, partial waste disposal, and waste utilization; 2) practical aspects of the application of a certain waste management method, including in comparison with the approaches of the states in accordance with their national waste management strategies and plans. In addition, with the help of the combination of the conceptual and comparative methods, a comparative analysis of the key dogmas of the practical implementation of national waste management strategies and plans in developed countries, states with economies in transition, and developing countries was carried out. As a result of the study, knowledge about the practical aspects of the implementation of national waste management strategies and plans in various states was updated and systematized, the advantages and disadvantages of certain waste management forms were revealed, and the actual failure of states to fulfill the obligations they assumed under national strategies and plans was described.

Based on the conceptual method, the analysis of the nature of waste management as part of state and local policies was carried out; the advantages and disadvantages of complete waste disposal, partial waste disposal, and waste utilization as forms of waste management were considered and the practical aspect of the application of waste management strategies in developed countries, countries with economies in transition, and developing countries was studied.

With the help of the combination of the conceptual and comparative methods, a comparative analysis of the key dogmas of the practical implementation of national waste management strategies and plans in developed countries, states with economies in transition, and developing countries was carried out. As noted above, developed states (for example, Germany, the USA, Japan, Singapore, etc.), states with economies in transition (for example, the Russian Federation, the Republic of Kazakhstan, etc.) and developing countries (for example, Malaysia, Myanmar, Brazil, etc.) were involved in the study.

At the same time, the limitation of the study is the fact that it considers exclusively practical aspects of the implementation of national waste management strategies and plans. Each practice, taken separately, has individual internal specifics, the mechanism of functioning of which cannot be perceived in the conditions of the practices of other states. Here the limitation concerned the understanding of political, socio-economic realities, as well as the level of awareness and activity of the local

population regarding the implementation of projects aimed at improving waste management since such data has not been measured globally, only for some regions.

Information Sources and Search Strategy: Based on the eligibility criteria of the review, electronic searches on Scopus and Web of Science databases and Google Scholar were conducted from 1 March 2021 to 30 December 2021. The search strategies for each search engine included titles and abstracts. Each objective of this review was also searched for (i.e., waste management policy and legal frameworks, official stat data and challenges in developed and developing countries, plus countries in transition). The online search strategy was restricted to the English language for developed and developing countries, to the Russian language for countries in transition like Russia and Kazakhstan and the timeframe included published and unpublished studies dating back to 1999.

Study Selection: Following the initial screening for duplication, the reviewers independently reviewed the studies by titles and abstracts and discussed the final records. The entire contents of the selected papers were then examined for the eligibility criteria by a single reviewer. The final decision was made by discussing the independently screened studies by titles, abstracts, and eligibility criteria. Fig. 1 shows the 58 studies qualified for this systematic review.

Data Collection Process: Standardized data extraction was developed to extract the study characteristics, such as study year, study`s scope, content details, and the plot was tested on seven randomly selected articles. Data extraction was then performed for all articles, and the proceedings were checked for the final outcome.

Study Risk of Bias Assessment: The risk of bias was assessed using the measurement tool to assess systematic reviews, during which the contents of the included articles were focused upon. Then, the detailed results of this systematic review are discussed in the next section.

Results

This study focuses on state strategies, plans, as well as measures taken in various developed countries (the USA, Australia, Japan, Israel, Germany, Sweden, etc.). The study reviews the current situation in waste management practices, covers both the implementation and actual non-fulfillment by states of their obligations under the developed national strategies and plans. Taking into account the fact that the study considers the possibilities of using full and/or partial disposal and disposal as forms of waste management, it should be understood that this practice depends on the preparedness of the state in this matter. Taking into account the different structure of the economy, the maturity of understanding the risks of pollution and

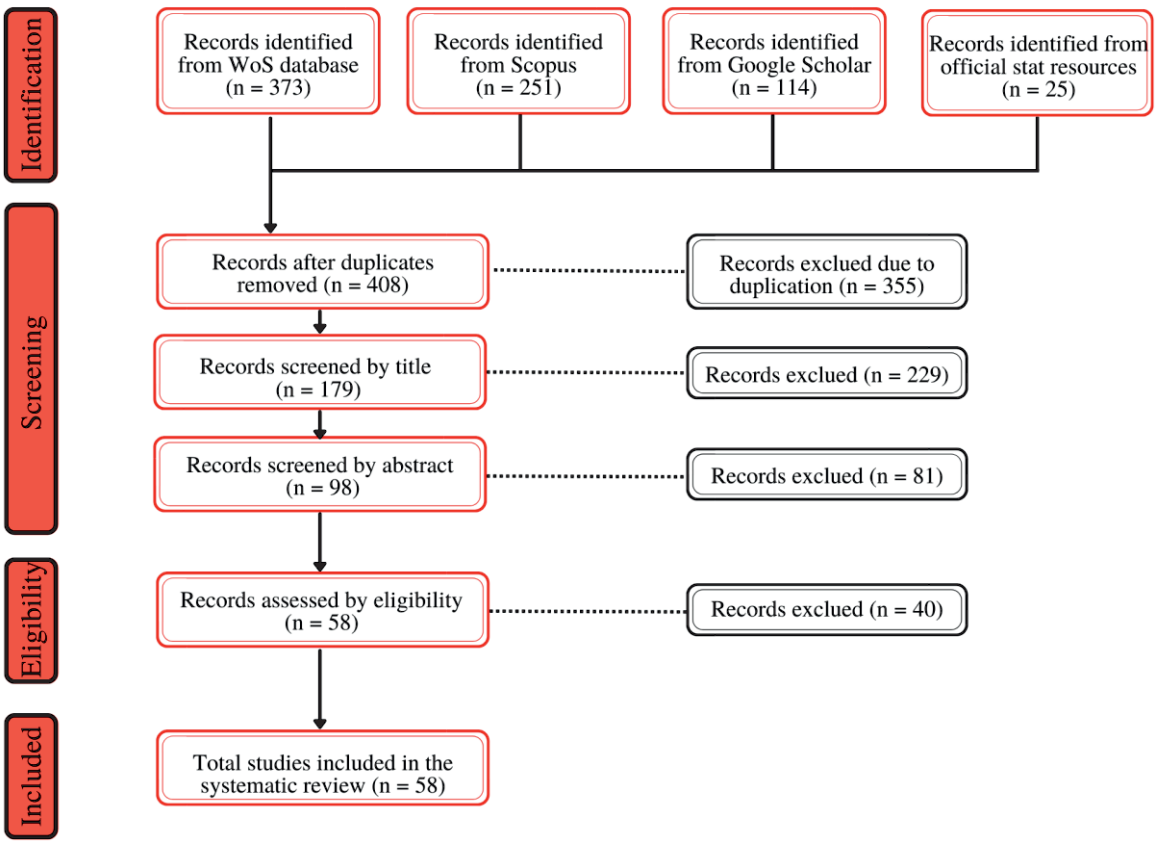

Fig. 1. Flowchart for the summary of study selection.

the understanding of environmental policy in general, it was advisable to group the considered ones according to their level of development.

To take into account all the above factors, the results of the study were structured in three paragraphs, each of which would cover a separate review of waste management policies for developed countries, countries with economies in transition, developing countries.

Review of National Waste Management Strategies and Plans in Developed Countries

In the field of waste management, developed countries are predominantly characterized by the utilization approach to solving problems, refusal from complete and partial waste disposal (especially complete) due to the inefficiency of these methods and unjustified risk to the environment [10, 16]. This study focuses on state strategies, plans, as well as measures taken in various developed countries (the USA, Australia, Japan, Israel, Germany, Sweden, etc.).

In particular, in Japan, which is characterized by little availability of land for the creation of numerous landfills, utilization is an integral piece of the national waste management strategy; this is confirmed by some principles of business management: reduction, reuse, and recycling [24]. Nevertheless, thermal recycling continue to be the main method to recycle plastic waste. With this method, waste is incinerated to generate energy. The government reports an 84% recycling rate, one of the highest in the world, but this includes thermal recycling, where plastic is burned for energy. Only 27% of collected plastic is reprocessed into usable material [25]. Japan encourages enterprises and households to independently sort and recycle waste in order to reduce pressure on the competent local/state authorities, as well as to make the population more environmentally conscious [4]. This policy is driven by the fact that the lion's share of municipal solid waste (MSW) is plastic, which is an integral part of such everyday products as plastic packaging and plastic containers for food and drinks, plastic containers for storing household items, plastic utensils. The next important component of the local waste structure is the fact that Japan ranked among the major countries that generate electronic waste, so the local government become the first of ones in Asia, which has implemented an electronic waste recycling program [26]. Israel, being a developed state, took a greener growth path only at the beginning of the 21st century, including giving preference to waste utilization rather than to its disposal. However, despite this, an environmentally friendly economy is being formed and developed in Israel [24]. As for the waste structure, Israeli realities are not very different from Japanese ones. The lion's share in the structure of waste is also plastic, electronic waste, waste from the construction industry [27]. In general, paper, metal and plastic account for 45% of Israel's waste by weight. Organic material, such as food scraps, accounts for 34%. Local experts and government officials prioritize vision, which calls for half of the country's waste to be recycled, another quarter to be burned for energy, and just a quarter going to landfills by 2030 [28].

Australia is characterized by a dual situation. Thus, on the one hand, landfills are owned predominantly by the state (and only a small number of them are owned by individuals or companies), while the processing industries, on the contrary, are owned by private individuals. This confirms the fact that the maximum involvement of the public in solving environmental problems contributes, among other things, to an increase in the effectiveness of the implementation of national waste management strategies and programs. Concurrently, a negative factor inherent in Australia is private landfills as, on the one hand, they are potentially harmful to both the environment and human health and, on the other hand, the private property of such entities often makes it virtually impossible for the public to control their activities [29].

Against this background, the issue of construction waste management occupies a special place within the field of administrative and legal regulation. The construction industry in Australia has grown significantly over the past two decades due to demographic expansion, migration and higher education popularization. As a consequence, population growth has necessitated extensive real estate development and improved public transport and infrastructure. To achieve all this, construction activity has intensified, which, in turn, led to a significant increase in construction and demolition waste (CDW). Under these circumstances, construction waste management has spurred new challenges affecting Australian society, the environment and the economy [30].

The development of common approaches for the country in the context of achieving the declared ambitious goals defined by the Australian National Waste Policy Action Plan 2019 is of particular importance. The principles of the strategy that determine the appropriate policy in the framework of achieving the circular economy imply avoiding waste; improving resource recovery; increasing the use of recycled materials and creating demand and markets for recycled products; better material flows management for the benefit of human health, the environment and the economy; and improving information exchange to support innovation, investment and enable informed consumer decisions [31]. Among other things, by the year 2030, the national targets under the Action Plan strive to reduce the total amount of waste generated in Australia by 10% per person and achieve an 80% average resource recovery rate from all waste streams in accordance with the waste hierarchy [31].

In the USA, despite the preference for the waste utilization method, the issue of such management is still quite relevant due to its problematic nature. In particular, its relevance is reflected by the landfills located in a number of states (for example, the states

of Oregon, California), which are mostly filled with waste of the most diverse origin - from the usual plastic and food waste, ending with construction and hazardous chemical waste with reactive components. The situation has become so shocking that it is already known that the USA produces an average 773 kg per person of food, plastic, and hazardous waste, which includes 12% of Earth's MSW, or about 239 million tons [32]. Today, such landfills require urgent government intervention in order to recycle or dispose of waste, including due to the negative impact on the environment and the health of people living in their vicinity [33]. Therefore, the issue of obtaining maximum profits, as well as minimizing the costs of waste utilization/recycling while avoiding the risks of potential costs of solving environmental problems, which can arise due to the failure to make an adequate decision on this issue, is relevant [4]. It is this approach that maximizes the local transition (due to the federal nature of this state) to the utilization method while abandoning complete and partial waste disposal methods [33].

The advanced member states of the European Union should also be considered progressive in the context of this issue. France, Germany, Sweden and Italy, as well as Denmark and the Netherlands are the ones that most often use secondary raw materials [4,8]. For example, in Sweden, in the post-war period, the majority of the population of the state was involved in waste management. When developing thematic legislation, the Swedish authorities, on the one hand, considered the requirements of environmentalists, who insisted on recycling waste to be further reused, and, on the other hand, followed the economic need to reduce the number of landfills. Further government measures were aimed at: 1) assigning responsibilities for waste management to the competent municipal authorities; 2) imposing a tax, and in some cases a ban on the disposal of specific waste categories; 3) imposing a tax on waste disposal by households with priority incentives to sort waste to be further recycled. Today, the municipal authorities are obliged to collect only 25% of waste while the collection of the remaining 75% of waste is assigned to individuals and companies [4,8]. Germany has a similar policy on this issue with the amendment that the assignment of responsibility for waste management to municipalities did not confirm the expectations for its efficiency. Thus, an interesting practice has developed: firstly, both federal and local authorities took on the responsibility for waste management simultaneously (one of the consequences of this was the widespread elimination of small and often unauthorized landfills, as well as the preference for large landfills); secondly, the dual system of assigning responsibility for the product waste utilization or disposal to manufacturers (who can either themselves ensure processing of such waste or, on a contractual basis, transfer this responsibility to the companies that belong to the Duales System Holding GmbH and Co) [8, 24, 34]. In parallel, along with the progressiveness of the European region on the waste management issue, there are also a number of unresolved problems, including in the advanced member states of the European Union. The accuracy of this thesis can be assessed through the example of Italy. Despite the high waste processing indicators, there are a number of problems that need to be addressed in national waste management strategies and/or plans, in particular: 1) inadequate level of sorting of a number of waste categories; 2) inadequate number of production capacities for waste utilization/disposal, which results in the slow waste management process and its further accumulation [35]; 3) imperfection of national legislation on this issue [10, 36].

Speaking about the policy of the developed countries of the world in the field of waste management and methods of their disposal, one cannot but pay attention to the trends that have developed as a result of the policies pursued by these countries. Given the fact that the developed countries affected by the study are members of the Organization for Economic Co-operation and Development (OECD), each country is closely monitored by the relevant directorates for environmental protection. Considering the last 10 years, observers can obtain up-to-date data in the field of waste generation, incineration with energy recovery, and recycling [37]. Relevant data are presented in Table 1, Table 2, Table 3, respectively.

As seen, it is clear that despite policies to introduce environmentally friendly methods of waste disposal, the amount of generated garbage continues to increase. The situation of Italy, despite the above institutional and infrastructural problems, can be characterized by the phasing out of industrial production after the first 2 years after the 2008 financial crisis, as well as the gradual awareness of the population about the problems of waste and the mobilization of local grassroots movements to counter the top-down misguided authoritarian approach in environmental regulation [38]. As for the rest of the developed countries of Europe, one should not blame only the failure of initiatives related to waste disposal and the delimitation of powers on waste management policy between the center and the province in a particular country. An important factor to note is the demographic factor, namely the population of European countries and the United States, which is formed not due to high birth rates, but due to incoming migrants [39]. In addition, the impact of the COVID-19 pandemic on the increase in waste, including biomedical waste, could also be explored, but this will not be relevant here as several countries have not yet submitted their 2020 data.

As seen, all mentioned developed countries, with the exception of Australia and Japan, increased the volume of waste incineration in their industries. This process can be called necessary because countries have a demand for energy that can be converted from existing waste.

In contrast to the practice of Western countries (except Sweden), in Australia and Japan, the volume

Table 1. Municipal waste, Generation and Treatment.

Topic	Municipal waste, Generated											
Unit	Tones, Thousands											
Country	Year											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 2010 / 2020 (%)
USA	227 749.0	228 583.0	228 873.6	231 395.6	234 416.5	237 782.2	243 225.0	243 724.3	265 224.5	No data	-	14.3
France	34 609.0	34 790.0	34 484.0	34 176.0	34 260.0	34 344.0	35 355.9	35 817.3	35 888.6	37 397.1	36 153.6	4.3
Germany	49 237.0	50 237.0	49 759.0	49 570.0	51 102.0	51 625.0	52 133.0	51 790.0	50 260.0	50 611.8	52 567.0	6.3
Italy	32 440.0	31 386.0	29 994.0	29 573.0	29 652.0	29 524.0	30 112.0	29 572.0	30 165.0	30 023.0	-	-8.1
Sweden	4 140.1	4 277.9	4 323.5	4 371.5	4 294.9	4 421.6	4 439.4	4 550.9	4 415.6	4 610.8	4 459.8	7.2
Israel	4 623.2	4 745.8	4 837.4	4 861.9	4 955.3	5 081.7	5 261.4	5 434.7	5 658.2	5 759.3	5 982.3	22.7
Australia	13560.5	13 472.5	13 572.3	13 694.7	13 789.4	13 964.2	13 019.3	12 605.3	12 641.5	12 571.7	-	-7.9
Japan	45 359.0	45 430.0	45 234.0	44 874.0	44 317.0	43 981.0	43 170.0	42 894.0	42 727.0	42 737.0	-	-6.1

Source: OECD Stat [32]

Table 2. Municipal waste, incineration with energy recovery.

Topic	Incineration with energy recovery											
Unit	Tonnes, Thousands											
Country	Year											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 2010 / 2020 (%)
USA	26 590.0	29 130.0	29 574.0	30 119.0	30 109.0	30 436.0	30 999.0	31 044.0	31 343.0	-	-	15,2
France	11 634.0	11 832.0	11 790.0	11 747.0	11 852.0	11 957.0	12 063.0	12 195.5	12 287.5	12 190.8	13 705.1	15,1
Germany	7 722.0	8 074.0	8 863.0	11 471.0	11 553.0	12 068.0	14 260.0	15 946.0	15 646.3	15 980.0	16 492.7	53,2
Italy	5 387.0	5 552.0	5 529.0	5 970.0	5 868.0	2 969.0	3 866.0	5 378.0	5 576.0	5 711.0	-	5,7
Sweden	2 123.7	2 235.7	2 270.7	2 235.9	2 148.6	2 284.2	2 262.6	2 400.4	2 362.2	2 426.6	2 679.8	20,8
Israel	-	-	-	-	-	-	6.8	33.3	66.5	95.3	95.2	92,9
Australia	139.0	139.0	124.8	110.7	96.5	114.4	123.2	37.9	32.1	64.6	-	-115,2
Japan	34 946.0	31 498.0	31 461.0	31 074.0	30 383.0	30 010.0	31 229.0	31 603.0	31 694.0	32 128.0	-	-8,8

Source: OECD Stat [32]

Table 3. Municipal waste, Generation and Treatment.

Topic	Recycling											
Unit	Tonnes, Thousands											
Country	Year											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 2010 / 2020 (%)
USA	59 203.0	60 500.0	59 393.0	58 913.0	60 010.0	61 289.0	62 178.0	60 763.0	62 677.0	-	-	5,5
France	6 937.0	7 184.0	7 293.0	7 402.0	7 605.0	7 808.0	8 256.8	8 706.4	8 908.7	8 760.3	8 152.0	14,9
Germany	22 476.0	23 135.0	23 596.0	23 094.0	24 302.0	25 155.0	25 435.0	25 355.0	24 703.6	24 292.9	25 124.8	10,5
Italy	6 107.0	7 149.0	7 177.0	7 335.0	7 472.0	7 864.0	8 093.0	8 218.0	8 675.0	9 048.0	-	32,5
Sweden	1 414.4	1 407.6	1 404.7	1 444.8	1 419.7	1 418.5	1 434.5	1 425.8	1 319.7	1 496.8	898.4	-57,4
Israel	-	-	-	353.6	379.9	368.3	369.0	393.6	389.1	394.0	384.6	8,1
Australia	4 381.2	4 532.2	4 313.7	4 234.3	4 188.9	4 143.5	3 502.3	3 094.7	2 830.5	2 820.8	-	-55,3
Japan	9 446.0	9 156.0	9 127.0	9 117.0	8 972.0	8 843.0	8 619.0	8 495.0	8 360.0	8 236.0	-	-14,7

Source: OECD Stat [32]

of waste processing has been reduced. It is assumed that this is due to the general trends in reducing the generation of waste in general, which is confirmed by the data in Table 1.

In conclusion, developed countries have several common and separate problematic aspects. Common problems come from their general conditions in which these countries operate. Having to a greater extent the same geographical location, a common historical experience and mentality, common institutions like the EU, countries are trying to find common waste management methods and unify the existing ones using technological developments. The issue of using complete or partial waste disposal depends both on the interest of business, and on civil society and specialized NGOs, which influence the decision-making process of both local and national governments.

Review of National Waste Management Strategies and Plans in Transition Economies

Unlike developed states, transitional economies, that is, states that due to some political, social, or other factors, have changed their political, and therefore economic systems, are characterized by the use of complete or partial waste disposal methods rather than the waste utilization method. At the same moment, waste disposal is less acceptable as it causes damage to the environment while the society does not receive considerable benefits [4].

Today, the transition economies include both the EU member states (namely, the states of the former socialist camp) and non-member states (the former member states of the USSR, China, Vietnam, Albania). In particular, national waste management strategies and plans of such states as Poland, the Czech Republic, Hungary, Slovakia, and a number of other countries, being members of the European Union, copy the policies of developed European countries (Germany, France, Italy, Sweden, etc.). Thus, these strategies are adopted and implemented in national legislation and initiatives, including through the introduction of regulations and directives of the European Parliament and the Council of the EU on this issue [4, 34, 40].

For this reason, it is more relevant to first study the experience of other states. Within the framework of the research, national waste management strategies and plans implemented in economies in transition are considered on the example of two states: the Russian Federation and the Republic of Kazakhstan. Unlike such post-socialist countries as Moldova, Ukraine, the countries of the Western Balkans, they do not implement EU legislation, but are guided by the internal specifics of working with waste, using the positive practices of the Soviet legacy. Moreover, the Russian Federation and Kazakhstan do not give absolute priority to waste management due to low demand from civil society and an underdeveloped environmental movement [37].

In the Russian Federation, as indicated above, the method of waste disposal prevails. At the same time, in the scientific community of this state, the issue of the need to switch from waste disposal to waste recycling is being actively discussed. Experts in the field provide numerous pros for the need to abandon waste disposal (both complete and partial) as an unacceptable method. Among other things, considerable support is given to the necessity to introduce a cyclical economy in the context of waste reuse and the European Union practice of sorting various waste types to ensure the acceleration of waste processing, as well as cost reduction [24, 41]. On the other hand, a positive trend in the Russian Federation (partly its success can be attributed to the government) is the introduction of the practice of private economic activities aimed at sorting and processing waste in order to make it reusable. However, today this practice is a relatively rare phenomenon [42].

In the Republic of Kazakhstan, the President plays an authoritative role in decision-making. Namely, he often indicates the realization of current or the introduction of new vectors of state development. Within the framework of such messages, a Concept for the implementation of the 'green economy' policy was developed. One of the key points of the concept implementation is the need for effective waste management. This issue is quite relevant for the Republic of Kazakhstan due to the following circumstances: 1) significant accumulation of waste in landfills, which in fact can no longer withstand the load; 2) only 5% of the total quantity of waste can be recycled. Thus, in order to effectively solve problems in the field of waste management, the following key tasks should be singled out as priorities: 1) construction of processing plants and their provision with qualified workers; 2) the requirement for product manufacturers to produce products that can decompose easily and do no harm to the environment and human health [43]. Generally, it should be noted that the issue of promoting innovative approaches to a greater extent depends on the support from the authorities and the interest of big business. Separate waste disposal innovations are applied locally, subject to public demand for municipal waste sorting. However, this phenomenon does not have a mass nature, which is why in these countries, innovations are not applied everywhere, only procedurally drawing attention to the need to implement the UN climate protection agenda.

Review of National Waste Management Strategies and Plans in Developing Countries

Within the framework of the study, the strategies of waste management in developing countries are analyzed based on the example of Latin American and Southeast Asian states. Bolivia, Paraguay, Peru, Colombia, Cambodia, Thailand, Myanmar and a number of other states in these regions have been studied.

It should be noted that the waste collection system in Latin American states varies significantly from state to state and is actually divided into two categories. In the first group of states, waste collection is assigned to the competent state bodies (these states include Bolivia); waste cannot be collected by non-state informal organizations and companies. The second group of Latin American states (for example, Brazil, Colombia, Peru) is characterized by the presence of exclusively private companies and organizations involved in waste collection [5]. On the one hand, the approach of states that prohibit the collection of waste by private companies is due to a kind of marginalization of this activity. On the other hand, the approach of states assigning the collection of waste to private companies and organizations is explained by the factual inability of the state to ensure this process. As for recycling or another solution to the waste problem, the most common option is waste disposal in the form of open or closed dumping sites due to its low cost. More progressive solutions to the problem of waste (for example, various waste disposal methods) are very rare due to their relatively high cost; in this context, the leaders in the Latin America region are Brazil and Colombia [5, 44].

The Southeast Asian countries with the exception of the developed ones (for example, Singapore) can be characterized by similar principles. Generally, waste management is governed by national legislation, as well as national concepts and plans adopted on its basis (for example, Indonesia, Cambodia, Vietnam). In a number of states, the adoption of waste management strategies and plans is initiated by local authorities of certain settlements (as a rule, this applies to rich cities). For example, these initiatives can be found in Thailand and Myanmar. These local initiatives are due to the need to redistribute the national budget throughout the country, which significantly reduces the possibility of its adequate use in each locality; the weakness of the political will of the national government; and the prevalence of economic interests (primarily of a separate group of pro-government persons) over environmental ones. Singapore is a developed economy that greatly differs from other states in the region in terms of waste disposal strategies. Thus, waste collection is followed by its sorting in order to extract secondary raw materials while the remains can be destroyed by incineration and release energy to be used in thermal power. These technologies are not available for other states in the region. Primary problems arise at the stage of waste collection, which is not centralized in all states of Southeast Asia. This problem is the reason for the emergence of spontaneous non-centralized landfills on the outskirts, along the roads, in water bodies and other places (for example, in Malaysia). Also, there are problems at the stage of waste processing. Due to its low cost, the priority for such states remains complete or partial waste disposal despite being harmful to the environment and human health. As for waste utilization as a priority form of waste management around the world, such initiatives often come from individuals and companies, but most of them are not implemented [45].

In parallel with this, the variability of problems also covers the social sphere, the reaction of which should influence the resonance of the problem in the field of waste. Numerous studies have found that the challenges in developed countries include a lesser emphasis on waste management by the local government, the scarcity of land to perform different activities concerning waste management, particularly for temporary storage and disposal sites, financial scarcity, the lack of waste collection and transportation infrastructure, and the lack of high-qualified human resources [46, 47].

Given the nature of the problems, the following nature of the problems faced by developing countries can be surveyed. Fig. 2 details the problems associated with the current state of the political and legal framework, public response, financial situation in most of the countries considered in this material:

Like the countries of Southeast Asia, India and China have similar problems. The rapid growth of industrial production, the ongoing urbanization, the population of one billion in each country create enormous problems in the field of waste management. In some industrial regions, waste is traditionally buried, while recycling is only just being introduced as a permanent practice. However, there is one characteristic difference from other developing countries - the experience in dealing with new global challenges like COVID-19. The pandemic brought not only a slowdown in the economy, a large number of deaths, a healthcare crisis in general, but also environmental problems, namely the production of a huge amount of biomedical waste. As they responded to the pandemic, the experience of India and China took into account the administrative, legal and technical practices against the spread of biomedical waste. In India, this is waste disposal in New Delhi, Bangalore, and other large agglomerations. In China, the central topic was the situation in the city of Wuhan, where the city witnessed a 600% increase in medical waste generation during the height of the COVID-19 outbreak [38]. In particular, the strictest quarantine was introduced at the administrative level. Further, on the technical side, in the city, and then in other regions of China, three major changes were made: the transition from decentralization to centralization of waste management, the establishment of a transition from waste incineration to technologies for their disposal without combustion - steam in an autoclave, dry heat, chemical disinfection, or the use of microwave ovens [39]. In addition, administrative control over the distribution of personal protective equipment (PPE) in the context of Asian economies is taken into account [46]. For example, in India, there has been a revision of the guidelines for the handling, treatment and disposal of waste generated during the treatment/diagnosis/quarantine of patients with COVID-19 [47], considering implemented WHO recommendations [48]. In the context of the pandemic and the high level of PPE turnover, China does not stop trying to reproduce energy from materials from landfills. Unfortunately, a large amount of fugitive CH4 is emitted into the atmosphere because of the lower landfill gas (LFG) collection efficiency and poor

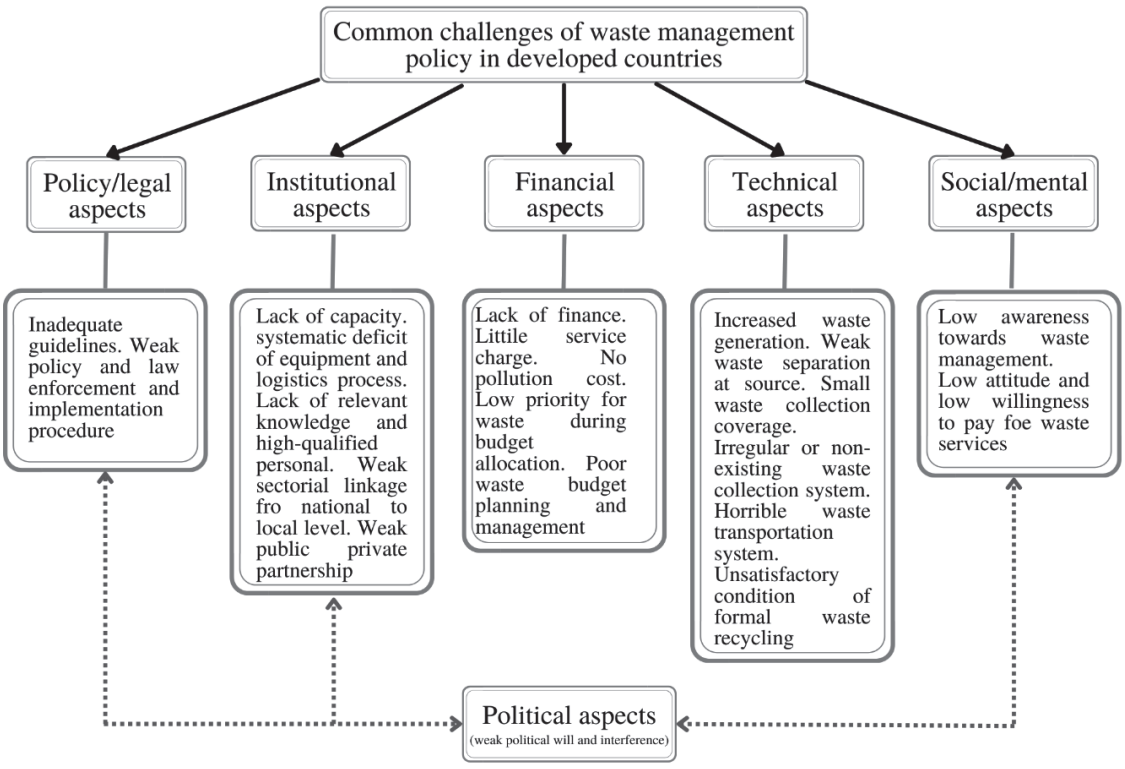

Fig. 2. Summary of the major challenges in reviewed developing countries.

management of many landfills. But the situation can be corrected. Landfill CH4 is not only a greenhouse gases (GHG) but also an energy reservoir that can be exploited for electricity generation or as liquid fuel [49]. Through some landfill closures in China, there is potential to develop local projects (or public-private partnership initiatives) aimed at converting landfill gas into energy to improve the energy efficiency of certain areas [50].

Discussion

Taking the above-mentioned aspects and global trends, which were an integral part of this review material, the peculiarities of waste management vary significantly in accordance with the group of states and each individual state. This can be confirmed by numerous other studies on waste management issues, with a special focus on developing countries, with their socio-economic, financial and technological problems. Such management is carried out in accordance with national laws on the basis of national strategies and plans adopted by the competent authorities.

Waste management at the national level is implemented in its various forms, which are complete and partial waste disposal, as well as waste utilization [51]. At the same time, utilization, being a topic of considerable attention in the modern scientific context, remains a prioritized form of waste management [52]. At a fundamental level, utilization is a relatively expensive waste management category. Though, the economic side of the high cost is correlated with environmentally friendly efficiency [53].

Developed countries, among which some member states of the European Union should be singled out, tend to carry out waste management in the form of utilization. Technologies that allow these states to utilize waste are relatively expensive; however, such a high cost is typical only for the initial or 'set-up' stage [24,34]. No less important here is the fact that waste utilization, in addition to ensuring environmental achievements of the countries applying it, also has a number of economic advantages: 1) the possibility of separating waste which is subject to reuse; this saves on the production of new products; 2) the possibility of disposal of that part of the waste that is not recyclable for the benefit of the public good (for example, the use of energy from the destruction of waste in thermal power plants, thus turning waste into free raw materials) [4].

The prospect of the active application of waste utilization as a form of waste management is also a priority for economies in transition and for developing countries. Among both groups of states, those that are more developed in comparison with the other states of their group can be singled out (for example, Poland, the Czech Republic, Hungary, Lithuania, etc. can be singled out among the states with economies in transition, as well as the United Arab Emirates, Saudi Arabia, etc. among the number of developing countries). The technologies used in such states (including in the field of waste management) are similar in terms of their level of development to the technologies used in developed states, and therefore it is often difficult for such states to be attributed to one group or another while being guided by the criterion of the level of development of the waste management system [4, 45]. It should be noted that this approach is beginning to be applied in developed countries, for example, in the EU. For example, when it comes to medical waste, hospitals in Germany, France and Britain use such methods of partial waste disposal as the use of microwave ovens, autoclaving and steaming, which are much more environmentally friendly than the banal waste incineration common in the world [54]. However, if we look at the mass application of such environmentally friendly technologies, then such methods are still unsuitable and unrealistic for many reasons, including the lack of the ability to process large volumes, as well as the high cost [55]. Therefore, they continue to be used as part of the partial recycling. Moreover, another positive effect of the quality management of these types of waste is the contribution to the maintenance of policies to counteract and overcome the consequences of the spread of existing and future viral diseases, the source of which is untreated medical waste.

When characterizing the approaches described in national waste management strategies and plans in transition economies and developing countries, it should be pointed out that despite the declarative priority of the utilization method and the recognition of its advantages, complete or partial waste disposal methods are mainly used. Consequently, both groups of states have widespread problems in the form of significant damage from landfills to the environment and human health [5, 56]. In line with this, while the majority of countries with economies in transition can actually switch to waste utilization (however, they do not for reasons most likely associated with the reluctance of one-off significant financing of projects), many developing countries are not ready to centrally switch to the utilization form of waste management. For this reason, as discussed earlier, there is a significant number of private companies and organizations that take on the responsibility of collecting waste, as well as sorting and recycling it in one form or another. Nevertheless, in many developing countries, such private initiatives face problems related to the fact that the state considers private collection and recycling of waste with the subsequent receipt of profit as a 'marginal' activity [57, 58].

Conclusions

The review of the current policy of household waste management presented in the article in different countries with different understanding of their solution

and elaboration allows us to conclude that waste management is part of a state or local policy, the purpose of which is to solve the problem of waste and determine its further processing. It is carried out based on national strategies and plans and can include such management forms as complete and partial waste disposal. Today, the very idea of managing waste emphasizes the prevention of damage to the environment and human health. In this respect, waste utilization can be safely assumed to be the most effective form of waste management.

Waste utilization as a form of waste management is the most promising and effective; however, it requires the use of technologies of a sufficiently high level, as well as initially high financial investments. As a result, utilization as a form of waste management is inherent mainly in developed countries regardless of the region, as well as in a few countries with economies in transition and developing countries. The conducted investigation unveiled that, in most economies in transition and developing countries, recycling as a form of waste management is declared at the level of national legislation, as well as national strategies and plans, but in fact remains inapplicable or applicable in a very small number of cases. The reasons for this ineffective waste management are as follows:

1) absence of political will of the government on the issue of making a decision on a nationwide transition to waste utilization;

2) lack of financial resources allowing the state to quickly make the transition from complete or partial waste disposal to the utilization form of waste management;

3) incomplete awareness of governments, as well as people in general, of the problem of waste management and the dangers that ineffective waste management can entail both for the environment and human life.

Together with this, it was established that utilization is also a cost-effective form of waste management due to:

1) the possibility of reusing part of the waste, thus saving part of the financial capital for the production of new products;

2) the option of effective waste disposal, for example, the use of thermal energy from combustion at thermal power plants.

In this case, it is recommended to implement not only the declarative consolidation of the utilization form of waste management in the national strategies and plans of states with economies in transition and developing states, but also the actual fulfillment of obligations assumed by their governments in this context.

Conflict of Interest

The authors declare no conflict of interest.

References

1. AVMA. Definitions: What Is Waste? American Veterinary Medical Association, **2021**. Available online: https://www.avma.org/resources-tools/one-health/waste-disposal-veterinary-practices/definitions-what-waste#:~:text=It%20may%20seem%20easy%20%E2%80%93%20%22waste,Right.andtext=The%20majority%20of%20household%20and,%22solid%22%20in%20physical%20form (accessed on 15 November 2022).
2. METALSPACE. Classification and Disposal of Solid Household Waste, Municipal Solid Waste, **2021**. Available online: https://metalspace.ru/education-career/osnovy-metallurgii/tbo/923-tverdye-bytovye-otkhody.html (accessed on 15 November 2022).
3. UNECE, 1-3: Recycling and Reuse of Waste, Glossary, List of Abbreviations, Symbols and Units of Measure, **2021**. Available online: https://www.unece.org/fileadmin/DAM/env/europe/monitoring/Indicators/I-3-glos-ru-final.pdf (accessed on 15 November 2022).
4. ALDIERI L., IOPPOLO G., VINCI C.P., YIGITCANLAR T. Waste recycling patents and environmental innovations: An economic analysis of policy instruments in the USA, Japan and Europe. Waste Manage. **95**, 612, **2019**.
5. MARGALLO M., ZIEGLER-RODRIGUEZ K., VÁZQUEZ-ROWE I., ALDACO R., IRABIEN Á., KAHHAT R. Enhancing waste management strategies in Latin America under a holistic environmental assessment perspective: A review for policy support. Sci. Total Environ. **689**, 1255, **2019**.
6. EDITORIAL, Overview of EC legislation on waste. Eur. Energy Environ. Law Rev. **1** (6), 171, **1992**.
7. KORYAKOV A. KULIKOV M. Features of development of Russian garbage treatment clusters through the implementation of project management methods. Econ. Innov. Manag. **4** (7), 16, **2018**.
8. NIKULICHEV Y. Waste Management, The Experience of the European Union, Analytical Review, The Russian Academy of Sciences, Institute for Scientific Information For Social Sciences, **2017**, Available online: http://inion.ru/site/assets/files/1109/nikulichev_upravlenie_otkhodami.pdf (accessed on 15 November 2022).
9. VOLYNKINA E., KUZNETSOV S. Analysis of waste management models and development of an integrated model for regional solid waste management. Bulletin of the Siberian State Industrial University. **3** (5), 47, **2013**.
10. AVILOVA A. Waste management problem in Italy. Scientific and Analytical Bulletin of IE RAS. **5**, 78, **2019**.
11. KUZNETSOV N. About Modern Solutions to the Problems of Solid Waste Management. In: The Effectiveness of the Sphere of Commodity Circulation: A Collection of Scientific Articles of the 5th Session of Pisarenkov's Readings Dedicated to the 55th Anniversary of the University. Gomel: Belarusian Trade and Economic University of Consumer Cooperation, 54, **2019**.
12. ALEKSEEV A., MAKHATADZE L., KARLIK A. Development of a regional waste management system: the experience of the SE500 project. Modernization of the Regional Economy. Economics and Management. **4** (90), 12, **2013**.
13. ULANOVA O., STAROSTINA Y. A brief overview of the method of assessing the life cycle of products and waste management systems. Modern Problems of Science and Education. **4**, 138, **2012**.

14. EREPORT. Classification of Countries, Economic Classification of Countries, World Economy, **2021**. Available online: http://www.ereport.ru/articles/mirecon/classif.htm (accessed on 15 November 2022).
15. GRANDARS. Classification of Countries by the Level of Socio-Economic Development, **2021**. Available online: http://www.grandars.ru/student/mirovaya-ekonomika/uroven-socialno-ekonomicheskogo-razvitiya.html (accessed on 15 November 2022).
16. KHAFIZOV T., BAIBURIN A., DENISOV S., TUPITSYN R., TUPITSYNA D., KAMINSKIY M. Underground-surface complex for waste management. Bulletin of SUSU. Series Construction and Architecture. **19** (3), 10, **2019**.
17. POCKLINGTON D. The Changing Importance of" Recovery" and" Recycling" Processes in EU Waste Management Law. Eur. Energy Environ. Law Rev. **9** (10), 272, **2000**.
18. CHALGANOVA A. Separate Collection and Processing of Waste to Achieve Sustainable Development Goals and Some Problems of State Regulation of Waste Management in Russia. In: Collection of Scientific Articles Based on the Materials of the Conference "Implementation of Sustainable Development Goals: European and Russian Experience", St. Petersburg: Publishing house of St. Petersburg State University of Economics, 209, **2019**.
19. MMEREKI D., BALDWIN A., LI B. A comparative analysis of solid waste management in developed, developing and lesser developed countries. Environ. Technol. Rev. **5** (1), 120, **2016**.
20. HAZRA T., GOEL S. Solid waste management in Kolkata, India: practices and challenges. Waste Manage. **29**, 4708, **2009**.
21. NYAKUMA B.B., IVASE T.J.P. Emerging trends in sustainable treatment and valorisation technologies for plastic wastes in Nigeria: A concise review. Environ. Prog. Sustain. Energy. **40** (5), e13660, **2021**.
22. SADEGHI AHANGAR S., SADATI A., RABBANI M. Sustainable design of a municipal solid waste management system in an integrated closed-loop supply chain network using a fuzzy approach: a case study. J. Ind. Prod. Eng. **38** (5), 323, **2021**.
23. BOEX J., MALIK A. A., BROOKINS D., EDWARDS B., ZAIDI H. The political economy of urban governance in Asian cities: delivering water, sanitation and solid waste management services. In: New Urban Agenda in Asia-Pacific. Springer, Singapore, 301, **2020**.
24. MINTZ K.K., HENN L., PARK J., KURMAN J. What predicts household waste management behaviors? Culture and type of behavior as moderators. Resour. Conserv. Recycl. **145**, 11, **2019**.
25. BRASOR,P. Japan faces an uphill battle to reduce plastic consumption. The Japan Times, **2019**. Available online: https://www.japantimes.co.jp/news/2019/07/06/national/media-national/japan-faces-uphill-battle-reduce-plastic-consumption/ (accessed on 15 November 2022).
26. KLEIN C. Solid waste management in Japan - statistics & facts. Statista, **2022**. Available online: https://www.statista.com/topics/8443/solid-waste-management-in-japan/#dossierKeyfigures (accessed on 15 November 2022).
27. MARAQA M., FISHMAN T., SACKS R., SPATARI S. Reducing construction and demolition waste through lean production: Observations from Tel-Aviv, Israel. In: 9th International Conference on Sustainable Solid Waste Management. Corfu, Greece, 1, **2021**. Available online: http://uest.ntua.gr/thessaloniki2021/pdfs/THESSALONIKI_2021_Maraqa_et_al.pdf (accessed on 15 November 2022).
28. LIDMAN M. Looking to dump poor recycling record, Israel asks public to start pitching in. The Times of Israel, **2019**. Available online: https://www.timesofisrael.com/ministry-says-the-public-is-key-to-sorting-out-israels-trashy-recycling-record/ (accessed on 15 November 2022).
29. PANDEY L.M.S., SHUKLA S.K. An insight into waste management in Australia with a focus on landfill technology and liner leak detection. J. Clean. Prod. **225**, 1147, **2019**.
30. SHOOSHTARIAN S., MAQSOOD T., WONG P.S., YANG R.J., KHALFAN M. Review of waste strategy documents in Australia: Analysis of strategies for construction and demolition waste. Int. J. Environ. Technol. Manag. **23** (1), 1, **2020**.
31. OA COMMONWEALTH. National Waste Policy: Less Waste More Resources, Canberra, Australia, **2018**. Available online: https://www.awe.gov.au/sites/default/files/documents/national-waste-policy-2018.pdf (accessed on 15 November 2022).
32. OECD. Municipal waste, Generation and Treatment. OECD Stat, **2022**. Available online: https://stats.oecd.org/index.aspx?DataSetCode=MUNW# (accessed on 15 November 2022).
33. JAUNICH M.K., LEVIS J.W., DECAROLIS J.F., BARLAZ M.A., RANJITHAN S.R. Solid waste management policy implications on waste process choices and systemwide cost and greenhouse gas performance. Environ. Sci. Technol. **53** (4), 1766, **2019**.
34. OGUNMAKINDE O.E. A review of circular economy development models in China, Germany and Japan. Recycling. **4** (3), 27, **2019**.
35. BELOVA N., VOSKRESENSKAYA E., VORONA-SLIVINSKAYA L. Entrepreneurship Development in the Field of Transport Recycling. IOP Conf. Ser. Mater. Sci. Eng. **918** (1), 012212, **2020**.
36. SAMUTIN N.M., RUSAKOV N.V., BUTORINA N.N., KOBZEV N.S., USTINOV A.K. Approaches of European and Russian legislation in the field of management of medical waste. Gigiena i Sanitariia. **93** (6), 9, **2014**.
37. MINGALEVA Z., VUKOVIC N., VOLKOVA I., SALIMOVA T. Waste management in green and smart cities: A case study of Russia. Sustainability. **12** (1), 94, **2019**.
38. SINGH N., TANG Y., ZHANG Z., ZHENG C. COVID-19 waste management: effective and successful measures in Wuhan, China. Resour. Conserv. Recycl. **163**, 105071, **2020**.
39. JIAJUN W. Cement Industry in China Assisted with Disposal of Covid-19 Healthcare Waste. ZKG, **2020**. Available online: https://www.zkg.de/en/artikel/zkg_Cement_industry_in_China_assisted_with_disposal_of_Covid-19_healthcare_3535100.html (accessed on 15 November 2022).
40. NOWACKI K. Waste Management in Polish Environmental Law and Approximating to European Law. Eur. Public Law. **5**, 49, **1999**.
41. CHALGANOVA A. Tasks of Nature Management Economy from the Perspective of a Cyclical Economy. In: Collection of the Materials of the 11th All-Russian Scientific-Practical Conference "Science at the Turn of the Millennium", St. Petersburg: Ministry of Education and Science of the Russian Federation, Russian State Hydrometeorological University, 79, **2018**.

42. PONOMAREV M. Legal Regulation of Environmental Protection When Handling Production and Consumption Waste (PhD dissertation), Moscow: Institute of Legislation and Comparative Law under the Government of the Russian Federation, **2019**.
43. ZHUMAMURATOV N.A. Development of a green economy policy in Kazakhstan (based on the example of waste recycling). Electronic library of BSU, **2019**. Available online: https://elib.bsu.by/bitstream/123456789/219890/1/403-404.pdf (accessed on 15 November 2022).
44. PSHEBELSKAYA L. Polymeric Waste Management Department, Electronic Library of BGTU, **2019**. Available online: https://elib.belstu.by/bitstream/123456789/30058/1/Pshebel%27skaja_Upravlenie.pdf (accessed on 15 November 2022).
45. HOANG N.H., ISHIGAKI T., KUBOTA R., YAMADA M., KAWAMOTO K. A review of construction and demolition waste management in Southeast Asia. J. Mater. Cycles Waste Manag. **22** (2), 315, **2020**.
46. SANGKHAM S. Face mask and medical waste disposal during the novel COVID-19 pandemic in Asia. CSCEE. **2**, 100052, **2020**.
47. GOSWAM, M., GOSWAMI P.J., NAUTIYAL S., PRAKASH S. Challenges and actions to the environmental management of Bio-Medical Waste during COVID-19 pandemic in India. Heliyon. **7** (3), e06313, **2021**.
48. ALRAWI A.S., AMIN S.A., Al-ANI R.R. Medical waste management during COVID-19 pandemic, a review study. IOP Conf. Ser. Earth Environ. Sci. **779** (1), 012130, **2021**.
49. AYDI A., ABICHOU T.Z., SDIRI A. Assessment of electrical generation potential and viability of gas collection from fugitive emissions in a Tunisian landfill. Energy Strategy Rev. **8**, 8, **2015**.
50. BIAN R., CHEN J., LI W., SHI W., LIN Y., CHAI X., SUN Y. Methane emissions and energy generation potential from a municipal solid waste landfill based on inventory models: A case study. Enviro. Prog. Sustain. Energy. **40** (5), e13654, **2021**.
51. WANG G., KRZYWDA D., KONDRASHEV S., VORONA-SLIVINSKAYA L. Recycling and upcycling in the practice of waste management of construction giants. Sustainability. **13** (2), 640, **2021**.
52. CHECHINA O., TREIMAN M., BEZDUDNAYA A. Waste management and organization of its transportation (based on the materials from the industrial pharmaceutical cluster of St. Petersburg). Economy of Enterprises, Regions and Industries. **1** (115), 83, **2019**.
53. ULASOVICH D.A. Waste Management Hierarchy, **2019**. Available online: https://rep.bntu.by/bitstream/handle/data/55600/Ierarhiya_upravleniya_othodami.pdf?sequence=1 (accessed on 15 November 2022).
54. KENNY C., PRIYADARSHINI A. Review of current healthcare waste management methods and their effect on global health. Healthcare. **9** (3), 284, **2021**.
55. TUDOR T.L., TOWNEND W.K., CHEESEMAN C.R., EDGAR J.E. An overview of arisings and large-scale treatment technologies for healthcare waste in the United Kingdom. Waste Manag. Res. **27**, 374, **2009**.
56. ALI M., GENG Y., ROBINS D., COOPER D., ROBERTS W., VOGTLÄNDER J. Improvement of waste management practices in a fast expanding sub-megacity in Pakistan, on the basis of qualitative and quantitative indicators. Waste Manage **85**, 253, **2019**.
57. LU H., SIDORTSOV R. Sorting out a problem: A co-production approach to household waste management in Shanghai, China. Waste Manage. **95**, 271, **2019**.
58. ZHANG A., VENKATESH V.G., LIU Y., WAN M., QU T., HUISINGH, D. Barriers to smart waste management for a circular economy in China. J. Clean. Prod. **240**, 118198, **2019**.