Implementation of separate household waste collection in Astana

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Executive summary

The country faces escalating challenges due to rising waste volumes driven by increasing consumption, population growth, and urbanization. With approximately 4.5-5 million tons of household solid waste generated annually, projections indicate this figure could reach 8 million tons by 2025.

In 2020, only 30% of disposed household waste was recycled, with an even lower 2.9% recycling rate for the total waste generated. The country ranks 175th out of 180 countries in terms of recycling performance. Despite efforts by the government to modernize waste management facilities and improve processing capacity, such as the planned construction of 37 new plants, the success of these initiatives depends heavily on the active participation of citizens.

Separate waste collection is seen as a crucial step toward addressing these challenges and achieving higher recycling rates. Studies suggest that waste sorting at the household level can dramatically increase recycling rates from 5-7% to as high as 50%. However, the widespread adoption of separate waste collection in Kazakhstan remains limited, and public engagement in recycling efforts is low.

Thus, the topic of this research is how separate waste collection can be implemented in Astana for effective waste management and further recycling. This research aims to explore the obstacles hindering the implementation of separate waste collection in Astana and propose solutions to improve the situation. The research questions are:

1. What are the obstacles to the implementation of effective separate waste collection in Astana?
2. What could be done to improve the situation?

Waste management in Kazakhstan is regulated by several ministries, with key legal frameworks established by the Ecological Code and Sanitary Rules. The current Ecological Code mandates the separation of waste into "wet" (food waste) and "dry" (recyclables such as paper, plastic, and metal). However, despite this legal framework, local authorities have limited enforcement responsibilities, which hinders the widespread adoption of separate waste collection at the municipal level. In Astana, some progress has been made with separate waste collection through the installation of colored containers for different waste types, but public participation remains low.

Astana's waste management system faces significant challenges due to rapid urban growth and a growing waste volume, which exceeds the city's capacity. In 2023, the city collected approximately 1,200 tons of waste per day, a figure that has outpaced the city's waste management infrastructure. Although separate waste collection has been introduced since 2018, the practice is not widespread among residents. Educational campaigns, special events, and social videos have been used to encourage participation, but only a small percentage of waste is recycled. Factors influencing waste separation include the public's lack of awareness and inadequate waste management systems.

Methods, innovations, successes, and failures in the field of separate waste collection are also studied through case studies of municipal waste management in Sweden, Japan the Brazil.

Sweden’s waste management system is considered a model of sustainability, with extensive recycling programs and WtE incineration. The system is underpinned by strong regulatory frameworks and public incentives, such as lower waste fees for households that participate in recycling. Sweden’s success is attributed to a combination of effective public education, robust infrastructure, and community engagement. These principles could be adapted to Astana, where similar public engagement strategies, such as information campaigns and recycling incentives, could be implemented.

Japan’s waste management system is highly efficient, with strict regulations and a strong emphasis on recycling. Households are required to sort waste into categories like burnable, non-burnable, and recyclables. Japan also uses waste-to-energy (WtE) incineration to reduce waste volume and generate electricity. Successful public engagement, such as educational campaigns and penalties for non-compliance, has been critical in Japan’s success. These strategies could be adapted to Astana to improve public participation and the effectiveness of waste separation efforts.

Brazil faces challenges like inadequate infrastructure, low recycling rates, and reliance on informal waste pickers. Similar to Kazakhstan, Brazil’s lack of strong local waste management policies and investment in waste infrastructure has hindered effective waste separation and recycling.

The research uses a mixed-methods approach, combining both quantitative (web-based survey) and qualitative (semi-structured interviews) data collection techniques. A web-based social survey was conducted among Astana residents, with participants recruited

through social networks (e.g., WhatsApp groups for condominium residents). The survey used volunteer sampling, with a total of 326 responses. 10 semi-structured interviews were conducted with key stakeholders, including:

- Ministry of Ecology and Natural Resources
- Waste collection companies
- Heads of property owners' associations
- Environmental activists

While 31% rated themselves highly (5 out of 5) in understanding waste sorting, a significant portion (53.7%) rated themselves lower (3 or below), indicating a basic understanding but room for improvement. 56.7% of respondents find separating waste easy, though 43.3% report difficulty, indicating that infrastructure and other barriers might hinder recycling efforts. Only 37% actively sort waste, with plastic, paper, and food waste being the most commonly separated types. Key obstacles include the lack of separate containers (36%), distrust in waste management systems (36%), and lack of time (13%).

There is strong public support for mandatory waste separation, with some concerns about enforcement and system transparency. The majority of respondents emphasized the need for better education, improved infrastructure, and stronger legislative support. Many cited examples from countries like South Korea and Japan as models for effective waste management.

A major barrier is the lack of adequate waste containers for sorting different types of waste. The absence of separate bins and instances of waste being mixed during collection undermine citizens' efforts and trust in the system. Expanding and improving infrastructure is critical to increasing participation in sorting.

Many respondents expressed skepticism about the effectiveness of the recycling system, fearing that their sorted waste is eventually mixed with regular trash, due to improper handling by waste management services.

Despite a general interest in waste sorting, there is a significant knowledge gap about proper sorting practices. Public engagement campaigns are sparse, and respondents requested more consistent educational efforts, particularly in schools and communities.

Time constraints and a lack of willingness were also cited as reasons for not sorting waste. Many people see it as a burdensome task with no immediate benefits.

There is a demand for stronger waste separation laws, including enforcement mechanisms and financial incentives, to encourage compliance. The current policies are seen as inadequate, with no clear enforcement or support systems in place.

The private sector can play a significant role by investing in waste management infrastructure and incentivizing recycling. Examples like reverse vending machines or deposit-return systems for bottles have proven effective in other countries, and similar initiatives could be introduced in Astana.

The study emphasizes the need for widespread public education on waste sorting, using simple and clear guidelines, social media, influencers, and community outreach programs. Schools should integrate waste-sorting education into curricula to foster habits from a young age.

A mandatory waste separation policy is suggested to create accountability. This would include clear guidelines, penalties for non-compliance, and rewards for those who consistently sort their waste. Authorities could introduce phased regulations, ensuring proper infrastructure is in place before enforcement begins.

In conclusion, this research advocates for a holistic and integrated waste management strategy that involves not only the government but also individuals and the private sector. Sustainable waste management is vital for minimizing environmental impacts, improving public health outcomes, and achieving national recycling goals. A collaborative effort toward public education, stronger legislation, and investment in infrastructure is crucial in addressing the escalating waste crisis in Kazakhstan and promoting long-term sustainability.

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Abstract

The growing waste management challenges in Astana, Kazakhstan, particularly with municipal solid waste, highlight the importance and necessity of separate waste collection at the household level. With separate waste collection, the targeted 40% rate of recycling could be achieved.

This research investigates the current obstacles to the implementation of separate waste collection in Astana and what can be done to improve the situation. Through mixed-methods research, including surveys among the population of Astana city and interviews with the Ministry of Ecology and natural resources of the Republic of Kazakhstan, employees at waste collection companies, and representatives of the local population, the study identifies issues related to the lack of infrastructure, inefficiency in the whole waste management process, insufficient awareness of the population about proper waste management, cultural resistance to change, and absence of appropriate legislation.

Key suggestions include increasing private sector involvement, focusing on enhancing public education and strengthening policy enforcement to foster consistent, sustainable waste management practices. The findings contribute to understanding effective frameworks for separate waste collection and offer a foundation for advancing waste recycling efforts across Kazakhstan. However, introducing a system of financial remuneration or level of fines for non-compliance should be further researched. Overall, the proposed recommendations will be useful for everyone interested in improving waste management in Astana, and the local governing bodies across Kazakhstan.

List of abbreviations

EPR – Extended Producer Responsibility

MoENR – Ministry of Ecology and Natural resources of the Republic of Kazakhstan

MSW – Municipal Solid Waste

PAYT – Pay-as-you-throw

POA – Property owners' association

WtE – Waste-to-energy

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1. Introduction

1.1. Background

Since the problem of increasing waste is well known to society, the demand for sustainable waste management is rising. Nowadays, this is one of the most pressing environmental issues across Kazakhstan (Butenko, 2023). Landfills emit greenhouse gases as organic waste decomposes. Incineration can also have environmental and health impacts if not managed correctly. In addition to the escalating amount of waste, the composition has changed with the proliferation of single-use plastics and electronic waste (e-waste), which can be challenging to manage if not disposed properly (Hieronymi et al., 2012). Moreover, waste management workers are often exposed to hazardous materials and unsafe working conditions. This will, therefore, require an elaborate public sensitization and awareness campaign to actualize the effectiveness of waste management in Astana. It will call for community education, emphasizing the benefits of waste separation and how to go about this, as this is likely to increase the efficiency and effectiveness levels. It's, therefore, pivotal that all media channels, from social media to local television, together with community workshops, be able to facilitate the more extensive and comprehensive outreach of this effort to nurture a sense of environmental responsibility. Urban areas need efficient, sustainable waste management systems to address these growing challenges, which often require significant investments (Tretyakov, 2021). Proper disposal of waste is essential to prevent pollution and protect public health. Establishing a well-developed waste management policy may lead to both environmental and health protection of citizens (Kaza et al., 2018).

Growing consumption and the rise of the population in Kazakhstan lead to an annual increase in the amount of municipal solid waste (Association of Environmental Organizations of Kazakhstan, 2022). Nowadays, most of the human activity causes all types of waste, which ends up in landfills and incinerators. Approximately 4.5-5 million tons of household solid waste (HSW) are generated in Kazakhstan every year (Electronic government of the Republic of Kazakhstan, 2023). According to Bekturova (2018), it is projected that this quantity could increase to 8 million tons by 2025. The total accumulated amount of solid domestic waste by 2019 reached 125 million tons (Khavratova T. & Alikhan B., 2021). Additionally, ongoing urbanization causes rising waste accumulation in cities. Thus, governments would be forced to deal with a

tremendous amount of waste in the near future that would require advanced waste management systems (EnergyProm, 2023).

According to the Electronic government of the Republic of Kazakhstan (2023), 30% of disposed household solid waste was recycled in 2020, with the aim to reach a 40% recycling rate by 2030. However, according to the Yale Center for Environmental Law & Policy (2022), Kazakhstan ranks 175th among 180 entries in the recycling rate, and the amount of recycled household waste accounts only for 2.9% of the total generated waste. The underlying issue could be a poor comprehension of the recycling process in Kazakhstan. Recycling is a complex process by which materials are processed and transformed into new products or materials to reduce the consumption of raw materials, energy usage, and the environmental impact associated with the extraction and production of new materials (PCC Group, 2022). The process includes several stages: collection, sorting, processing, manufacturing, distribution, and sale (PCC Group, 2022). However, the recycling process in Kazakhstan includes only collection and manual sorting that takes place in the sorting centers and not in households (EnergyProm, 2023).

It has been announced that the Ministry of Ecology and Natural Resources of Kazakhstan has developed 45 projects for processing solid household waste (Vaal, 2024). The Ministry also plans to build 37 new factories across the country and modernize eight existing plants with a total capacity of more than 1.2 million tons per year (Vaal, 2024). The total cost of the projects amounts to 171.6 billion tenge (Vaal, 2024). Nonetheless, taking into account the scope and criticality of the problems in the field of waste management in Kazakhstan, some researchers call for a holistic and integrated approach. It is important to note that without individual recycling efforts, achieving high recycling rates is challenging and not feasible (Kaza et al., 2018). Global and countrywide sustainability goals are the responsibility of the citizens and businesses to reduce, reuse, and recycle.

According to Khavratova et al. (2021), without pre-sorting, the recycling rate of waste in Kazakhstan is as low as 5-7%. In contrast, with waste being pre-sorted before delivery to a waste management facility, a recycling rate could rise to 50% (Khavratova T. & Alikhan B., 2021). Therefore, it is crucial to start with the introduction of separate waste collection by individual households.

1.2. Problem statement and research questions

Separate waste collection by individual households is a crucial step towards recycling, addressing environmental challenges, conserving resources, reducing pollution, and promoting sustainable communities and economies (Scotford, 2013). Although separate waste collection and sorting is being introduced both in large cities and districts of Kazakhstan, it has not received widespread application (Kurmanov, 2023). Existing research collectively covers various aspects of waste management and environmental behavior in Kazakhstan. Some researchers have noted the importance of demographic factors such as gender, education, and type of settlement to influence waste sorting practices. Therefore, they propose a comprehensive approach to promoting environmental behavior, recommending infrastructure development and educational initiatives (Zhidebekkyzy et al., 2023). The positive sentiments of citizens and the role of public awareness campaigns also have a fundamental role and deserve special attention in solving waste management problems (Sarbassov et al., 2019).

Nevertheless, the current low level of recycling across Kazakhstan indicates poor involvement of the public even though it is a tangible way for individuals to make a positive impact on the planet and leave a healthier environment for future generations (EnergyProm, 2023). Emphasizing recycling's positive impact, the study of Zhidebekkyzy A. et al. (2022) underscores the need for efficient programs involving public institutions, academia, businesses, and non-profits. While municipal waste recycling rates are crucial, their recommendations include raising awareness, sustainable business initiatives, and legislative proposals. Only a few conscientious citizens divide their garbage according to the principle of “organic”, “glass” and “polymers” (Kurmanov, 2023). Furthermore, in Astana, the sorted waste is pressed and stored in the landfill, without further reuse and recycling (Tretyakov, 2021).

Therefore, the topic of this research is how separate waste collection can be implemented in Astana for effective waste management and further recycling. As the capital of Kazakhstan, Astana should have all the prerequisites for the successful implementation of a sustainable waste management system. Despite challenges, the implementation of separate waste collection practices in Astana would be a great foundation for the nationwide application of the program.

This research aims to establish the reasons behind poor waste management, and how separate waste collection programs can be implemented in Astana. The following questions will be addressed:

1) What are the obstacles to the implementation of effective separate waste collection in Astana?
2) What could be done to improve the situation?

1.3. Summary

To conclude, inadequate waste management causes significant environmental, social, and public health issues that can have far-reaching consequences. The growing economy and increasing consumption of people will inevitably lead to a high volume of waste. By 2025 the amount of solid household waste in Kazakhstan could increase to eight million tons per year (Kurmanov, 2023). In a world interconnected by environmental challenges, individual recycling efforts contribute to global sustainability goals and demonstrate responsible consumption patterns (European Environmental Bureau, 2020). Individual behavioral change would also encourage businesses to reduce, reuse, and recycle, preventing such problems as illegal dumping of construction or commercial waste.

This research aims to investigate the causes of ineffective waste management and explore ways for widespread implementation of separate waste collection practices in Astana. The literature review in Chapter 2 identifies issues behind municipal waste management in Kazakhstan, the significance of the separate waste collection in Astana, and provides examples of practices from foreign countries. Chapter 3 describes the methodology used to conduct the research. The results of the research are outlined in the Chapter 4 with a following discussion in in Chapter 5. The concluding Chapter 6 provides prospective recommendations for further robust implementation of the separate waste collection in Astana, identifies areas where additional study may be necessary, and summarizes the conclusions of the research. A reference section and full research findings are presented in the appendices.

2. Literature review

This chapter includes general overview of the literature on the current state of implementation of the separate waste collection in Kazakhstan and in Astana. State legislations, government publications, journals' publications and news articles are used in the literature review.

The literature review starts with analysis of the governance of municipal waste management in Kazakhstan. Then, the chapter follows with the current state of the municipal waste management in Astana. Methods, innovations, successes, and failures in the field of separate waste collection will also be studied through case studies of municipal waste management in Sweden, Japan the Brazil.

2.1. Governance of municipal waste management in Kazakhstan

This research focuses on separate municipal solid waste, generated by individuals and households within a municipality or urban area. It includes everyday items such as food waste, building waste, paper, and plastic that are discarded by the citizens (Zaman & Ahsan, 2016).

Currently, the waste management issues in Kazakhstan are governed by several ministries such as the Ministry of National Economy, Ministry of Energy, Ministry of Ecology and Natural Resources, Ministry of Construction and Infrastructure (Khavratova T. & Alikhan B., 2021). The regulations and requirements have been set in the Ecological Code of the Republic of Kazakhstan since 2007 and in the Sanitary Rules since 2010 (Inglezakis J. et al., 2017). The Ecological Code regulates the environmental matters and policies that cover areas such as environmental protection, natural resource management, pollution control, conservation, and sustainable development (Ecological Code of the Republic of Kazakhstan, 2021). It also serves as a primary legal document to guide and ensure the preservation of the environment and the sustainable use of natural resources in Kazakhstan. According to Article 321 of the Ecological Code, separate waste collection is conducted into two fractions: "wet" (food waste) and "dry" (paper, plastic, glass, metal).

According to Article 292 of the previous Ecological code, established in 2007, local executive bodies are responsible for organizing a rational and environmentally friendly municipal waste collection system, regular removal, processing, disposal, and neutralization of hazardous components of municipal waste, as well as cleaning the

territory of the populated area (Ecological Code of the Republic of Kazakhstan, 2007). Local executive bodies also ensure compliance with environmental requirements when handling municipal waste. However, such Article has not been included in the current version of the Ecological code, and no responsibility is identified by the local governing bodies.

Nevertheless, Akimat of Astana has implemented separate waste collection by households with the use of different containers placed in residential buildings. Plastic yellow containers are used to collect “dry” waste, such as plastics, metals, glass, and paper, and the sorted waste is removed by a white garbage truck (Clean City NC LLP, 2023). Whereas green plastic and galvanized metal containers are used for the “wet” non-recyclable waste, which is removed by orange garbage trucks (Clean City NC LLP, 2023). According to Clean City NC, such distribution makes it possible to process waste more efficiently and increase the level of its processing (Kazinform, 2023). Yet, a separate waste collection policy has not seen widespread adoption among the citizens of Kazakhstan (Kurmanov, 2023).

2.2. Municipal waste management in Astana

Astana city produced roughly 1,118 tons of municipal solid waste per day in 2013, while the capacity for waste collection is only 600-800 tons (Inglezakis et al., 2014). However, because of the absence of weighing equipment in landfills, low collection rates by companies, illegal dumping, and booming economic activities in the city, which attracts an increasing number of workers who generate waste but are not officially registered as citizens of Astana, the official statistics do not represent actual situation (Inglezakis J. et al., 2017). The Clean City enterprise, which is engaged in waste removal in Astana, has already begun to experience a shortage of equipment due to the growth of the city’s population by 2023. 1,200 tons of garbage are removed daily (Kudabeirgenov A., 2023). Over the period of seven months in 2023, more than 165.2 thousand tons of waste were collected and removed in Astana (Kudabeirgenov A., 2023). Thus, the government is already forced to deal with the tremendous amount of waste.

Separate collection and sorting have been actively introduced in Astana since 2018. All city waste is transported to the Astana Eco Polygon waste processing plant, which was built in 2012 (Mazurenko Y., 2023). The landfill's capacity reaches 300 thousand tons and consists of two sections. One of them is already full and has been sealed. The second

section is projected to be filled by 2025. About 4 million tons of waste are buried there. Butenko (2018) states that the first thing that strikes at the Astana landfill is not even the smell, but it's incredible scale, which is filled with garbage. Additionally, more than 8 thousand unauthorized landfill sites were found in Kazakhstan in 2018 and more than 4 thousand of them are still in use (Khavratova T. & Alikhan B., 2021).

According to the Akimat of Astana, 17,000 containers are installed in the city: 4,137 yellow containers for collecting the "dry" fraction, 10,190 green and metal containers for collecting the "wet" fraction, 308 mesh containers for collecting plastic, 648 orange containers for collecting mercury-containing waste, 1,300 green barrels for bakery waste (Mazurenko Y., 2023). It was expected that Astana residents would separate all waste according to the requirements. To promote the separate collection of solid waste in Astana special environmental events, master classes on the separate collection of solid waste in residential complexes, social videos, and environmental lessons in educational institutions are carried out among the population (Zhasyl Damu, n.d.). The fate of the entire project will depend on the consciousness of the capital's residents because only 10% of solid waste is recycled in Astana (Butenko M, 2018).

Also, Aliyeva et al. (2018) identified the factors influencing the separation of household waste in Astana, offering policy alternatives such as information campaigns and educational approaches. Inadequate waste management creates significant environmental, social, and public health issues, making it necessary to establish well-developed waste management policies (Kaza et al., 2018).

2.3. Case study – Osaka, Japan

Waste management in Japan is known for its efficiency, innovation, and dedication to environmental sustainability (Sakai et al., 2008). The country has developed a comprehensive and well-structured waste management system that prioritizes recycling, reducing waste generation, and minimizing the environmental impact of waste disposal. Similar to Sweden, Japan employs waste-to-energy (WtE) incineration as a key component of its waste management system (Sakai et al., 2008). Japanese households are also required to separate their waste into various categories, which typically include burnable waste, non-burnable waste, recyclables (such as paper, glass, metal, and plastic), and sometimes organic waste (Wang et al., 2023).

Strict waste management regulations are in place with penalties for non-compliance (Wang et al., 2023). This helps ensure that residents and businesses follow waste management rules. According to Sakai et al. (2008), the introduction of unit-charging programs known as pay-as-you-throw (PAYT) for municipal solid waste in Japan also reduced the amount of residual waste generated by 20% to 30%. However, Shimamoto (2019) states that the economic development in Japan increases municipal solid waste per capita and significantly decreases recycling rates.

Nonetheless, the government, along with municipalities, also encourages recycling through various campaigns and initiatives. For example, Osaka's Maishima Incineration Plant is known as the "*world's most beautiful waste treatment plant*" (Sugiura, 2023). Due to its prominent and artistic façade, it attracts many visitors, contributing to the understanding of waste management issues. The incineration process at Maishima is highly efficient, with advanced emission control systems in place to minimize environmental impact. The recovered heat is harnessed for electricity generation, contributing to the local power supply and reducing the facility's carbon footprint (Sugiura, 2023). The revenue received from selling electricity in 2021 accounted for approximately 657 million JPY (Sugiura, 2023). The Maishima Plant, with its vibrant colors, promotes the favorable perception of a waste treatment facility that is an integral part of the local community.

This example shows that the presence and enforcement of waste separation regulations and policies at the local and provincial levels play a significant role in shaping citizens' intentions and behavior. The Ministry of Ecology and National Resource together with Akimats could use a similar approach to create satisfactory conditions for waste separation in residential areas whilst implementing the investment strategy to build 37 waste processing plants across the country. However, local authorities and waste management companies must also engage citizens in waste separation to promote environmentally friendly behavior before trying to obtain higher participation rates. Public awareness campaigns, educational programs, and community-friendly facilities can greatly influence citizens' attitudes toward waste separation.

2.4. Case study – Brazil

Similar to Kazakhstan, Brazil is a developing country and the selective waste collection service is also administered by the local governments in collaboration with the private

sector (Lino et al., 2023). According to Alves et al. (2023), the National Solid Waste Policy (NSWP), sanctioned by Law 12,305 of August 2, 2010, introduced significant changes in the management of municipal solid waste in Brazil. However, Brazil is a vast and diverse country, and the effectiveness of the policy varies by region (Lino et al., 2023). Also, Brazil has a significant population of informal waste pickers who play a crucial role in waste management and recycling (Pisano et al., 2022). Nevertheless, the management of municipal solid waste remains inadequate as local authorities encounter numerous obstacles and financial constraints when it comes to making investments in modern infrastructure and machinery required to manage the ever-growing volume of municipal solid waste effectively (Lino et al., 2023). Due to the lack of priority of the regional and local public policies and setting ambitious goals, Brazil has not yet achieved the targeted advancement in waste management and the country still bears ineffectiveness of low waste sorting and recycling (Poletto et al., 2016).

Lack of waste management system in the cities, local legislation, quality of work of garbage collectors, and low level of investment in infrastructure results in poor implementation of the program. Looking at similar results in Brazil, it could be deduced that the presence and enforcement of waste separation regulations and policies at the local and provincial levels play a significant role in shaping citizens' intentions and behavior. When there are clear guidelines and penalties for non-compliance, residents are more likely to adhere to waste separation rules.

2.5. Case study – Sweden

Waste management in Sweden is regulated by a combination of national (Environmental Code, Waste Framework Directive 2008/98/EC), regional, and local legislation all aimed at promoting sustainable and environmentally responsible waste management practices. Since 2018 EU laws have also required municipalities to ensure separate collection of plastic, glass, paper, metals, waste oils, textiles, hazardous materials, and organic waste for further recycling (European Environmental Bureau, 2020). Local governments have the authority to create their own ordinances and regulations to meet specific waste management targets (European Environmental Bureau, 2020). The household waste collection system consists of separation among household and food waste, colored glass, plastics, paper, cardboard, clear glass, and metals (Avfall Sverige, 2012). Emptying is done by the vehicles with separate compartments, thus making mixing of fractions

impossible. With this solution, a 91% purity packaging and paper, and 98% purity in food waste is collected.

The sorting is ensured through improved communication with households through information flyers, calendars, instructions in waste collection spaces, appendix to invoices, cooperation with property owners, homepage, advertisements, study visits, and school information (Avfall Sverige, 2012). Additionally, there are monetary incentives through the PAYT program, when waste fees are lower for the households that choose the separate waste collection bins and generate less residual waste (Avfall Sverige, 2012).

In practice, full operation is undertaken by Tekniska Verken, a Swedish profitable municipal utility company (Smart City Sweden, 2023). Tekniska Verken promotes the separation of waste at the household level (Smart City Sweden, 2023). Recyclable materials are then sent for further processing and reuse. Non-recyclable waste is incinerated to generate electricity and heat, adhering to the WtE approach (Smart City Sweden, 2023). This approach reduces the volume of waste sent to landfills and provides an environmentally friendly source of energy. The heat generated from WtE incineration is often used to produce district heating for residential and commercial buildings, reducing the need for individual heating systems and fossil fuels (Smart City Sweden, 2023). Furthermore, Tekniska Verken runs educational programs and campaigns to raise public awareness about responsible waste management and the importance of recycling (Smart City Sweden, 2023).

Sweden has achieved significant results in sustainable waste management through a combination of strategies that prioritize recycling, WtE incineration, and minimal landfill use (Moalem & Schmidt, 2023). Although Sweden's waste management system is often seen as a model for sustainability, it may not be entirely replicable in other countries due to specific cultural, economic, and geographical factors. Nonetheless, the principles of recycling, waste-to-energy, control by the local governing bodies, and public engagement can be adapted to the context of Astana. For example, the research conducted by Noya et al (2018) insists that benefits could be derived from the recovery of material and the generation of energy from organic waste. Those practices would bring about an enormous amount of environmental improvement and enlighten the important aspect of improved waste management for Kazakhstan, including strategies for better renewable energy production at maximum and better recycling rate strategies for the country (Noya, 2018).

2.6. Summary

Waste management in Astana has some ineffective practices and systems for the disposal, and handling of waste materials (EnergyProm, 2023). There are also a number of issues with interpretations of the regulations set by the Ecological Code and lack of the regulations for municipal waste management by households. By implementing effective awareness campaigns and appropriate public policies, it is feasible to implement the practice of separate waste collection, fostering more sustainable behavior among citizens in Astana. It is important to note that according to the case studies to process and manage waste efficiently, investments in advanced waste management infrastructure, including waste sorting facilities, recycling plants, and WtE incinerators are essential. Addressing this issue will require a holistic approach that incorporates all stakeholders and encourages widespread adoption among households and communities.

Despite the availability of the literature, there is lack of there is a lack of studies on the markets for recyclable materials in Kazakhstan, including supply chain analysis and involvement of the private markets. Also, there is a scarcity of official up to date and credible information on the current state of recycling infrastructure in Kazakhstan, particularly on the availability, accessibility, and distribution of waste collection points, sorting facilities and landfills.

The research can be useful for raising the awareness of the general public, as well as other researchers, specialists in the field of ecology, and government officials. Together with stakeholders from the Ministry of Ecology and natural resources of the Republic of Kazakhstan, and waste collection companies in Astana, the research will address issues regarding the ineffectiveness of the existing recycling process, the obstacles to implementing separate waste collection in Astana, and potential solutions to improve the situation. These findings would also be supported by a short survey of the citizens in Astana. Taking into account foreign best practices and the recommendations of the authority and public opinion, the research aims to propose solutions for introducing separate waste collection and recycling policies.

3. Methodology

The following chapter outlines the methodology employed in this research. Firstly, the research questions are reiterated. Secondly, two data collection approaches are identified to address the research questions. Finally, units of analysis and observation and ethical considerations for the research are defined.

3.1. Research questions

The research aims to establish the reasons behind poor waste management, and how a separate waste collection program can be implemented in Astana. The following research questions will be addressed:

1) What are the obstacles to the implementation of effective separate waste collection in Astana?
2) What could be done to improve the situation?

3.2. Data collection

The methodological approach of the research is mixed, consisting of qualitative and quantitative approaches.

3.2.1. Quantitative approach

To address the research questions, quantitative research was conducted among the residents of Astana through a web-based social survey. The invitations to participate were distributed via social networks, particularly WhatsApp groups for condominium residents only throughout Astana city.

The sampling method is volunteer sampling for surveys. Participants self-select into the study, responding to an open invitation for participation through social networks. To understand the response rate, the number of respondents is compared to the approximate total number of individuals who received the survey invitation. The survey received 326 answers out of approximately 1535 people, which gives a response rate of 21,2%.

To ensure the participation only by adults the survey includes a selection of the various age gaps, above 18. Also, to ensure participation only by Astana residents, the questions included a selection among the Astana districts as a current area of living. The research ensures anonymity to enhance true responses and higher participation rates.

The social survey was initially tested within a small sample to get feedback regarding the simplicity of the process and correct understanding of the questions. The questions are

also structured so that the data can be quantified for the analysis. For instance, a question with answer options such as, “scale 1 to 5”, “agree, disagree” etc. The analysis of the responses is presented as statistical data, using tools, such as charts and graphs. The survey questions with results are outlined in Appendix A.

3.2.2. Qualitative approach

To cover all areas of waste management in Astana and engage all stakeholders of the process, the qualitative approach is used to support the quantitative approach. It includes semi-structured interviews with officials from the Ministry of Ecology and natural resources of the Republic of Kazakhstan, professionals from the waste collection companies, and community representatives. The aim is to gather specialized insight knowledge, understand public perception and behavior, and receive suggestions for enhancing waste management practices in Astana.

The qualitative research is targeted specifically at employees, government officials, environmental activists, households, or other entities that have insights and are directly involved in waste management in Astana.

Firstly, interviews were conducted with representatives from the Department of Waste Management from the Ministry of Ecology and natural resources of the Republic of Kazakhstan. This department is responsible for conducting state policy in solid municipal waste management and implementation of state investment policy in the field of waste management of waste from production and consumption activities.

Secondly, the interviews were conducted with waste collection companies in Astana. Such specialized knowledge from professionals who have firsthand experience with waste management in Astana will provide sound information on the issues, challenges, and recommendations.

Lastly, the research concludes with interviews with Heads of the property owners’ association (POA) and environmental activists as representatives of the Astana population. The number of interviews is as follows:

Name of stakeholder	**# of interviews**
Department of Waste Management from Ministry of Ecology and natural resources of the Republic of Kazakhstan (MoENR)	2

Representative of waste collection company	2
Head of property owners' association (POA)	3
Environmental activists	3

Table 1 Number of interviews

Interviewees were asked identical questions. This type of research method with open set-up questions allows receiving out-of-box responses, ensuring flexibility in discussions and coverage of all relevant topics. To minimize the impact of data limitations an interview protocol was in place.

The interview questions are presented in Appendix B. The analysis of the obtained information will be through a thematic analysis of interview transcripts.

3.3. Unit of analysis & Unit of observation.

The unit of analysis and observations is the level of separate waste collection by households in Astana. Additionally, the unit of analysis and observations are variables that affect waste management practices and factors that influence the legislative decisions of the Ministry of Ecology and natural resources of the Republic of Kazakhstan regarding waste management.

3.4. Ethical considerations

Before the start of the survey and interviews, consent from the participants was gained. Clear information on the study's purpose was also given. The research ensured open research goals and notification of applied methods. Both survey and interviews ensured the confidentiality and anonymity of participants, and the interviewees were notified about confidentiality in advance.

3.5. Summary

The aim of the research is to address obstacles to separate waste collection and propose improvements for waste management in Astana. The methodological approach combines qualitative and quantitative methods. The quantitative aspects entail a web-based social survey among Astana's population. Qualitative aspects involve semi-structured interviews with the Ministry of Ecology and natural resources of the Republic of Kazakhstan, waste collection companies, and representatives of the Astana population to cover the entire waste management cycle. The research ensures participant consent, transparency about the study's purpose, confidentiality, and anonymity for interviewees.

4. Findings

The following chapter provides findings from conducting the web-based survey as a quantitative research method and interviews as a qualitative research method.

4.1. Quantitative research

The web survey was taken by 326 people and participants could choose either Kazakh or Russian language. The demographic profile of the respondents is represented as follows:

Demographics	Description	Number of responses	Percentage
Age	18-35	194	59.5
	36-50	93	28.5
	over 51	39	12.0
	Total	**326**	**100.0**
Area of Astana	Esil	119	36.5
	Saryarka	14	4.3
	Almaty	65	19.9
	Baikonyr	12	3.7
	Nura	115	35.3
	Not answered	1	0.3
	Total	**326**	**100.00**
Type of housing	Apartment building	306	93.7
	Private house	7	2.1
	Other	5	1.5
	Not answered	8	2.7
	Total	**326**	**100.00**

Table 2 Demographic profile of the respondents to the web-based survey

Question 5 delves into the issue of the current state of separate waste collection among the general public. The responses reveal that while many people are well-informed about waste sorting (with 31% rating themselves a 5), there is still a significant portion who are less confident (with 53.68% rating themselves a 3 and lower). The group, rating themselves a 3, indicates that many people might have a basic understanding of recycling, but there's room to refine their knowledge.

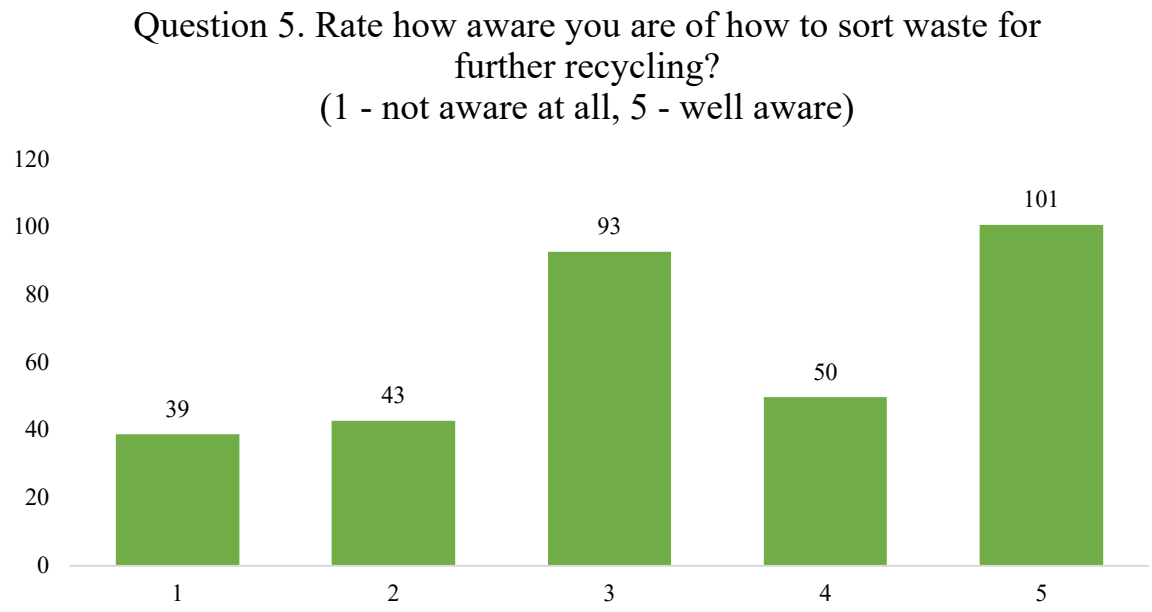

Figure 1 Responses to the Question 5

Following a detailed explanation of the separate waste collection procedure in Astana according to the legislation and requirements of the waste collection companies, Question 6 asks for the feasibility of the current requirements for separate waste collection among the citizens.

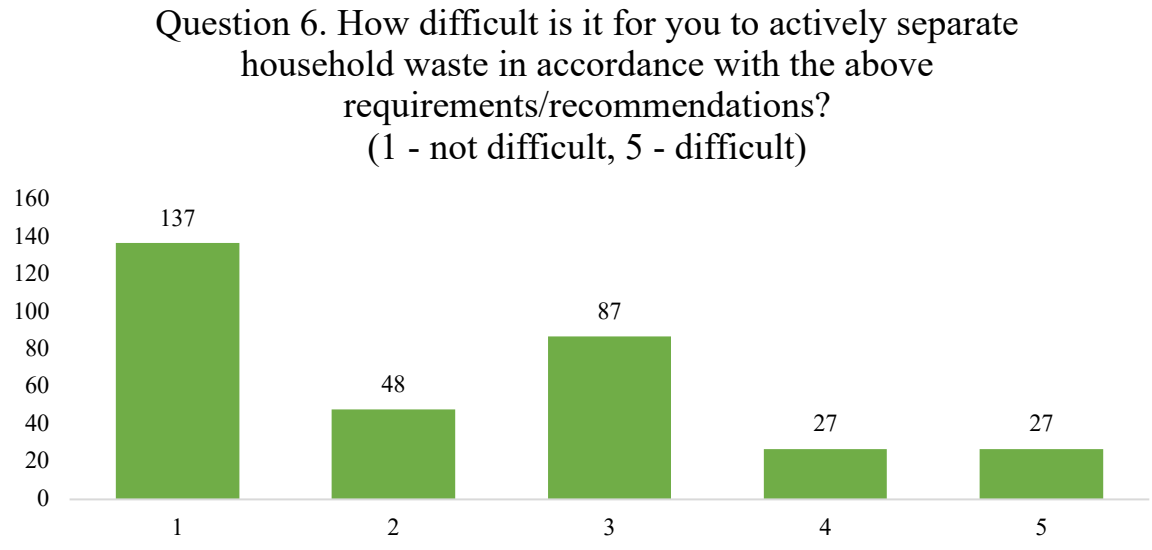

Figure 2 Responses to the Question 6

More than half of the respondents (56.74%) find it easy to separate household waste, suggesting that a large portion of the population feels confident and equipped to handle recycling tasks. This indicates that for many, waste separation processes are accessible and user-friendly. However, 43,26% of people (categories 3, 4, and 5) experience some

level of difficulty, which suggests that despite awareness, practical challenges are still a significant barrier to effective recycling for many households.

The responses to Question 7 “Do you sort household waste for further recycling?” are as follows:

- Yes – 119 responses
- No – 207 responses.

A substantial majority of respondents (approximately 63%) do not actively sort their household waste for recycling. This is a significant portion, highlighting a potential gap in recycling behaviors, whether due to lack of awareness, difficulty in the process, or barriers such as insufficient infrastructure.

Around 37% of respondents do not sort their household waste for recycling. This indicates a positive level of engagement with recycling practices among the surveyed population. Given that a high percentage are sorting waste, it suggests that awareness and motivation to recycle are working to a certain extent.

The respondents indicate that plastic, paper, and food waste are the most commonly sorted types of waste.

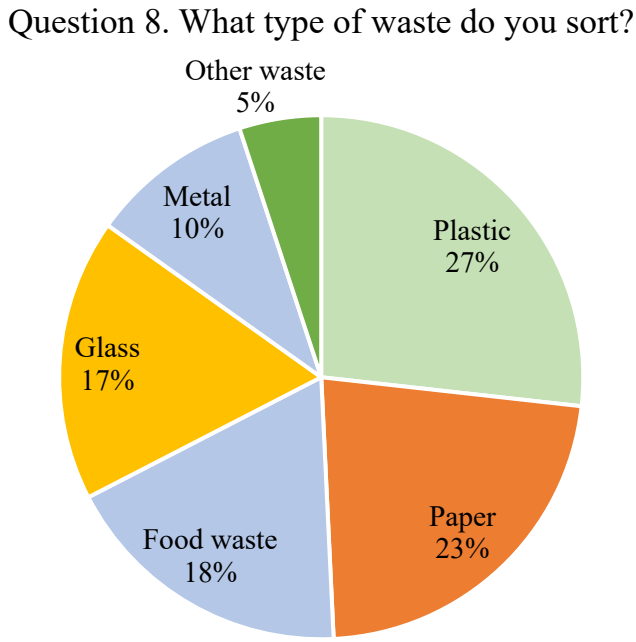

Figure 3 Responses to the Question 8

Less frequent is the sorting of metals and other types of waste.

Question 9 “What is your reason for not separately collecting household waste?” helps to address the first research question and identify the barriers people face when it comes to separate waste collection. It is asked to indicate the 3 most important aspects.

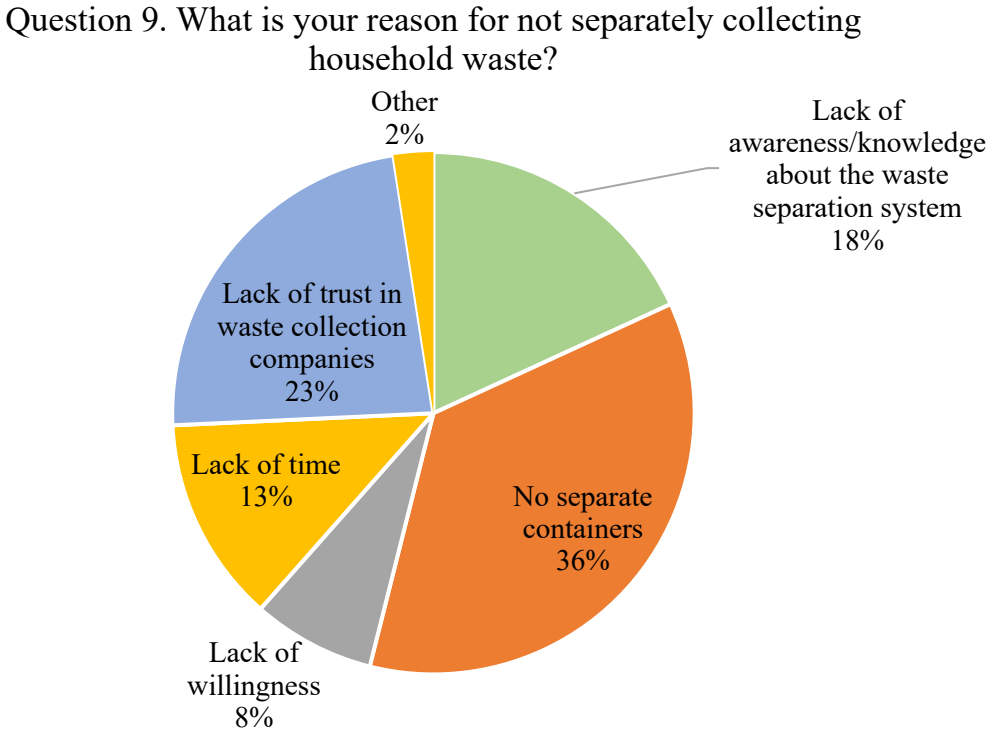

Figure 4 Responses to the Question 9

The most cited reason for not sorting waste is the absence of separate containers for different types of waste (146 responses, 36%). The second most common reason for not sorting waste is a lack of trust in waste collection companies, with 36% of respondents expressing doubts about whether the sorted waste is processed separately. This reflects a perception that even if people do their part by sorting waste, it may all be mixed later, rendering their efforts pointless. The specific comments emphasize this distrust, with respondents mentioning incidents where they observed sorted waste being combined into a single collection truck or handled improperly. This reinforces a broader belief that recycling programs may not be as effective or genuine as claimed.

Other respondents cited a lack of time and a lack of willingness to sort waste. This could reflect a general indifference or low motivation towards recycling or environmental

issues. The responses under the category “Other” reiterate the above-mentioned arguments and include such issues as:

- Nobody sorts waste, society and the state are not interested;
- There is no point in sorting as there is no further recycling anyway;
- Garbage gets mixed during the collection by the waste collection companies;
- No containers for separate waste.

Question 10 looks for the readiness of participants to actively sort household waste in their everyday life.

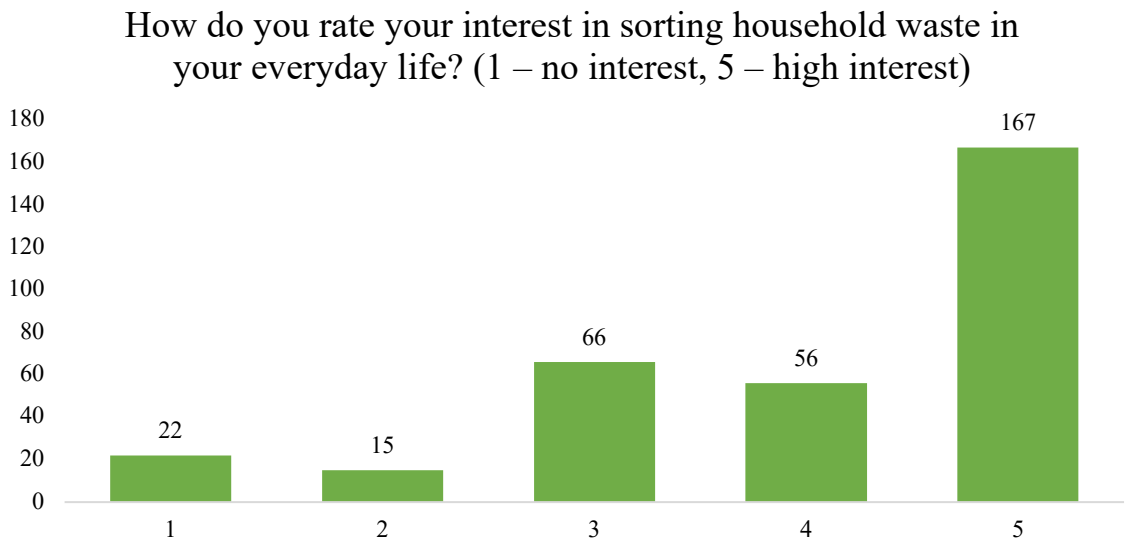

Figure 5 Responses to the Question 10

The fact that over 70% of respondents express high (4) or very high (5) interest in sorting household waste is encouraging and shows that the majority of people are willing to participate in recycling efforts. This suggests a strong foundation for increasing participation if proper infrastructure and education are provided. Given this high level of interest, people are likely to respond well to improved recycling systems, as they already have a personal commitment to sorting waste.

A moderate group (22.1%) presents a key opportunity for increased engagement, while a small percentage of disinterested individuals (10%) could benefit from targeted interventions that address specific barriers.

The next question “What factors can motivate you to take a more active part in the separate collection of household waste?” addresses the second research question and

determines the factors that would possibly motivate respondents to actively sort household waste.

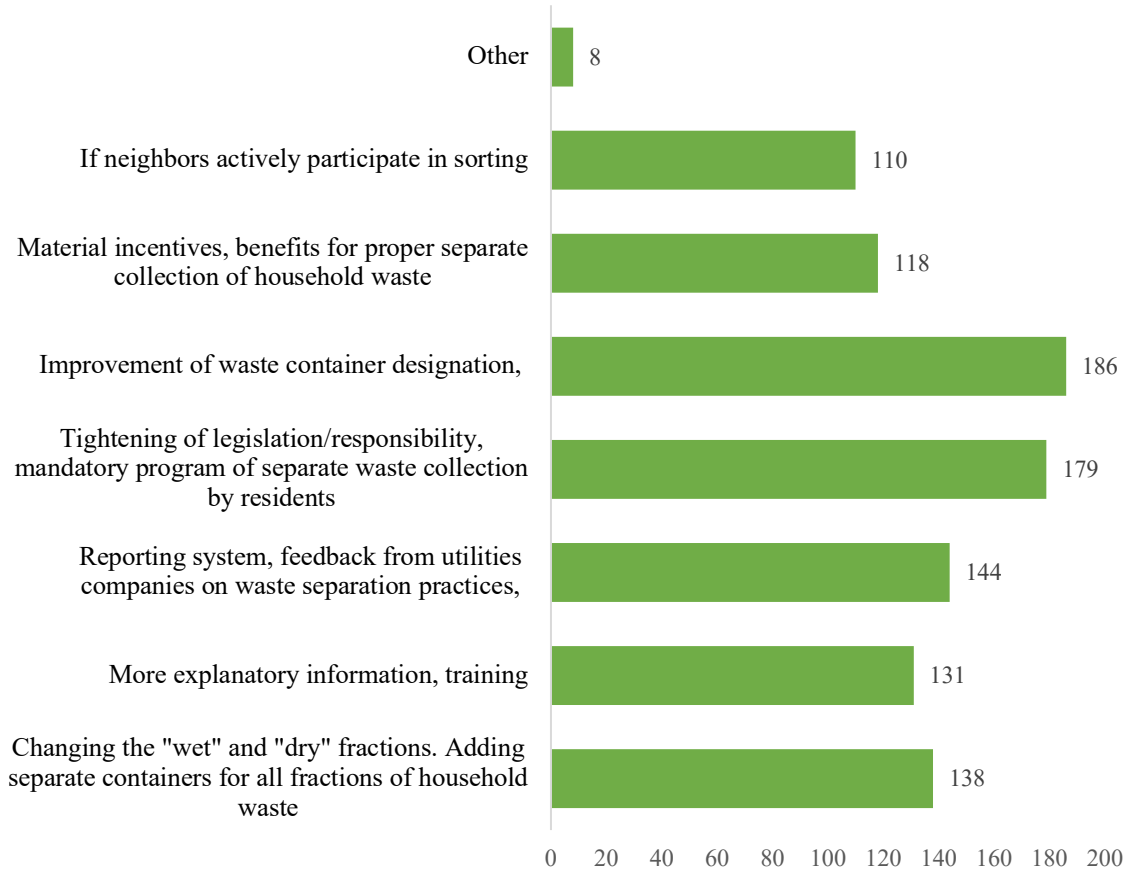

Figure 6 Responses to the Question 11

The results show that the most significant motivating factor identified by respondents is improving the designation of waste containers. This suggests that clear, well-marked, and accessible containers for different waste types are crucial for encouraging proper sorting and it helps remove confusion and makes it easier for people to know how to sort their waste correctly.

The second most cited motivating factor is the tightening of legislation and the implementation of mandatory waste separation programs. This reflects a belief that legal requirements can drive behavior change, pushing residents to comply with sorting protocols.

The absence of a reporting system and feedback from utility companies regarding waste separation practices suggests that people are motivated by understanding how their efforts

impact recycling outcomes. Transparency about what happens to sorted waste and how it contributes to environmental goals can reinforce positive behaviors.

The introduction of material incentives for proper waste separation reflects a desire for tangible rewards, such as discounts on utility bills or monetary benefits for recycling efforts.

The desire for more educational resources and training about waste separation is highlighted by 110 respondents. This indicates a recognition that many individuals may not fully understand how to sort waste correctly or the importance of doing so.

The need to differentiate between "wet" and "dry" waste through better container systems also suggests a practical approach to sorting.

The influence of neighbors participating in waste sorting indicates that social norms and community engagement play a significant role in motivating individuals. People are likely to be influenced by the behaviors of those around them, reinforcing the idea that community-based initiatives can be effective.

The “Other” category includes such responses as:

- Importance of explaining the issue to other people;
- Introduction of PAYT program similar to South Korea and Japan;
- Greater responsibility by the management company;
- Selling garbage bags of more colors according to the colors of garbage containers.

This category also highlights a variety of unique suggestions for motivating better waste sorting, such as community campaigns, the involvement of younger generations, and the introduction of colored garbage bags for easier sorting. Some respondents referenced successful practices from other countries (e.g., South Korea, and Germany) as models for improving local recycling efforts. This suggests respondents are cognizant of good international practices and are ready to provide insights for enhancing local programs.

Question 12 tests whether the participants would support the introduction of a mandatory requirement for separate waste collection by households (homeowners, housing associations, housing cooperatives) to improve waste management in Astana (with fines for households in case of non-compliance) and also evaluates the possible recommendation for implementation of effective separate waste collection policy.

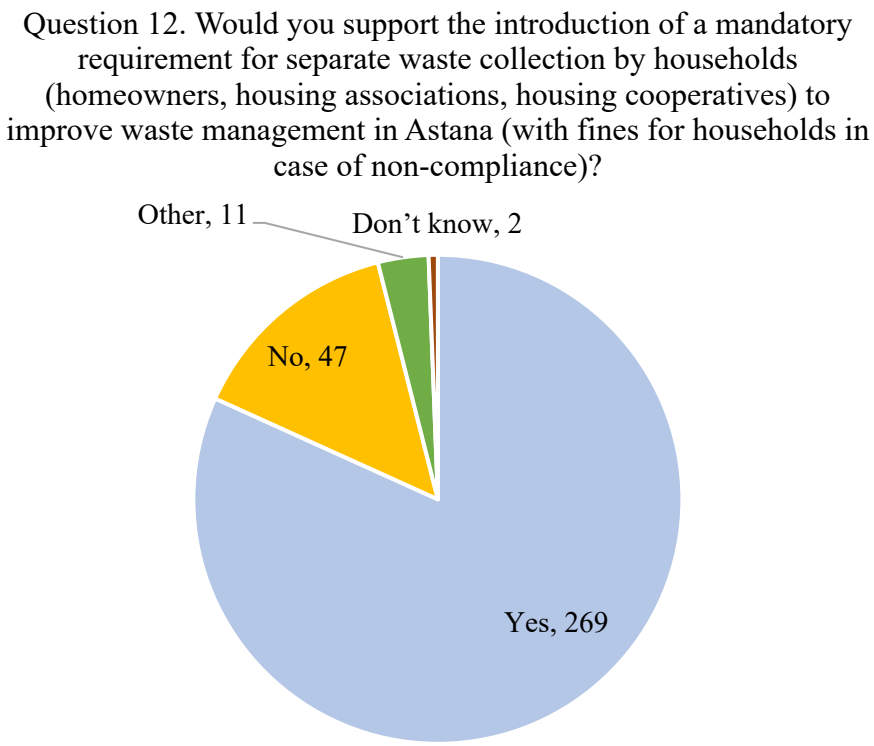

Figure 7 Responses to the Question 12

The results indicate a strong public support for mandatory waste separation, reflecting a community ready to embrace environmental responsibility. Although there are concerns regarding fines and system transparency. Moving forward, leveraging the existing support and addressing potential barriers will be critical in successfully implementing effective waste management policies in Astana in the future.

The final 13th Question is an open question and asks for additional suggestions for improving the practice of separate waste collection among Astana's citizens. There are 75 suggestions and the general trend in the responses reflects the following key themes:

1) Awareness and Education. Many respondents emphasize the need to raise awareness about waste sorting, especially starting from schools and kindergartens. There is a call for more educational campaigns, both in the media and at the community level, to change attitudes toward waste sorting.
2) Infrastructure Improvements. A recurring theme is the lack of adequate infrastructure for waste sorting. Suggestions include adding more containers for different types of waste (plastic, glass, paper), increasing the number of collection points, and making sorting bins available in more residential areas.

3) Incentives and Penalties. Several respondents suggest introducing financial incentives for proper waste sorting, such as cashback or utility bonuses. Conversely, penalties for non-compliance, like fines for improper disposal, are also frequently mentioned as necessary measures.
4) Government and Legislative Action. There is a clear call for stronger government intervention, with many suggesting that waste sorting should be made mandatory through legislation. Respondents also want the government to ensure proper waste collection and disposal processes are followed by public utilities.
5) Learning from Other Countries. A significant number of responses reference successful waste management practices in countries like South Korea, Japan, Austria, and Germany, proposing that Kazakhstan adopt similar systems, such as separate containers, cameras to monitor waste sorting, and organized collection of recyclable materials.
6) Skepticism and Frustration. Some respondents have expressed frustration or skepticism about the current system, noting that even if waste is sorted, it may not be collected properly. This undermines their motivation to participate in sorting efforts, indicating a need for transparency and accountability from waste management services.

4.2. Qualitative research

The interviews were carried out in Astana, and participants were selected based on their field of work and relationship to the field. A total of 10 responses have been received.

Name of stakeholder	**# of interviews**
Department of Waste Management from Ministry of Ecology and natural resources of the Republic of Kazakhstan (MoENR)	2
Representative of waste collection company	2
Head of property owners' association (POA)	3
Environmental activists	3

Table 1 Number of interviews

Each agency plays a distinct role in the waste management ecosystem, from operational tasks at the local level to policy-making at the national level. The Ministry of Ecology and Department of Waste Management focus on establishing regulations and ensuring compliance, while entities like waste collection agencies and the OSI focus on service delivery and engagement with the local community.

The current situation with waste collection in Astana

The waste collection and recycling situation in Astana is generally considered problematic by all respondents. Major issues include insufficient recycling efforts, logistical and operational challenges in waste collection, and a lack of public adherence to waste separation policies.

The representative from the waste collection company mentioned that there is a significant buildup of waste in Astana, with landfills being used mainly for burial. Workers in waste collection facilities were also reported to be falling ill due to their work conditions. Overall, recycling is also either absent or limited in its scope and reach, causing environmental and public health concerns.

Another common theme across respondents is the lack of active waste separation by the households and improper disposal of non-household waste. The transition to separate waste collection has been slow, with a cultural shift towards waste separation yet to take hold. The current infrastructure, policies, and public engagement strategies are not yet robust enough to manage the situation effectively. Containers for separating waste are either absent, or the infrastructure does not support convenient sorting.

Some respondents also note logistical issues in terms of timely waste removal and lack of adequate waste collection machinery. Improper waste disposal contributes to unsanitary conditions, particularly in summer. Improvements have been noted in some areas, but overall, the system is struggling to cope with increasing waste production due to population growth.

Current policy/regulation about separate waste collection

The effectiveness of the current policy on separate waste collection in Astana is widely regarded as insufficient across respondents, although the division of waste by two fractions, “wet” and “dry,” is perceived as sufficient. Half of the respondents agree that many residents do not separate their waste due to convenience, cultural resistance, and behavioral issues. Still, inadequate infrastructure fails to support separate waste collection regulations.

The regulations would also benefit from the competition and funding for waste management, as it currently limits innovation and efficiency. Furthermore, arguments

have been made for insufficient economic incentives to encourage public participation in waste sorting, stricter enforcement, and better alignment between policy and practice. The execution of the policy needs to be improved and strictly controlled.

The root causes of the low rate of separate waste collection in Astana among householders

Key causes are categorized as follows:

1) Inadequate infrastructure: the absence of a reliable and convenient infrastructure; waste containers for separate waste collection. People are demotivated when they see that even separated waste is collected by the same garbage truck.
2) Weak motivation: there is a general lack of willingness among the public.
3) Education and information: a major issue is the public's limited awareness and knowledge of waste separation processes and the benefits of recycling. Many residents do not understand the importance of separate waste collection.
4) Discrepancies in population data: hidden registrations, where more people live in a household than are officially registered, contribute to inadequate waste projections and allocation of resources by the waste collection companies.
5) Public distrust in the system: residents have lost trust in the system due to inconsistent practices. When people observe that separated waste is collected together, they lose faith in the waste separation policy. Citizens express skepticism about the efficacy of recycling programs, suggesting that they believe their efforts may not make a difference.
6) Absence of fines and incentives, legislation: there's a consensus that clear regulations and policies are needed to enforce waste separation and improve compliance. Respondents also call for a balanced approach that includes both incentives for compliance and penalties for non-compliance. There's an understanding that a dual approach may motivate different segments of the population effectively.

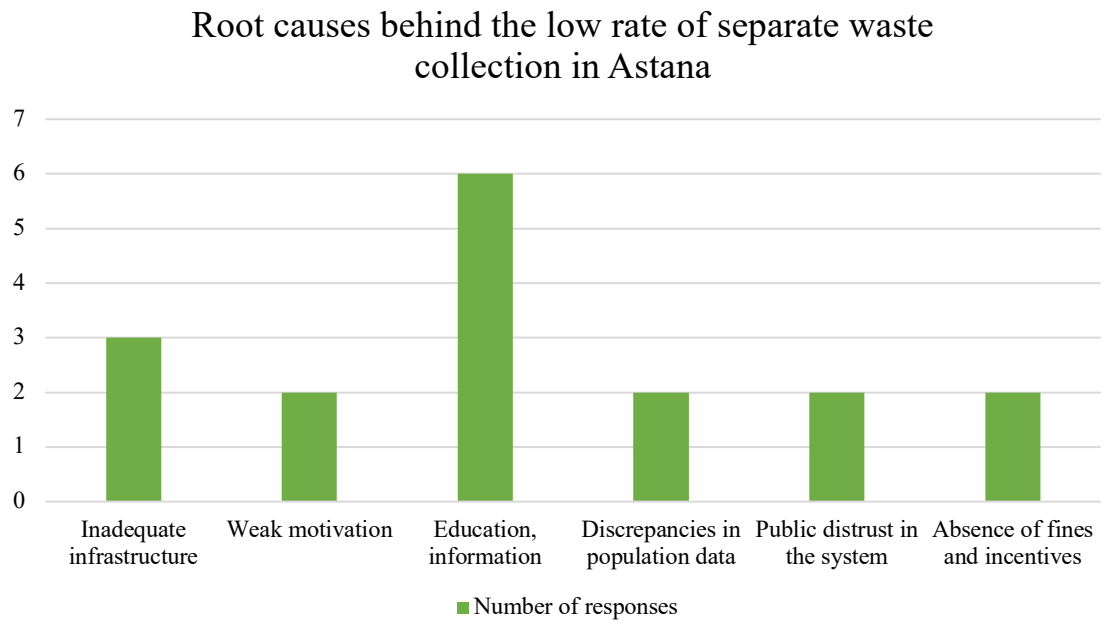

Figure 8 Root causes behind the low rate of separate waste collection in Astana

Current level of awareness of the Astana population about waste management issues

The majority of respondents emphasize that the general level of awareness among the Astana population is low. People are largely uninformed about waste management issues, including the importance of separate collection and recycling. The public mostly focuses just on waste removal without much understanding of what happens beyond the collection phase.

Around 10-20% of the population, particularly younger people, students, and those who have been exposed to international practices, are aware of waste management issues and willing to participate in recycling and separation activities. There is also an increasing stream of ideas and proposals on how to improve waste management from the public to the MoENR.

Encouraging citizen participation in waste sorting

Several institutions admit they are not actively engaging with the public on waste sorting, passing the responsibility to local authorities or businesses. Additionally, sporadic propaganda events or awareness campaigns have been organized, but these efforts are not consistent or ongoing. The MoENR has recently begun working on a Concept of Environmental Culture, targeting educational institutions such as preschools and schools.

Environmental activists interestingly stress the role of businesses in promoting recycling initiatives. Examples include companies that facilitate recycling programs and engage in sustainability practices as part of their corporate social responsibility. Suggestions are made for providing incentives to businesses that participate in waste sorting and recycling, which could help stimulate broader community involvement.

Nevertheless, there's a recognition that adults often resist change due to established habits and beliefs. Engaging younger generations is viewed as a more effective strategy for fostering a culture of recycling and sustainability.

Mandatory separate waste collection policy in Astana

Some interviewees agree that without the infrastructure to support separate waste collection, no mandatory separate waste collection policy should be introduced. It will be ineffective without fully functional recycling plants and the necessary waste separation infrastructure. Recycling plants, proper containers, and transportation systems need to be developed before any policy can be effective. Otherwise, it would place an undue burden on the public, which would result in a backlash to the government and Akimats. Moreover, there is skepticism about whether the public is ready or willing to comply with mandatory separation without first experiencing clear benefits and adequate infrastructure.

On the other hand, several interviewees agree that mandatory separate waste collection is necessary. Referenced successful waste management practices in countries like Japan and South Korea support the belief that structured, mandatory systems can effectively change citizen behavior and improve outcomes. Also, without encouragement to participate, the policy would fail, as people are not motivated to separate waste if they don't see the value or know where to take it. Enforcing mandatory policies will be also difficult without clear accountability mechanisms. POAs and local organizations currently lack the authority to issue fines or ensure compliance, so enforcement will need to involve law enforcement or other dedicated agencies. Otherwise, the POA will have to bear the burden of the fines and redistribute it to all citizens of a condominium.

Overall, interviewees suggest a phased implementation of mandatory policies, allowing time for public adaptation and infrastructure development. There is recognition that sudden changes might lead to widespread confusion and non-compliance.

Practical steps can be taken to improve the waste collection and recycling infrastructure in the city

The need for better waste collection infrastructure is a consistent theme. Respondents highlighted the importance of installing containers for separate collection in every yard, with regular maintenance and replacement. The containers often wear out quickly due to the rough handling by garbage trucks.

Many respondents stressed the importance of educational programs, particularly in schools. Some suggested that companies involved in waste management should conduct visits to schools to explain and raise awareness among children. Additionally, family-based education is seen as crucial, with parents playing a key role in teaching children about waste management.

Respondents suggest using slogans, banners, and social media influencers to raise awareness and change public attitudes towards waste separation. Regular communication through various media can help normalize recycling practices. Interestingly, environmental activist highlights importance of social influence and subconscious behavior in promoting waste sorting and recycling. Separate waste collection should become a trend. It can significantly shift public attitudes as people are more likely to engage in a behavior if they see others doing it.

The role of businesses in waste collection was emphasized, with suggestions that private businesses should be incentivized by the government to set up collection points for secondary raw materials. Financial support and subsidies that businesses can receive through recycling fees and state programs like “EcoQoldau” can relieve some of the burden from the state.

Furthermore, respondents suggested various incentive mechanisms to encourage citizens to participate in waste sorting, including financial rewards for handing over recyclables. However, they noted that these incentives must be compelling, as offering small payments (e.g., 50-100 tenge per kilogram) may not motivate large segments of the population. Some proposed linking recycling to community-oriented goals, such as helping others or contributing to environmental causes, as a way to appeal to citizens’ sense of responsibility and common good.

4.3. Summary

The structured interviews and web survey provided insight into the personal views of the sample of industry professionals and the general public who participated in the fieldwork investigation. Despite a wide range of participants in the web survey, there was a general trend that reveals the majority of citizens have similar views about the separate waste collection process and how it is currently implemented.

Following the logic of the literature review, the anticipated findings from observing the research settings suggest that policies for separate waste collection involve a strategic approach that combines the collaboration of different institutions and community engagement. A detailed analysis of the findings is shown in the following chapter.

5. Discussion

This chapter synthesizes and analyses the findings presented in Chapter 4 from both quantitative and qualitative research. The discussion is constructed with regards to addressing two research questions: a range of interconnected challenges that impact the effective implementation of separate waste collection among Astana's citizens, and actionable solutions that would result in the recommendations of the research.

5.1. Obstacles to the implementation of effective separate waste collection in Astana

5.1.1. Infrastructure

Both quantitative and qualitative research revealed that the lack of appropriate containers for different fractions significantly impacts the active separate collection of waste.

The absence of containers for separate waste collection was the most cited barrier (51.9% of respondents). Many participants mentioned that there are not enough designated bins for different types of waste (plastic, paper, glass, etc.), making it difficult for citizens to engage in proper sorting. Even when containers are available, respondents reported that they saw waste being mixed in collection trucks, undermining their efforts and trust in the system. This logistical flaw discourages participation.

This represents a significant infrastructural and logistical barrier. Without proper infrastructure, people feel that sorting is either impractical or impossible. This highlights the importance of providing accessible waste collection systems, and bins for different types of waste. Improving the availability of separate containers in residential areas could lead to a substantial increase in waste sorting.

Governments or local waste management services should prioritize expanding access to the necessary infrastructure to facilitate easier sorting at the household level. Also, introducing more convenient waste sorting systems, such as easy-to-use bins and curbside pickup, could help alleviate the time burden.

5.1.2. Distrust in the waste collection and recycling process

A significant portion of respondents (32.7%) mentioned distrust in the waste collection process, believing that their sorted waste would eventually be mixed with other trash during collection or at disposal sites.

Specific instances of waste being improperly handled by collection companies were highlighted, contributing to a widespread belief that recycling programs are ineffective or not genuine. The interview results, indicating that the recycling facility is currently closed for modernization, confirm and reiterate the lack of reliability in the whole process.

5.1.3. Lack of information

While 71% of respondents indicated they actively sort waste, there remains a knowledge gap. Many people (33.9%) rated their confidence in understanding waste sorting practices as mediocre (a score of 3 or lower). Although 70% of respondents indicated an interest in actively sorting waste, the research showed that there is a lack of consistent public engagement from authorities and companies. Respondents noted sporadic campaigns, but these efforts were not enough to drive significant behavior change.

Both web survey participants and interviewees called for more education and awareness programs—especially targeted at schools, kindergartens, and families—to promote a culture of recycling from a young age. This advocates for a continuation and increase in public education and awareness campaigns to enhance people's understanding of how and why to sort waste.

5.1.4. Willingness of people

Lack of time (15.9%) and lack of willingness (10%) were also cited as reasons for not sorting waste, indicating that some individuals see sorting as a burdensome task that requires extra effort. Motivation could be enhanced through incentives or social programs that encourage participation, such as rewards for consistent recyclers or penalties for not sorting waste. Additionally, increasing the visibility of environmental impact could shift attitudes toward more sustainable behavior.

The qualitative interviews revealed that cultural habits are slow to change, and many residents are reluctant to adopt waste-sorting practices. This is partly due to convenience factors, as well as a lack of perceived immediate benefits to sorting waste. There is also a disconnect between policies and public adherence to these policies. Even when aware of the importance of waste sorting, citizens may be slow to adapt due to ingrained behaviors or perceived difficulties in the process.

5.1.5. Weak legislation and policy support

Several participants suggested that stronger legislation and mandatory waste separation policies are needed. Though there was broad support for stricter laws, including fines for

non-compliance, the lack of enforcement and practical support systems (e.g., proper containers and collection systems) was seen as a barrier to implementing these policies.

Interviewees also noted the insufficient economic incentives to encourage residents and businesses to participate in waste sorting, suggesting that policies should include stronger incentives or penalties.

5.2. Suggestions to improve the situation

5.2.1. Private sector involvement

Interview results have shown that a significant increase in separate waste collection could be achieved when businesses have a vested interest in high-quality recyclables. The private sector can play a pivotal role in helping the government implement effective separate waste collection systems by leveraging its resources, expertise, and innovative approaches. For example, some respondents mentioned that recycling machines in shopping centers offer incentives such as bonuses or discounts on certain goods in exchange for recyclable materials (plastic and metal bottles). Retailers and manufacturers, for instance, drinking water companies, can install reverse vending machines or implement deposit-return schemes for items such as plastic bottles and cans, similar to Germany. These systems incentivize consumers to return their recyclable waste in exchange for small financial rewards, boosting recycling rates.

Sound competition among different private organizations for raw recyclable materials is argued to have positive results. Private companies can invest in building and maintaining separate waste collection infrastructure, including the installation of durable and strategically placed waste separation containers. They can also provide maintenance services for these collection points. One respondent shared an example from Temirtau, where a private company implemented effective waste sorting practices by providing specialized containers that attracted attention and motivated people to sort their waste. The success of this initiative was largely due to the company's interest in collecting high-quality secondary raw materials, which incentivized them to maintain clean, efficient, and attractive sorting processes, similar to the case study in Japan.

The MoENR has also indicated that the program “EcoQoldau” has been relaunched under the supervision of the “Jasyl Damu” JSC, which in turn is a fully subordinate organization of the MoENR (Gov.KZ, 2022).

Thus, this research suggests that partnerships formulated between local government bodies, private sector companies, and other non-governmental organizations will enable the two entities to harness the strengths of their respective abilities and resources towards ensuring that the waste management system becomes both effective and sustainable.

5.2.2. Education and awareness campaigns

The research findings have also indicated a need for further education or awareness initiatives. Lack of knowledge about the waste separation system was the third most common reason for not sorting. This suggests that some people may not fully understand the benefits, methods, or guidelines for sorting waste. The complexity or absence of clear information may create confusion or discourage people from making the effort. Educational campaigns and simple, easy-to-understand resources like guidelines, infographics, public awareness campaigns, media, and community workshops could provide clarity. These can cover topics like what is separate waste collection, understanding the need behind waste separation, and the waste management cycle from start to finish that takes place in the Astana recycling plants

Furthermore, state organizations such as Akimats and waste collection companies could improve communication and transparency, showing how sorted waste is processed and where it goes. Proof of proper further recycling, perhaps through public awareness campaigns or reports, could enhance public trust and compliance and, as a result, encourage more people to sort their waste.

As suggested by one respondent, separate waste collection should become a trend among people. Utilization of social media, “influencers”, who have a much greater connection with the general public, could be used by the Akimats and other government bodies to translate the need and inspire their followers to engage in waste separation. Building trust in the whole system demands stability and full enforcement of the policy on all levels. This trust restoration process requires strategies focused on prudent management and credibility.

5.2.3. Mandatory policy for separate waste collection by households

By enforcing stricter regulations, authorities can create accountability and ensure that residents participate in waste separation as a civic duty. This highlights the need for governmental support and policy changes to enhance recycling efforts.

Our investigation may be considered as progress toward the implementation of the policy for separate waste collection by households in Astana by Akimat of Astana with the help of related governing authorities. The choice between centralized and decentralized decisions often depends on a country's governance structure, policy objectives, and the desired level of flexibility and participation for its citizens. However, Kazakhstan is often considered a “strong” authoritarian state, where the government makes decisions independent of dominant classes. It is also important to recognize that many individuals will not consider future implications and do not have incentives for separate waste collection without an element of compulsion or automatic enrollment. Despite the introduction of the Ecological code, there have been no significant improvements in the separation of waste, and people in Kazakhstan still prefer to dump household waste without consideration for further reuse and recycling. Also, clear information on the “EcoQoldau” program and the procedure for participation is absent, making it difficult for the private sector to get engaged and take part. Therefore, a centralized decision, introduction of mandatory waste separation should guarantee the achievement of the desired outcomes set by the environmental regulations.

5.3. Summary

The responses to the survey reveal a robust desire among citizens of Astana for improvements in waste management practices. The themes of awareness and education, infrastructure improvements, financial incentives, government action, learning from successful international models, and addressing skepticism indicate that a multi-faceted approach is necessary. By addressing these key areas, authorities can effectively enhance the practice of separate waste collection and promote a more sustainable community.

6. Conclusion

6.1. Research summary

The study provided a clear overview of the importance of proper waste management for the sustainable development of cities, as well as highlighting the problems faced by cities in the field of waste management, and the need for effective policies and strategies to address these problems. The research focused on the current waste management issues in Astana and the legislation that governs the waste management practice in Kazakhstan.

The literature review emphasizes the importance of separate collection of household waste and the various methods that can be used for its implementation. Case studies of Sweden, Japan, and Brazil help to get information about various approaches that can be applied in Astana to achieve successful waste management. In addition, the quantitative and qualitative approaches used in this study provide a level of understanding of the waste management situation in Astana.

6.2. Recommendations

To sum up the suggestions made by the respondents, the recommendations could be outlined as follows:

1) Engage the private sector to address the lack of proper infrastructure to support separate waste collection through Public-Private Partnerships

Businesses can establish and operate waste sorting facilities and recycling plants, taking on part of the operational burden that would otherwise fall on the government. Private companies can partner with the government through Public-Private Partnerships (PPPs) to co-invest in waste management projects. These collaborations can focus on shared infrastructure, waste processing plants, and recycling programs.

Private companies have incentives and resources to collect high-quality recyclables. Thus, placing containers for different waste types (e.g., plastic, paper, glass, and organic waste) throughout residential areas, separate collection trucks, and clear information guidelines will be the responsibility of the privately owned companies that operate the recycling facilities.

2) Comprehensive education and awareness campaigns

Firstly, MoENR with Akimats should provide easy-to-understand resources like infographics, workshops, and instructional videos that explain the sorting process, the

importance of waste separation, and the environmental impact of responsible waste management.

Secondly, waste sorting education should be integrated into school curricula to raise awareness and foster early habits of responsible waste disposal among younger generations.

Finally, as proposed by one interviewer, government bodies should leverage social media platforms and popular influencers to promote waste sorting as a trend, making it a socially supported practice.

3) Implement and enforce mandatory waste separation policy for Astana citizens.

After ensuring the availability of necessary infrastructure, MoENR could start a phased approach for the implementation of mandatory waste sorting regulations with clear guidelines and penalties for non-compliance to encourage civic participation and accountability. The policy should also consider outlining financial incentives or utility discounts for households that consistently sort their waste properly, balancing fines for non-compliance with rewards for positive behavior.

6.3. Limitations of the study

It could be argued that the number of respondents in the survey is low to accurately represent the whole population in Astana. Due to the uncontrollable distribution of the survey through social networks, the study possibly missed certain neighborhoods in the sampling frame, creating bias. Also, since participation in the survey was nonobligatory, it could be considered that only interested and cognizant of the issue citizens have participated in the survey.

Non-response and refusal to participate could be due to lack of credibility, time constraints, or inconvenient methods of the survey. Invitation to participate in an online survey could be viewed as a nuisance.

Furthermore, to show the easiness of the process and achieve a representable number of responses, the number of questions and wording of questions were limited. Due to these limitations in formatting, the responses could be skewed or biased. Therefore, the findings from the quantitative research were supplemented with a qualitative approach through semi-structured interviews with stakeholders in the field.

The number of interviewees within one organization was one or two, which would affect the scope of the results. Also, each organization has its own practices and opinions regarding the problem. Some stakeholders provided limited information due to concerns about confidentiality and exposure of the issues and weaknesses within the organization and the system. The social desirability effect might also take place as the state enterprises understand what is perceived to be socially desirable and what is not (Bryman, 2012). Conducting research across diverse organizational settings means navigating different cultures, which can affect the way data is perceived, collected, and interpreted.

Researchers might also unintentionally introduce bias due to their own understanding or familiarity with one organizational setting over another (Bryman, 2012). To address this issue, consistency in data collection methods, metrics, and analysis across different organizational settings was ensured.

6.4. Further study and unanswered questions

Extended Producer Responsibility, or EPR in Kazakhstan, refers to a policy framework where producers, importers, and manufacturers are responsible for the entire lifecycle of their products, particularly in terms of waste management and recycling after the product has been used by consumers (Zhasyl Damu, n.d). The goal of EPR is to minimize the environmental impact of products by encouraging manufacturers to design products that are easier to recycle, have longer lifespans, and reduce overall waste generation.

Companies are required to organize or finance the collection, sorting, and recycling of the waste generated by their products. This can include setting up recycling infrastructure or partnering with recycling companies. In practice, this means businesses must ensure there are mechanisms for waste separation, collection points, and recycling facilities for the materials their products are made from.

Producers often have to contribute to a fund or pay fees, which are used to subsidize waste collection and recycling programs. In Kazakhstan, the EPR operator (recycling operator) manages the collection of these fees, which are then directed toward environmental projects and infrastructure development. EPR is part of Kazakhstan's “green economy policies” and is embedded in various legislative documents, including environmental regulations. Thus, further study could include an evaluation of policy implementation and whether the policy has achieved its intended goals or not.

It is proposed to consider the possibility of introducing a system of financial remuneration or punishment, depending on citizens' compliance with the rules of waste collection and disposal, according to the studied examples of countries. However, further study is required on the acceptable level of fines for no compliance, introduction of joint liability among the residents within one residential complex, and feasibility of the enforcement in the district of private housing.

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Appendices

Appendix A – Survey results

#	Question	# answers		
1	**What language do you want to take this survey?**	**Kazakh**	**Russian**	**Total**
		76	**250**	**326**
2	**Your age?**			
	18-25	10	35	45
	26-35	29	120	149
	36-50	26	67	93
	51-60	9	15	24
	over 60	2	13	15
	Not answered			0
3	**What area of Astana do you live in?**			
	Esil	30	89	119
	Saryarka	2	12	14
	Almaty	18	47	65
	Baikonyr	3	9	12
	Nura	23	92	115
	Not answered		1	1
4	**What type of housing do you live in?**			
	Apartment building	65	241	306
	Private house	1	6	7
	Other	2	3	5
	Not answered			0
5	**Rate how aware you are of how to sort waste for further recycling? (1 - not aware at all, 5 - well aware)**			
	1	10	29	39
	2	10	33	43
	3	29	64	93
	4	11	39	50
	5	16	85	101
6	**How difficult is it for you to actively separate household waste in accordance with the above requirements/recommendations? (1 - not difficult, 5 - difficult)**			
	1	37	100	137
	2	13	35	48
	3	16	71	87

	4	3	24	27
	5	7	20	27
7	**Do you sort household waste for further recycling?**			
	Yes	47	72	119
	No	29	178	207
8	**What types of waste do you sort? (You can select multiple answers)**			
	Plastic	43	63	106
	Paper	39	50	89
	Food waste	28	44	72
	Glass	26	43	69
	Metal	16	24	40
	Other waste	5	15	20
9	**What is your reason for not separately collecting household waste? (Please indicate the 3 most important aspects)**			
	Lack of awareness/knowledge about the waste separation system	6	68	74
	No separate containers	13	133	146
	Lack of willingness	12	19	31
	Lack of time	17	35	52
	Lack of trust in waste collection companies	11	84	95
	Other			10
	I saw how all the supposedly sorted garbage at work was simply collected by an apashka in one big black bag and she also said: "nobody sorts it, it's all a fairy tale))"	1		1
	People don't know about separate waste and the waste is still mixed. There is no point in sorting	1		1
	Garbage is mixed and separated during loading	1		1
	No further plan after sorting (we seem to just burn everything)	1		1
	there is no result because society and the state and the workers themselves are not interested and indifferent to sorting and processing	1		1
	I saw how they were taken away in one car.		1	1
	Everyone throws it in one container, I'm the only one who separates the trash.		1	1

	In our house there are bins for household waste without sorting. In addition, there is an acute problem of insufficient number of containers for waste and untimely removal of waste. It would be great if there were separate containers for sorting waste.		1	1
	There is only one container for all the garbage. When I lived in Europe, I sorted it because there were a lot of different containers for each type of garbage.		1	1
	Question: Is there separate recycling?		1	1
10	**How do you rate your interest in sorting household waste in your everyday life? (1 – no interest, 5 – high interest)**			
	1	9	13	22
	2	6	9	15
	3	19	47	66
	4	14	42	56
	5	28	139	167
11	**What factors can motivate you to take a more active part in the separate collection of household waste? (You can select multiple answers)**			
	Changing the "wet" and "dry" fractions. Adding separate containers for all fractions of household waste	32	106	138
	More explanatory information, training	28	103	131
	Reporting system, feedback from utilities companies on waste separation practices,	30	114	144
	Tightening of legislation/responsibility, mandatory program of separate waste collection by residents	38	141	179
	Improvement of waste container designation,	45	141	186
	Material incentives, benefits for proper separate collection of household waste	21	97	118
	If neighbours actively participate in sorting	31	79	110
	Other		3	8
	Different bags by color	1		1
	We need to highlight this, talk about it and explain to people the importance of recycling. Our people don't even understand why we need to sort garbage.		1	1

	I would suggest sorting garbage like in South Korea and Japan, how much garbage you throw out, it is all weighed and you pay. But for it to get to this point, the population needs to be trained and ready.		1	1
	So that there are separate waste containers with markings all over the city		1	1
	Place responsibility on the axles and the management company. Apply a system of fines		1	1
	Incentives do not play such an important role, but in a state where money is collected for many things, it is possible to make life easier for citizens in the form of benefits for public services or other incentives. Our social awareness requires motivation.		1	1
	It is necessary to legislatively tighten the requirements for waste removal and sorting. And also campaigning and flash mobs. Involve children and young people.		1	1
	It is necessary to sell garbage bags of two or three or more colours in stores according to the colours of garbage containers, so that sorting begins according to the colours of bags in the apartment. And then people will throw coloured bags according to the colours of the containers. Secondly, it is necessary to organize the collection of glassware for money at residual value, as in Germany, because the budget costs will be the same with manual garbage sorting.		1	1
12	**Would you support the introduction of a mandatory requirement for separate waste collection by households (homeowners, housing associations, housing cooperatives) to improve waste management in Astana (with fines for households in case of non-compliance)?**			
	Yes	55	214	269
	No	21	26	47
	Other		1	11
	Don’t know		1	2
	Show usefulness		1	1
	What does KSK or OSI have to do with it?		1	1

	More encouragement than fines, I prefer soft measures. If they don't keep clean repeatedly, you can fine them.		1	1
	But those who do not separate waste should be fined. Our garbage containers contain not only household waste but also grass and dry leaves.		1	1
	The responsibility for waste separation should rest with the individual who is directly responsible for his actions		1	1
	waste collection companies say they dump everything in one pile anyway		1	1
	without fines		1	1
	I don't believe that the system will work.		1	1
	Before introducing a fine system, citizens must understand and see that waste is really given a second life, and not stupidly thrown into a common dump. Otherwise, it will be unfair to citizens, this is a question regarding the application of a fine.		1	1
13	**Do you have any suggestions for improving the practice of separate collection of household waste among the population of Astana?**			
	Garbage and waste in general are a very big problem in the Republic of Kazakhstan, because the topic of ecology is not very interesting to the people. Of course, it would be nice to make covered garbage containers and equip them with cameras and increase the tax, as in Japan and South Korea (I think it is even possible to copy their system). But we don't have an apparatus or separate containers for handing over bottles of drinks in the MZK, the garbage containers are not separated) I think it is possible to add subjects to the school curriculum or to put an apparatus and special containers in the school canteen or store and teach children to sort the garbage so that it remains as a habit In addition, now people buy necessary and unnecessary, everything is available, especially Chinese ornaments. I hope that someday I will come to minimalism and consume it consciously. Unfortunately,			

	people are not ready now, they need to raise a generation with other values and education.			
	There is a strict requirement and legal requirement for separate sorting of household waste from OSI KSK, as well as additional containers depending on the type of waste. It is necessary to increase the literacy of residents about waste sorting, and OSI KSK has done extensive work on it.			
	More individual containers for collecting plastic bottles and batteries/light bulbs. Containers for collecting electronic devices. And we need information about what codes can be thrown into which containers			
	A clip showing the products made from disassembly and saying thank you. A person understands the importance of his work. To tell the consequences of not collecting.			
	Increase the number of reception points for plastic, glass, paper waste, increase information about methods and processes of separate collection of organic waste			
	I think it would be good if utility bonuses and cashbacks for waste sorting were introduced, and the reward system was implemented through bank applications.			
	It would be good if the videos on the importance of sorting and how to sort are widely distributed on the TV channel and WhatsApp			
	I won't say much, I will say only one thing: citizens, let's protect the environment, let's save it for our future			

	If the bread boxes are placed everywhere, the bread will go together. If the boxes are taken away on time.			
	Obligation for every apartment owner. If you don't do that, don't take away the waste. Penalty.			
	Incorporation into lessons in schools, and explanation through parent meetings.			
	I want to drink coke like in Korea			
	Place a camera next to each trash can. And notices are in two languages			
	Waste could be placed in containers with a label			
	Place sorting containers. Pick it up on time			
	Legally, it is necessary to make it stricter and oblige sorting.			
	Increase and fence litter boxes			
	More information and fines			
	Teach children from kindergarten			
	Convenient sorting containers			
	Increasing information campaigns			
	I lived abroad, I know			
	No		150	
	Use biodegradable bags and disposable containers wherever possible, provide more information about waste sorting (in entrances, on buses, etc.), introduce explanatory talks in kindergartens and schools (10-15 minutes) at least once a month, or make sure that children bring plastic, cardboard, paper, etc. once a month (encourage everyone for this, show a cartoon to younger classes at school, etc.) everything needs to be shown as an example, also show more commercials about how the planet is being filled with waste, add more bins around the city for 2-3 types of waste, unfortunately in the future this will be a very global problem for all planets!!! Good luck to you guys!!!		1	

	I think it makes sense to start implementing something that is accessible to consumers at arm's length: - different types of bags for different types of garbage. - selling garbage containers for the home with markings indicating what kind of garbage it is intended for. - making it a mandatory condition in renovation plans to plan a place for separate garbage collection so that several containers with markings can fit. - introducing a garbage sorting service for the especially lazy. - making garbage removal scanning: a person puts a bag in the machine, it scans it, if the machine finds different types of garbage in one bag, it gives it back, i.e. does not accept it.			
	Require garbage trucks to put the container in place with the inscription on the front side or hang a sign separating garbage by the colour of the containers, when you approach and get confused where each garbage can is. Hang a sign warning people to put garbage correctly and reminding them that they may face a fine. Require the KSK and OSI to install a surveillance camera opposite the garbage can to record violators. This is the only way to teach residents to be tidy. Put a separate box for light bulbs and batteries and identify construction waste. Good luck to you!			
	It is necessary to sell garbage bags of two or three or more colours in stores according to the colours of garbage containers, so that sorting begins according to the colours of bags in the apartment. And then people will throw coloured bags according to the colours of the containers. Secondly, it is necessary to organize the collection of glassware for money at residual value, as in Germany, because the budget costs will be the same with manual garbage sorting.			
	I think we need to put bins for bottles near each trash can. A small, clear sign indicating where and what to send will increase the efficiency of sorting. Create a control and recording system (while there are cameras			

	everywhere, you can record sorting like Sergek); put it in the wrong place once - a fine, put it correctly - a reward. There will be involvement like in a game; all people love social approval.			
	On the left bank, many residential complexes do not have containers for separate waste collection at all, and in this part of the city there are practically no separate waste collection points. That is, in general, there is no separate collection system in Astana. It is necessary to tighten the legislation and fine the Akimats for sabotaging this problem. But the population also needs to be more actively trained. A good example is eco fairs.			
	There is an opinion or even rumour that even if you sort garbage and throw waste into containers specific to each type, then as a result, the municipal services involved in garbage removal still throw waste into the general garbage bin. In this regard, there is no need for sorting.			
	First, it is necessary to establish order among the companies that remove the garbage. It is not known whether there are not enough of these companies or whether these companies do not have enough resources. But the mountains of untimely removed household waste are a fact. When we establish order in this, then we can raise the issue of sorting.			
	Hello! I suggest you study the Korean practice. I lived there for some time for work, I was so pleasantly surprised by their attitude to waste sorting. They sort food into a separate place, that is, it is not a container but rather a recipient of food. Still, I ask you to study their practice.			
	I think two containers will not be enough. We also had a container for bread, but then it was removed for some reason, being a Muslim it is difficult for me to throw bread together with the rest of the garbage, I think we should return the containers for bread, and maybe food waste can be put there too			

	We need to put up videos in all public places explaining the importance of sorting garbage, not just forcing people or fining them, but explaining why it needs to be done so that we don't leave a mountain of garbage for our children. Thank you very much for covering this topic.			
	I would suggest many things, but there are factors influencing my suggestions. Such work should be carried out not only within Astana. But throughout the republic. NOT only in the family but also within the walls of schools, children should be taught cleanliness and order, separation of solid waste.			
	Put different containers with markings for the type of waste. Not wet and dry. For example, plastic and tetra packs can go in one container, paper and cardboard in another, glass in another container and waste in a separate one.			
	More containers for plastic and other materials. So that there are reverse bonuses/accruals for buying food/household goods, etc. The Sparklo system works great. Make more of these projects			
	Introduce information work in all residential complexes and districts, equip all waste collection points with the ability to accept sorted waste, introduce fines for mixing waste			
	Yes. Start campaigning with kindergartens and schools. Encourage separate containers. Vending machines for accepting plastic and other containers in exchange for phone balance or bonuses Caspian and many others.			
	Mass agitation, education of the people, starting from kindergarten, etc., in the media and social networks, a state program for separate storage and disposal, recycling is needed			
	Start at least with installing separate containers for sorting garbage in all residential complexes of the capital. There is			

	a desire to sort garbage, but there are no containers for this			
	It's useless. We haven't grown up to this yet. Until we keep an eye on each other, who throws out trash how, and report it to the OSI, KSK, there will be nothing for fining.			
	A big question about separate transportation and separate recycling. In practice, one garbage truck comes and takes everything, without taking into account separate collection			
	More information on sorting in tanks, training in KSK or Axis chats, and installation of containers for sorting within walking distance from home.			
	Make reports and make information public. Start with mandatory waste sorting in schools and universities, all state and quasi-state organizations.			
	Distribution of waste sorting bins, waste sorting propaganda on popular platforms - TikTok, Instagram, Telegram			
	Separate waste collection needs to be established at the legislative level; if citizens do not comply with this law, a fine should be imposed			
	It is necessary to strengthen the legislative responsibility of public utilities for the timely collection and destruction/recycling of waste			
	At the very least add more collection points, all collection points on the left bank are closed, it is inconvenient to get to the right bank without a car			
	Material interest. For example, accepting used plastic bottles for money in stores.			
	Visually show in the media the process of separate waste collection and their subsequent fate in the recycling process			
	Punish those who throw garbage outside the bins. And for those who do not sort it, you can simply cut off the ears.			
	Mixing waste when loading different containers reduces the effectiveness of all			

	innovations in solid waste management to zero			
	It is difficult, but possible, to teach and train everyone in the family and at school, starting from kindergarten age.			
	Convey to people the positive results of waste separation, explain more why it is necessary			
	Install more bins for plastic waste, muscle, lamps, aluminium cans and glass			
	More information for the population so that residents can take a conscious approach to waste disposal			
	It is necessary to use foreign experience and introduce a system of fines and incentives			
	Collection points for waste paper and plastic should be organized with incentives in each district			
	To use organic waste as fertilizer and make money from it.			
	It is possible to allocate space inside the parking lot for batteries and wires.			
	make special containers for paper bottles plastic			
	Increase the number of plastic collection points on the left bank			
	There should be a sufficient number of waste containers.			
	install more vending machines for plastic bottles			
	Garbage bins are separate, closed, and can be opened with your feet.			
	Container for household appliances or light bulbs batteries			
	There is no separate waste collection by the municipal service			
	More outreach work starting from school			
	Yes, we need to start with kindergartens and primary schools.			
	Conduct explanatory work with the population			
	It would be better if there were different containers.			
	We need to learn from the experience of Austria and Germany			

	Review waste collection systems in residential complexes			
	What does KSK have to do with it?			

Appendix B – Interview Questions

1. Please provide a brief description of the role of your agency and the nature of services.
2. In general, how would you describe the current situation with waste collection in Astana?
   2.1. How is waste recycling being implemented in Astana?
   2.2. Is the current level of waste manageable/problematic or not?
3. How could you assess the effectiveness of current policy/regulation about separate waste collection?
4. In your opinion, what are the root causes of the low rate of separate waste collection in Astana among householders?
5. What is the current level of awareness of the Astana population about waste management issues?
6. What measures are being taken in your institution to encourage citizen participation in waste sorting?
7. Do you believe that a mandatory separate waste collection policy would positively affect the waste management issues in Astana?
   7.1. What challenges do you see in the implementation of mandatory separate waste collection?
8. What practical steps can be taken to improve the waste collection and recycling infrastructure in the city?
   8.1. Are there any incentives or initiatives that could encourage more participation in waste separation?