

# Preferences of the Population Concerning Municipal Waste Disposal Systems

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**Abstract:** One of the important areas of city and municipal management is the decision-making process related to waste disposal systems. The applied system should definitely contribute to the sustainable development of cities, municipalities and society as a whole and should also be economically acceptable. However, the real success of these systems depends on the willingness of the population to participate in the system. Therefore, when designing these systems, cities and municipalities should know and respect the preferences of their inhabitants concerning the system of sorting and disposal of waste from the given city or municipality. This issue is addressed in the paper. It presents the results of the primary quantitative research among 500 inhabitants of the Czech Republic intended to identify preferences of the inhabitants in the field of waste disposal. Research shows that the systems that are currently used as standard are the most preferred, i.e. the system "maintaining the current flat rate and free use of common containers for sorted waste" and "maintaining the current flat rate with periodic collection of sorted waste". The biggest differences in respondents' opinions are those depending on the form of housing.

**Keywords:** sustainability; waste management; municipal management; preferences of inhabitants

**JEL Classification:** D1; M1; Q5

## 1. Introduction

Waste management is an important part of environmental protection. Countries proactively fulfilling the sustainability strategy monitor the volumes of waste produced (including municipal waste) and strive to reduce the volume of unsorted and unused waste in particular.

An international comparison of municipal waste generation per capita is relatively favorable for the Czech Republic. There are countries whose municipal waste generation per capita is almost double (e.g., Denmark, Luxembourg) and a number of countries that are comparable according to this criterion (e.g., The Netherlands, Slovenia, Portugal). However, it is true that there are countries with half to two-thirds of the volume of municipal waste per capita, such as Romania or Poland (Czech Statistical Office, 2021a).

In principle, the average generation of municipal waste per capita in the Czech Republic comprise an annual volume of municipal waste higher than 5 million tons and an annual

volume of municipal waste generated by municipalities currently approaching 4 million tons. These numbers are constantly increasing over time, as shown in Table 1 and Table 2.

**Table 1.** Municipal waste generation in tonnes (Czech Statistical Office, 2021a)

Year	2017	2018	2019
<b>Municipal waste (t)</b>	5,176,513	5,247,462	5,337,521

**Table 2.** Municipal waste generated by municipalities in tonnes (Czech Statistical Office, 2021a)

Year	2017	2018	2019
<b>Municipal waste (t)</b>	3,669,883	3,731,469	3,831,493

Waste management systems designed at the level of individual cities and municipalities have certain degree of variability. When designing and modifying these systems, the general goal is to minimize the volume of non-reusable waste, especially by introducing or improving sorting systems. The result of this effort is an increase in the utilization of municipal waste. Currently, approximately 52% of municipal waste is utilized annually (Czech Statistical Office, 2021a) and further increase in utilization depends not only on the sophistication of the waste management systems applied, but also on the motivation and willingness of the population to utilize it. Therefore, it is desirable to conduct research revealing this motivation and willingness, or to directly reveal the wishes, requirements and preferences of the population. However, these sociological researches are not carried out, either in the Czech Republic or in the world. That is why we are dealing with this area. The aim is to publish the results of research focused on understanding the preferences for the system of municipal waste disposal in cities (or municipalities) and thus contribute to the improvement of waste management systems not only in the Czech Republic.

## 2. Theoretical Background

Factors to be taken into account when deciding on the system for disposing of municipal waste include, in particular, the sizing of the whole system, deciding on the sorting system for sortable municipal waste constituents, the method of disposing of unsorted municipal waste and setting municipal waste disposal charges.

According to Pierini et al. (2021), all municipal waste comprises the following 5 main categories: (1) paper and cardboard (all types of paper and cardboard including Tetra Pak® packages); (2) plastic (all kinds of plastics); (3) other recyclable waste (metal, glass, textiles); (4) organic waste (food and garden waste) and (5) non-recyclable waste (e.g. disposable napkins, diapers, contaminated pet bedding, dirty non-washable containers).

According to Gu et al. (2015), the total volume of municipal waste generated by individual households is shaped by the level of education of the main organizer of the family, but also other factors such as local customs and culture, applied consumption patterns and housing. Pierini et al. (2021) add that the volume of municipal waste generated is increased by home food preparation, the presence of infants and domestic animals. In their opinion, however, it is not affected by sorting or composting habits. The total volume of municipal

waste in a given area is then influenced by factors such as the living standards of the population, population density, geographical conditions, etc. (EKO-KOM, 2021).

Regarding the possibility of sorting, according to Pierini et al. (2021) and Dangi et al. (2013), half of domestic waste generation corresponds to organic waste and almost a third corresponds to recyclable materials. According to research by Gu et al. (2015), compostable and recyclable waste accounts for up to 89.3% of municipal solid waste. The sorting system can therefore reduce the volume of non-reusable waste to 10-20% of total municipal waste. According to Gu et al. (2015), the largest share consists of packaging (non-refundable 51%, returnable 15.8%).

Recyclable materials were defined by Abarca-Guerrero et al. (2013) for the purposes of own study as follows: plastics, paper, metal, glass, organic waste, batteries, electrical and electronic waste. A more detailed classification (in the field of plastics) was then discussed in research by Putri et al. (2018). Having divided plastics in waste into three types, PET bottles and PP cups, hard plastics and soft plastics, they found that 100% of respondents collected PET bottles and PP cups, 90% of respondents collected rigid plastics, but only 10% of respondents collected soft plastics. In their view, the main reason for this is the need to spend additional time and space, with soft plastics having little or no value in the recycling market.

When designing a separate waste collection system, the fact that different types of sorted waste are generated differently during the week, as shown by Gu et al. (2015), should also be taken into account. They state, for example, that the largest amount of paper and plastics is generated on weekends (which in their opinion is due to the concentration of consumer purchases on the weekend).

Closely related to the success in sorting and the volume of unsorted waste are the costs of waste management arising at the level of cities and municipalities. These depend on the amount and structure of waste, on the scope and method of service provided in accordance with legislative requirements and, last but not least, on mandatory expenditures given by legislation (charges and taxes) (EKO-KOM, 2021). The municipality's waste management costs are then offset by waste charges paid by citizens. They are collected on the basis of the Local Fees and Charges Act, with the amendment thereto defining two "new" local charges, namely the municipal waste management system charge and the charge for disposing of municipal waste from real estate. Municipalities can choose only one of them (epravo, 2021).

The creation and operation of a waste management system is often perceived only as the responsibility of the local government, the population is at best considered co-responsible together with the city or municipality. However, this is a narrow view of the issue, waste management involves a large number of stakeholders who play their roles in shaping the system, but have different interests (Abarca-Guerrero et al., 2013).

One of the most important stakeholders is the population. The success of any waste management system depends on its active and sustainable participation (Kattoua et al., 2019) If there is none, it is one of the main reasons for complaints from the public administration (Filho et al., 2020).

The role of the population is both to reduce the total volume of waste and the volume of non-reusable waste. The total volume of waste is reduced as a result of individual decisions

on what to buy, while the volume of non-reusable waste is reduced as a result of decisions on the method of disposing of household waste. It is therefore essential to have a good understanding of the factors influencing the preferences and behavior of individuals in this area, or at least of these preferences (Pierini et al., 2021). However, this understanding is only marginal so far as the outputs of such research are rather partial. Still, it was found, for example, that 81% of households sort their waste consistently and also that in 68% of households that do so, 5–9 categories of waste are sorted, while in 5% of these households it is sorted only according to 1–2 categories (Pierini et al., 2021). It has also been revealed that the waste management equipment available significantly influences the choice of waste disposal method and also that the insufficient capacity of waste containers and the longer distance to reach them increase the likelihood of illegal dumping in public spaces (Tadesse et al., 2008). However, research aimed at finding out people's preferences in the field of municipal waste disposal has not yet been carried out. Therefore, we conducted primary quantitative research in this area and formulated its conclusions.

### **3. Research Methodology**

The main goal of the primary research was to find out people's preferences for different household waste disposal systems.

The individual household waste disposal systems were defined as a combination of 2 factors that can fundamentally affect household preferences. These were the method of calculating the payment for waste disposal (increased payment without waste sorting, current payment with waste sorting and weight-based pay-as-you-throw scheme) and the separate waste collection method (free disposal of separate waste in local public containers, free periodic collection of separate waste, purchase of sorted waste at special civic amenity sites). The following household waste disposal systems were investigated:

- Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system.
- Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.
- Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.
- Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.
- Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.
- Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.

As part of the questionnaire survey, respondents were asked to determine the order of individual methods of waste disposal according to declining preference using values 1–6 (i.e., 1 to indicate the most preferred system). The questionnaire also included the survey of demographic characteristics of respondents (gender and age) and data related to the surveyed household (size of municipality and type of household).

An electronic questionnaire was used for data collection. Comprehensibility and time the respondents needed were examined within the piloting of the questionnaire. It showed that the comprehensibility of the questions was sufficient and the time requirements bearable.

Data collection took place in the period from August to October 2021 among the population of the Czech Republic aged 15–64. 500 respondents were included in the research on the basis of quota sampling with quotas for gender and age according to CZSO data as at 31 December 2020 (Czech Statistical Office, 2021b). Their structure by age and gender is shown in Table 3.

**Table 3.** Structure of respondents by gender and age

Gender	Age					Total
	15–24	25–34	35–44	45–54	55–64	
Male (%)	7.2	10.2	12.4	11.8	9.4	51
Female (%)	7.0	9.6	11.6	11.2	9.6	49
<b>Total (%)</b>	14.2	19.8	24.0	23.0	19.0	100

Respondents came from municipalities with less than 2,000 inhabitants (25.0%), 2,001–10,000 inhabitants (21.0%), 10,001–100,000 inhabitants (32.9%) or cities with a population of more than 100,000 (21.2%). In terms of household type, 51.0% of respondents living in a housing unit and 49.0% of respondents living in family houses took part in the survey.

Descriptive and inferential statistics methods were used in the data analysis. A mean rank was used to evaluate the preferences for the disposal system. Friedman test at 0.05 significance level was used to verify the statistical significance of differences in the order of individual disposal systems. Bonferroni correction was used in post hoc pairwise comparisons. The Kruskal-Wallis test at 0.05 significance level was used to verify the statistical significance of differences in the attitudes of respondents from different groups (by gender, age, municipality size and household type).

#### 4. Research Results

Primary quantitative research has provided a number of interesting findings in the area of people's preferences for various household waste disposal systems. Based on a comparison of the mean rank of individual systems, it can be stated that the most preferred variants are systems in which the current amount of flat-rate payment for municipal waste is maintained in combination with free removal of sorted waste to common containers or periodic collection of sorted waste (see Table 4).

The result of the Friedman test ( $\chi^2 = 469.4$ ;  $p < 0.001$ ) shows that the differences in the preferences for household waste disposal systems are statistically significant. Post hoc pairwise comparisons revealed that the difference in the preference for maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers (mean rank 2.55) and maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection (mean rank 2.71) is not statistically significant ( $\chi^2 = 5.814$ ;  $p = 0.239$ ). Therefore, the systems that are

**Table 4.** Preferences for individual municipal waste disposal systems from the point of view of the population surveyed

<b>Municipal Waste Disposal System</b>	<b>Mean Rank</b>
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.55
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	2.71
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	2.98
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.18
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.36
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.74

currently used by default have the greatest preference. This points to the limited possibilities of changing existing systems more radically. From the point of view of the population, the system based on paying a higher lump sum payment for municipal waste with leaving the household sorting system has the least chance of acceptance (mean rank 4.74).

The analysis of opinions depending on the respondent characteristics showed differences in opinions according to gender, age, size of the municipality and type of household.

Men do not differ in their preferences from women as regards the two most used systems today, so both genders prefer the same methods of household waste disposal as the entire surveyed population (see Table 5).

**Table 5.** Differences in the preferences for individual municipal waste disposal systems depending on gender

<b>Municipal Waste Disposal System</b>	<b>Mean Rank</b>		<b>Kruskal-Wallis test</b>	
	men	women	$\chi^2$	<i>p</i>
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.64	2.45	2.760	0.097
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	2.71	2.72	0.062	0.804
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	3.02	2.94	0.362	0.547
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.35	3.01	4.625	0.032
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.36	3.37	0.029	0.865
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.57	4.91	5.736	0.017

However, there are statistically significant differences between two systems that are not currently common. Women more strongly than men prefer the weight-based pay-as-you-throw scheme combined with free periodic door-to-door collection ( $\chi^2 = 4.625$ ;  $p = 0.032$ ). Conversely, men, more than women, prefer a higher flat-rate payment for municipal waste and abandonment of the household waste sorting system ( $\chi^2 = 5.736$ ;  $p = 0.017$ ).

The differences in respondents' opinions between various age groups are statistically significant for two systems. In principle, it can be stated that the preference for maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection increases with age ( $\chi^2 = 18.70$ ;  $p = 0.001$ ). This trend can also be traced in the case of the weight-based pay-as-you-throw scheme combined with free periodic door-to-door collection ( $\chi^2 = 15.98$ ;  $p = 0.003$ ) (see Table 6).

**Table 6.** Differences in the preferences for individual municipal waste disposal systems depending on age

Municipal Waste Disposal System	Mean Rank					Kruskal-Wallis test	
	15–24	25–34	35–44	45–54	55–64	$\chi^2$	$p$
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.85	2.51	2.70	2.33	2.44	7.909	0.095
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	3.17	3.01	2.58	2.44	2.57	18.70	0.001
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	3.13	2.97	3.00	2.97	2.87	1.161	0.884
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.31	3.73	2.93	2.96	3.11	15.98	0.003
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.62	3.62	3.30	3.23	3.16	7.434	0.115
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.93	4.83	4.63	4.85	4.51	4.886	0.299

**Table 7.** Differences in the preferences for individual municipal waste disposal systems depending on the size of the municipality

Municipal Waste Disposal System	Mean Rank				Kruskal-Wallis test	
	up to 2000	2001–10000	10001–100000	100001+	$\chi^2$	$p$
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.47	2.83	2.50	2.42	4.132	0.248
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	2.48	2.48	2.90	2.90	11.72	0.008
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	3.06	2.99	3.01	2.81	1.902	0.593
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.30	2.77	3.31	3.26	7.611	0.055
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.34	3.22	3.37	3.55	3.436	0.329
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.49	4.85	4.87	4.71	3.372	0.338

Regarding the differences in opinions according to the size of the municipality, a statistically significant difference was demonstrated only for the system "maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door

collection". With the size of the municipality, the preferences for this system decrease ( $\chi^2 = 11.72$ ;  $p = 0.008$ ). It is more preferred by cities and municipalities with up to 10,000 inhabitants (see Table 7).

The most significant differences in respondents' attitudes can be observed depending on the form of their housing. Respondents living in housing units prefer the system "maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers" more than respondents living in family houses ( $\chi^2 = 12.24$ ;  $p < 0.001$ ). Conversely, they prefer maintaining the current amount of the flat-rate payment for municipal waste but combined with free periodic door-to-door collection ( $\chi^2 = 7.954$ ;  $p = 0.005$ ). Respondents living in family houses generally prefer a periodic collection. Even if the payment was weight-based, they prefer periodic collection of sorted waste more than respondents living in housing units ( $\chi^2 = 9.714$ ;  $p = 0.002$ ) (see Table 8).

**Table 8.** Differences in the preferences for individual municipal waste disposal systems depending on the type of household

Municipal Waste Disposal System	Mean Rank		Kruskal-Wallis test	
	unit	house	$\chi^2$	$p$
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.31	2.80	12.24	<0.001
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	2.89	2.53	7.954	0.005
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	2.95	3.02	0.264	0.607
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.42	2.94	9.714	0.002
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.44	3.28	1.532	0.216
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.62	4.86	2.522	0.112

## 5. Conclusion

The primary research examined the preferences of the population in relation to municipal waste disposal systems defined by a combination of two factors (the amount of payment and the method of waste collection). The main findings can be formulated as follows:

- systems that maintain the current level of charges are preferred, weight-based pay-as-you-throw systems are less preferred, and systems that would lead to increased charges are least preferred;
- periodic collection is generally preferred by households from family houses and the elderly;
- women are more willing to sort waste. Compared to men, they prefer weight-based systems. At the same time, less than men, they prefer systems without waste sorting.

These findings suggest that the population has at least a minimal environmental inclination, but is reluctant to bear the higher costs associated with waste disposal. However, what the real motives of the population evoking the preferences identified has not yet been



clarified. Therefore, follow-up research should focus on revealing these motives. Knowing them, and knowing the preferences as well, can then become the basis for improving municipal waste disposal systems at the level of cities and municipalities.

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## References

- Abarca-Guerrero, L., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management*, 33(1), 220–232. <https://doi.org/10.1016/j.wasman.2012.09.008>
- Czech Statistical Office. (2021a). *Generation, Recovery and Disposal of Waste for the Period 2019* [Data set]. Retrieved June 26, 2021, from <https://www.czso.cz/documents/10180/123243248/28002020.pdf/2b10e665-7aac-4baf-9ff9-d097203573c1?version=1.5>
- Czech Statistical Office. (2021b). *Distribution of the population by age* [Data set]. Retrieved June 26, 2021, from [https://vdb.czso.cz/vdbvo2/faces/cs/index.jsf?page=vystup-objekt&pvo=DEMD001&z=T&f=TABULKA&katalog=33156&str=v4&c=v3-2\\_\\_RP2020MP12DP31](https://vdb.czso.cz/vdbvo2/faces/cs/index.jsf?page=vystup-objekt&pvo=DEMD001&z=T&f=TABULKA&katalog=33156&str=v4&c=v3-2__RP2020MP12DP31)
- Dangi, M. B., Urynowicz, M. A., & Belbase, S. (2013). Characterization, generation, and management of household solid waste in Tulsipur, Nepal. *Habitat International*, 40, 65–72. <https://doi.org/10.1016/j.habitatint.2013.02.005>
- EKO-KOM. (2021, June 9). *Economics of waste management in 2020*. <https://www.ekokom.cz/ekonomika-odpadoveho-hospodarstvi-v-roce-2020/>
- E-pravo. (2021, February 15). *Waste charges since 2021 - simplification or complication?* <https://www.epravo.cz/top/clanky/poplatky-za-odpady-od-roku-2021-zjednoduseni-nebo-komplikace-112556.html?mail>
- Filho, J. A. P., Ghermandi, A., Dias, A. J. G., Gonçalves da Luz, E., & Cortese, T. T. P. (2020). Stakeholder views of source separation collection programme in East São Paulo, Brazil. *Waste Management & Research*, 39(1), 93–100. <https://doi.org/10.1177/0734242X20972774>.
- Gu, B., Wang, H., Chen, Z., Jiang, S., Zhu, W., Liu, M., ... & Bi, J. (2015). Characterization, quantification and management of household solid waste: A case study in China. *Resources, Conservation and Recycling*, 98, 67–75.
- Kattoua, M. G., Al-Khatib, I. A., & Kontogianni, S. (2019). Barriers to the propagation of household solid waste recycling practices in developing countries: State of Palestine example. *Journal of Material Cycles and Waste Management*, 21(8), 774–785. <https://doi.org/10.1007/s10163-019-00833-5>
- Pierini, V. I., Mazzeo, N., Cazenave, M., & Semmartin, M. (2021). Waste generation and pro-environmental behaviors at household level: A citizen science study in Buenos Aires (Argentina). *Resources Conservation and Recycling*, 170, 105560. <https://doi.org/10.1016/j.resconrec.2021.105560>
- Putri, A. R., Fujimori, T. & Takaoka, M. (2018). Plastic waste management in Jakarta, Indonesia: evaluation of material flow and recycling scheme. *Journal of Material Cycles and Waste Management*, 20(4), 2140–2149. <https://doi.org/10.1007/s10163-018-0753-2>
- Tadesse, T., Ruijs, A., & Hagos, F. (2008). Household waste disposal in Mekelle city, Northern Ethiopia. *Journal of Waste Management*, 28(10), 2003–2012. <https://doi.org/10.1016/j.wasman.2007.08.015>