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Research Article

Solid Waste Analysis and Improvement Studies in Local Governments (Cayırova Municipality Example)

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ABSTRACT

Solid wastes have become one of the most critical problems in urban areas because of the increase in the amount and the environmental problems caused by the variety of these wastes. In the same local governments where waste management is mismanaged, much money is wasted, and landfills are unnecessarily occupied. Making a profit out of solid wastes, seen as a heavy burden to the world and our country, aims firstly to collect these wastes apart from their sources by characterizing them. Recycling of both household and industrial wastes should be planned and done at the source. Collection is the most laborious and costly element of solid waste management. The study area was divided into four groups according to income levels, and the waste generated there was evaluated. The study showed that for 2022, kitchen waste ranks first with 67.25%. Kitchen waste is followed by packaging waste at 21.03%; flammable wastes (textile etc.) at 21.04%; ash waste at 44%, While hazardous wastes have a share of 0.55%; lastly, park and garden wastes and electronic wastes were not detected at all. It is seen that waste management activities are carried out in the Çayırova region, but the integration of citizens into waste management activities needs to be increased. In this regard, improvement efforts have been made to increase efficiency in separating collection from the source and reduce the amount of final waste.

1. Introduction

In Environmental Law No. 2872, solid waste is defined as "solid waste materials that are generated as a result of domestic, commercial and/or industrial activities, which are intended to be disposed of by the producer on the grounds that they are no longer useful, and which must be disposed of regularly in order to protect the peace of the society and especially the environment" [1].

The two most essential parameters in solid waste generation are population and unit solid waste production amount. The amount of unit solid waste production varies depending on factors such as socio-economic status, living standards, living habits, geographical location, climate characteristics, and the size of the settlement. In general, as people's economic status increases, the amount of waste they create also increases. There is a continuous increase for waste produced per person due to reasons such as rapid urbanization and increasing consumption trends in parallel with changes in living conditions [2].

Solid wastes have become one of the most critical problems in urban areas due to the increase in their amount and the serious environmental problems caused by the diversity in their content. It is possible to classify the methods used to eliminate the solid waste problem caused by human activities as irregular (wild) storage, regular storage, composting, reuse, recycling, recovery, and incineration [3, 4].
Landfill is the most common way to reduce the amount of solid waste. However, any waste not

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separated at its source will unnecessarily occupy the sanitary landfills and adversely affect public health by increasing the formation of flies and mice in provinces and/or towns without sanitary landfill facilities [5]. In addition, considering our rapidly developing cities and increasing population, it has become challenging to meet the criteria in the Regulation on the Landfill of Wastes, which came into force after being published in the Official Gazette dated 26.03.2010 and numbered 27533 for sanitary landfills [6].

Domestic solid wastes pose a biological, physical, and chemical hazard to human and environmental health. If solid wastes are not disposed of in accordance with the technique, leachate generated in landfills can cause pollution of soil, surface, and underground waters, while landfill gas can cause air pollution due to its high methane content, causing chemical and biological problems [7]. According to the European Union Waste Framework Directive, the first goal of any waste policy should be to reduce the harmful effects of waste production and management on human health and the environment [2]. On the other hand, solid waste management aims to use scarce natural resources such as energy and raw materials with maximum efficiency, support low-waste production, recover and reuse wastes, and dispose of them without harming air, water, soil, and living things in all disposal processes. The daily increase in solid waste with industrialization and the development of environmental awareness in global market economy conditions necessitate effectively managing these solid wastes [8]. The first step of waste management begins with separating waste at its source. Solid wastes It is divided into various branches as domestic wastes, packaging wastes, domestic, commercial wastes, coarse bulky wastes, rubbish wastes, treatment sludge, marketplace wastes, hazardous and medical wastes, construction wastes, accumulators and waste batteries, and end-of-life tires [9, 10]. The National Waste Management and Action Plan (NWMAP) covering 2016-2023 has been prepared. National Waste Management and Action Plan (2016-2023), in order to achieve the goals of an integrated waste management system in all 81 provinces, to reduce and limit the amount of waste going to landfills within the framework of the circular economy, and to determine the targets for the needed waste recovery, recycling and energy production. It was published in 2017 for this purpose. According to the National Waste Management and Action Plan, it aims to recover 35% of the waste generated in 2023 and dispose of 65% by landfill. NWMAP revision studies have been initiated for the years 2023-2035 in order to harmonize existing management plans with the zerowaste management plan, increase and disseminate separate collection efficiency at the source, and determine recovery and disposal methods. According to the Ministry of Environment, Urbanization and Climate Change data, this figure is currently 22.4% in Türkiye [11].

The collection, removal, and disposal of solid wastes fall under the responsibility of local governments. The provision of these services requires a holistic approach, which is achieved through solid waste management [12].

Our Constitution has made local governments responsible for waste collection, transportation, and disposal following Municipality Law No. 5393 [13] and Metropolitan Municipality Law No. 5216 [14-15]. In our country, there are two different types of local government units as villages and municipalities in the local government system [16]. In addition, according to these laws, the task of disposing of solid wastes is assigned to metropolitan municipalities in places with a metropolitan organization and to provincial, district, and town municipalities without a metropolitan organization [17].

For the protection and improvement of the environment, municipalities' implementation of a transparent management model and their openness to public participation, and therefore acting in cooperation and communication with the public, will ensure the integration of the municipality and the local people. As the "Local Environmental Manager" and the self-organization of society, municipalities should realize this natural necessity—environmental management at different growing scales and including each other. Local governments, especially municipalities, have a particular

importance in these structures. Because municipalities are institutions that both affect the environment with the other public services they carry out and can directly assume functions in environmental management [18].

It is seen that consumption culture in the world is shaped according to income level. The income level is efficient for waste generated. Countries in the upper-income group produce more waste, while countries in the lower-income group produce the least waste. It is observed that a person living in high-income countries, that is, in developed countries, produces waste between at least 0.70 kg and at most 14 kg per day [19]. On average, a high-income person generates nearly three times more waste than a low-income person. The waste produced by the upper-income group constitutes approximately 46% of the total produced globally. In other words, about half of the waste produced in the world is produced by the upper-income group. People in wealthy, developed, and underdeveloped or developing countries can be low-income, lower middle income, upper-middle-income, or high-income. Considering the composition of the wastes produced in developed countries, the organic wastes produced are at a lower rate than those in developing countries. In addition, it is noteworthy that metal, paper, and glass wastes are high. Today, countries in Africa and South Asia produce the least amount of waste globally, while developed countries such as the USA, Canada, Germany, England, etc. OECD countries, which are formed by countries, produce about half of the waste produced in the world [20].

In the study conducted by Pires et al. in 2011, models and tools that will eliminate the uncertainties in waste management studies in European countries as much as possible were carried out comprehensively. They covered the pros and cons of waste management practices in each European Union member country. On the other hand, while Southern European Union countries need to develop more measures and reach EU directives to implement integrated solid waste management, the middle/central European Union needs models and tools to make technological preference management strategies efficient. However, it is also stated that system analysis models and tools, taken together, will provide opportunities to develop better solid waste management strategies that will ensure compliance with current standards and help develop future perspectives of both the waste management industry and government agencies in the EU [21]. Within the scope of solid waste management in Türkiye, different studies have been carried out for the evaluation of solid waste management based on provinces and districts such as Eskişehir, Malatya, Bitlis, Konya, İstanbul, Bursa [7, 20, 22-25]. In the study of Güvenç (2016), they stated that electricity generation from solid waste and solid waste characterization are the most critical factors affecting environmental sustainability, and they stated that municipal solid waste characterization depends on social status and income level. The characterization study, carried out by conducting a seasonal analysis of the amount of municipal solid waste generated in the Kartal District of Istanbul, depending on the income level, aimed to determine the diversity in the waste components [24]. In another study, because of the analysis made throughout Türkiye, it was thought that it would be beneficial for municipalities to organize waste collection activities effectively because of determining the optimum population sizes for the municipalities to perform waste management activities effectively and estimating the marginal and average costs of the waste management system [8].

In this study, based on 2022, the processes of reducing the waste at the source and evaluating the wastes, from the generation of domestic waste to the disposal process, were evaluated according to the income levels in the borders of Çayırova District. In addition, how waste characterization has changed with the last ten years' data was examined and compared.

2. Material and Method

The rapidly increasing population and urbanization process have become one of the current problems of solid waste treatment, which is a part of local governments. In order to protect environmental health in urban areas, a planned solid waste management is needed to eliminate solid wastes that need to be regularly collected,

transported, stored and disposed of without causing major problems [26].

2.1. General information about Çayırova District

Çayırova, one of the most important industrial districts of Kocaeli, which is considered in the study, is Gebze in the east and south. The Şifa District of Tuzla, which is located within the borders of Istanbul in the west, is also located in the Akfırat District of Tuzla District in the north, and the area of the district is 27.391,221m². Çayırova Municipality 2022 population is 150.792.

As it is known, the essential condition for the proper execution of waste management is the excellent management of waste characterization. Among the factors affecting the character of waste are seasons, the economic situation of the people in the region, and the cultural structure.

In the Çayırova District of Kocaeli Province, located in the Marmara Region of Türkiye, a degraded Black Sea climate (hotter summers and colder winters) prevails. In determining the waste characterization, the neighborhoods within the boundaries of Çayırova Municipality, where the application will be made, are divided according to their income levels. The cultural structure of the district is cosmopolitan, and the income levels of the district quarters are;

• Low: Inönü District
• Medium: Freedom District, Yeni Mahalle, Çayırova District
• High: Cumhuriyet District
• Bazaar: Fatih Sreet is registered as Çobanoglu Street.

Waste samples were taken to the waste dump site or intermediate storage area by taking representative samples on Monday, the weekend, and Tuesday, the weekday.

2.2. Waste characterization and analysis

During characterization, weighing scale, plastic cover (5m*10m), plastic container, fixed volume container (1m*1m*1m or 1m*1m*0.5m), material (mask, etc.) equipment were used. In addition, disposable gloves and disposable overalls were supplied and used by the personnel in accordance with hygiene and safety rules. The wastes brought by separating them according to their income levels on the cover laid on the floor are emptied in 4 heaps. Then, they are taken from the wastes created according to the income level in order (in the form of a separate process for each), and the waste is placed in the container with the dimensions of 1m×1m×1m, with an open top. The container filled with waste is lifted by holding its handles, and a substance group analysis is performed on the waste remaining on the plastic cover. Afterward, the wastes for which the substance group analysis is made are placed in a previously tared plastic bucket with labels. The entire container is weighed, and the difference between gross and tare is recorded as net weight.

The characterization study of the district has been carried out twice a year, in summer and winter, and improvement studies are still being carried out in the region according to the characterization results. The photograph of the waste characterization study of Çayırova Municipality is given in Figure 1 below.

Figure1. Example of characterization study

As improvement works, the "Mobile Waste Collection Vehicle" for the separate collection of waste at the source was put into service, and the issue of including street collectors in waste management, which came into force with the Circular No. 2022/6 published by the Ministry of Environment, Urbanization and Climate Change, was discussed. In this study, street collectors give the recyclable materials they sort to licensed facilities. Trainings on "Zero Waste" were organized in all schools and it was planned to include students in the system with these trainings.

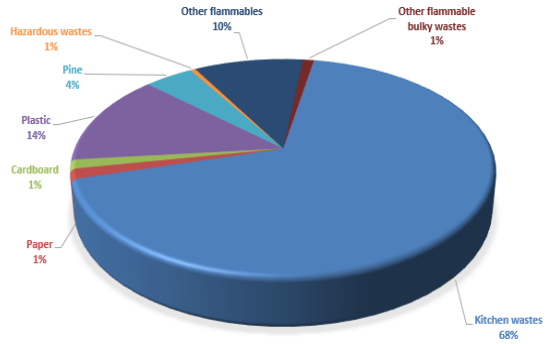
3. Results and Discussion

3.1. Solid waste characterization assessment for 2022

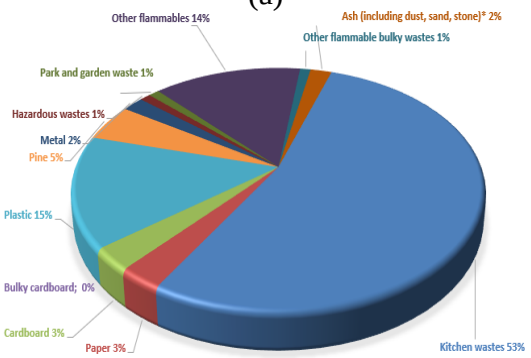
In a city with an average population, garbage varies between 0.7-1 kg per person [19]. In Kocaeli, the daily waste amount of a person was determined as 1.2 kg in 2002, 0.8 kg in 2014 and 0.82 kg in 2018. It is seen that the amount of waste per person in Kocaeli was always below the Türkiye average during the examined period [27]. In Türkiye, 1.03 kg of waste per person per day was reported in 2022, and 0.82 kg in Kocaeli. When these rates are compared, the amount per person in Kocaeli remains below the Türkiye average [28]. For Çayırova Municipality, for the year 2022, the average amount of solid waste produced per person(kg/person-day) was reported as 0.91 and 0.67 (kg/person-day) for summer and winter seasons. In Figure 2, the waste characterization graph of Çayırova Municipality in (a) and Kocaeli province in (b) can be seen.

The general characterization for Çayırova for 2022 results of the municipality are given in Table 1 by dividing them for each waste type according to their income.

Considering the general characterization results for 2022 in Table 1, although wastes were collected from different regions with different income levels, it is seen that kitchen wastes constitute the most significant proportion, with 67.25%. Similarly, in the solid waste composition of Malatya in general, with a rate of 43%, kitchen waste constitutes a large part of the composition. When we compare the solid waste composition of Çayırova and Türkiye, it is seen that there is a parallelism between the two compositions in general [20]. For example, while kitchen waste has the highest rate with 67.25% in Çayırova, it still has the highest rate with 34% in Türkiye. While the paper rate in Çayırova is 4.39%, it is 11% in Türkiye. While the rate of other non-flammable solid waste was not detected at all in Çayırova, it was 22% in Türkiye, and the rate of other flammable solid waste was 9.88% in Çayırova and 19% in Türkiye.



(a)



(b)

Figure 2. Waste characterization graph for Çayırova municipality (a) and Kocaeli city [29]. (b).

In addition, 21.03% of these wastes are packaging wastes, 9.88% are flammable wastes (textiles, etc.) and 0.44% are ash wastes. This is followed by hazardous waste with 0.37% and finally electronic waste with 0.07%. In a similar study; As result of studies carried out in the Municipality of Kano, Northern Nigeria, A high amount of garbage in the world is created (30.97% - 21.67%), plastics (29.22% - 27.88%), agricultural waste in the waste composition (21.785% - 15.54%), textile wastes (11.48% - 5.13%), papers (9.8%) 12.68 - 4.70%), food waste and residues (7.49 - 0.67%), while glass (3.63% - 1.57%) and metals (0.19 - .0.00%) were found to be the least [30].

In Ankara, Türkiye's second-largest city, 43.80% of the waste generated in 2018 was kitchen waste, 40.40% was excavation waste, 10.10% was park and garden waste, 2.40% was textile waste, 2.40% was wasted. 1.50% comprises plastic waste, 1.40% comprises paper waste, and 0.30% comprises metal waste [31].

Table1. Çayırova municipality characterization study average data for 2022

Solid Waste Components	Income Levels																					
	LOW				MIDDLE				HIGH				BAZAAR				AVERAGE					
	Gross	Tare	Net	Ratio (%)	Gross	Tare	Net	Ratio (%)	Gross	Tare	Net	Ratio (%)	Gross	Tare	Net	Ratio (%)	Gross	Tare	Net	Ratio (%)		
Kitchen wastes	94.50	5.90	88.60	65.36	56.25	5.10	51.15	53.36	74.55	6.30	68.25	65.28	158.25	8.90	149.35	76.43	89.34	67.25				
Paper	0.00	0.00	0.00	0.00	2.45	1.30	1.15	1.20	5.80	2.60	3.20	3.06	5.35	1.90	3.45	1.77	1.95	1.47				
Cardboard	3.30	0.70	2.60	1.92	2.35	0.70	1.65	1.72	0.00	0.00	0.00	0.00	4.20	1.30	2.90	1.48	1.79	1.35				
Bulky cardboard	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Plastic	30.35	9.05	21.30	15.71	25.55	6.80	18.75	19.56	26.45	8.10	18.35	17.55	24.75	11.30	13.45	6.88	17.96	13.52				
Pine	8.80	2.55	6.25	4.61	6.30	1.40	4.90	5.11	5.40	1.40	4.00	3.83	11.00	2.95	8.05	4.12	5.80	4.37				
Metal	2.55	2.00	0.55	0.41	1.70	1.30	0.40	0.42	1.25	1.15	0.10	0.10	1.40	0.70	0.70	0.36	0.44	0.33				
Bulky metal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Waste electrical and electronic equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Hazardous wastes	2.10	0.70	1.40	1.03	1.60	1.15	0.45	0.47	1.40	0.70	0.70	0.67	1.05	0.70	0.35	0.18	0.73	0.55				
Park and garden waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Other un- flammables	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Other flammables	19.35	6.85	12.50	9.22	17.75	2.55	15.20	15.86	11.95	2.00	9.95	9.52	17.95	3.10	14.85	7.60	13.13	9.88				
Other flammable bulky wastes	0.00	0.00	0.00	0.00	3.50	1.30	2.20	2.30	0.00	0.00	0.00	0.00	3.45	1.15	2.30	1.18	1.13	0.85				
Other un -flammable bulky wastes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Ash (including dust. sand. stone)*	3.05	0.70	2.35	1.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.44				
TOTAL			135.55	100.00			95.85	100.00			104.55	100.00			195.40	100.00	132.84	100.00				

While characterizing the wastes, the content of the hazardous wastes recorded at the rate of 0,55% is recorded as the packaging of cleaning materials, and fluorescent, battery, etc., are recorded in the wastes. In this situation, it is understood that the waste batteries and fluorescents are not thrown into the domestic waste containers by the public and that the district municipality carries out the necessary studies to collect such waste.

3.2. Solid waste characterization assessment for 2022-2013

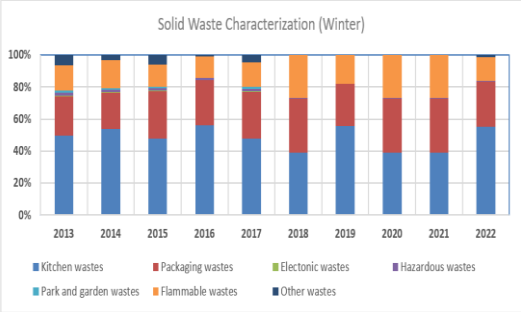
Solid waste characterization was also evaluated on a seasonal basis. Winter waste characterization studies were carried out by analyzing the waste group as of February, and summer waste characterization studies were carried out covering the six-month period in August. Seasonal percentages are given in Figure 3.

The seasonal solid waste characterization for 2022 shows that kitchen waste in the summer season (74.48%) increases compared to the winter season (55.37%). It has been observed that flammable and packaging wastes are more prevalent in winter than in summer. The amount of flammable waste in winter and summer was determined as 15.10% and 8.07%, and packaging waste was 28.18% and 16.68%, respectively.

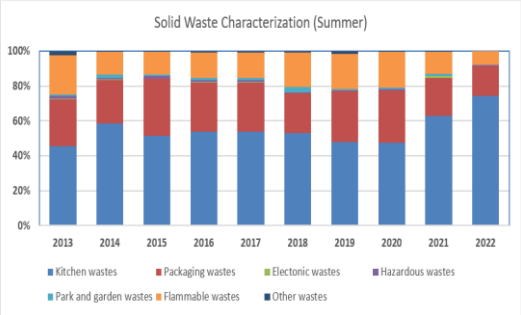
If an evaluation is made for the last ten years, except for 2013 and 2019, kitchen waste has always been analyzed higher in summer than winter. Considering the winter season, the highest value in packaging waste is seen as 56.35% in 2016. In 2022, waste close to this value was generated at 55.37%. In the summer season, the highest packaging waste was seen in 2015, with 32.77%, while the lowest value was determined to be 16.68% in 2022. While electronic waste could not be detected after 2018, it was seen as 1.23% in the winter of 2021. While park and garden waste were not detected in the winter season after 2017, in the summer season, these wastes were detected in other years except 2022.

Flammable wastes were found to be higher than the summer season, especially in the winter season, 26.69%, 26.69%, and 15.10%,

respectively, in 2020-21-22. In 2022, flammable waste in the summer was determined to be 8.07%, the lowest value in the last ten years. In winter, it was found to be very similar to 2013. Hazardous waste was found to be higher in winter than in summer in all years except 2017.



(a)



(b)

Figure 3. 2022 winter (a) and summer (b) season characterization results

When the data in Figure 3 are examined, it is seen that the kitchen waste, which has the largest share in the waste content, increases in the summer months, and it is thought that the reason for this increase is the rapid deterioration of the food with the warming of the weather.

68.87% of domestic solid wastes in Türkiye are organic and wet solid wastes, 14.09% are recyclable solid wastes, and 17.04% are ash and slag wastes. In Kocaeli province, when the solid waste characterization results are evaluated, approximately 46.2% are organic wastes, 23.7% are packaging wastes, and 30.01% are other waste groups. In the years 2010-11-12, there is not much difference in these categorization distinctions [19]. In Mustafakemalpaşa district, 65% of domestic solid wastes are vegetables and decomposable materials, 22% are recyclable solid wastes, and 13% are ash and slag wastes. Waste characterization of the district is higher than the average of Türkiye in terms of recovery rate [25].

In the study of Zhang et al. 2010, the formation and waste composition of municipal solid wastes in China were examined, and it was revealed that the waste composition in China contains a high percentage of organic waste and moisture from kitchen waste has the highest proportion (about 60%) of municipal solid waste has been placed [32]. In the study of Güvenç (2016), organic waste was determined to be the highest amount, with 57.69% [24]. In another study, 40-85% of total solid waste is food waste, 5-60% is recyclable solid waste and 0-10% is ash, dust, etc. It has been stated that [33].

While the amount of packaging waste was 28.18% in winter, it decreased to 16.68% in summer. Since Çayırova district, an industrial area, is not a tourist center, the population of the region's people decreases significantly following the school holidays in summer, which causes a decrease in the rate of packaging waste collected from schools and residences. Contrary to packaging waste, the increase in glass waste in summer is undoubtedly caused by the rapid consumption of cold drinks in glass bottles in hot weather.

Considering the composition of wastes produced in developed countries, organic wastes are at a lower rate than those in developing countries. In addition, it is noteworthy that metal, paper, and glass wastes are high [34]. A one-year study was conducted by Gidarakos et al. (2006) in a large area of Crete to describe waste composition (including physical and chemical characterization) and seasonal variations. Metals such as lead, cadmium, and mercury were also investigated by classifying the collected wastes into plastics, paper, metal, aluminum, leather-wood-textile-rubbers, organic wastes, non-flammable and mixed categories [35]. Three main categories of waste have been identified, representing 76% of the total mixed waste in Crete: organic waste, paper, and plastics. In addition, the high percentage of glass waste and seasonal aluminum detection in the waste composition is explained as the result of some human activities such as tourism.
Although there is no significant difference in other waste types, there was an increase in the amount of ash in winter due to the presence of houses using stoves in the region and an increase

in summer characterization study for this type of waste due to the construction and maintenance of parks and gardens in summer.

Waste characterization percentages show that although the Municipality carries out studies on the separate collection of wastes at the source, the public's indifference is an obstacle to the healthy execution of the project. The raw materials of some packaging wastes are imported, and the recyclable wastes that go to landfills are not evaluated, causing high economic losses. This situation causes the project life to decrease and air and water pollution to increase by filling the regular landfills, which are designed for storing domestic waste, with other wastes. The comparison of waste characterization data for 2013-2022 is given in Figure 4.

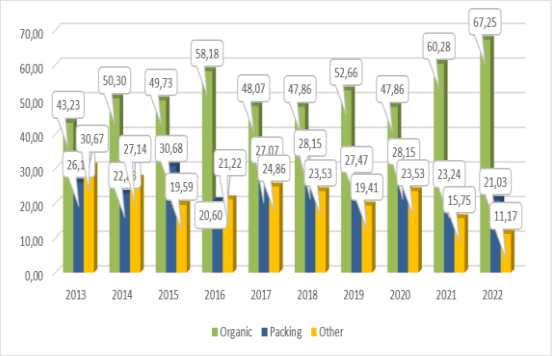


Figure 4. Characterization data for the last ten years

According to the data in Figure 4, while organic waste distribution is expected to decrease, it is seen that the lowest organic waste distribution was in 2013, with 43.23%. The distribution of organic waste, which is expected to increase depending on the population, is expected to decrease in line with the studies carried out within the framework of the legislation and the information activities covered by these studies. The amount of organic waste increased to 50.3 percent in 2014, 49.73 percent in 2015, 58.18 percent in 2016, and decreased to 48.07 percent in 2017. While the amount of organic waste was close to each other between 2017 and 2019, it was observed that it increased by 60.28% in 2021 and 67.25% in 2022.

When looking at the percentages of packaging waste in these distributions, the fact that the highest rate was 30.68% in 2015 and the lowest rate was 20.6% in 2022 shows that there are some disruptions in the functioning of the system. In the study, electrical and electronic equipment wastes, hazardous wastes, park and garden wastes, other flammable materials, other non-flammable wastes, other flammable wastes, bulky wastes, other non-flammable bulky wastes, ash, etc. The distribution of waste is named "Other". The highest two-year "Other" rate in the last ten years was 30.67% in 2013 and then 24.86% in 2017. In the last two years, it can be seen that the category waste amounts are characterized by the lowest value of 11.17% in 2022 when it decreased significantly.

Although it is seen that the amount of packaging waste collected in Çayırova Municipality varies constantly over the years, when the data of the last decade is examined, the high rate of packaging waste among the wastes to be directed to final disposal shows that the collection activities carried out by the Municipality are inefficient. In the Regulation on the Control of Packaging Wastes, issued with reference to the Environmental Law No. 2872, published in the Official Gazette No. 18132 dated 11.08.1983, it is seen that the variability of the free phase is the biggest reason for the instability in waste collection [36].

The fact that the rate of glass waste was 3% in the 2022 characterization results shows that the public is more sensitive about glass waste, and the municipality is more efficient in collecting glass waste. In addition, education and awareness-raising activities of the people of the district should be accelerated, and citizens should be encouraged to use returnable products.

The fact that the percentage of textile waste comes right after organic waste in the waste characterization data that will go to landfill in 2022 has revealed the need for Çayırova to carry out studies to collect textile wastes separately at the source. In this regard, as of 2018, the district municipality has started to recycle textile waste, and textile waste collection boxes have been placed on suitable streets in the region.

4. Conclusion

In this study, a characterization study was carried out by grouping the domestic wastes of Kocaeli

Çayırova Municipality according to their income levels. This study was conducted primarily for the year 2022 and evaluated how the waste content changed with the data of the last ten years. In the study, for 2022, kitchen waste was 67.25%, packaging waste was 21.03%, flammable wastes (textile, etc.) with 21.04%, ash waste at 44%, and Hazardous wastes were detected at a rate of 0.55%. Considering the last ten years, it has been determined that 2022 will have the highest percentage of organic waste and the lowest percentage of packaging waste. When evaluated based on summer and winter seasons, it was observed that kitchen waste was generally higher in summer for all years. "In this study, it was seen that waste management activities are carried out in the Çayırova region, but the integration of citizens into waste management activities should be increased. In a process where the implementation is continued in terms of legislation, the fact that there is already waste going to the landfill in the characterization data shows that incentive efforts should be increased to direct citizens to separate collection activities at the source.

Domestic organic wastes, packaging wastes, textile wastes (as of 2018), glass wastes, construction and demolition wastes, hazardous domestic wastes (used batteries, fluorescent lamps, etc.), and bulky wastes are collected separately at the source by the Municipality. "Mobile Waste Collection Vehicle" has been put into service, and it is planned to include students in the system by organizing training on "Zero Waste" in all schools. If the public does not show interest in the subject, the rates targeted by local governments cannot be reached, and an inefficient collection will develop.

The conscious and concerned segment of the public is negatively affected by the lack of continuity in collections and the occurrence of disruptions. In this regard, the Municipality's posters and billboards should be used periodically to train the public. The Ministry and its provincial and central organizations are obliged to impose administrative sanctions on natural or legal persons who directly or indirectly dump their wastes into nature within the framework of the provisions of Mer legislation. A practical result cannot be achieved. For this reason, the institutional capacity of the competent authorities needs to be increased.

Article Information Form

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There is no conflict of interest between the authors. All authors have read, understood, and have complied as applicable with the statement on “Ethical responsibilities of Authors” as found in the Instructions for Authors.

The Declaration of Ethics Committee Approval
This study does not require ethics committee permission or any special permission.

The Declaration of Research and Publication Ethics
The authors of the paper declare that they comply with the scientific, ethical and quotation rules of SAUJS in all processes of the paper and that they do not make any falsification on the data collected. In addition, they declare that Sakarya University Journal of Science and its editorial board have no responsibility for any ethical violations that may be encountered, and that this study has not been evaluated in any academic publication environment other than Sakarya University Journal of Science.

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