Kurdistan Engineers Union

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Term Engineering Paper:
Municipal Solid Waste Quantity and Components in Raparin Independent Administration, And Possible Solution.

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ABSTRACT

Over the past year, the substantial increase in the Creation of solid waste in municipalities. (MSW) Has occurred recognized as a significant worldwide environmental concern, attributed Due to the expansion of population, advancements in the economy, and industrial growth. transformation. The purpose of this study was to evaluate MSW production, amount, and composition in the Raparin Independent Administration in the winter and summer of 2023. Findings indicated an average daily solid waste production of 404 tons and 0.902 kg per capita. The predominant components of MSW were organic matter, constituting 68.315% of the district's waste, followed by 7.955% plastic, with metal being the least prevalent at 2.47%. Paper and cardboard, fabric. & leather, and glass waste comprised 6.98%, 9.175%, and 1.935%, respectively. Seasonal fluctuations have a major impact on the composition, especially with regard to organic materials and textiles and leather. There are also variations in the rates of trash formation, especially with regard to organic matter. reduced from 70.39% to 66.24% during winter and summer, while the proportion of leather and textiles fell considerably from 8.68% to 9.67% in the same time frame. Similar to this, during the transition from the rainy to the dry season, the rate of waste creation increased from 0.902 kg per capita per day to 0.906 kg per capita per day.

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1. INTRODUCTION

The issue of solid waste has been a source of concern for humanity throughout history, as people have sought suitable methods to dispose of waste, especially when it began accumulating in residential areas. Consequently, innovative solutions were developed to address this problem, leading to the disposal of solid waste away from inhabited areas. The management of solid waste has been a part of modern human life since the early stages of civilization on Earth. However, with the growth in population, economic development, and industrialization, it has evolved into a significant global problem. Ineffective solid waste management has adverse effects on both the natural environment and public health, often resulting in serious health issues. In the modern world, finding exact answers to a range of solid waste problems is essential to achieving sustainable development (Ministry of Environment, 2014).

According to Silpa Kaza et al. (2018), the quantity of garbage created globally is predicted to increase to 2.59 billion tons yearly and reach 3.4 billion tons worldwide by 2050. Solid waste, especially Municipal Solid Waste (MSW), is a major issue in metropolitan areas of Iraq and the Kurdistan region. The post-2003 period saw a substantial increase in waste generation due to population growth, increased consumption, and economic expansion, resulting in environmental contamination. Challenges include a lack of vision, insufficient mechanisms to handle large quantities Regarding waste, and the involvement of the private sector limited contribution to addressing the issue (Jassim M. M. 2018).

The eastern region of the Sulaymaniyah area under the Raparin Independent Administration is the primary subject of this study. The absence of efficient waste management systems exacerbates the solid waste issue. inappropriate disposal techniques in the autonomous management. Solid waste consists of regular home and business garbage, often referred

to as municipal solid waste (MSW), which is made up of different solid and semi-solid things that a community discards, such as food waste (also known as trash) and other products (also known as junk). Bigger home objects, such outdated appliances, are considered trash. Materials such as plastics and aluminum cans are recent additions to the waste (Jassim M. M. 2018) and (Ati U. Z. 2011).

Lack of finance and qualified personnel engaged in putting solid waste management strategies into effect further exacerbates complications. through a number of phases, including gathering, moving, treating, and final disposal. Although there is a growing need for solid waste recovery and reuse due to alternatives like recycling, the problem is made more difficult by the fact that these efforts are sometimes unorganized or influenced by stock availability (Ruth F. et al, 2003; Jasim M. M. 2018).

Over the last few decades, there has been a notable global rise in the amount of garbage being disposed of in the environment. Of particular note is the large production of municipal solid waste, which is acknowledged as a serious environmental concern. As a result, there have been negative effects on the environment, including soil contamination, groundwater contamination of surface and groundwater, air pollution from burning garbage, and the spread of diseases by insects, birds, and rodents. (Thomas M. Muhammad, 2011). A major portion of MSW, organic waste, can be improperly managed, which can lead to a deterioration in the air, soil, and water quality. presenting health hazards by acting as a breeding ground for pests and a disease-transmission vector (Ahmed A. B., 2011).

Because solid waste is varied in terms of substances, materials, and objects, it can be difficult to identify, define, and categorize. (T. W. Pal, 2005). The solid waste collected from the independent administration's collected samples revealed a wide variety of materials, such as metals, worn-out or torn clothing, broken furniture parts, plastics, papers, plastic

bags, packaging items, and used or damaged plastics and glass. Because of this variability, waste management plans are more complex, especially during the trash separation phase, which makes it challenging to put successful solutions into practice.

dependable waste Scientific studies and management data are essential for a thorough evaluation of waste management options. Nevertheless, in many underdeveloped nations, it might be difficult to gather these crucial information. Potential investors in the solid waste management industry are confused and hesitant as a result of contradictory data, which is frequently available while depending on assumptions rather than scientific measures (Kodwo M. K et al, 2015) (Diana S., 2018). Similar problems exist in Iraq, where most communities lack efficient systems for collecting and treating solid waste, leaving roadways clogged with debris. Environmental contamination and public health are at risk due to insufficient solid waste management and treatment, as well as the lack of recycling initiatives (UNAMI Newsletter, 2011). Due to their negative impacts, insufficient solid waste management programs represent serious risks in poor countries, where 80% of the world's population lives. These systems can lead to air, water, and land contamination as a result of limited financial resources (Ali Ch., et al., 2015).

There are four main ways to dispose of MSW: Materials like glass, metal, paper, and plastic can be used or recycled;2) energy can be extracted by burning organic waste components;3) bioconversion involves the controlled aerobic oxidation of natural organic components in MSW; and4) sanitary landfilling is the process of disposing of non-recyclable materials in landfills that have been designed with the right engineering. (Environment Ministry, Manatn, 2009).

Raparin independent Administration The historical context and current situation of managing solid waste.

The Raparin Independent Administration, located in the Iraqi Kurdistan Region's Sulaymaniyah governorate, is the subject of this study. Situated precisely at the boundary between Iraq and Iran, about 153 kilometers east of Sulaymaniyah City, Raparin Independent Administration occupies an area of more than 3000 km². The main urban center is Rania Town, which is made up of two districts and thirteen sub-districts, with a total population of 446,123 (Map of estimated population of Sulaymaniyah governorate, 2015) (Karen Radner et al., 2017). The districts are Sanga Sar, Zharawa, Halsho, Hero, Haji awa, Chwarqurna, Shxarta, Kidran, Bosken, and Isewa. Up to June 2023, the collected municipal solid waste (MSW) in the region was traditionally disposed of in an open space, as shown in Figure 1, due to the lack of a sanitary landfill and a distinct solid waste management system. Unfortunately, this approach was inappropriate because appropriate landfill site selection necessitates following important scientific and environmental guidelines, such as topography, wind patterns, proximity to residential areas, proximity to surface water bodies, distance from protected areas, geological features, land use, groundwater levels, proximity to major roads, slope of the terrain, agricultural regions, and distance from airports and hydrology (Sehnaz S., et al., 2010). The selected dumping location was found to be scientifically inappropriate and undesirable based on these standard standards and factors because of its topography and near proximity to a seasonal.

Figure 1 shows unscientific land fill without any treatment

Since 2014, the municipality of the Raparin Independent Administration has been tasked with overseeing the operations of Garrix Company, the contracted entity responsible for solid waste management in the area. The company employs various collection methods, including curbside pickup and community bin collection. However, their responsibility extends solely to the disposal of the entire district's waste at the designated site, without employing any treatment or considering alternative measures such as recycling, reuse, composting, or incineration.

Supported by institutions such as the United Nations Environment Program (UNEP), which has carried out multiple investigations on the amount, composition, and environmental assessments of municipal solid waste (MSW), several studies on solid waste management have been carried out in Iraq (UNEP in Iraq, 2007). Further studies have looked into the features and makeup of solid waste in Mosul City (Sati M. et al., 2013), waste

management in the southern Governorates of Iraq (Riyadh A. et al., 2012), and a comprehensive investigation in Kerbala that examined the solid waste mixture and focused on waste management during religious events (Muhammad A. et al., 2017). Studies on solid waste management, especially in Erbil, have also been carried out in the Kurdistan Region of Iraq. As an example, Shoukr et al. (2019) investigated the handling of recyclable solid waste products, while Sirwa Q. S. (2017) assessed the Erbil dump site's environmental impact, emphasizing adverse consequences on the neighborhood. Notably, a case study on solid waste management has been conducted in the governorate of Sulaymaniyah, namely in Chamchamal (the open landfill in the Dwbra valley) (Chrakhan R., et al., 2018).

This study project is the first attempt to investigate solid waste management in the Sulaymaniyah territory's Raparin Independent Administration. This investigation's main goal was to assess the composition and volume of municipal solid waste (MSW), emphasizing how crucial it is to separate recyclables in order to minimize the quantity of garbage that is dumped at disposal sites. The goal of this emphasis on trash segregation is to reduce the hazards to the environment and health issues related to open dumping sites.

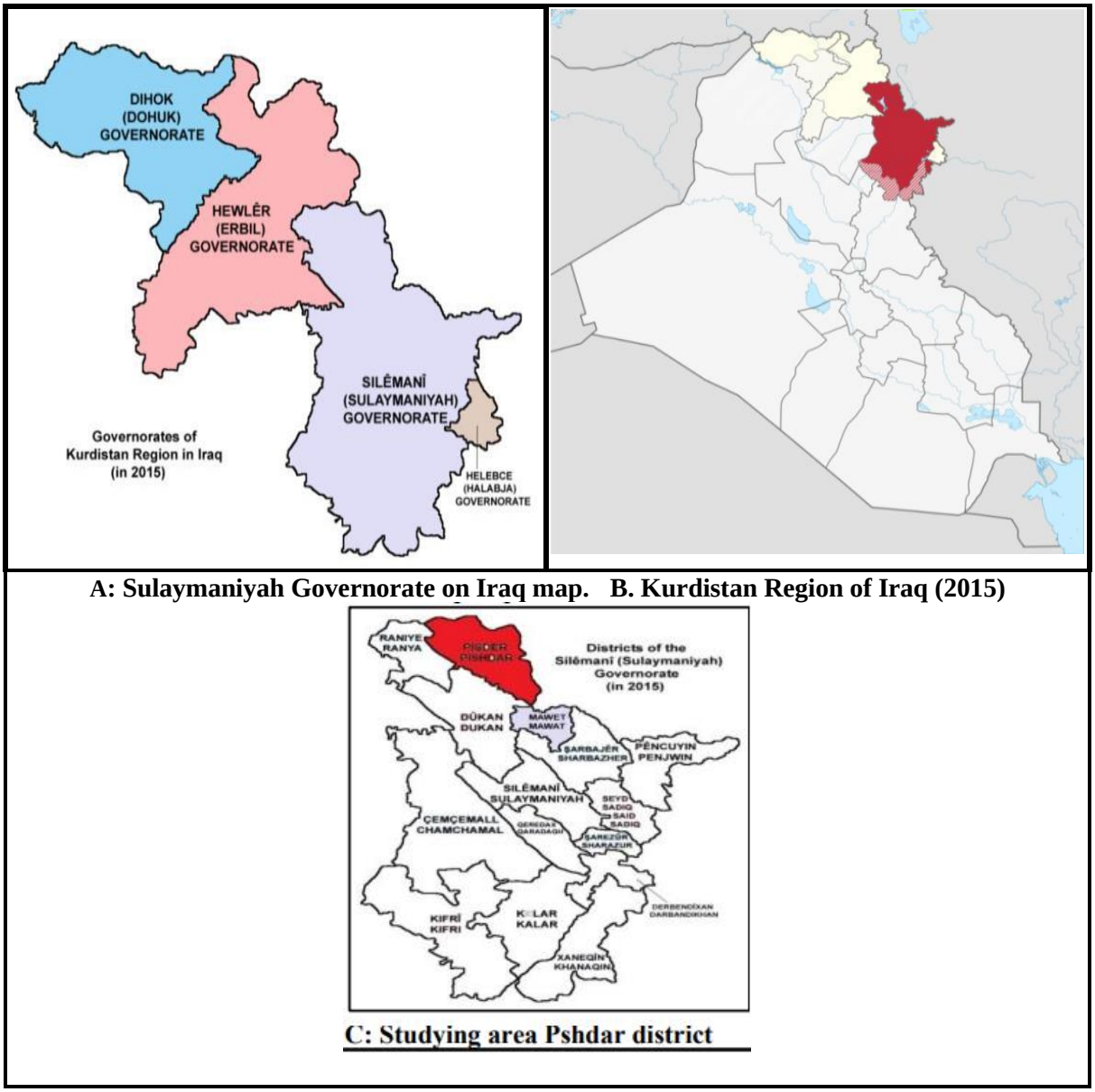

Fig. 3. The location of studying area.

2. METHODOLOGY

2.1 Materials and Methods

The current study was conducted in 2023 during the winter and summer seasons. This strategy was chosen in light of the possibility that seasonal variations and socioeconomic variables might affect the creation of household solid trash and its composition. During both seasons, samples were collected in the morning from six distinct zones within the independent administrator. Z1=Rania, z2=Qaladza, z3=Chwarqwrna,

z4=Bngrd, z5=Haji Awa, z6=Shkarta, z7=Sarwchawa, z8=Xdran, z9=buskin, z10=Sarkapkan, z11=Sanga saar, z12=Zharawa, z13=Halsho, z14=Hero, z15=Esewa, It depicts the Rania district as the hub of the 15 zones that make up the Raparin autonomous Administration. Using tipper lorries and compactor vehicles made specifically for moving rubbish to the disposal site, waste from each zone was collected separately. From each zone, one truck was chosen at random and weighed. After mixing the waste samples from each zone, the mixture was separated into four equal portions. After physically separating the components and weighing them with a digital balance, the proportion of each component was determined. Refer to Figure 4.

Fig. 4. Waste separation process, summer season.

2.2Percentage proportion Calculations for solid waste composition involved determining the percentage ratio of each ingredient across various zones through the following steps:

The overall quantity of each ingredient was computed for all zones, followed by the determination of the total weight of municipal solid waste in the independent administration.

For the winter season, the total daily quantity of solid waste in the independent administration was calculated. = 404.453 Tons/day.

Organic matter % = $\frac{[\boldsymbol{weight\ zone\ 1+zone\ 2+\cdots\ldots+zone}\ 15}{\boldsymbol{total\ quantity\ of\ MSW\ of\ the\ district}} \times 100 = \frac{283.38}{402.568} \times 100 = 70.39\%$
]

Paper & Cardboard% = $\frac{23.643}{402.568} \times 100 = 5.87\%$

Plastic % = $\frac{33.042}{402.568} \times 100 = 8.21\%$

Metal% = $\frac{12.593}{402.568} \times 100 = 3.13\ \%$

For calculating the Generation Rate of solid waste (GRW) in the independent administrate depending on theobtained date, the below equation was used:

$$GRW=\frac{Qs}{P}\ldots\ldots\ldots \quad (1)$$ (Ali Chabuk, et al., 2015)

Where:

GRW: Generation of solid waste kg / (capita –day).Qs: total Quantity of solid waste (kg)

P: Population of the studying area

For determining the generation rate of solid waste in the independent administrate the above equation was applieddepending on the population which is about (446123 inhabitants).

According to winter season data:

$$GRW=\frac{404.453\times1000}{446123}=0.906 \text{ kg/capita-day}$$

According summer season data:

$$GRW=\frac{382734\times1000}{446123}=0.858 \text{ kg/capita-day}$$

3. DISCUSSION

Municipal solid waste (MSW) varies in quantity and composition depending on the location. Factors like manufacturing facilities, consumer behavior, demographics, waste production by individuals, and cultural, social, and economic conditions—particularly those related to the economy—have a significant impact on MSW composition. These differences in the composition of MSW can have a significant effect on the quality of trash, affecting the characteristics of incineration residues, landfill discharges, and different areas of waste management systems (Shafiul A., et al., 2004). Thus, the main objective of this study was to determine the compositions of MSW, with a particular emphasis on comprehending how seasonal fluctuations affect the amount and components of MSW. Based on findings from a study by Gintaras D. et al. (2014), this investigation was carried out in the winter and summer.

To establish the waste generation rate, samples of Municipal Solid Waste (MSW) were obtained from different zones, and their weights were measured over the study period. The average of all waste generated during both seasons was then calculated, resulting in an average of 402.568 tons for winter and 404.453 tons for summer. Detailed information on the average components and quantities of solid waste for all zones during both winter and summer seasons can be found in Table 1 and Table 2.

Table 1. Total quantity and ingredients of solid wastes data for summer season, 2023/. Municipal Solid Waste Quantity, Ingredients, and Site Disposal Problems in Pshdar District in Sulaimanyah: Iraqi Kurdistan Region, Iraq.

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Zones/name	Total solid waste day (ton)	Main Components of the solid wastes					
		Organic matter ton/day	**Paper& Cardboard** ton / day	**Plastic ton/ day**	**Metal ton** /day	**Glass ton /day**	**textile &** leather
Z1/ Rania	**86.190**	**36.800**	**11.450**	**10.650**	**2.500**	**2.540**	**22.250**
Z2/Qaladza	**56.889**	**39.589**	**9.500**	**5.200**	**1100**	**0.300**	**1.200**
Z3/Chwarqwrna	**51.500**	**32.600**	**7.450**	**5.150**	**1.500**	**0.300**	**4.500**
Z4/bngrd	**11.450**	**7.690**	**0.910**	**0.690**	**0.710**	**0.630**	**0.820**
Z5/Haji Awa	**107.179**	**94.251**	**3.602**	**5.648**	**1.133**	**0.925**	**1.620**
Z6/Shkarta	**11.385**	**8.937**	**0.723**	**0.896**	**0.217**	**0.173**	**0.439**
Z7/Saruchawa	**14.870**	**12.418**	**0.658**	**1.109**	**0.166**	**0.155**	**0.364**
Z8/Xdran	**11.937**	**5.030**	**0.787**	**0.871**	**0.329**	**0.357**	**4.563**
Z9/Buskin	**9.220**	**2.950**	**1.150**	**0.950**	**0.740**	**0.550**	**2.880**
Z10/Sarkapkan	**8.160**	**3.690**	**0.900**	**0.810**	**0.540**	**0.630**	**1.590**
Z11/SangaSar	**16.920**	**10.321**	**0.846**	**3.384**	**0.288**	**0.389**	**1.692**
Z12/ Zharawa	**9.845**	**6.173**	**0.492**	**1.772**	**0.236**	**0.187**	**0.985**
Z13/Halsho	**4.635**	**3.850**	**0.091**	**0.559**	**0.013**	**0.026**	**0.096**
Z14Hero	**2.553**	**2.210**	**0.075**	**0.155**	**0.011**	**0.012**	**0.090**
Z15/Esewa	**1.720**	**1.392**	**0.079**	**0.138**	**0.155**	**0.008**	**0.093**
Total	**404.453**	**267.901**	**38.713**	**37.982**	**9.493**	**7.182**	**43.182**
Quantity Percentage	**100%**	**66.24%**	**9.57%**	**9.39%**	**2.34%**	**1.78%**	**10.68%**

Table 2. Total quantity and ingredients of solid wastes data for winter season, 2023./ Municipal Solid Waste Quantity, Ingredients, and Site Disposal Problems in Pshdar District in Sulaimanyah: Iraqi Kurdistan Region, Iraq.
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		Main Components of the solid wastes					
Zones	Total solid waste / day (ton)	Organic matter ton/day	Paper &Cardbo ard ton / day	Plastic ton/ day	Metal ton /day	Glass ton /day	textile & leather
Rania	**91.690**	**33.513**	**10.741**	**9.240**	**7.349**	**5.120**	**25.727**
Qaladze	**52.792**	**44.720**	**1.325**	**5.300**	**0.098**	**0.197**	**1.152**
Chwarqwrna	**54.300**	**42.440**	**3.010**	**3.400**	**1.840**	**1.810**	**1.800**
Bngrd	**10.900**	**8.368**	**0.590**	**0.520**	**0.485**	**0.302**	**0.635**
Haji Awa	**83.435**	**75.725**	**2.325**	**3.417**	**0.596**	**0.560**	**0.812**
Shkarta	**27.345**	**24.098**	**0.810**	**1.435**	**0.287**	**0.225**	**0.490**
Sarwchawa	**20.185**	**16.843**	**0.794**	**1.695**	**0.296**	**0.165**	**0.392**
Khdran	**14.220**	**10.845**	**0.850**	**0.860**	**0.395**	**0.290**	**0.980**
Buskin	**8.150**	**2.690**	**1.093**	**1.386**	**0.342**	**0.311**	**2.318**
Sarkapkan	**7.120**	**1.471**	**0.744**	**1.087**	**0.506**	**0.592**	**1.720**
Sanga Sar	**12.620**	**8.077**	**0.505**	**2.145**	**0.252**	**0.281**	**1.360**
Zharawa	**10.106**	**6.774**	**0.404**	**1.618**	**0.097**	**0.206**	**1.007**
Halsho	**6.972**	**6.119**	**0.191**	**0.514**	**0.023**	**0.039**	**0.086**
Hero	**1.703**	**0.785**	**0.210**	**0.400**	**0.020**	**0.053**	**0.235**
Esewa	**1.030**	**0.917**	**0.051**	**0.025**	**0.007**	**0.012**	**0.018**
Total quantity	**402.568**	**283.385**	**23.643**	**33.042**	**12.593**	**10.163**	**38.732**
Percentage	**100 %**	**70.39%**	**5.87%**	**8.21%**	**3.13%**	**2.53%**	**9.62%**

Municipal solid waste Composition: The six main constituents of municipal solid waste (MSW) that are evaluated in this survey are organic matter, paper and cardboard, plastic, metal, glass, and textile and leather. With an average percentage of 68.315%, organic matter is the most prevalent component in the

trash during both periods, according to Table 3 and Figure 5 data. Biodegradable and decomposed materials fall under this category. Closely after, accounting for around 7.955% of the garbage, is plastic waste, which includes a sizable amount of recyclable materials. Glass, on the other hand, is the least common waste element, making up only 1.935% of the total. The mean Paper and cardboard, cloth and leather, and metal make up 6.98%, 9.175%, and 2.47% of the waste components, respectively.

Similar results have been found in studies conducted in Iran, Baghdad, and Erbil. For instance, the percentages for organic matter, paper, plastic, metal, and textile in Mahabad town were reported to be 61.785%, 6.98%, 7.955%, 2.47%, and 9.175%, respectively (Tasnim F. Ch., 2016), (Yahya A., 2011), and (Soran E., et al., 2015).

The analysis indicates that organic waste represents a considerable proportion of the local garbage and a sizable amount of material that may be recycled. This emphasizes the possibility of making fertilizer specifically for nearby nurseries. The process of producing fertilizer entails the aerobic biological decomposition of organic materials. Microbial activity transforms organic waste into a stable, humus-like material throughout the composting process (Hussein I. et al., 2018). Pshdar's MSW is appropriate for the composting process because of its high level of organic waste content. It is imperative that the public and private sectors in the autonomous administration take into consideration creating a composting facility, as there isn't one in the area at the moment.

Municipal Solid Waste creation: Comprehensive data on trash generation and physical waste examination are provided in Tables 3 and 4, which also compare waste components to results from previous local and worldwide research. The study's waste

generation rates were found to be 0.902 kg/capita/day in the winter and 0.906 kg/capita/day in the summer, with an average of 0.904 kg/capita/day, as shown in Table 3. While this average rate is higher than that of other Iraqi cities like Mosul (0.680) and Babylon (0.670), it is lower than the average trash generation rate for Europe and Central Asia, which is documented at 1.18 kg/capita/day. Furthermore, the estimated generation rate is less than Erbil (1.27 kg/capita/day) but higher than Baghdad (around 0.900).

Seasonal variation impact on MSW creation and ingredients percentage:

The most notable variation in the content of Municipal Solid Waste (MSW) between the winter and summer seasons is found in organic materials, which is followed by textile and leather, as shown in Table 5 and Figure 5. In winter, the average proportion of organic matter was 63.52%; in summer, it was 60.05%. Given the district's renown for its agricultural industry, it is assumed that this change is related to variables like food waste and other organic materials, which are impacted by increased consumption of agricultural produce. The rate of solid waste formation increases from the rainy season to the dry season, going from 0.902 kg/capita/day to 0.906 kg/capita/day, notwithstanding this shift in organic matter. The amounts of trash made of leather and textiles also show a noteworthy disparity.

Table 3. Average waste ingredients quantity and weight percentage of MSW in Raparin independent Administration for winter and summer season in 2019.

Municipal Solid Waste Quantity, Ingredients, and Site Disposal Problems in Pshdar District in Sulaimanyah: Iraqi Kurdistan Region, Iraq.AA Hamza - Kufa Journal of Engineering, 2020

Ingredients	Winter (%)	Ton/Day	Summer (%)	Ton/Day	Average	Ton/Day
Organic waste	70.39	283.385	66.24	267.901	68.315	275.643
Paper $ Cardboard	5.29	23.643	8.67	38.713	6.98	31.178
Plastic	7.40	33.042	8.51	37.982	7.955	35.512
Metal	2.82	12.593	2.12	9.493	2.47	11.043
Glass	2.27	10.163	1.60	7.182	1.935	8.6725
Textile & leather	8.68	38.732	9.67	43.182	9.175	40.957
Total	89.98	402.568	90.62	404.453	90.3	403.5150
Generation rate (kg/capita-day)	0.902		0.906		0.904	

Table 4. Comparison of solid waste generation rates of the current research with the other reported researches.

Municipal Solid Waste Quantity, Ingredients, and Site Disposal Problems in Pshdar District in Sulaimanyah: Iraqi Kurdistan Region, Iraq.

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References	Generation rate (kg/cap-day)	Organic waste%	Paper $ Cardboard %	Plastic %	Metal%	Glass %	Textile & Leather %
Current Study	0.761	75.71	3.74	13.18	0.93	1.66	4.76
Baghdad, Iraq (Tasnim F.CH., 2016)	0.900	70.00	5.00	5.30	2.20	2.20	-
Erbil, Iraq (Shoukr Q. et al. 2019)	1.27	28.00	13.00	35.00	2.00	2.00	5.00
Mosul, Iraq, (Sati M.&Taha A. ,2013)	0.680	68.17	9.6	5.29	3.15	2.61	5.48
Babylon, Iraq (Ali Chabuk, et al., 2015)	0.670	55	5	8	10	5	5
Tehran, Iran (Soran Erami, et al., 2015)	0.840	69.66	9.37	6.82	1.53	-	1.89
Mahabad, Iran (Soran Erami, et al., 2015)	0.878	75.17	3.79	9.78	0.83	-	1.93
Istanbul, Turkey, (Huseyin K. O., et al., 2016)	0.955	61.64	5.72	8.75	0.82	4.60	-
Ghana, (Kodwo M. K., et	0.531	61.00	5.00	14.00	3.00	3.00	2.00

al., 2015)							
Europe and Central Asia, (Silpa Kaza, et al.,2018)	**1.18**	**36.00**	**18.60**	**11.50**	**3.00**	**8.00**	**-**
Al-Najaf, Iraq (Riyadh A. Y. & Zaidon N.A., 2009)	**0.42**	**69.03**	**3.06**	**5.09**	**7.09**	**2.71**	**3.59**
Nasiriya, Iraq (Riyadh A. Y. & Zaidon N.A., 2009)	**0.68**	**70.18**	**3.42**	**6.75**	**3.55**	**3.95**	**2.54**

In the winter, the percentage of trash made up of textiles and leather was 9.62%; in the summer, it significantly increased to 9.67%. Given the unique cold winter and hot summer conditions in the Raparin Independent Administration, where temperatures vary significantly from 47°C to -5°C between summer and winter, this variation is clearly associated with the increased use of clothing and leather during the winter season. The proportion of paper and plastic changed little between the two time periods, with paper falling from 5.87% to 8.67%. In the same way, plastic's share dropped from 8.21% to 8.51%.

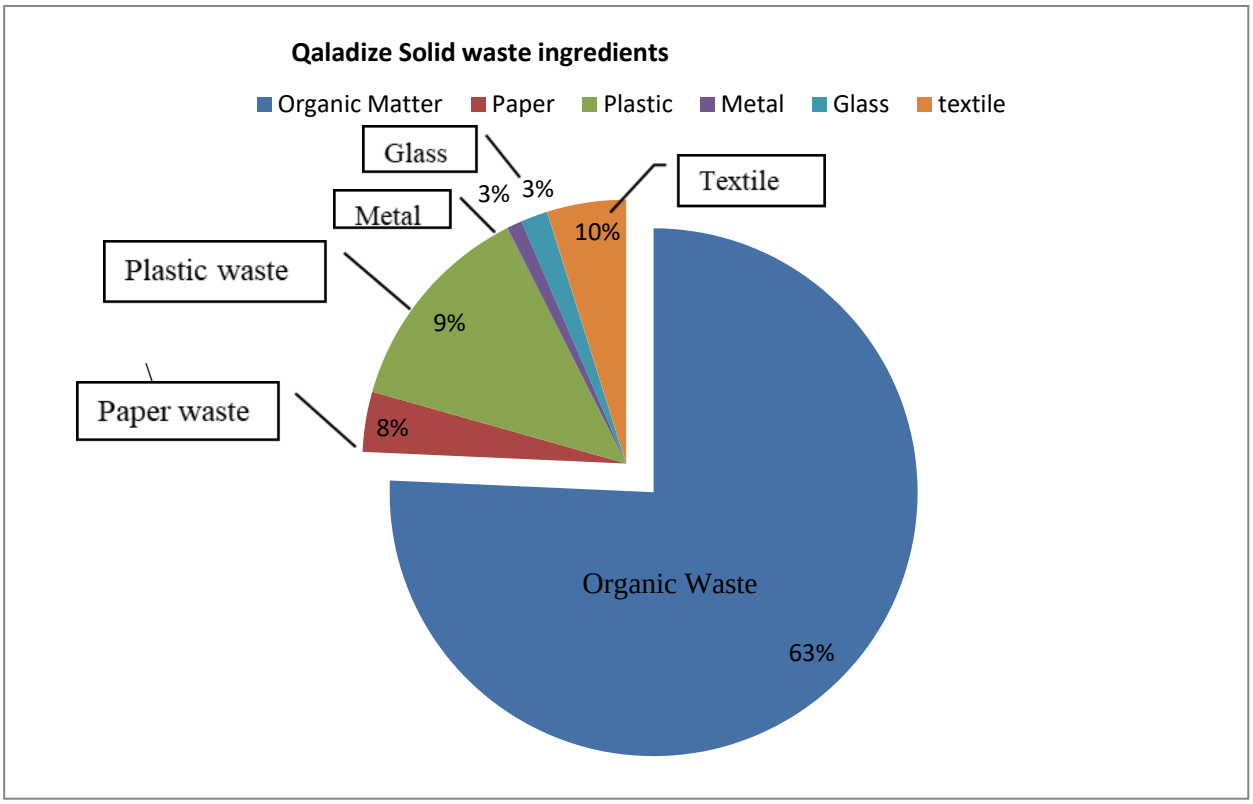

Fig. 5. Average of Total Raparin independent administrator Solid waste ingredients, 2023.

from the winter to the summer. In the meanwhile, seasonal volatility led to a notable decline in the proportion of glass and metal. From winter to summer, the proportion of glass fell from 2.53% to 1.60%, while the amount of metal fell from 3.13% to 2.12%.

Table 5. Percentage Average of MSW contents and seasonal percentages.

Solid waste Components	MSW Percentage %			
Seasonal Effect	Winter	Summer	change%	Average
Organic Matter	63.52	60.05	-3.47	61.785
Paper	5.29	8.67	3.38	6.98
Plastic	7.40	8.51	1.11	7.955
Metal	2.82	2.12	-0.7	2.47
Glass	2.27	1.60	-0.67	1.935
Textile & leather	8.68	9.67	0.99	9.175
Generation rate (kg/capita-day)	0.902	0.906	0.004	.0.904

4. CONCLUSIONS

Growing populations and economic growth have made efficient disposal, recycling, and trash reduction—all components of solid waste management—more crucial in recent years. In order to evaluate trash creation, composition, disposal techniques, and seasonal fluctuations in waste content, this study focuses on the Municipal Solid trash situation in the Raparin Independent Administration in the Kurdistan Region of Iraq. According to the research, the district generates 0.904 kg of garbage per capita per day on average, which is less than the average for Erbil (1.27 kg/day) and Europe and Central Asia (1.2 kg/capita-day). It does, however, exceed the rates of garbage creation in Ghana, Babylon, and Mosul, which are 0.531 kg/day, 0.670 kg/day, and 0.680 kg/day, respectively.

The study emphasizes that, at 63.52% in the winter and 60.05% in the summer, organic waste makes up the largest share of the district's MSW. Furthermore, the district's primary technique of disposing of solid waste—open dumping—is not considered to be ecologically or scientifically friendly. The study's conclusion highlights the necessity of joint efforts between public and private sectors in order to create a workable strategy for improving solid waste management procedures. It also promotes other ways to cut down on garbage that ends up in landfills. Additionally, in order to promote community involvement in solid waste management techniques, the public and commercial sectors should actively participate in public awareness initiatives that make use of panels and workshops.

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