



## **ENVIRONMENTAL ASSESSMENT OF SOLID WASTE IN THE LEFT SIDE OF MOSUL CITY**

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<b>Received:</b> 6 <sup>th</sup> February 2022 <b>Accepted:</b> 6 <sup>th</sup> March 2022 <b>Published:</b> 18 <sup>th</sup> April 2022	The study included all areas of the left side of the city of Mosul, and in each area or residential neighborhood, two sites were randomly selected, where samples are collected on a daily basis after distributing the bags to the specified sites, for a period of six months. Where the results of the research conducted in the year 2021-2022 showed that the left side of the city of Mosul produces approximately (780) tons per day of municipal solid waste, Where the results of the study showed through the field survey process that the study area contains more than 397 landfills for waste within residential neighborhoods, which occupy an area of more than 28376m <sup>2</sup> . As organic waste constitutes the largest proportion of the components, with a percentage (67.50%), plastic, nylon (7.66%), paper and cardboard (10.32%), glass (3.10%), metals (1.02%), textiles (2.99%), wood (1.65%), diapers ( 5.74%), so some of them must be recycled and others re-used and treated to produce other materials, thus reducing the volume of waste and producing other materials such as organic fertilizers and soil conditioners, and in the end we reduce the use of land as landfill sites, as well as providing an economic resource for the city and the country in general.

**Keywords:** Solid waste, Mosul city, Production rate, Random landfills

### **1. INTRODUCTION**

In fact, solid waste constitutes the most important challenges facing developed and developing societies alike, through the process of collecting, transporting and final disposal of it, and it is linked to a direct relationship with a group of variables, including the economic level, population density, customs and traditions, scientific and cultural level, environmental awareness in dealing With solid waste, family size, number of people inside the housing unit, Solid waste can be defined as the materials that are disposed of at the sources that generate them, and they have little apparent value, but they can be of economic value in other locations and other circumstances [1]. Therefore, waste must be treated and disposed of in safe environmental ways at the lowest costs. The city of Mosul is one of the Iraqi cities that suffer from the waste problem due to the lack of financial disciplines available to treat it, in addition to the shortcoming in the work of municipal cadres in some neighborhoods of the city, and the lack of environmental awareness among some residents. Therefore, a balance must be achieved between the following elements, saving energy in consumption of natural resources, protecting the environment from pollution, and the cost required to dispose of waste.

In order to achieve these goals, it is necessary to know the quantity and quality of waste produced, the method of waste collection in the places of production or outside, and the method of transportation to deliver it to intermediate stations, treatment places or places of disposal.

The problem of solid waste management in the city of Mosul faces several challenges, including the continuous increase in the population with the increase in economic activity, which leads to a difference in components and an increase in production, and the change in the lifestyles of different families leads to a difference in the proportions of waste components and the quantity produced. The growth of environmental awareness and the growing awareness of the negative effects of the presence and spread of solid waste plays an active role in dealing with waste. It is also not possible to neglect the view of local governments and municipal departments to waste as an economic resource and not just an environmental burden or waste. Therefore, integrated solid waste management must be activated, which means that it is a process that includes the whole process of dealing with solid waste, which includes production, preservation, treatment or treatment, and dealing with waste and disposing of it in a way that makes it harmless to humans, animals, ecology and the environment, and

this requires effective and timely management of waste in accordance with the principle Sustainable development, which requires meeting the needs of the present without compromising the ability of future generations to meet their own needs [2].

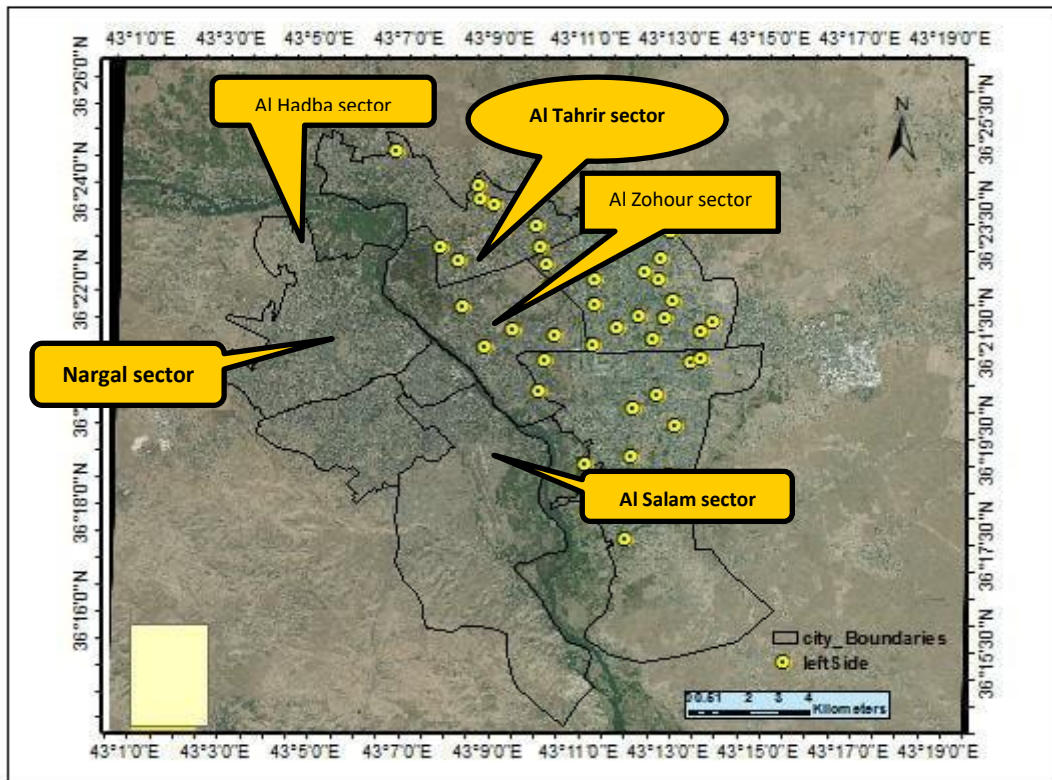
## 2. OBJECTIVE

Estimating the amount of solid waste produced by the individual, as well as estimating the number and area of landfills within residential neighborhoods and determining their location on the map, in addition to evaluating the mechanisms of solid waste management in the region, starting from the source of the waste to the landfill, and ways to treat it afterwards.

## 3. MATERIALS AND WORKING METHODS

The study included an assessment of the environmental reality of solid waste in all areas of the left side of the city of Mosul, which are located within the service of five municipal sectors (Al-Hadba - Nargal - Al-Tahrir - Al-Zohour - Al-Salam) to know the quantity of waste produced, its

components, methods of collection, transportation, treatment or disposal. Where the study samples were chosen randomly to include different people of different economic, social, cultural and other levels. He samples were chosen randomly, with two houses from each region, containing a different number of individuals in different age groups. Waste collection bags were distributed to the specified homes to be collected on the second day after 24 hours. The method adopted in this study is the method used by [3] And [4], A questionnaire was also distributed, to help obtain some information, including regarding the serviced areas or not, the amount of solid waste produced by each individual per day, the number of waste collection times per week, and identifying the areas that use the direct transport system, etc. The process of collection and sorting of waste continued for six months, starting from the beginning of October until the end of March. During this period, (360) samples were collected from different regions of the left side of the city of Mosul. And Figure No. (1) Represents the neighborhoods that were elected to conduct the study.



**Figure No. (1) An aerial map showing the residential neighborhoods on which the study was conducted on the right side of the city of Mosul**



#### 4. RESULTS AND DISCUSSION

After research and conducting a field survey, it was found that most of the neighborhoods on the left side of the city of Mosul suffer from weak or lack of proper solid waste management, as the spread of random libraries within residential neighborhoods, especially near schools, health centers and abandoned lands, and this indicates a weak environmental awareness of the citizen. Therefore, it is necessary to activate the integrated management of solid waste, with joint cooperation between citizens and municipal cadres, to get rid of its health, environmental, economic and social risks. In addition to activating the system of direct transport of waste from the source to get rid of the problem of the spread of landfills within residential neighborhoods, and among the neighborhoods that follow the direct transport system on the left side of the city of Mosul are (Al Dubbat - Al Muthanna- Al Baladiyah). As for the reasons for the lack or absence of mechanisms, capsules and containers in some neighborhoods of the city of Mosul, it is due to the lack of financial specialization, and that the containers and capsules that were distributed to most neighborhoods are from international organizations in cooperation with the Mosul municipality and not from the municipality itself. Also, in every meeting of the Mosul municipality, the issue of waste recycling is raised, but it is not implemented due to the lack of financial specialization.

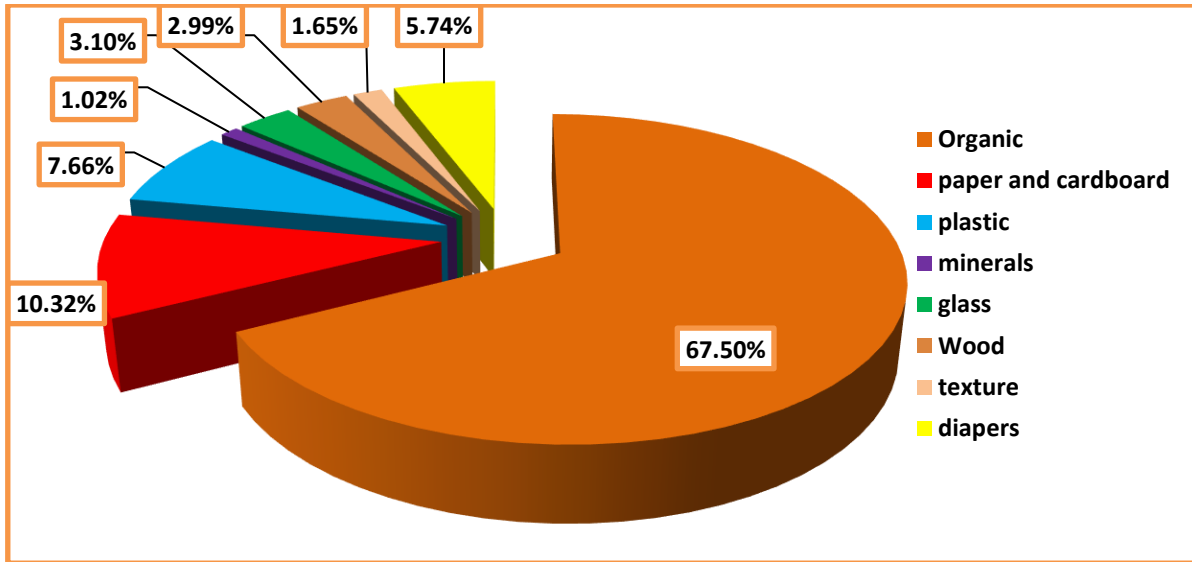
##### **Domestic solid waste generation rate**

Table (1) shows the per capita production of solid waste in most or all areas of the left side of the city, and this represents the rate of residential productivity. As for the rest of the industrial, commercial, agricultural, medical and

institutional activities, they represent twice the residential productivity in the city, as stated by the source [5] for countries. He emphasized that the city's productivity of population waste in developing countries represents 50% of the total productivity.

The production rate per capita of total household solid waste on the left side of the city of Mosul after analyzing 360 samples was (0.982) kg/person. This is consistent with what was found by [6] regarding developing countries. But if we compare this figure with local studies, we find it within the limits of [7] and [8], as the rate of production per capita of household solid waste in the city of Mosul, according to these two studies, was (0.35-0.70). Kg/person per day and (0.43-0.75) kg/person per day, respectively. The reason for the difference in the results of local studies is attributed to several factors, the most important of which are the factors of time and place, which clearly affect the results, in addition to the economic and cultural situation and others. Thus, the production of the left side of the city of Mosul is approximately (780) tons per day of municipal solid waste, and the city's population is 1471353 [9], where the right side represents about 54% of the city's population [10].

Waste components were sorted and diagnosed, and the weight percentages were calculated for each component of the samples taken. Where the organic waste represented the largest proportion of the components, at a rate of 67.50 %, paper and cardboard by 10.32%, plastic and nylon by 7.66%, metal 1.02%, glass 3.10%, fabric 2.99%, diapers 5.74%, wood and the rest of the components 1.65% and Figure No. (2) Shows the percentages of waste components solid household .



**Figure No. (2) Percentages of household solid waste components on the left side of the city of Mosul**

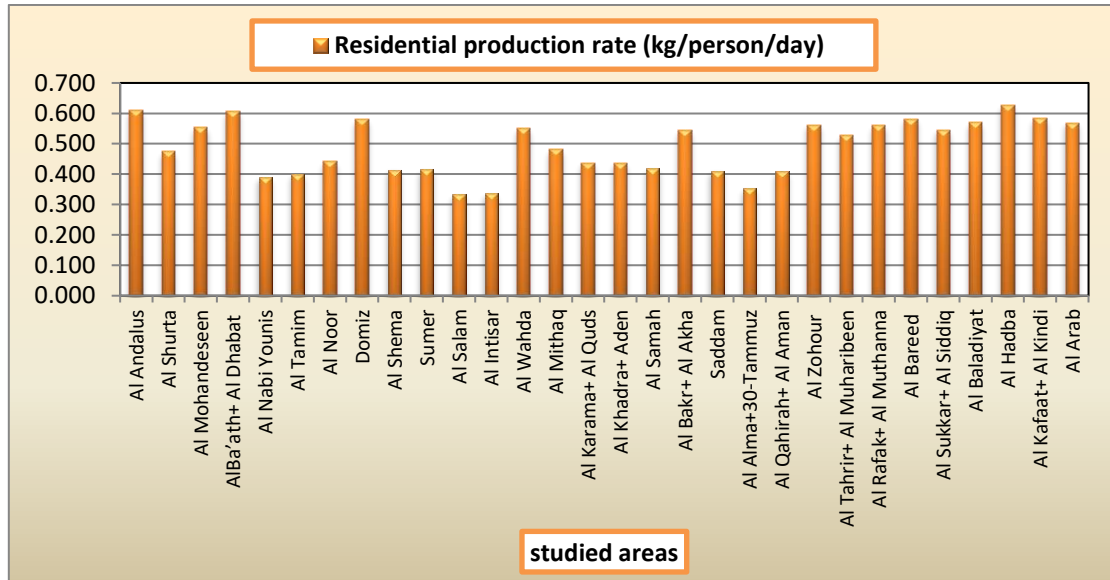
**Table No. (1) The rate of solid waste production on the left side of the city of Mosul (kg/person/day)**

Study date	October (kg/person/day)		November (kg/person/day)		December (kg/person/day)		January (kg/person/day)		February (kg/person/day)		March (kg/person/day)		Residential production rate	Total production rate
	1	2	3	4	5	6	7	8	9	10	11	12		
Al Andalus	0.59 3	0.68 5	0.61 7	0.60 6	0.56 7	0.58 3	0.61 7	0.59 3	0.64 2	0.59 3	0.57 5	0.63 8	0.60 9	1.21 8
Al Shurta	0.58 5	0.40 2	0.54 8	0.48 6	0.43 5	0.38 7	0.44 8	0.40 8	0.46 3	0.41 7	0.57 3	0.53 8	0.47 4	0.94 8
Al Mohandes een	0.56 3	0.47 2	0.53 3	0.48 3	0.59 7	0.53 6	0.61 2	0.58 2	0.56 7	0.56 8	0.57 7	0.55 4	0.55 4	1.10 7
AlBa'ath+ Al Dhabat	0.66 3	0.52 6	0.76 7	0.48 8	0.65 5	0.56 5	0.61 7	0.54 8	0.65 3	0.57 5	0.69 3	0.52 6	0.60 6	1.21 2
Al Nabi Younis	0.37 8	0.40 3	0.35 5	0.37 7	0.35 6	0.38 9	0.39 1	0.40 6	0.41 1	0.41 8	0.40 5	0.39 8	0.39 1	0.78 1
Al Tamim	0.44 2	0.38 3	0.38 1	0.38 9	0.38 7	0.42 7	0.34 1	0.43 2	0.37 9	0.44 5	0.41 5	0.39 4	0.40 1	0.80 1
Al Noor	0.48 2	0.42 9	0.45 8	0.40 6	0.42 8	0.37 2	0.43 2	0.44 4	0.47 6	0.46 7	0.50 4	0.40 9	0.44 2	0.88 5
Domiz	0.49 5	0.53 3	0.57 6	0.59 3	0.50 1	0.65 3	0.49 7	0.71 7	0.53 2	0.64 3	0.61 8	0.61 3	0.58 1	1.16 2
Al Shema	0.37 8	0.38 2	0.37 8	0.41 4	0.40 4	0.44 4	0.41 6	0.43 2	0.42 5	0.46 8	0.39 9	0.42 8	0.41 4	0.82 8
Sumer	0.45 7	0.35 4	0.45 5	0.36 6	0.36 9	0.44 7	0.40 3	0.41 1	0.39 4	0.43 9	0.49 3	0.40 8	0.41 6	0.83 3
Al Salam	0.33 7	0.33 9	0.30 1	0.31 1	0.29 8	0.37 3	0.30 1	0.36 7	0.32 1	0.39 6	0.32 7	0.33 9	0.33 4	0.66 8
Al Intisar	0.35 9	0.37 7	0.30 6	0.33 2	0.31 3	0.31 3	0.31 3	0.35 7	0.33 1	0.38 2	0.32 1	0.32 7	0.33 6	0.67 2



Al Wahda	0.50 8	0.47 8	0.62 2	0.50 2	0.58 2	0.49 8	0.62 6	0.50 3	0.64 8	0.48 5	0.62 2	0.52 5	0.55 0	1.10 0
Al Mithaq	0.49 3	0.51 3	0.42 7	0.47 5	0.41 3	0.53 3	0.43 5	0.55 8	0.44 6	0.54 3	0.39 2	0.54 3	0.48 1	0.96 2
Al Karama+ Al Quds	0.41 4	0.40 2	0.47 8	0.45 9	0.41 4	0.40 9	0.43 6	0.42 8	0.41 4	0.46 3	0.50 6	0.41 4	0.43 6	0.87 3
Al Khadra+ Aden	0.48	0.39 2	0.40 5	0.36 1	0.45 7	0.34 5	0.52 3	0.44 3	0.56 3	0.43 5	0.44 8	0.38 6	0.43 7	0.87 3
Al Samah	0.49 5	0.38 3	0.42 8	0.40 9	0.43 5	0.38 1	0.45 5	0.39 9	0.46 8	0.41 9	0.34 8	0.39 6	0.41 8	0.83 6
Al Bakr+ Al Akha	0.53 2	0.58 5	0.49 8	0.52 3	0.55 8	0.58 8	0.58 6	0.56 5	0.51 8	0.54 8	0.50 6	0.50 5	0.54 3	1.08 5
Saddam	0.41 3	0.45 3	0.34 2	0.36 8	0.37 8	0.50 3	0.37 3	0.49 7	0.39 7	0.44 3	0.34 7	0.41 5	0.41 1	0.82 2
Al Alma+30- Tammuz	0.35 9	0.42 5	0.35 9	0.35 4	0.34 1	0.35 3	0.35 9	0.37 2	0.33 2	0.33 8	0.31 7	0.32 8	0.35 3	0.70 6
Al Qahirah+ Al Aman	0.46 6	0.36 9	0.42 2	0.35 4	0.46 6	0.35 6	0.48 2	0.39 6	0.45 4	0.37 1	0.41 3	0.36 3	0.40 9	0.81 9
Al Zohour + Al Qadisiyah	0.65 5	0.54 1	0.59 8	0.45 3	0.57 2	0.45 5	0.59	0.51 9	0.63 8	0.55 1	0.63 8	0.53 4	0.56 2	1.12 4
Al Tahrir+ Al Muharibee n	0.44 7	0.58 3	0.44 9	0.63	0.39 7	0.67 7	0.42 3	0.64 3	0.43 1	0.61 3	0.42 3	0.61 7	0.52 8	1.05 6
Al Rafak+ Al Muthanna	0.52 6	0.57 7	0.55 8	0.57 7	0.50 4	0.51 2	0.55 2	0.55 8	0.56 4	0.54 7	0.60 6	0.63 3	0.56 0	1.11 9
Al Bareed	0.55 5	0.65 5	0.52 6	0.63	0.48 1	0.57 5	0.57 8	0.62 5	0.49 6	0.60 5	0.59 5	0.65 7	0.58 2	1.16 3
Al Sukkar+ Al Siddiq	0.48 3	0.64 3	0.46 9	0.59	0.41 4	0.58 3	0.50 7	0.65 3	0.47 1	0.59 7	0.47 3	0.66 3	0.54 6	1.09 1
Al Baladiyat	0.57 7	0.52 8	0.62 3	0.59 8	0.53 2	0.48 3	0.55 8	0.50 9	0.60 2	0.53 2	0.70 3	0.59 8	0.57 0	1.14 1
Al Hadba	0.60 6	0.64 8	0.69 8	0.60 8	0.58 8	0.57 7	0.62 2	0.59 2	0.63 8	0.61 3	0.66 8	0.65 8	0.62 6	1.25 3
Al Kafaat+ Al Kindi	0.65 3	0.49 6	0.62	0.51 1	0.59	0.57 4	0.61 3	0.52 3	0.63 7	0.53 1	0.65 3	0.58 3	0.58 2	1.16 4
Al Arab	0.61 3	0.54 8	0.55 8	0.48 2	0.48 7	0.62 3	0.51 4	0.66 8	0.54 4	0.62 5	0.59 2	0.55 8	0.56 8	1.13 5
													<b>0.4 91</b>	<b>0.9 82</b>



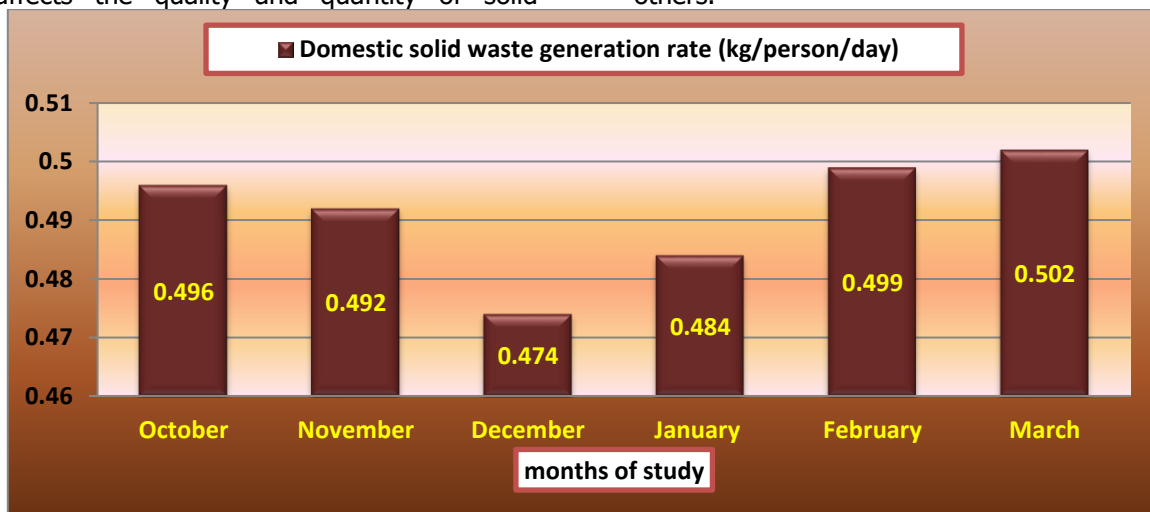


**Figure No. (3) Average daily production of residential solid waste (kg/person) in most areas on the left side of the city of Mosul**

**The effect of the monthly variation in the rate of household solid waste production**

As it is known, the weather and climate have an impact on the rate of waste production, and Figure (4) shows this change during the months of the study, as a discrepancy is noted in the rate of household solid waste production during the study period, Climate change affects the quality and quantity of solid

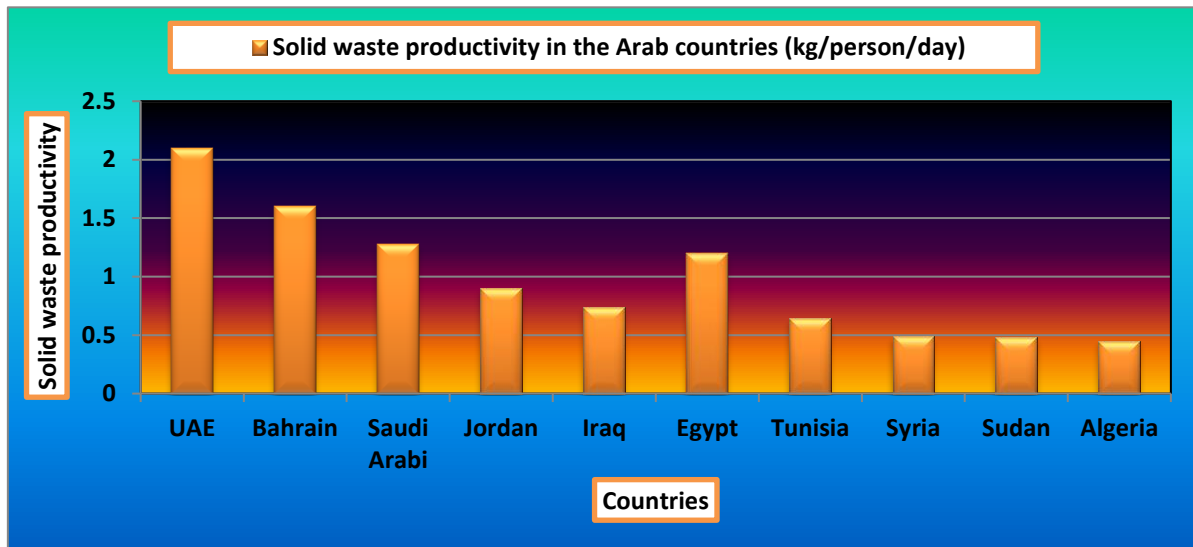
materials consumed by the individual. The obtained results show that the highest rate of household waste production is in the month of October, and then begins to decrease slightly, after which it begins to increase. This is due to the decrease in the consumption of vegetables and fruits compared to the summer. The reason for this is the consumption of dry food and others.



**Figure No. (4) Monthly variation in the rate of residential solid waste production**

**Table No. (2) Estimates of the rate of solid waste generation according to studies conducted on the city of Mosul for the previous years**

Estimation of household solid waste (according to)	Residential production rate (kg/person/day)	Total production rate (kg/person/day)
[11]	0.39	0.78
[12]	0.32	0.60
[3]	0.496	0.992



**Figure No. (5) Productivity per capita of solid waste in the Arab countries.** [13]

Table (3) shows the waste dumps scattered randomly within residential neighborhoods and their dangerous environmental and health impacts, the most important of which is the increase in global warming as a result of the rise of fumes and gases, whether from the anaerobic decomposition process or from the combustion process. As well as its impact on sewage

blockage, which causes floods, especially in the winter season. And its impact on soil and groundwater pollution, in addition to its health effects by providing a suitable environment for the spread of rodents, insects and germs, and ultimately affecting the general appearance of the residential neighborhood.

**Table No. (3) Landfill sites within the residential neighborhoods of the left side of the city of Mosul and its area**

ID	Residential areas	The minimum number of landfills inside the neighborhood	The minimum area of landfills within the neighborhood in units (m <sup>2</sup> )	Coordinates of some landfill sites		Are there containers inside the neighborhood
				Lat	Long	
1	Al Andalus	5	155	36.381657	43.129533	Yes
2	Al Shurta	6	73	36.377718	43.136424	Yes
3	Al Mohandeseen	8	276	36.363585	43.138336	Yes
4	Al Faisaliah	3	58	36.350844	43.146962	Yes
5	Al Ba'ath	5	106	36.337313	43.166996	Yes
6	Al Dubbat	0	0	0	0	Yes
7	Al Mazra'a	6	694	36.315027	43.184441	a small percentage
8	Domiz	3	145	36.30931	43.202806	Yes
9	Sumer	7	1240	36.301659	43.198984	a small percentage
10	Al Shema	6	650	36.307295	43.206781	Yes



<b>11</b>	Yaramjah	<b>8</b>	<b>886</b>	36.300819	43.18672 1	a	small percentage
<b>12</b>	Al Salam	<b>21</b>	<b>2465</b>	36.291612	43.20020 4	a	small percentage
<b>13</b>	Jdeideh Al Mufti	<b>17</b>	<b>1293</b>	36.311604	43.21570 7	a	small percentage
<b>14</b>	Al Intisar	<b>20</b>	<b>2145</b>	36.327483	43.21805 7	a	small percentage
<b>15</b>	Al Mithaq	<b>9</b>	<b>571</b>	36.332735	43.20203 9	a	small percentage
<b>16</b>	Al Wahda	<b>14</b>	<b>1096</b>	36.317622	43.20189 7		Yes
<b>17</b>	Al Karama	<b>20</b>	<b>1521</b>	36.347389	43.22349 1	a	small percentage
<b>18</b>	Al Walid	<b>7</b>	<b>540</b>	36.336675	43.21048 8	a	small percentage
<b>19</b>	Al Quds	<b>8</b>	<b>1040</b>	36.348532	43.22721 9	a	small percentage
<b>20</b>	Al Millions	<b>5</b>	<b>210</b>	36.36025	43.23101 7		No
<b>21</b>	Al Khadra	<b>15</b>	<b>802</b>	36.356706	43.22657 6	a	small percentage
<b>22</b>	Aden	<b>8</b>	<b>368</b>	36.360766	43.21320 2		Yes
<b>23</b>	Al Akha	<b>6</b>	<b>135</b>	36.354276	43.20917 9		Yes
<b>24</b>	Al Samah	<b>11</b>	<b>750</b>	36.366674	43.21569 4	a	small percentage
<b>25</b>	Al Alma	<b>8</b>	<b>930</b>	36.37307	43.21094 6		No
<b>26</b>	30-Tammuz	<b>6</b>	<b>430</b>	36.379388	43.21152	a	small percentage
<b>27</b>	Saddam	<b>16</b>	<b>2155</b>	36.388203	43.21468 3	a	small percentage
<b>28</b>	Al Tahrir	<b>9</b>	<b>1215</b>	36.391101	43.20402 9	a	small percentage
<b>29</b>	Al Qahirah	<b>5</b>	<b>340</b>	36.40104	43.18979 7		Yes
<b>30</b>	Al Muharibeen	<b>4</b>	<b>210</b>	36.384359	43.19320 1		Yes
<b>31</b>	Al Aman	<b>5</b>	<b>118</b>	36.391607	43.18734 6		Yes
<b>32</b>	Al Bakr	<b>9</b>	<b>480</b>	36.36159	43.20353 3		Yes
<b>33</b>	Al Muroor	<b>5</b>	<b>175</b>	36.37537	43.20547 2		Yes
<b>34</b>	Al Zohour + Al Masarerf	<b>6</b>	<b>159</b>	36.377725	43.18344 8		Yes
<b>35</b>	Al Qadisiyah + Al Mishraq	<b>4</b>	<b>290</b>	36.372807	43.18711 5		Yes
<b>36</b>	Al Noor	<b>5</b>	<b>248</b>	36.364505	43.18686		Yes
<b>37</b>	Al-Alam	<b>9</b>	<b>534</b>	36.357764	43.19529		Yes

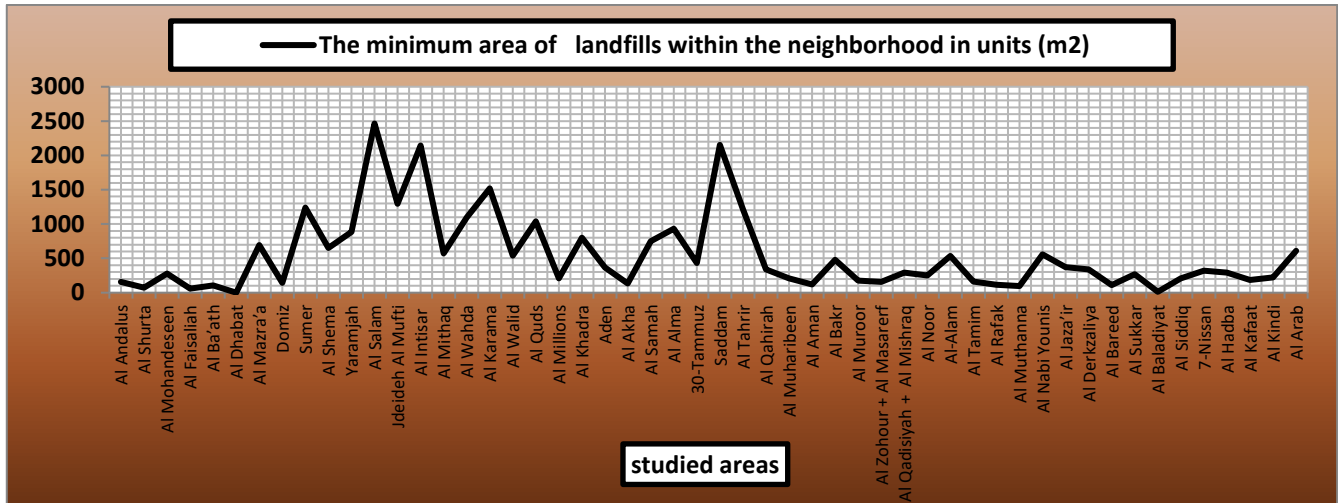




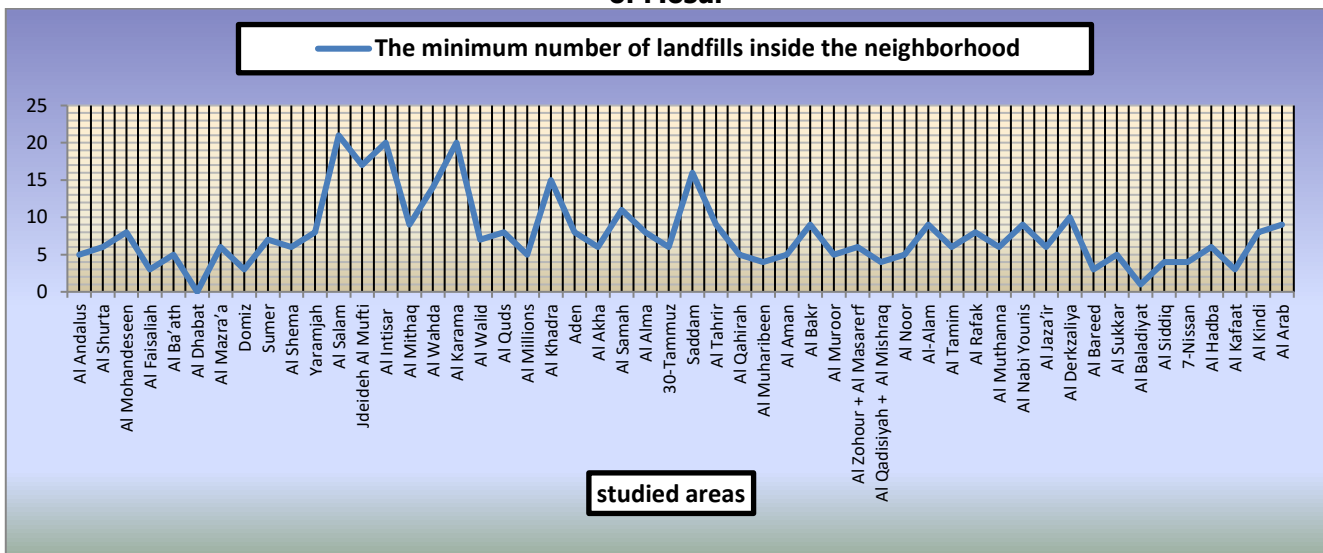
<b>38</b>	Al Tamim	<b>6</b>	<b>162</b>	36.352472	43.186608	Yes
<b>39</b>	Al Rafak	<b>8</b>	<b>115</b>	36.377312	43.168801	Yes
<b>40</b>	Al Muthanna	<b>6</b>	<b>97</b>	36.370296	43.17107	Yes
<b>41</b>	Al Nabi Younis	<b>9</b>	<b>560</b>	36.347274	43.168769	Yes
<b>42</b>	Al Jaza'ir	<b>6</b>	<b>372</b>	36.355271	43.172808	Yes
<b>43</b>	Al Derkzaliya	<b>10</b>	<b>337</b>	36.356315	43.156911	Yes
<b>44</b>	Al Bareed	<b>3</b>	<b>110</b>	36.393548	43.184036	Yes
<b>45</b>	Al Sukkar	<b>5</b>	<b>270</b>	36.388829	43.164727	Yes
<b>46</b>	Al Baladiyat	<b>1</b>	<b>14</b>	36.382641	43.166647	Yes
<b>47</b>	Al Siddiq	<b>4</b>	<b>210</b>	36.387471	43.153217	Yes
<b>48</b>	7-Nissan	<b>4</b>	<b>318</b>	36.401525	43.164823	Yes
<b>49</b>	Al Hadba	<b>6</b>	<b>293</b>	36.395552	43.149116	Yes
<b>50</b>	Al Kafaat	<b>3</b>	<b>185</b>	36.3969	43.144455	Yes
<b>51</b>	Al Kindi	<b>8</b>	<b>221</b>	36.401374	43.143111	Yes
<b>52</b>	Al Arab	<b>9</b>	<b>609</b>	36.41172	43.112652	Yes
<b>Total</b>		More than 379 landfills	More than 28376m <sup>2</sup>			

Where the (Al Salam) neighborhood contained the largest number of landfills and a wide spread of landfills, which occupy an area of about 2456 m<sup>2</sup> and with more than 21 landfills, followed by the neighborhoods of (Al-Intisar and Saddam), which occupy an area of more than 2000 m<sup>2</sup>, with more than 15 landfills for each neighborhood. These neighborhoods suffer from the lack of services and the lack of containers for waste. The rest of the neighborhoods contain dumpsites ranging in number

from 1 to more than 13 square meters for each neighborhood, which occupy an area ranging from 14 m to more than 900m<sup>2</sup> for each district., as for the neighborhoods of (Al-Dubbat - Al-Muthanna - Al-Baladiyat) they are characterized by the absence of random landfills inside them, as there is a container (barrel) in front of each house, and thus they use the direct transport system of waste from the house to the final or middle landfill, and the two figures (6) and (7) show the area and numbers of random dumps.



**Figure No. (6) The area of random dumps inside residential neighborhoods on the left side of the city of Mosul**



**Figure No. (7) Number of random dumps inside residential neighborhoods on the right side of the city of Mosul**

## 5. CONCLUSION

1- Most of the neighborhoods of the city of Mosul use iron drums with a capacity of (200 liters) instead of containers in storing household solid waste, and this does not meet the environmental and health requirements regarding waste storage containers, and it also increases the time required to complete the collection process. It is also exposed and does not have a cover, and this provides an environment for the reproduction of rodents and insects and the emission of gases and unpleasant odors. This in turn leads to the formation of sharp edges that may injure the collectors and others, in addition to eroding the base of the barrel and leaking liquids from it on the

sidewalk. Also, the process of collecting solid waste is tiring and takes longer when using these drums due to the weight of the drums themselves 2- The lack of containers in most of the city's neighborhoods, whether stationary containers (SC) or transported containers (Hauled Containers (HC), which led to the accumulation of waste in the form of random dumps inside residential neighborhoods

3- The use of large containers (transported containers) inside residential neighborhoods leads to the accumulation of waste around the container, due to the lack of commitment by most citizens to throw waste inside the containers 4- The study estimated that the necessary number of compressor cars to



provide the service of collecting household solid waste only generated on the left side of the city of Mosul is (156) cars (large compactors with a capacity of 5 tons) or (312) large compactors with a capacity of (2.5 tons) And a work crew of (624 people), including (156 drivers and 468 collection workers) in the event of collection, once a day.

## 6. RECOMMENDATIONS

1- It is preferable to use the Stationary Containers System (SCS) in residential neighborhoods because the dwellings are separate dwellings and thus the collection process is highly productive.

2- The horizontal expansion witnessed by the city leads to depriving some dwellings of the service of removing the waste generated when using the movable container system; Some citizens who are far from the container are forced to throw their waste in any location near their homes or dispose of the waste by burning it, which leads to environmental problems.

3- Activating the direct transport system of waste from the source to the landfill .

4- Work to raise the level of environmental awareness for both residents, workers and local bodies.

5- Work to create a development plan for solid waste management that takes into account the future population increase that will occur in the population.

6- Increasing the number of solid waste management elements, including workers, containers, compactor trucks, and street sweepers.

## REFERENCES

1. Keeler E. Environmental Geology, Translated University Books Series (Basic Sciences), Obeikan Library for Printing and Publishing, Riyadh, Saudi Arabia. 2014:519.
2. Patricia E U and Angela N N. Solid Waste Recycling in Anambra State: negotiations for media Enlightenment. Global Journal of Applied, Management and Social Sciences (GOJAMSS). 2020; 18.
3. Bernache-Perez G, Sánchez-Colón S, Garmendia A M, et al. Solid waste characterization study in Guadalajara Metropolitan Zone, Mexico. Waste Management and Research. 2001; 19: 413-424.
4. Hamad A T and Suleiman F A. Determination of the Composition and Generation Rates of Residential Solid Wastes in Mosul City. Tikrit

Journal of Engineering Sciences. 2016; 23(4): 103-108.

5. Hickman H J. Principles Of Integrated Solid Waste Management. In American Academy of Environmental Engineers USA .1999: 660.
6. Rushbrook P and Pugh M. Solid Waste Landfills in Middle- and Lower-Income Countries. A Technical Guide to Planning, Design, and Operation, The International Bank for Reconstruction and Development. 1999.
7. UNOPS. Enhancement of Solid Waste Management Capacity and Facilities in Mosul City. Amman, Jordan. 2007: 37.
8. Al-Tayyar T. Characteristics of Plastic Solid Wastes in Mosul City and Their Reuse. Earth and Environmental Science. 2022.
9. Republic of Iraq, Ministry of Planning, Central Statistical Organization, Nineveh Statistics Directorate, unpublished data. 2021.
10. Republic of Iraq, Ministry of Planning, Central Statistical Organization, Nineveh Statistics Directorate, unpublished data. 2020.
11. UNEP. Desk study on the Environment in Iraq Kenya. 2003: 96.
12. Al-Rawi S M. Selection, Design, and Management of Landfill Site(s) for Mosul City ASTF. 2007: 246.
13. Asfari A and Al-Mashaan M. Solid Waste Management in Some Arab Countries Publications of the Kuwait National Library for Publishing under the supervision of the Kuwait Society for Environmental Protection. 2002 : 216.