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Original Article

Investigation of Environmental Pollution in Residential Areas From Littered Wastes

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Abstract
Background: The problem of waste littering in urban areas is a widespread issue in most cities and represents a significant challenge in waste management. Hence, this study aimed to assess the level of environmental pollution in urban areas in terms of litter density.
Methods: The quantity of littered wastes (LWs) was examined across six residential areas, with observations and waste counting conducted over a two-month period on both working days and weekends. The LWs were categorized into four groups, and their on-site density was calculated.
Results: The results indicated that the average waste density in the locations studied was 5.08 number/m^2. The lowest recorded LW number was 19.49 number/100 m, while the highest was 30.49 number/100 m. The categories of plastic and tobacco wastes comprised 13.25% and 82.64% of the total LWs, respectively. On average, 0.71 number/100 m of paper were observed in the areas studied, accounting for 2.8% of the total LWs. The presence of suitable waste bins in the areas surveyed underscores the significant influence of individual behavior on urban pollution.
Conclusion: Therefore, there is a pressing need to raise awareness among citizens regarding the consequences of littering and to implement more effective urban cleanup methods.
Keywords: Cleanup efficiency, Waste management, Urban pollution

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Introduction
The growth of urban areas and the higher concentration of people have led to a rise in the generation of municipal solid waste.[1] Solid waste poses health and environmental risks, including soil and water contamination, along with the potential for spreading infectious diseases.[2] Waste management systems are established with the aim of mitigating these outcomes through actions such as waste collection, recycling, and proper disposal. Additionally, addressing pollution generated by landfill leachate and incinerator emissions, which are by-products of waste management, is a key focus within waste management priorities.[3,4] The initial step in municipal solid waste management involves efficient collection, which necessitates the collaboration of residents in appropriately disposing of solid waste into storage containers.[5] Nonetheless, some of the solid wastes are not disposed of correctly by citizens and end up being scattered or littered on city streets. To address this issue, various cities have established urban cleanup systems designed to collect these littered wastes (LWs) from urban environments.[6-8] LWs in urban environments represent a category of solid waste items that are discarded improperly by urban residents on city streets. These LWs have the potential to release various pollutants, including heavy metals and polycyclic aromatic hydrocarbons (PAHs), into the environment.[9] Numerous studies have been conducted in cities across Spain, Argentina, and Iran have affirmed the presence of LWs in urban environments.[10] As a result, the prevalence of LWs in urban areas is a widespread phenomenon observed in various cities. LWs in urban settings can even lead to economic implications and impact the selection of tourist destinations.[10] Among the LWs in urban areas, the most significant contributor is cigarette butts. These butts contain numerous chemicals resulting from the trapping of cigarette smoke pollutants in the filter.[9] These wastes are sources pollution emissions, particularly when exposed to rainy conditions and influenced by humidity. For instance,

the leaching of nicotine from discarded cigarette butts into water sources is a significant cause for concern.[11] Plastic items like candy wrappers, disposable spoons, and bottle caps represent other noteworthy categories of LWs in urban environments. These items have been highlighted in numerous studies as some of the most prevalent forms of LWs.[12] The primary determinant of LWs in public areas is the behavior of citizens. In some instances, despite the presence of an adequate number of trash bins at suitable intervals, LWs have still been observed on the streets.[10]

In this study, one of the cities of Iran was evaluated in terms of the quality and density of LWs. The objective of this study was to investigate the level of pollution in residential areas and it was tried to identify the high potential locations of LWs. One of the aims of this study was to determine the proportion of LWs components in residential areas. Also, determining the difference in the number and density of LWs on working days and holidays was one of the aims of this study.

Methods

This study was conducted through direct observation of LWs in residential areas of Ilam, Iran, during two distinct periods, encompassing both weekdays and weekends.[12] The observation process covered six streets, with a comprehensive examination of both sides of each street to tally the LWs.[10] The characteristics of each of the six investigated locations have been listed in Table 1. For the street assessments, the final hour of the day was selected to minimize potential interference with the urban cleanup system's activities and its potential influence on the quantity and density of LWs.[13] These LWs were categorized into four groups: paper, plastic, tobacco waste, and other waste, as these have been identified in numerous studies as the most significant components of LWs.[13,14] The density of abandoned wastes was calculated based on Equation 1 by dividing the number of the observed wastes in the area studied.[13]

$$\text{LWs density} = \frac{Number}{(lenght \times width)} \quad (1)$$

The study focused on areas with the greatest quantity and concentration of LWs to identify patterns that could help pinpoint locations with a high likelihood of LW presence. To minimize the influence of environmental factors such as humidity and pollution, this research exclusively involved LW counting, while measurements involving weighing and weight ratios were omittee.[12]

Table 1. Characteristics of Locations Studied

	Land-Use	Study Length	High-Potential Points	Low Access Point
L1	Residential	800	Supermarket	Tree pit, runoff canal
L2	Residential	500	Supermarket, ATM	Tree pit, runoff canal
L3	Residential	950	Supermarket, ATM	Runoff canal
L4	Residential	700	Supermarket	Runoff canal
L5	Residential	700	Supermarket, ATM	Tree pit, runoff canal
L6	Residential	600	Supermarket	Tree pit, runoff canal

Results and Discussion

The findings indicated that the streets under investigation had a range of 19.49 to 30.49 LWs per 100 m. Consequently, the average LW count in the areas studied amounted to 25.37 per 100 m. As shown in Table 2, the greatest LW density was detected in location L2 at a rate of 6.77 number/m^2, whereas the lowest LW density was recorded in L3, amounting to 3.47 number/m^2. These results showed that the average LWs density in this study was found to be 5.08 number/m^2. In the highly polluted area, the count of LWs exceeded that in the less polluted area by 56.4%. Furthermore, the density of LWs in the highly polluted location was twice as high as in the less polluted location. The difference in the number of LWs in the areas studied was not noticeable during weekends in comparison to weekdays; on average, the LW density was lower on weekends than on working days. Across all investigated locations, fewer LWs were observed during weekends compared to weekdays.

As shown in Figure 1, tobacco waste was the most observed LWs in the residential areas studied, which included an average of 82 % of the total counted LWs, while plastic and paper consisted of 13.2 and 2.8% of the counted LWs, respectively. However, the distribution of LW types across the examined locations did not follow a uniform pattern, as illustrated in Figure 2. Notably, the highest density of tobacco waste was observed in L2, amounting to 25.1 number/ m^2, representing a 50% increase compared to L4, which exhibited the lowest tobacco waste density. Additionally, the most significant quantities of paper and plastic were found in L2 and L3, measuring 0.9 and 4.1 number/100 m, respectively. Conversely, the lowest amounts of paper and plastic were detected in L4 and L3, respectively. Overall, the average densities of plastic, paper, tobacco waste, and other waste types across the examined locations were 3.3, 0.7, 20.9, and 0.3 number/m^2, respectively.

The results of this study demonstrated that the pollution caused by LWs was evident in the residential areas investigated. These data corresponded with the results presented by Seco Pon and Becherucci, performed in one of the Argentinean cities[15]; they reported plastic constituted 22% of LWs, while in our study, plastic constituted an average of 13.2% of the LWs. Also, on

Table 2. Observed LWs in the locations studied (number/100 m)

	Littered Plastic	Littered Paper	Tobacco Waste	Other Wastes
L1	3.8	0.7	23.3	0.41
L2	4.1	0.9	25.1	0.39
L3	2.5	0.9	17.2	0.22
L4	2.9	0.3	16.1	0.19
L5	3.3	0.8	21.4	0.45
L6	3.6	0.7	22.6	0.36

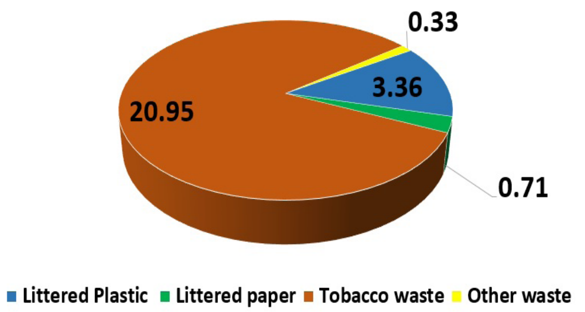

Figure 1. Average of Littered Wastes Categories in the Locations Studied (number/100 m)

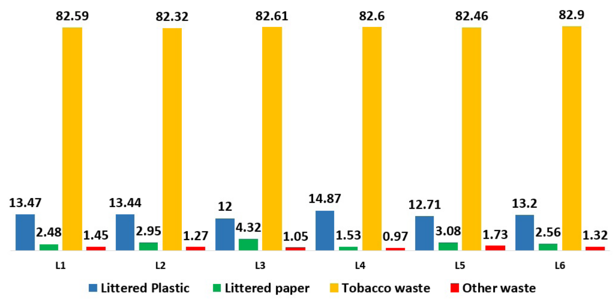

Figure 2. Littered Wastes Composition in Different Locations Studied (%)

average, in the residential areas investigated, the ratio of littered paper was 31% of the LWs, while Seco Pon and Becherucci, reported that it was 31%.[15] One reason for the difference in the LWs ratio in this study with other studies is the land use of the areas investigated. Seco Pon and Becherucci investigated four land uses, including commercial, residential, industrial, and seaside resort, while in our study, only a residential area was investigated. The effect of land use on the number and density of LWs has been confirmed in other studies. The observations reported by Gholami et al, who studied the LWs in one of the cities of Iran, showed that the number and composition of LWs in different land uses were not the same [12]. In the residential areas studied by Gholami et al, tobacco waste had the largest ratio on the composition of LWs, which is consistent with our findings in the six residential areas studied. But the reported ratio of tobacco waste by Gholami et al was 83%, which is different with results of that obtained in our study.[12] When comparing the findings of this study to those reported by Gholami et al, it becomes evident that there exists spatial variation in LWs. This discrepancy is notable because, despite examining two areas with identical land use, the number and density of LWs differ across various cities within the same country.

One significant factor contributing to the spatial variation in the number and density of LWs in different urban areas, even in areas with similar land use in different cities, is population density.[13] Given that the quantity of LWs is closely linked to citizens' littering behavior, areas with a higher population density are more likely to experience improper waste disposal by a greater number of individuals. This phenomenon is supported by observations in various studies. For instance, significant disparities in cigarette butt density have been documented in different areas of Berlin.[11] Conversely, difference in the effectiveness of the cleanup system can also contribute to variations in the quantity and density of LWs within urban environments, as noted in the study on discarded cigarette butts in Madrid.[16] But as reported by Gholami et al, due to the same quality of the cleanup system in the parts of the city, which is observed in most cities of Iran, this reason cannot justify the difference in the number and density of the LWs in our study.[12] It should be noted that a clear reason for the difference in the number and density of the LWs in the residential areas investigated is the difference in the presence of high potential LWs points. Apparently, places such as around stores and supermarkets, around fast food centers, and around ATM locations have a high potential for littering.[13] In our study, supermarket and ATM locations were more observed, and LWs were observed in these areas up to three times more than in other areas. Additionally, areas like tree pits and open runoff collection channels are conducive to waste accumulation and the proliferation of litter and debris due to their limited accessibility for cleaning.[12,13] In this study, more than 60% of the number and density of LWs were counted in these places.

LWs bring negative consequences to urban areas, with undesirable landscapes being one of the most conspicuous impacts.[17] Furthermore, LWs can negatively impact the local economy, particularly in tourist destinations, as one of the criteria for selecting tourism spots is the overall cleanliness and healthiness, which can be compromised when LWs are prevalent.[10] Moreover, the transfer of pollutants from LWs to the environment, along with the potential for disease transmission to residents, are additional repercussions of LWs in urban settings. Recent studies have revealed that during the COVID-19 pandemic, a substantial number of disposable face masks and gloves were discarded as litter by individuals in public and urban areas.[18] In our study, we specifically assessed the plastic category of LWs, which included disposable face masks and gloves. The presence of these items within LWs raises concerns about the potential transmission of infectious diseases to individuals involved in cleanup efforts, as well as to those engaged in high-risk activities such as waste picking. This situation heightens the overall risk of disease transmission stemming from solid waste.[19] Furthermore, our study identified facial tissue within the composition of LWs as potentially infectious waste, and it was categorized under paper waste. These LWs are considered hazardous owing to the potential presence of pathogens, leading them to carry a higher weight in the indices used to assess environmental conditions, highlighting their increased significance.[12,13] The release of pollutants from certain types of LWs into the environment is a significant cause for concern. Some littered plastics, particularly face masks, contribute to the introduction of microplastics into the environment, representing one of the sources of this environmental issue.[20] Microplastics have the potential to enter into water and soil sources as a result of the breakdown of littered plastics, ultimately infiltrating the food chain. This phenomenon has recently emerged as a notable health threat.[21] Additionally, cigarette butts, which were found to be the most prevalent form of LWs in our study and in numerous similar studies, serve as a source of heavy metal emissions, including chromium, cadmium, lead, mercury, and nickel.[9] Furthermore, cigarette butts contain other harmful toxins like nicotine and cyanide, which are known pollutants that can contaminate water sources and the environment. It has been documented that the nicotine from a single cigarette butt is sufficient to pollute ten liters of water.[11] One limitation of this study was its focus on a single land-use type, neglecting other land-uses like commercial and recreational areas. Nonetheless, the study's strengths included examining the chosen land-use on both working days and weekends and the careful consideration of high-potential areas within that land-use.

Conclusion

The investigation concentrated on residential areas to assess the quantity and composition of LWs. The findings revealed that cigarette butts, categorized as tobacco waste, constituted the largest portion of LW in these areas, accounting for 82.6% of the total. Plastic waste and paper waste made up an average of 13.2 and 2.8% of the observed LW, respectively. The waste density within the surveyed residential areas ranged from 3.4 to 6.7 number/m^2, with an average of 5.08 items per square meter. Notably, high-potential areas like those around supermarkets exhibited three times the LW compared to other locations, and a majority of these wastes were found in low-access areas, such as tree pits. Given the health and environmental significance of LW, including the risk of infectious disease transmission to waste management personnel and the release of various pollutants like heavy metals and microplastics, it is imperative to develop strategies for managing this type of waste. Additionally, there is a critical need to enhance public education regarding the consequences of improper waste disposal and littering to encourage responsible waste disposal practices and prevent littering.

Authors' Contribution

Conceptualization: Najme Masihi, Maryam Zare Bidoki, Farogh Kazembeigi.
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Project administration: Farogh Kazembeigi.
Resources: Najme Masihi.
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Supervision: Farogh Kazembeigi.
Validation: Najme Masihi.
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Writing–review & editing: Maryam Zare Bidoki, Najme Masihi, Marziye Moradgholi, Farogh Kazembeigi.

Competing Interests

The authors of this article declare that they have no conflict of interests.

References

1. Ogbonna DN, Amangabara GT, Ekere TO. Urban solid waste generation in Port Harcourt metropolis and its implications for waste management. Manag Environ Qual. 2007;18(1):71-88. doi: 10.1108/14777830710717730.
2. Kapelewska J, Kotowska U, Karpińska J, Astel A, Zieliński P, Suchta J, et al. Water pollution indicators and chemometric expertise for the assessment of the impact of municipal solid waste landfills on groundwater located in their area. Chem Eng J. 2019;359:790-800. doi: 10.1016/j.cej.2018.11.137.
3. Lin X, Ma Y, Chen Z, Li X, Lu S, Yan J. Effect of different air pollution control devices on the gas/solid-phase distribution of PCDD/F in a full-scale municipal solid waste incinerator. Environ Pollut. 2020;265(Pt B):114888. doi: 10.1016/j.envpol.2020.114888.
4. Kamaruddin MA, Yusoff MS, Rui LM, Isa AM, Zawawi MH, Alrozi R. An overview of municipal solid waste management and landfill leachate treatment: Malaysia and Asian perspectives. Environ Sci Pollut Res Int. 2017;24(35):26988-7020. doi: 10.1007/s11356-017-0303-9.
5. Nemerow NL, Agardy FJ, Sullivan PJ, Salvato JA. Environmental Engineering: Environmental Health and Safety for Municipal Infrastructure, Land Use and Planning, and Industry. John Wiley & Sons; 2009.
6. Silva-Cavalcanti JS, de Araújo MC, da Costa MF. Plastic litter on an urban beach---a case study in Brazil. Waste Manag Res. 2009;27(1):93-7. doi: 10.1177/0734242x08088705.
7. Yousefi M, Kermani M, Farzadkia M, Godini K, Torkashvand J. Challenges on the recycling of cigarette butts. Environ Sci Pollut Res Int. 2021;28(24):30452-8. doi: 10.1007/s11356-021-14058-3.
8. Yousefi M, Oskoei V, Jonidi Jafari A, Farzadkia M, Hasham Firooz M, Abdollahinejad B, et al. Municipal solid waste management during COVID-19 pandemic: effects and repercussions. Environ Sci Pollut Res Int. 2021;28(25):32200-9. doi: 10.1007/s11356-021-14214-9.
9. Torkashvand J, Farzadkia M, Sobhi HR, Esrafili A. Littered cigarette butt as a well-known hazardous waste: a comprehensive systematic review. J Hazard Mater. 2020;383:121242. doi: 10.1016/j.jhazmat.2019.121242.
10. Jonidi Jafari A, Latifi P, Kazemi Z, Kazemi Z, Morovati M, Farzadkia M, et al. Development a new index for littered waste assessment in different environments: a study on coastal and urban areas of northern Iran (Caspian Sea). Mar Pollut Bull. 2021;171:112684. doi: 10.1016/j.marpolbul.2021.112684.
11. Roder Green AL, Putschew A, Nehls T. Littered cigarette butts as a source of nicotine in urban waters. J Hydrol. 2014;519(Pt D):3466-74. doi: 10.1016/j.jhydrol.2014.05.046.
12. Gholami M, Torkashvand J, Rezaei Kalantari R, Godini K, Jonidi Jafari A, Farzadkia M. Study of littered wastes in different urban land-uses: an 6 environmental status assessment. J Environ Health Sci Eng. 2020;18(2):915-24. doi: 10.1007/s40201-020-00515-7.
13. Farzadkia M, Alinejad N, Ghasemi A, Rezaei Kalantary

R, Esrafili A, Torkashvand J. Clean environment index: a new approach for litter assessment. Waste Manag Res. 2023;41(2):368-75. doi: 10.1177/0734242x221117093.

14. Ong IBL, Sovacool BK. A comparative study of littering and waste in Singapore and Japan. Resour Conserv Recycl. 2012;61:35-42. doi: 10.1016/j.resconrec.2011.12.008.
15. Seco Pon JP, Becherucci ME. Spatial and temporal variations of urban litter in Mar del Plata, the major coastal city of Argentina. Waste Manag. 2012;32(2):343-8. doi: 10.1016/j.wasman.2011.10.012.
16. Valiente R, Escobar F, Pearce J, Bilal U, Franco M, Sureda X. Estimating and mapping cigarette butt littering in urban environments: a GIS approach. Environ Res. 2020;183:109142. doi: 10.1016/j.envres.2020.109142.
17. Araújo MCB, Costa MF. A critical review of the issue of cigarette butt pollution in coastal environments. Environ Res. 2019;172:137-49. doi: 10.1016/j.envres.2019.02.005.
18. Aragaw TA. Surgical face masks as a potential source for microplastic pollution in the COVID-19 scenario. Mar Pollut Bull. 2020;159:111517. doi: 10.1016/j.marpolbul.2020.111517.
19. Kazembeigi F, Ahmadinejad P, Aryaeefar MR, Ghasemi M, Hassani G, Kashi G. The impact of the COVID-19 pandemic on urban litter. Biomed Environ Sci. 2022;35(10):954-6. doi: 10.3967/bes2022.121.
20. Fadare OO, Okoffo ED. COVID-19 face masks: a potential source of microplastic fibers in the environment. Sci Total Environ. 2020;737:140279. doi: 10.1016/j.scitotenv.2020.140279.
21. Okeke ES, Okoye CO, Atakpa EO, Ita RE, Nyaruaba R, Mgbechidinma CL, et al. Microplastics in agroecosystems-impacts on ecosystem functions and food chain. Resour Conserv Recycl. 2022;177:105961. doi: 10.1016/j.resconrec.2021.105961.