

# Evaluation of Current Status of Household Solid Waste Management in Misrata City, Libya

Ibtisam Abdulsalam Albira<sup>1,2</sup>, Tengku Adeline Hamzah<sup>1</sup>, Safiah @ Yusmah Yusoff<sup>1</sup> and Nisfariza Mohd Noor<sup>1</sup>

<sup>1</sup> Department of Geography, Faculty of Art and Social Science, University Of Malaya, Kuala Lumpur, Malaysia

<sup>2</sup> Department of Geography, Faculty of Education, University of Misrata, Misrata, Libya

**Abstract:** Pollution via Household Solid Waste (HSW) remains a significant issue in Libya. The incompetence of the Public Company of Cleaning Services (PCCS) in managing HSW resulted in poor hygiene in the city due to the accumulation of waste in the public. Incinerating these wastes resulted in a polluted atmosphere due to the emission of greenhouse gases (GHG). These aforementioned factors prompted researchers to analyze the planning and development of waste management.

We personally observe Misrata, Libya, to determine the current situation and obtain relevant data. Questionnaires were distributed to 400 residents of the city to evaluate the current state of Household Solid Waste Management (HSWM). Interviews were held with the person-in-charge of HSWM in the city, such as the (PCCS) in Misrata. Photographs were taken to document the visits. The results confirmed that most residents are dissatisfied with the cleanliness and performance level in the city. The presence of illegal dump sites, burning HSW in housing areas, and the spread of HSW on the streets confirmed this. This confirms that there is an urgent need to improve (HSWM), and private companies should play a big role in decreasing the burden of (PCCS), thus increasing the level of cleanliness of the city.

**Keywords:** Household Solid Waste (HSW), Household Solid Waste Management (HSWM), Waste collection, Household Solid Waste evaluation.

## 1. Introduction

The management of solid waste is the responsibility of the local government, due to its intricate ties to the residents' health, the environment, and the preservation of natural resources [1]. The mismanagement of wastes could result in the inadvertent spread of disease and environmental degradation. This remains a global issue, due to the fact that people generate waste daily [2].

The fundamental of HSW management is to meet global needs, as per the solid waste management strategy (at state and local levels) in developing and optimizing its main elements [3]. The local governments are responsible for HSWM, however, many developing countries are unable to service large parts of its population, partly due to the rapid growth and expansion of its respective populations [2] [4], constantly shifting economies, and increased living standards alongside the lack of organization [5] [6] [7] [8]. Limited finance also curtailed waste management activities, due to the fact that waste management requiring expensive infrastructure and personnel [7] [9]. The municipal authorities in developing countries would require large capital investments in tandem with operational strategies in order to successfully collect, transport, and dispose of solid wastes [10] [7].

The management of household solid waste is multidisciplinary in nature, encompassing the generation, storage, collection, transportation, processing, and recovery and disposal [11]. One of the most important task in waste management is effectively collecting wastes from populated areas. Developing countries need to prioritize

waste collection and transport [12] [13]. However, increased demand for waste collection from the area tend to overwhelm the local authorities due to their limited resources. This necessitates the involvement of the private sector, and currently, the cooperation between the public and private sectors is commonplace in developing countries [2].

In Libya, waste management remains in its infancy. Improved living standards, as well as life changes, resulted in increased population and the aggravation of living standards in cities, such as Misrata [14]. Activities linked to HSWM (waste generation, collection, transportation, and disposal) are regarded as a major municipal problem in Misrata. This study focuses on HSW in Misrata, encompassing main and active solid waste generators. It is therefore imperative that we understand the perception in the context of storage, collection, transportation, disposal, and other matters linked to HSWM in Misrata. This work intends to elucidate the current status of HSWM in Misrata, and pinpoint the most significant challenges pertaining to HSWM in Misrata from the perspective of residents for use by policy makers and stakeholders towards enhancing HSWM.

## 2. Materials and methods

Misrata is located on the Mediterranean coast at longitudes  $14^{\circ} 36'$  and  $15^{\circ} 22'$  east, and between Latitudes  $31^{\circ} 33'$  and  $32^{\circ} 23'$  north (Fig 1). According to the Civil Status Authority, its population is ~400, 312 in 2014.

This study first began via personal observation, involving field visits to Misrata. The visits were made in October 2014 to elucidate the current situation and collected data from city sources. 400 questionnaires were distributed to the residents of Misrata for the purpose of evaluating the current state of HSWM from the perspective of the people, especially heads of households. The sample size of the questionnaire was calculated based on Krejcie and Morgan (1970) [15]. The personnel-in-charge of HSWM in Misrata (PCCS) were interviewed to gather information on waste collection, transportation, and disposal methods. Photographic evidence were collected to document these visits.

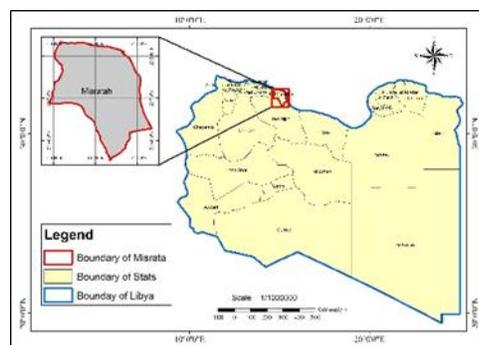


Fig. 1: Location of study area.

Source: Author

## 3. Results and discussion

### 3.1 Residence perception of the current status of HSWM in Misrata

#### 3.1.1. Satisfaction over the cleanliness level in Misrata

The data on the satisfaction level of the residents of Misrata were collected from the questionnaire and shown in Fig 2. It can be seen that 12.3% of the residents were completely dissatisfied, ~51.3% of the respondents were just dissatisfied, ~22.3% were neutral, ~12 % were satisfied, and 2.3% were very satisfied. [16] pointed out that in the case of implicit interpolation, a researcher needs to specify a value of 3.5 and above as a bar for a positive response. The mean value of satisfaction over the cleanliness in Misrata were (2.4075), which means that the majority of the respondents are dissatisfied with the cleanliness levels in Misrata.

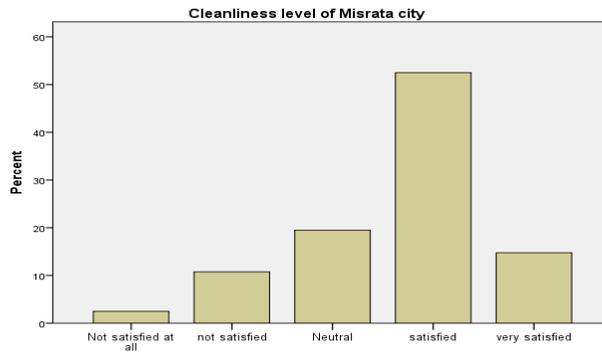


Fig.2: Satisfaction over the cleanliness level in Misrata city

### 3.1.2. Satisfaction over performance level of public cleaning offices

~7.8% of the residents reported not being satisfied at all with the services provided by the Public Company of Cleaning Services (PCCS), ~61.8% of respondents reported not being satisfied, ~18% reported being neutral, ~9.8% reported being satisfied with their services, and ~2.8% reported being very satisfied. Overall, the mean (2.3800) signifies that the majority of the respondents were dissatisfied with the performance and services provided by the PCCS (see Fig. 3).

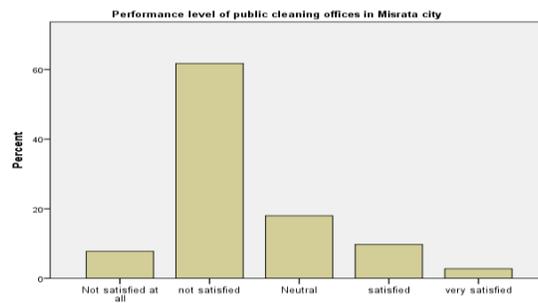


Fig. 3 Performance level of public cleaning offices in Misrata

### 3.1.3. HSW spread and accumulation

During the field trip to the residential area of Misrata, it can be seen that trash were placed on roadsides for collection due to the lack of solid waste litter bins and non-existent collection services. This resulted in the unnecessary accumulation of HSW, odors, and increased manifestation of insects and rodents (See Fig. 4).





Fig 4: Accumulation of HSW on the main roads

The respondents pinpointed several factors that resulted in the accumulation of garbage, such as the lack of containers, collection services, and interest (see Fig 5). ~38.50% of the respondents reported that the accumulation of garbage in neighborhoods and streets is caused by the lack of containers, ~27.75% believed that it is the lack of frequency collection by PCCS, ~23.75% believed that it is due to the lack of interest in the citizens due to them being unaware of the negative consequences of the spread of HSW, and ~10% believe that other factors resulted in the accumulation of wastes in the streets, such as;

- Irresponsible citizens, resulting in the spread of wastes in public.
- The lack of private companies to deal with this problem.
- The incompetence of the recycling industry, which is responsible for the collection of certain types of wastes such as plastics, aluminum, and other recyclables to help alleviate the problem.
- The absence of plans/programs for waste collection, such as proper organization and suitable number of mechanics/workers.
- The indifference of municipal authorities and the people.

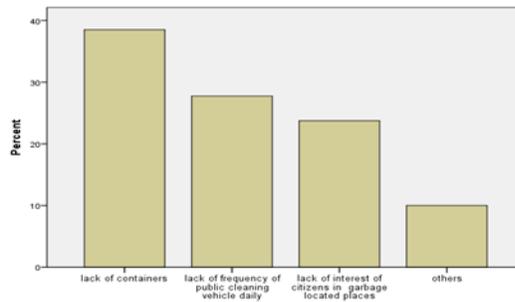


Fig.5: Reasons of HSW spread and accumulation in neighborhoods

### 3.1.4. The effects of HSW spread

The accumulation and mismanagement of waste can influence the environment at multiple scales. Public health is a primary concern, due to the accumulation of wastes attracting diseases vectors [17]. Fig (6) shows that improperly managed HSW pose a serious health hazard, leading to the uncontrollable spread of infectious diseases via vectors attracted by unattended HSW. Also, decomposing HSW emits unpleasant odors, culminating in unhygienic conditions that increases health risks. 56.07% of the respondents stipulated that the answers in the questionnaire are correct and valid, 16.54% believes that it mars the natural landscape, 11.63% believes that it causes pollution due to smoke generated by burning HSW, 9.30% believes that it resulted in the manifestation of disease vectors such as flies and rodents, and ~6.46% believes that it resulted in bad odors. It can be surmised that the respondents believe that HSW affect the area negatively.

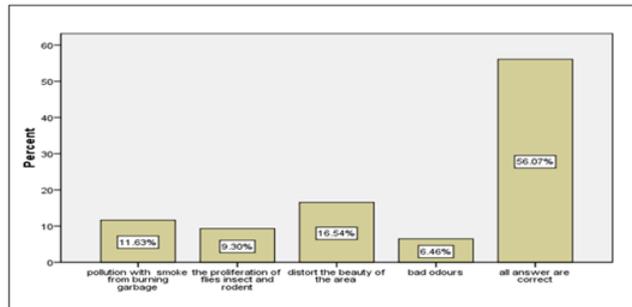


Fig.6: Effects caused by the spread and accumulation of HSW

### 3.1.5. The presence of illegal dump sites in the residential areas

Fig (7) details the presence of illegal dump sites near residential areas, ~38.50% answered no, ~38% are unsure, and ~23.50% answered yes, confirming that ~23.5% of the respondents are not being serviced by HSW collection in their areas. The availability of illegal dump sites in residential areas in Misrata underscores the inefficiency of its HSW collection, as per Fig (8).

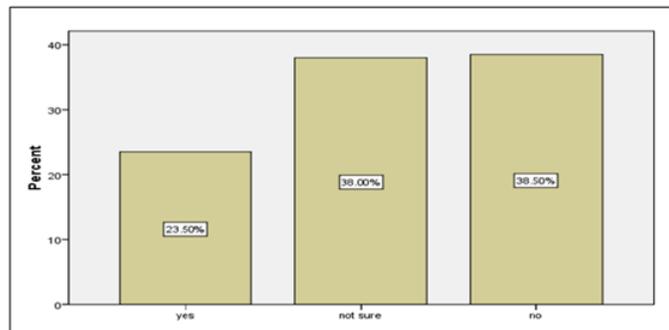


Fig.7: The presence of illegal dump sites in the residential area



Fig 8: Household solid waste disposed indiscriminately

### 3.1.6. Burning HSW by citizens in the residential areas

The burning of HSW in residential areas results in polluted air and environmental problems. ~43.75% reported that they do not burn their HSW, ~22.75% disagree with the statement, ~20.50% reported being neutral, ~8.75% reported burning their HSW, and ~4.25% strongly agree with the act of burning HSW. This basically means that ~13% of families burn their HSW due to the lack of collection and disposal services in their area (Fig 9).

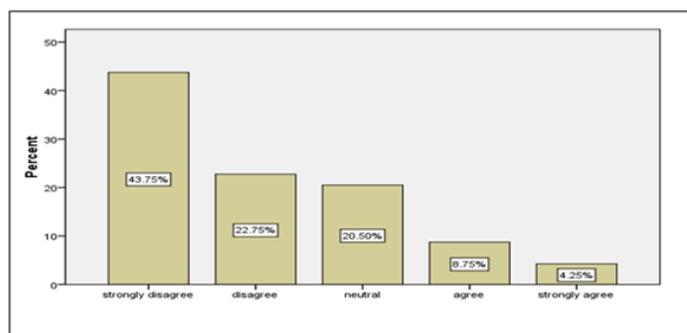


Fig 9: Burning HSW by citizens in the residential areas

### 3.1.7. The preference of waste collection service type

The majority of the respondents (65.26%) prefer the presence of public HSW collection (see Fig 10). They are currently dissatisfied with the collection service, due to factors such as the imposition of fees by private companies, and the fact that the PCCS and private companies collect all sorts of wastes instead of just HSW. The residents also expect this type of service from their local government. Other respondents believe that the current service is adequate. [18] carried out a study in Pakistan, measuring the respondents' willingness to pay for enhanced solid waste management. They confirmed that most of the respondents (84%) are unwilling to do so, believing it to be the responsibility of the local government. [19] stipulated that it is unfeasible to exclude unpaying clients from the wastes collection services, due to the public nature of the risks associated with HSW (diseases, environmental problems, etc).

~34.74% preferred private collection services (see Fig 10), due to the fact that they are dissatisfied with the current system. They also believe that private companies are more efficient in collecting HSW relative to PCCS. PCCS are also not held accountable in the event that they are unable to sufficiently execute their duties.

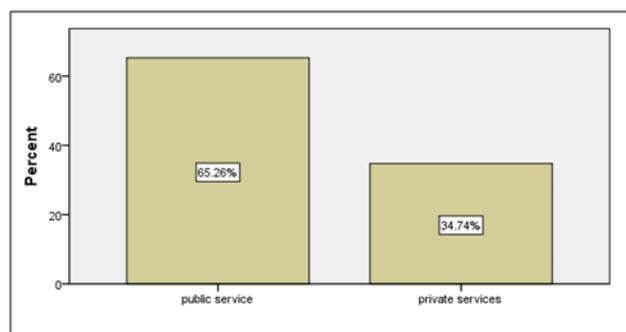


Fig.10: The most preferred waste collection service

In the majority of developing countries, MSWM is the responsibility of the local governments. However, the incompetence of the public sector of many developing countries necessitates the involvement of the private sector. [2] reported that Dar es Salaam, Tanzania, had its solid waste collection services being a public/private joint effort. It was reported that the waste collection services improved considerably due to the participation of the private sector. This also created job opportunities while also help improve the state of the city. [20] reported that in Lebanon, the public-private partnerships for MSW management services resulted in increased performance efficiency and environmental protection.

### 3.1.8. Improvements for HSWM in the city of Misrata

This work intends to explore how citizens benefit from PCCS improving HSWM systems. Fig (11) details how the PCCS in Misrata should improve. ~37.53% of the respondents outlined that the PCCS is required to

enhance its HSW storage method in the streets, such as providing a sufficient number of containers in the many neighborhoods. ~36.02% of the respondents pointed out that they are to focus on cleaning streets and public spaces, as the spread of HSW mars the beautiful image of the city. ~21.41% shows the HSW collection process, while ~5.04% of the respondents outlined other factors linked to this matter. PCCS is expected to develop;

- Hire more workers and use more machines to increase the efficiency of the collection of HSW.
- Allocate small transfer stations in the case of each district in the city so that the citizens who cannot access the HSW collection service will be able to do so in designated areas.
- Involve private companies in cleanliness services.
- Ratify laws that limit the presence of trash in public areas.
- Establish awareness programs so that citizens curb the spread and accumulation of waste.
- Provide public cleanliness services throughout Misrata.
- Increase collection services in isolated and remote residential neighborhoods.

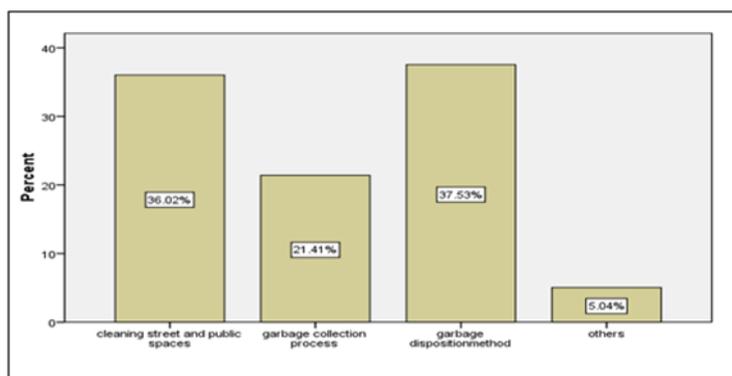


Fig 11: Aspects that the PCCS should improve in HSWM in Misrata City

## 4. Conclusion

It can be concluded that the majority of Misratans are dissatisfied with the cleanliness and performance of public cleaning offices in the city. Illegal dump sites, burning HSWs, and its proliferation in the city all confirm the inefficiency of HSWM in Misrata. There is an urgent need to improve HSWM in Misrata, which could entail the involvement of the private sector. Its improvement should also involve increasing the effectiveness of HSW storage collection, treatments, and disposals.

## 5. Acknowledgments

The author is thankful to the Libyan Ministry of Higher Education and University of Misrata for their financial support, as well as the Directors of Public Cleaning offices and Compost Plant in Misrata city for their co-operation.

## 6. References

- [1] Gallardo, A., et al., *Methodology to design a municipal solid waste pre-collection system. A case study.* Waste Management, 2015. **36**: p. 1-11.  
<https://doi.org/10.1016/j.wasman.2014.11.008>
- [2] Kassim, S.M. and M. Ali, *Solid waste collection by the private sector: Households' perspective—Findings from a study in Dar es Salaam city, Tanzania.* Habitat International, 2006. **30**(4): p. 769-780.  
<https://doi.org/10.1016/j.habitatint.2005.09.003>
- [3] Jovičić, N.M., et al., *Route optimization to increase energy efficiency and reduce fuel consumption of communal vehicles.* Thermal Science, 2010. **14**(suppl.): p. 67-78.

<https://doi.org/10.2298/TSCI100525067J>

- [4] Karadimas, N.V. and V.G. Loumos, *GIS-based modelling for the estimation of municipal solid waste generation and collection*. Waste Management & Research, 2008. **26**(4): p. 337-346.  
<https://doi.org/10.1177/0734242X07081484>
- [5] Guerrero, L.A., G. Maas, and W. Hogland *Solid waste management challenges for cities in developing countries*. Waste Management 2013. **33**, 220–232.  
<https://doi.org/10.1016/j.wasman.2012.09.008>
- [6] Yudoko, G., , *Exploring the potential of integrated municipal solid waste planning and management developing countries : a case study in the municipality of Bandung , Indonesia with a focus on households in planning*. 2000, Waterloo, Ontario, Canada.
- [7] Vijay, R., et al. *GIS-based locational analysis of collection bins in municipal solid waste management systems*. Environ. Eng. Sci., 2008. **7**, DOI: 10.1139/S07-033.  
<https://doi.org/10.1139/S07-033>
- [8] Al-Khatib, I.A., et al., *Public perception of hazardousness caused by current trends of municipal solid waste management*. Waste Management, 2015. **36**: p. 323-330.  
<https://doi.org/10.1016/j.wasman.2014.10.026>
- [9] Elfeki, M. and E. Tkadlec, *Treatment of municipal organic solid waste in Egypt*. J. Mater. Environ. Sci., 2015.
- [10] Sharholly, M., et al., *Municipal solid waste management in Indian cities–A review*. Waste management, 2008. **28**(2): p. 459-467.  
<https://doi.org/10.1016/j.wasman.2007.02.008>
- [11] Rada, E.C., M. Ragazzi, and P. Fedrizzi, *Web-GIS oriented systems viability for municipal solid waste selective collection optimization in developed and transient economies*. Waste management, 2013. **33**(4): p. 785-792.  
<https://doi.org/10.1016/j.wasman.2013.01.002>
- [12] Rushbrook, P., C. Macfarlane, and W.H. Organization, *Financial and operational factors influencing the provision of municipal solid waste services in large cities: report*. 1998.
- [13] Ghose, M., A.K. Dikshit, and S. Sharma, *A GIS based transportation model for solid waste disposal–A case study on Asansol municipality*. Waste management, 2006. **26**(11): p. 1287-1293.  
<https://doi.org/10.1016/j.wasman.2005.09.022>
- [14] Lamah, M.A., *"Public Cleaning & Methods of Domestic Wastes Disposal in Benghazi"*, in *Garyounis Scientific Magazine*. 1998, Garyounis University: Benghazi. p. 271.
- [15] Piaw, C.Y., *Mastering Research Methods* 2012, Malaysia: McGraw-Hill Education
- [16] Finstad, K., *The system usability scale and non-native english speakers*. Journal of usability studies, 2006. **1**(4): p. 185-188.
- [17] Vergara, S.E. and G. Tchobanoglous *Municipal Solid Waste and the Environment: A Global Perspective*. The Annual Review of Environment and Resources, 2012. 277-309 DOI: 10.1146.
- [18] Altaf, M.A. and J. Deshazo, *Household demand for improved solid waste management: A case study of Gujranwala, Pakistan*. World Development, 1996. **24**(5): p. 857-868.  
[https://doi.org/10.1016/0305-750X\(96\)00006-X](https://doi.org/10.1016/0305-750X(96)00006-X)
- [19] Cointreau-Levine, S., *Private sector participation in municipal solid waste services in developing countries*. Vol. 1. 1994: World Bank Washington DC.  
<https://doi.org/10.1596/0-8213-2825-5>
- [20] Massoud, M.a. and M. El-Fadel, *Public–private partnerships for solid waste management services*. Environmental Management, 2002. **30**(5): p. 0621-0630