RESIDENTS' PERCEPTION OF HOUSEHOLD SOLID WASTE MANAGEMENT IN MISRATA CITY, LIBYA

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ABSTRACT

Environmental pollution from improper management of Household Solid Waste (HSW) remains a significant issue in Libya as well as other places in the world. In Misrata city, Libya a number of residents had blamed the poor services provided by the Public Company of Cleaning Services (PCCS) in managing HSW for the accumulation of waste in the public area. Incinerating these wastes near housing areas resulted in a polluted atmosphere with the emission of greenhouse gases (GHG). These aforementioned situations prompted this research which aimed to analyze the planning and development of waste management. It was intended to help in projecting the best solutions to reduce the negative impacts of improper waste management in the city. Hence, the study adopted observatory and quantitative data collection approaches to identify the immediate waste management situation while obtaining the relevant data within Misrata, Libya. This included the distribution of questionnaires to 400 residents of the city that served as the representative population of Misrata. Interviews were held with the persons-in-charge of HSW management in the city, especially within the PCCS. The data were analyzed using descriptive statistics. Moreover, photographs were taken to document the visits. The results confirmed that about 64% of the residents are dissatisfied with the state of cleanliness of the city and performance of PCCS which manages the solid waste in the city. Another 22% of the residents were neutral to the state of cleanliness, and could possibly reflect the low level of environmental awareness. The presence of illegal dump sites, burning HSW in housing areas, and the spread of HSW on the streets confirmed this. Therefore there is an urgent need to improve HSW management, and private companies should play a big role in decreasing the burden of PCCS, and increase the level of cleanliness of the city.

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

INTRODUCTION

Human activities has continued to generate waste, which in turn occupies space and could constitute nuisance if not properly managed. Waste is whatever left behind from any activity and has no primary or secondary use for a human at source (Abou-Elseoud, 2008). However, there are many types of solid waste, the one which significantly cuts across every society (developed and developing nations) is household waste. This category of solid waste comprises wastes that are produced from household activities. These activities include food preparation, sweeping, cleaning, fuel burning, and garden wastes. They can also include old clothing, old furnishings, abandoned equipment, packaging, and newsprint (Pradhan, 2008; Sinha *et al*., 2011; Rushbrook & Pugh, 1999). Meanwhile, Solid Waste Management is defined as "the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitudes" (Cui, 2003).

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 (Gallardo *et al.,* 2015). 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 (Kassim & Ali, 2006). Therefore, it is very important to consider the resident's perception about HSWM, as well as other related the issues and challenges associated to daily generation solid waste. This can help the authority to figure out the main issues that the citizens face, and attempt to find the most suitable and effective solutions for more efficient HSWM in the city.

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 (Jovičić *et al*., 2010). The local governments are responsible for HSW management, 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 (Kassim & Ali, 2006; Karadimas & Loumos, 2008), constantly shifting economies, and increased living standards alongside the lack of organization (Guerrero *et al*., 2013; Yudoko, 2000; Vijay *et al*., 2008; Al-Khatib, 2015; Guerrero *et al*., 2013). Limited finance also curtailed waste management activities, due to the fact that waste management requiring expensive infrastructure and personnel (Vijay, 2008; Elfeki & Tkadlec, 2015).

Therefore, the researcher will give a general view of Municipal Solid Waste Management (MSWM) in Misrata city as the main body of HSWM. Indeed, the MSW problems can be solved if the shortfalls and constraints are clearly known. As Kum et al. (2005) stated that, "a patient's illness will probably be effectively cured if the cause of the disease is clearly identified". Therefore, it is important to review the existing MSWM system in the city to identify shortfalls and constraints in the system before proposing appropriate strategies. Figure 1 shows the current methods of MSWM in Misrata city.

In Misrata city, most of the residents complain about the unavailability of collection services provided by the PCCS and the frequency of collection and timing differences. Private companies in Misrata city, as well as other developing countries, can play a significant role to reduce the burden on the authority and improve the level of cleanliness in the area. Another issue in SWM in Misrata city is the disposal method (landfilling). It is not a sanitary landfill; it is just open dump site. There are no enough criteria followed to ensure environmental safety.

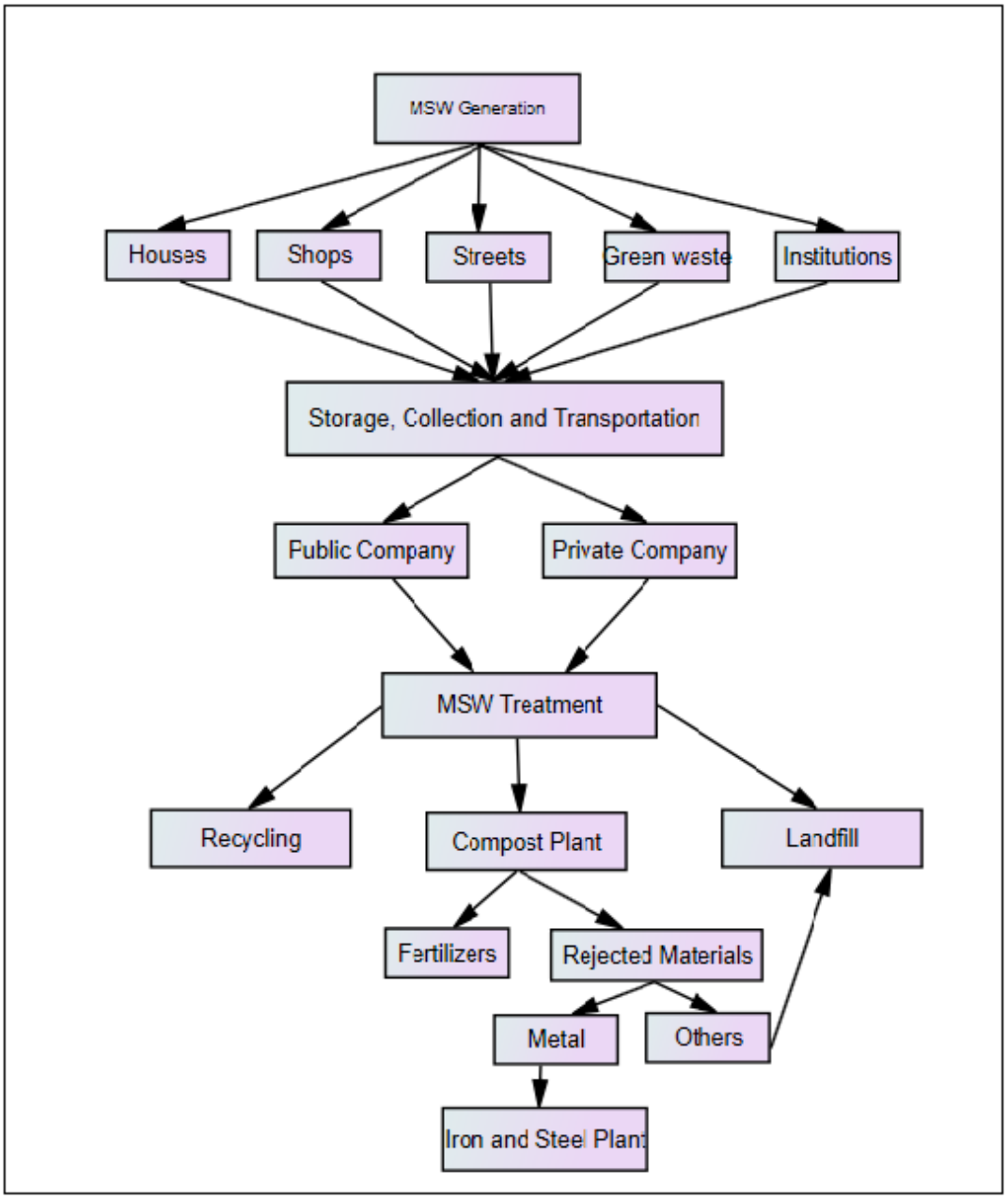


Figure 1: Overview of current MSWM in Misrata city

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 (Sharholy, 2008; Vijay *et al*., 2008). Similarly, Misrata city's population and economic growth influence increase in the generation rate of HSW, yet, the authority is short of the financial and human resources which are vital for the improvement of Household Waste Management in the city.

The management of household solid waste is multidisciplinary in nature, encompassing the generation, storage, collection, transportation, processing, and recovery and disposal (Rada, 2013). One of the most important tasks in waste management is to effectively collect wastes from populated areas. Developing countries need to prioritize waste collection and transport (Rushbrook *et al*., 1998; Ghose *et al*., 2006). However, increased demand for waste collection from the area tends 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 which is commonplace in developing countries (Kassim & Ali, 2006).

In Libya, waste management remains in its infancy. Improved living standards, as well as life changes, resulted in an increased population and the aggravation of living standards in cities, such as Misrata (Lamah, 1998). Activities linked to HSWM (waste generation, collection, transportation, and disposal) are regarded as 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, while pointing out the most significant challenges pertaining to HSWM in Misrata from the perspective of residents for use by policymakers and stakeholders towards enhancing HSWM.

STUDY AREA

Misrata municipality is one of the most important urban centres in the north of Libya. It is located on the Mediterranean coast at longitudes °14 ´36 and °15 ´22 east, and between latitudes °31 ´33 and °32 ´23 north. Administrative borders of Misrata municipality are the Mediterranean Sea from the north and the East, Almarkib from the West, Baniwalid from the West-South, Sirt from East-South. The city lays in the internal plan on the Libyan coast at 210 km East from Tripoli, the capital of the country, and 820 km West from Benghazi (Figure 2). According to the Civil Status Authority, its population is about 400, 312 in 2014.

The PCCS in Misrata city is responsible for municipal solid waste management. The company has about 920 local and 70 foreign workers, though it reflected a big decline in the number of foreign workers from 175 in 2010 to 70 in 2014 which is attributable to the unstable political situation in the country. PCCS has seven public cleaning offices, one in each district. These offices are responsible for the collection of municipal solid waste in the city of Misrata. This is primarily waste generated from households, shops, streets, public places, gardens, and other institutions.

PCCS derives its authorization (regulation, laws ...etc.) from the Ministry of Local Government (MoLG).

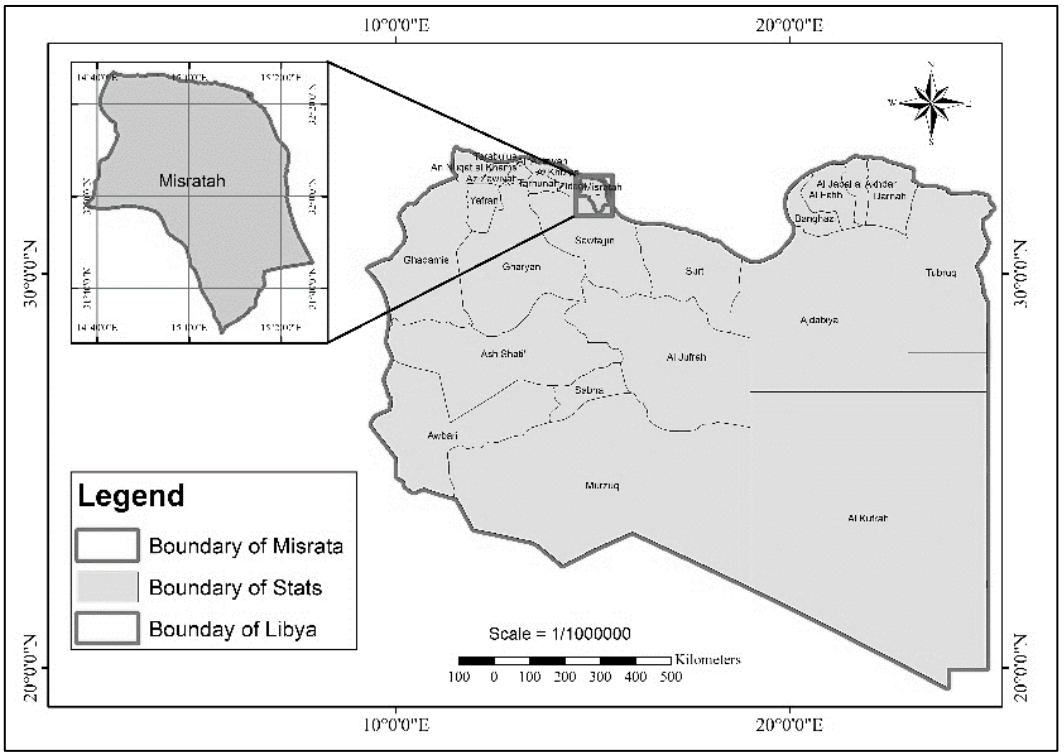


Figure 2: Location of study area

The PCCS has several types of vehicles used to transfer municipal solid waste to transfer station or landfills. These include tractor- trailers, dumper-placer, and normal trucks. These vehicles have become rickety because they are used to levels exceeding their capacity due to the shortage of vehicles. Although there is a standardized system of bins and containers that can be mechanically loaded into collection trucks, the number of bins is not enough and is yet to be distributed effectively in all districts of Misrata city. Most of the workers in this sector are foreigners because of the reluctance by Libyans to work in the public cleaning sector due to the low social acceptance associated with such jobs.

MATERIALS AND METHODS

The first approach was observatory and involved field visits to different residential areas in Misrata city. Such visits were made in October 2014 to observe the current situation and collect data from city sources. A total of 400 questionnaires were distributed to the residents of Misrata for the purpose of information gathering, evaluation and understanding 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 the work of Krejcie and Morgan in 1970 (Piaw, 2012) (see Table 1). Hence, 400 respondents participated in the survey considering the total population of Misrata (400,312) in 2014.

Table 1: Sample size

Population size	Sample size
50	44
100	79
200	132
500	217
1,000	278
2,000	322
5,000	357
10,000	370
20,000	377
50,000	381
100,000	383

The original questionnaire consisted of 21 questions which were divided into four sections to cover information related to composition and generation, collection process, separation of HSW and the evaluation of the cleanliness in the city of Misrata. However, this study presented only eight (8) of the most relevant questions. Respondents from all districts and different residential areas were surveyed. It is very important to measure and gather information from residents (household heads) of different districts in Misrata city about their views on HSWM in the different areas. This was to see their satisfaction of cleanliness level and to give an overall view and evaluation about HSWM in the city.

Open-ended interviews with officials in the environment protection authority and different stakeholders in the Public Company of Cleaning Services (PCCS) were conducted to gather information on the waste collection, transportation, and disposal methods, which will allow for incorporation of a variety of views on waste problems. Interviews were conducted with key informants in PCCS. The respondents interviewed had been working at the Public Company of Cleaning Services (PCCS) and involved in solid waste management issues for about 8 years. Such respondents had significant experience about household solid waste management in the study area. Photographic evidence was collected to document these visits.

In this study, different analysis techniques were established and data analysis for the research objective was carried out using the Statistical Package for Social Science (SPSS) version 20. Descriptive statistics were used to measure and describe the sample in terms of different aspects of HSWM in the study area. This study applied different statistical tools other variables were measured by the frequency, percentages, and means and the results were presented in charts and graphs descriptive reports.

With respect to the interview approach, the researcher prepared the transcripts of all the interviews and analyzed the content to get the information about HSWM. The purpose of the interviews was to build a picture of the current practices in order to further understand the problem and reflect the real situation of it. Moreover, it allows the study to incorporate a variety of views on HSW problem and clarify the main obstacles in order to get better household solid waste management.

RESULTS

Findings are presented and discussed in sections to reflect the objectives of the study. Hence, this section presented the actual state of HSWM in Misrata city, the public perception and potential factors that influence the overall waste management. In this section, there are eight main aspects studied in order to evaluate the current state of HSWM in Misrata city, as there is need to identify the main issues and associated challenges. The investigation covers; the presence of illegal dump sites, satisfaction over the state of cleanliness and performance level in the city, HSW spread and accumulation, effects of HSW spread, the type of waste collection services preferred, and the improvements for efficient HSWM in the city.

The presence of illegal dump sites in the residential areas

The first question investigated the presence of illegal dump sites near residential areas. Figure 3 detailed that 38.5% answered "no", 38% are unsure, and 23.5% answered "yes". Hence, it shows 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 Figure 4.

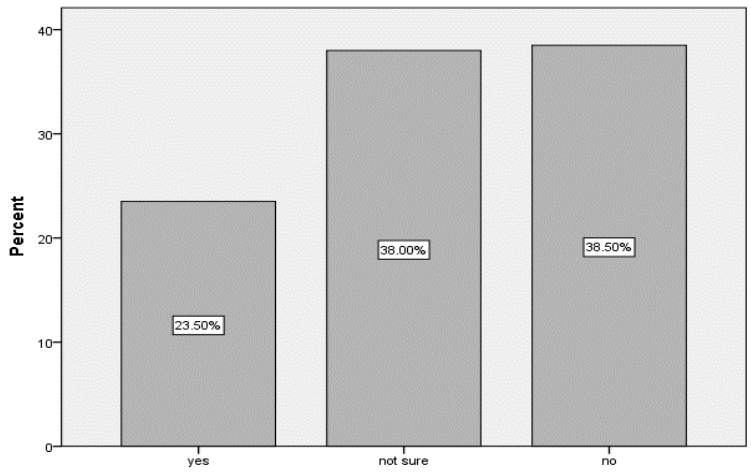


Figure 3: The presence of illegal dump sites in the residential area



Figure 4: Household solid waste disposed of indiscriminately

Satisfaction over the state of cleanliness in Misrata

The data on the level of satisfaction among the residents regarding the state of cleanliness of the city of Misrata were collected from the questionnaire and shown in Figure 5. It can be seen that 12.25% of the residents were completely dissatisfied, approximately 51.25% of the respondents were just dissatisfied, and about 22.25% were neutral, 12 % were satisfied, while 2.25% were very satisfied. Finstad (2006), pointed out that in the case of implicit interpolation, a study 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 was 2.4, which means that the majority of the respondents are not satisfied with the cleanliness levels in Misrata.

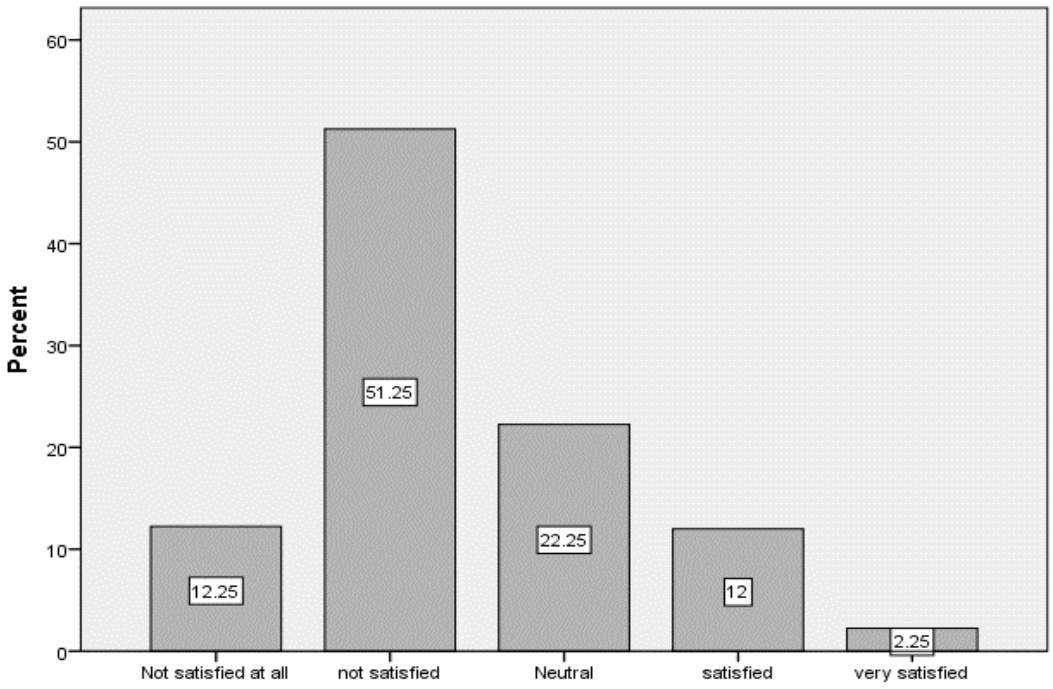


Figure 5: Satisfaction over the cleanliness level in Misrata city

Satisfaction over the level of performance of public cleaning services

The next question which was asked in the questionnaire pertains to the satisfaction level of the performance of public cleaning services. The results had shown that about 7.8% of the residents reported not being satisfied at all with the services provided by the Public Company of Cleaning Services (PCCS), about 61.8% of respondents reported not being satisfied, 18% reported being neutral, 9.8% reported being satisfied with their services, and roughly 2.8% reported being very satisfied. It implied that almost 70% of the respondents expressed dissatisfaction with the level of cleanliness in the area while considering the services perceived to be provided by the designate waste management group. Overall, the mean 2.38 signifies that the majority of the respondents were dissatisfied with the performance and services provided by the PCCS (see Figure 6).

HSW spread and accumulation

During the field trip to the residential area of Misrata, it can be seen that trash was placed on roadsides for collection and there were many illegal dump sites found. Such development could be due to inadequate provision of solid waste litter bins and inefficiency of collection the services and many others. This resulted in the unnecessary accumulation of HSW, odors, and increased manifestation of insects and rodents (See Figure 7).

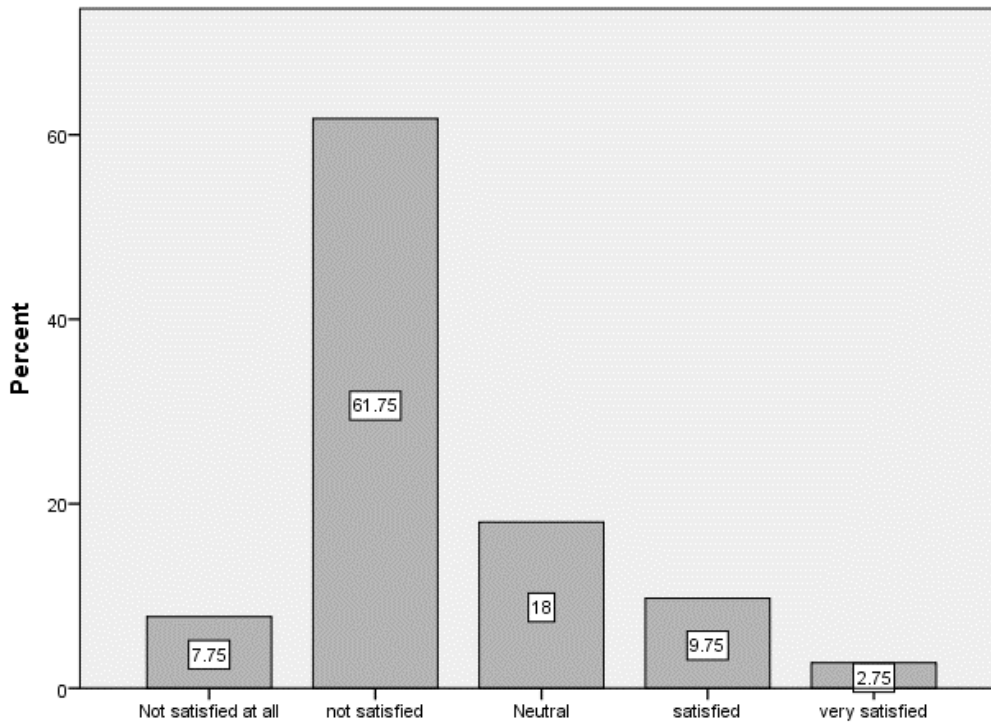


Figure 6: Performance level of public cleaning offices in Misrata



Figure 7: Accumulation of HSW on the main roads

Based on the investigation the respondents enumerated several factors that were the cause of the accumulation of garbage, which included provision of inadequate waste containers, and inefficient collection services (Figure 8). About 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 inconsistent collection periods by PCCS, about 23.75% believed that it is due to the lack of interest in the citizens associated to poor awareness on health implications of indiscriminate waste disposal, and 10% believed 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, especially plastics, aluminum, and other recyclables to help alleviate the problem.
- The absence of plans/programs for waste collection, such as proper organization and a suitable number of mechanics/workers.
- The indifference of municipal authorities and the people.

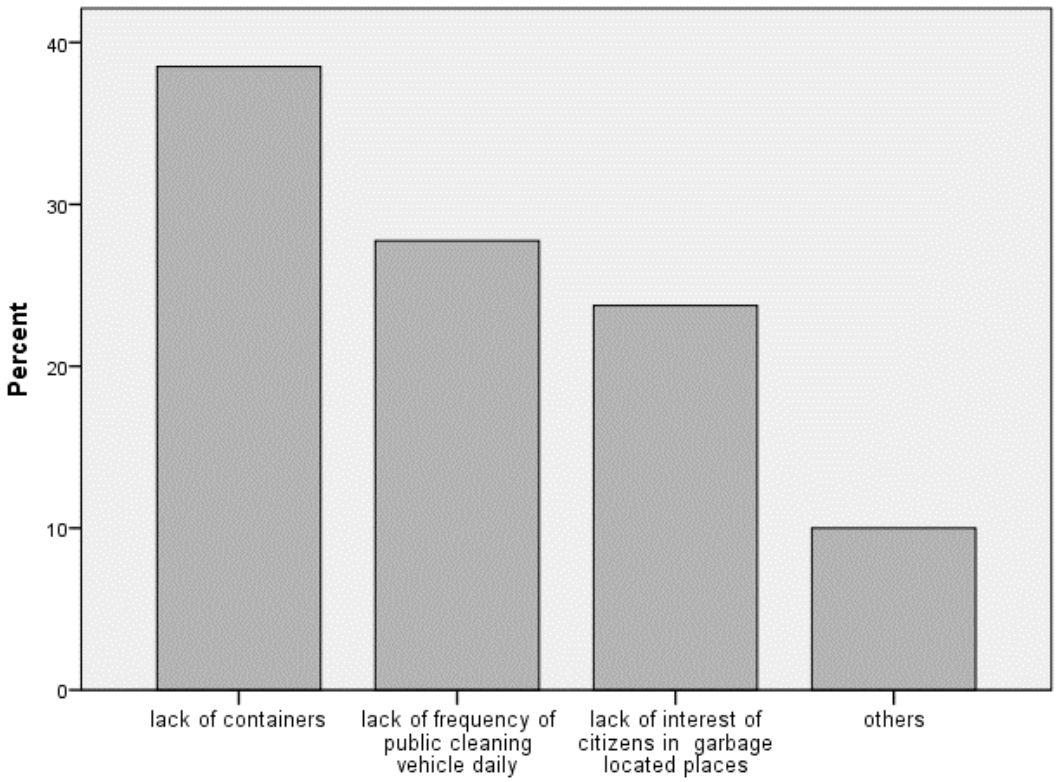


Fig 8: Reasons for HSW spread and accumulation in neighborhoods

The effects of indiscriminate dumping

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 which often attract diseases vectors (Vergara & Tchobanoglous, 2012). Figure 9 shows that improperly managed HSW pose a serious health hazard, leading to the uncontrollable spread of infectious diseases via vectors as certain vectors breed faster in the unattended HSW. Also, decomposing HSW emits unpleasant odors, culminating in unhygienic conditions that increase health risks. Similarly, 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 affects the area negatively.

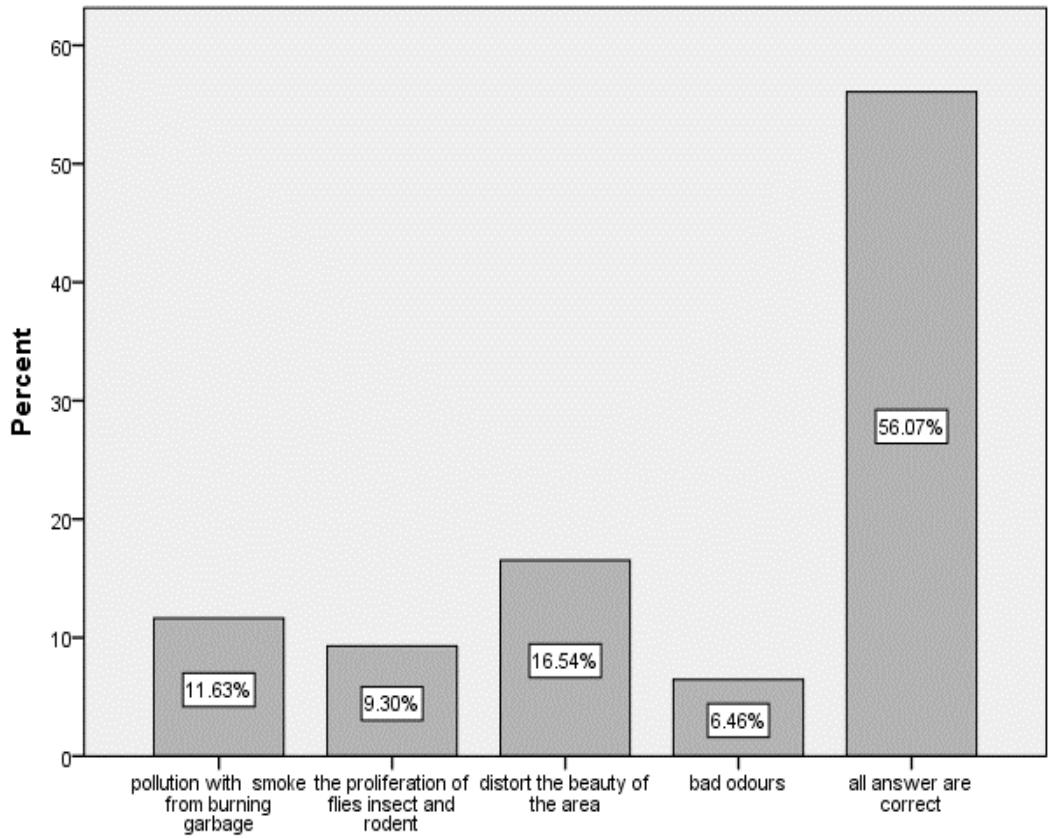


Figure 9: Effects caused by the spread and accumulation of HSW

Burning HSW by citizens in the residential areas

The burning of HSW in residential areas results in polluted air and environmental problems. Approximately 43.75% reported that they do not burn their HSW, about 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 (Figure 10).

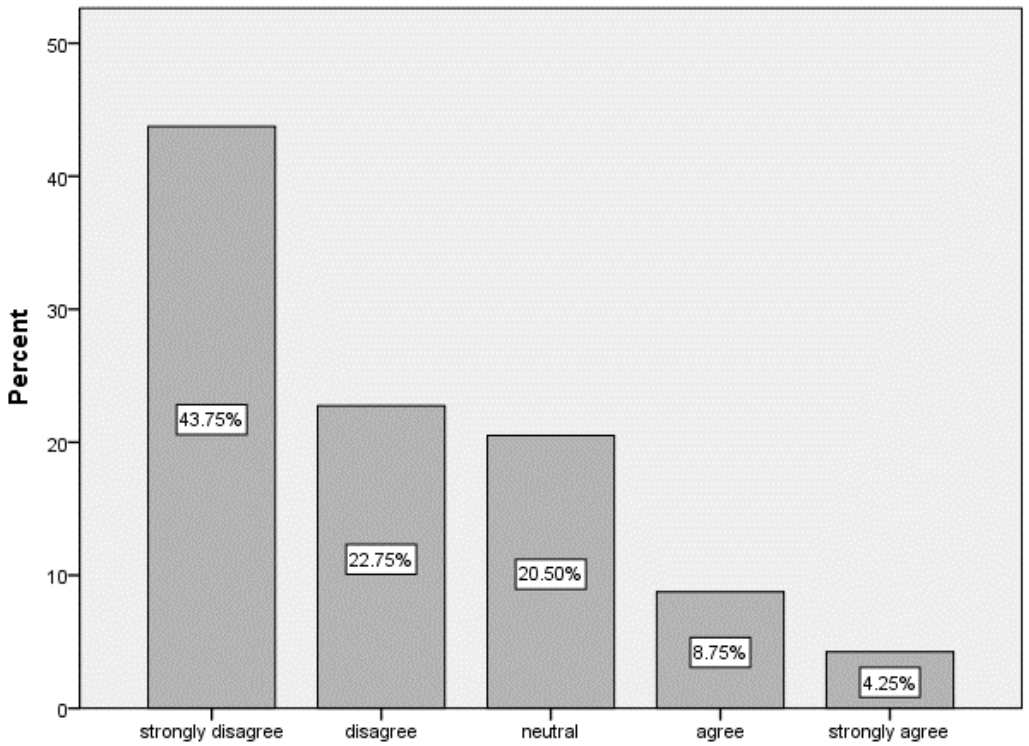


Figure 10: Burning HSW by citizens in the residential areas

The preference of waste collection service type

The majority of the respondents (65.26%) prefer the presence of public HSW collection (see Figure 11). They are currently dissatisfied with the collection service, due to certain issues, especially 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. Those respondents believe that the current service is adequate. Altaf & Deshazo (1996) 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. Cointreau (1994) stipulated that it is unfeasible to exclude other clients (those that fail to pay collection fees) from the wastes collection services, due to the public nature of the risks associated with HSW (diseases, environmental problems, etc).

Furthermore, 34.74% of respondents preferred private collection services (Figure 11), 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 efficiently execute their duties.

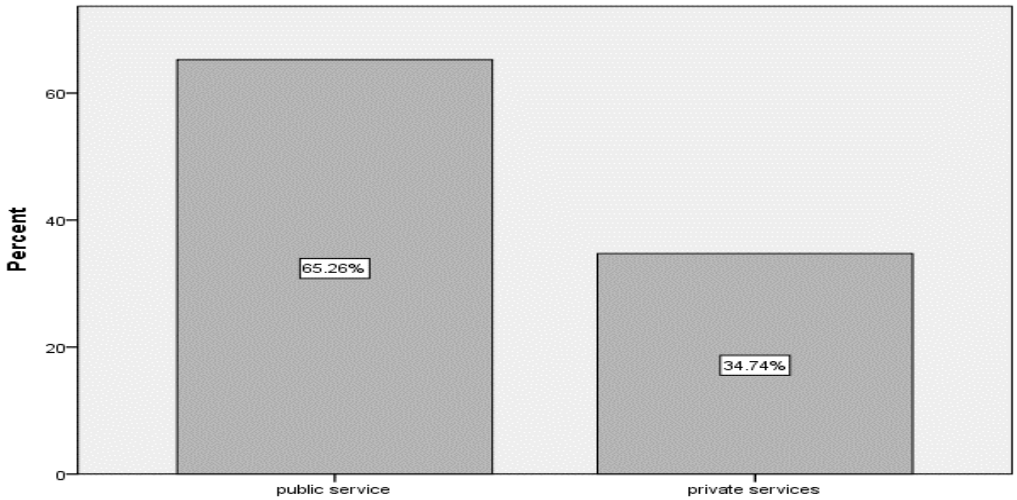


Figure 11: The most preferred waste collection service

Improvements for HSWM in the city of Misrata

This work intends to explore how citizens benefit from PCCS improving HSWM systems. Figure 12 details how the PCCS in Misrata should improve. About 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. Another 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. Approximately 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 and improve the following:

- 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.

- Impose 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.

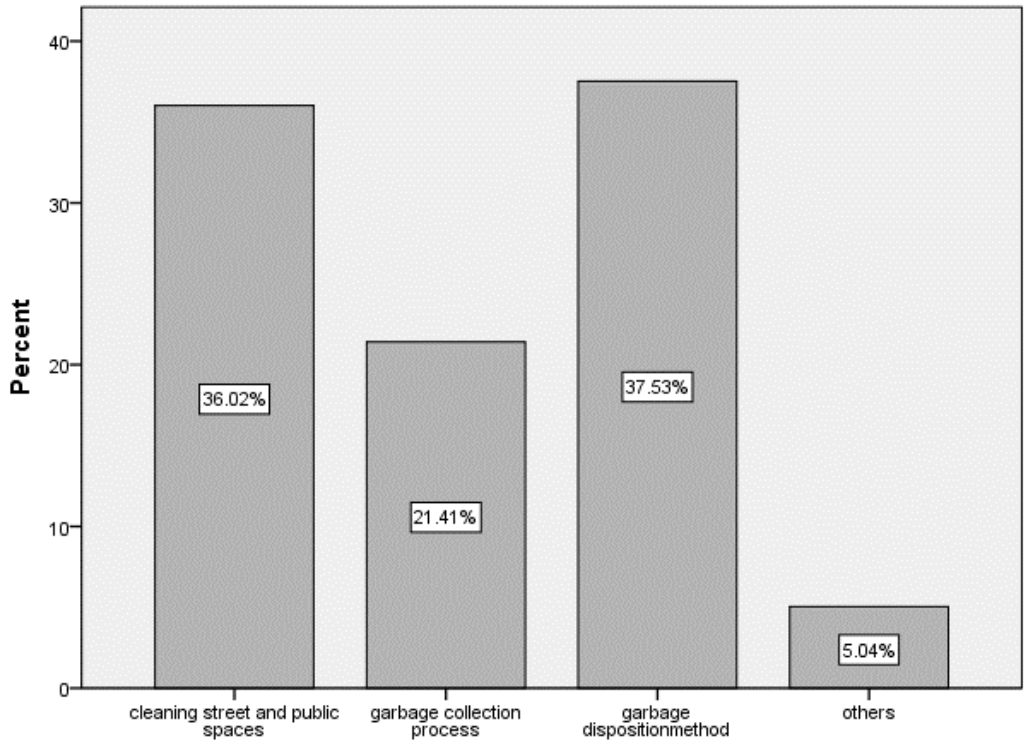


Figure 12: Aspects that the PCCS should improve in HSWM in Misrata City

DISCUSSION

Based on the results from this study, it can be deduced that the PCCS is not able to manage household solid waste in the city of Misrata. It failed to achieve its goal in HSW management, which is to maintain a good level of cleanliness within all the districts of the city and provide efficient services for HSW storage, collection, transportation, and treatment. This is based on observed indicators; the presence of illegal dump sites, satisfaction over the state of cleanliness and performance level in the city, HSW spread and accumulation, effects of HSW spread, and the type of waste collection services preferred.

In the majority of developing countries, SWM is the responsibility of the local governments. However, the incompetence of the public sector of many developing countries necessitates the involvement of the public sector. Kassim & Ali (2006) reported that in Dar es Salaam, Tanzania, the solid waste collection service is a joint effort of public and private sectors. It was reported that the waste collection services improved considerably due to the participation of the private sector. This also created job opportunities while improving the state of cleanliness of the city. Massoud & El-Fadel (2002) reported that in Lebanon, the public-private partnerships for MSW management services resulted in increased performance, efficiency and environmental protection.

In this study, the researchers found that the two main obstacles that PCCS is facing are the lack of human resources and financial resources. The researchers suggested that the PCCS should go under Public Private Partnership (PPP) or to fully privatize the HSW services. Moreover, a continued awareness campaign on HSW impacts and its management is significant to reduce the negative impacts resulted based on the residents' attitudes in Misrata city.

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, and this requires the involvement of the private sector. Its improvement should also involve increasing the effectiveness of HSW storage collection, treatments, and disposals services.

This study provides an overview of the current situation of HSWM practices in Misrata city. HSWM should be improved in terms of effectiveness of HSW storage collection, treatment, and disposal. The study concludes that a significant proportion of HSW is found in residential areas and even littered on streets. The city council is barely coping with HSWM as evidenced by the inefficient collection services and operation which are not well planned as well as the lack of prepared maps to mark routes which the collection service vehicles ought to follow to enhance frequency and efficiency in waste collection. Furthermore, the numbers of garbage containers are inadequate; as such waste is often dumped nearby the containers on the streets.

The problem of poor HSWM is compounded by inadequate investment in collection, transport and treatment utilities. Like the majority of cities in developing nations, the Misrata municipal council is inadequately equipped with respect to infrastructure and information. Provision of adequate infrastructure and information will deal with the increasing demands for efficient solid waste management; identifying how solid waste is generated, and how to effectively handle it, as well as how best to dispose of it in the growing city.

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