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SOLID WASTE MANAGEMENT IN MONROVIA, LIBERIA: IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT

Victor Emery David Jr.[a*], Jiang Wenchao[a], Yasinta John[a], Daniel Mmereki[b]

[a]Faculty of Urban Construction and Environmental Engineering,
Chongqing University, Chongqing, 400045, PR China
[b]Department for Management of Science and Technology Development,
Ton Duc Thang University, No. 19 Nguyen Huu Tho Street, Tan Phong Ward, District 7,
Ho Chi Minh City, Vietnam

emerydavid2011@gmail.com

ABSTRACT

The population of Monrovia is increasing accompanied by rapid urbanization. Due to rapid urbanization, economic development, higher living standards and changes in consumption patterns and lifestyle, the generation rate of waste has increased. Mismanagement of solid waste tends to hinder any progress towards environmental sustainability. This study endeavored to determine the adequacy of waste management services in the city, explore the linkage between population and development and the increase in the generation of wastes. The study assessed both qualitatively and quantitatively behavioral factors including knowledge, attitude and practices of solid waste management, collaboration among stakeholders, and challenges related to sustainable waste management in Monrovia. Households were selected randomly (simple and stratified) to show the socio-economic groups in the city. Purposive sampling was used to identify key informants or personnel in charge of waste management and the use of questionnaires captured vital information on waste management in the city. The major findings showed the main proportion of waste generated in Monrovia was organic refuse (40.2%) followed by plastic (14.2%). Waste generated are inadequately disposed of due to the inadequate collection system, as large fragment of waste remain uncollected resulting in open dumping and burning of wastes. These waste management challenges have become heightened as a result of insufficient technology to ensure proper management, low budgetary allocations for effective waste management, lack of skilled professionals, poor implementation of regulations to ensure adequate management, and poor public awareness.

Keywords: Sustainable waste management, Sustainable development, Municipal Solid Waste Management, Policy, Monrovia, Liberia

INTRODUCTION

The rise in commercial industries, increase in population size, rapid urbanization and expansion of cities are significant concerns on solid waste management efficiency. Wilson (2006) described waste as 'anything un-useful, discarded materials used up or left over from industrial, commercial, and domestic activities." Wilson (2006) highlighted that the primary focus of solid waste management to ensure a healthy environment, promote environmental quality, and ensure

*Corresponding author

environmental sustainability. Mismanagement of waste contributes to potential threats to the environment which may pose risks to human health and the environment (Akolkar et al., 2008; Zhuang et al., 2008). Consequently, the primary focus of solid waste management is to ensure a healthy environment by addressing concerns related to environmentally friendly disposal of waste (Henry et al., 2006). Creating a healthier environment can be achieved through the proper collection, storage, transfer, recovery, recycling, treatment, and disposal of waste (Shekdar, 2009; Samah et al., 2012). However, many developing countries are faced with numerous challenges in their pursuit to manage waste efficiently (Friedrich and Trois, 2013). The complexities of managing waste results from population growth, economic development, rapid urbanization and changes in consumption patterns and improved living standards (Pires et al., 2011; Kawai and Tasaki, 2016). Mismanagement of solid waste stems from the lack of financial resources, inadequate treatment systems, and disposal facilities, lack of skilled professionals and insufficient technologies for adequate management (Minghua et al., 2009; Buenrostro and Bocco, 2003; Agarwal et al., 2005). Waste Management has been a challenge for Monrovia for many years.Waste management in the city is inadequate, and a significant amount of domestic solid waste generated remains uncollected (UNEP, 2006).). It is worth mentioning that Industries and individuals continue to dump litter in open spaces, street corners and swamps posing threats to public health (David Jr, V. et al., 2016). According to Environmental protection Agency (2013), solid waste management is faced with challenges characterized by the following: low public awareness regarding waste and the risk to public health if not properly handled, poor environmental education, lack of coordination and participatory approach between stakeholders and policies makers. Insufficient resources directed towards waste management services, inadequate legislative provision, and lack of implementation of policies.

The city of Monrovia has experienced a huge increase in waste generation over the years due to rapid urbanization, increase in population, changes in the consumption pattern, etc. (Country Situational Analysis, 2011). Approximately 33.3 percent of all the Liberians live in Monrovia. (Country Situational Analysis, 2011). (UN data, 2017). The situation in the city is further has worsened by lack of adequate technological, technical financial, and human resources capacity (UNEP, 2006). With this in mind, t this study endeavors to analyze domestic solid waste management in Monrovia and make relevant recommendations for sustainable solid waste management in Monrovia.

The research problems center around the inadequacy of services provided for waste management, the lack of implementation of policies, the failure to achieve the goal of sustainable domestic solid waste management.

MATERIALS AND METHODS

Monrovia, the capital city of Liberia, situated in Montserrado County and has a life expectancy of 59.1 years (2010 UNDP). Monrovia accommodates at least one in every four people in Liberia and receives almost half as many again for daytime activities. Monrovia contains several semi-autonomous townships (Congo Town, New Georgia, Sinkor, Paynesville Gardnersville, Dixville, Barnesville, Caldwell, Johnsonville, and Garworlon) and the only borough in Liberia, New Kru town. The study was conducted in the city Monrovia (Figure 1). The target population of the study area

FIGURE 1
Map of Monrovia

consisted of 500 households

Both qualitative and quantitative approaches were employed to carry out the study. Various methods of data collection procedures were used in this study including the use of questionnaires. Permission to conduct research was obtained from the Monrovia City Corporation and the Environmental protection Agency. After permission had been granted, households were randomly selected according to the sample size determination method suggested by (Nordtest (1995) and (Gomez, G., Meneses, M., Ballinas, L. and Castells, F. (2008). The study targeted heads of households or their spouse. The sample of households was selected randomly (simple and stratified) from different zones of which the city of Monrovia is divided namely: Congo Town, Barnesville, Gardnerville, Dixville, Caldwell, Johnsonville, Garworlon and New Georgia. The concept of household in this study refers to as a person or group of related and unrelated persons who lived together in the same dwelling unit(s), who acknowledged one adult male or female as the head of the household, who shared the same housekeeping arrangements(LDHS, 2013). Also, purposive sampling was used to choose key informants.

Primary data was collected through open- and close-ended questionnaires, interviews and site visits, and observation. The questionnaire for households focused on collecting information about the respondent's socio-demographic information, existing waste management strategies, waste collection, sorting, storage, transport cost. The questionnaire also aimed at obtaining information regarding the frequency of waste collection, availability of communal bins in neighborhoods, types of disposal and challenges facing the existing management strategies. Face-to-face interviews elicited information from key informants. These included personnel in charge of MSW in Monrovia including the Monrovia City Corporation, Paynesville city corporation, The Environmental Protection Agency, The National Health Policy and policy and plan of the Ministry of Health and Social welfare, etc. Interviews conducted with personnel solicited information on waste collection up to disposal followed by the involvement of all stakeholders during the planning and decision-making process.

Field observation was also carried out as a technique for gathering information.The field observation, however, involved observing behaviors and practices to waste management. (Coolican, 1996). Field observation was an essential component used to investigate effective waste management practices in Monrovia. Photographs were taken during the observation regarding facilities, equipment used for storage, the vehicles used for transportation of waste to landfills, etc.

RESULTS AND DISCUSSIONS

Institutional setting

Set of laws and regulations have been formulated to address environmental issues in Liberia. However, the lack of enforcement and the availability of viable alternatives is a

TABLE 1
Institutions agencies with mandates on Solid waste management in Monrovia, Liberia

Institution	Mandate
Environmental Protection Agency, Liberia.	• Responsible for tackling environmental issues and waste management services, Coordination, monitoring and supervision of waste management projects. Consult with relevant stakeholders on all activities relating to the protection of the environment and sustainable use of natural resources. • Setting up national guidelines for solid waste management in Liberia, environmental quality standards and ensuring compliance with pollution control. • Providing guidelines for the preparation of environmental impact assessments (EIAs), audits/inspections and environmental licenses/permits for healthcare waste treatment plants.
The Environmental and Occupational Health Department of the Ministry of Health and Social Welfare, Liberia.	• Assess the environmental health of the population, thereby conducting sanitary inspections to evaluate compliance in line with the Public Health Law of Liberia.
The Ministry of Public Works (MPW), Liberia	• Installation of infrastructure for waste management delivery services, i.e., Waste collection to transfer stations and the construction of sanitary landfills.
The Ministry of Lands, Mines, and Energy (MLME), Liberia.	• Evaluating urban sanitation projects. • Providing guidance for engineered landfill sites for the disposal of nonhazardous waste generated from Healthcare facilities
Monrovia City Corporation	• Responsible for carrying out city ordinances, management of municipal wastes, recreation, public education and awareness and provision of services in environmental health and sanitation.
National Environmental Commission of Liberia	• Responsible to creates and promotes environmental awareness; develop a national environmental policy, environmental protection, and management law. Coordinates the activities of environmental related organizations, including NGOs and oversees international environment-related conventions.
National Environment Policy Council	• Responsible for policy making regarding the environment. It also set priorities for national goals and objectives for the protection of the environment • Promote co-operation among Line Ministries, local authorities, the private sector, non-governmental organizations engaged in environmental protection programs and the public

Source: (David Jr, V et al., 2016).

challenge. On the other hand, apart from being a technical issue, full implementation is also influenced by political, legal, socio-cultural, environmental, economic factors and unavailable resources.

Demographics and Social Characteristics of Respondents

Household respondents were females (66.04%) as against (33.96%) of males. This is because, in a typical African setting, women are usually the ones at home attending to the household. It also indicates that women are directly involved in household waste issues than men. This finding is consistent with previous research which established that in solid waste management especially in developing countries, women play a major role. Also, waste management in households is usually handled by women in these countries because they are directly concerned with household chores, (Eugene, A., Günter, B. and Lilian, N. (2013); (Scheinberg, A., Muller, M. and Tasheva, E.L. (1999). Moreover, the data contained in Table 2 further indicate that the overwhelming majority (44.2%) of respondents were between the ages 22-30 years; this shows that besides being females, the majority of re-

TABLE 2
Demographic and Social Characteristics of Respondents

Variable of respondents in percentage	
Gender	
Male	Female
33.96	66.04
Age-group	
21-30	44.2
31-40	30.6
41-50	8.4
51-60	16.8
N/A	
Education	
Doctorate	9.0
Masters	35.2
Bachelor	38.8
High school	16.2
N/A	0.8
Household size	
0-3	21.0
3-5	48.8
5 and above	30.2
Residence	
Sinkor	17.4
Paynesville	45.2
Gardnerville	3.6
Congo Town	20.2
Bushrod Island	10.4
Barnesville	0.8
Brewerville	2.4
Monthly Income in Liberian dollars(LD$)	
100,000-150,000	32.8
50,000-100,000	25.4
30,000-50,000	11.2
5000-25,000	29.0
N/A	1.6

Source: Author's fieldwork 2017.

spondents have the energy play an active role in issues relating to participatory solid waste management in Monrovia.

From the sampled population, the educational background of respondents ranged from 35.2% for masters, 38.8% bachelors, 16.2% high school graduate, 9.0% Doctorate and 0.8% N/A. This further indicates that education again is becoming a priority to Liberians after the post-war era.

The study also revealed the household size of the sampled population as (48.8%) for 3-5 persons per household, (30.2%) for 5 and above and (21.0%) for 0-3 per household. The slight increase in the number of individuals per household is due to increasing urbanization of the city. This finding is consistent with previous findings on Distribution of household population and household size by residence, which showed 4.8 as the average household size of Monrovia (LDHS, 2013). Table 2 also shows the distribution of respondents' monthly incomes. The majority, 32.8%, realize a maximum monthly income of (LD$) 100,000-150,000) which could be regarded as merely substantial.

Waste generation

A significant proportion of the waste generated in Monrovia is organic refuse followed by plastic. The increasing number of plastic waste is as a result of the increased use of plastic products on the market in Monrovia. (E.g. plastic sachet water, polyethylene terephthalate (PET) bottles and plastic bags). Other waste generated consisted mainly of a plastic 14.2%, glass/ceramics 10.5%, metals 3.0%, rubber 10.0% and batteries 9.9%.) These results are also in line with other studies which revealed that the highest component of wastes generated in developing nations consists of organic materials (UNEP, 2006) (David Jr, V. et al., 2016) (see Table 3).

Solid Waste collection and disposal

The study revealed that waste generated were not sorted and were randomly mixed. Wastes are being dumped in open spaces, streets corners, burnt, or buried in backyards. The percentage of waste collected by private companies and the Monrovia city corporation were mixed in refuse bags. There is little or no recycling of waste in the city. Wastes collected from households or designated points in communities are collected twice a week. The collection system, however, is ineffective. Thus, wastes are found by the roadside or street corners in the city. Figure 2 A&B show waste randomly mixed and left by the roadside.

The Monrovia City Corporation is responsible for waste management in the city. The city corporation along with the Paynesville city corporation and five private companies are in charge of collection and waste disposal of waste. It is worth mentioning that the city corporation and private companies are faced with challenges ranging from insufficient logistic, lack of finance, skilled individuals and inadequate corporation between stakeholders

Waste is being disposed of in one disposal site, named Whein town Landfill. The landfill, however, is filled and the government has designated a new landfill site in Cheesmanburgh. Adequate disposal is vital to the sustainability of any waste management system. Adequate disposal of municipal solid waste tends to minimize threats to health and environment. From the sampled respondents, 50% said that their waste was collected by private companies for disposal at the landfills while 20.2% said they buried waste in their backyards. 17.2% practiced open burning in the backyard, 8.8% give their waste to scavengers, 2% dump wastes into rivers and 1.8% dump their waste into swamps (Figure 3).

TABLE 3
Composition of solid waste generated in Monrovia

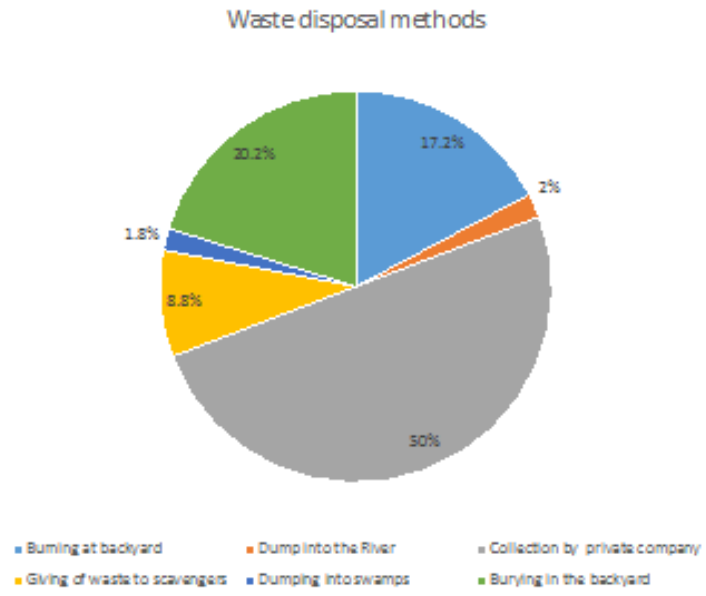
Composition	Percentage
Paper	12.2
Plastic	14.2
Glass/ Ceramics	10.5
Metal	3.0
Organic refuse, vegetables	40.2
Rubber	10.0
batteries	9.9
Total	100

Source: Author's fieldwork 2017

Source: Author's fieldwork 2017

A B

FIGURE 2
A&B showing waste randomly mixed and left by the roadside.



Source: Author's fieldwork 2017

FIGURE 3
Waste disposal methods

Waste recycling

Currently, there is no recycling Programme implemented by the City of Monrovia. Majority of the waste disposed of in the landfill consists of recyclable waste. Although the city does not have a formal waste recycling system, it was found that the disposal site has informal waste reclaimers that are collecting recyclable wastes. Waste reclaimers collect recyclable ranging from, plastics, metals cardboards, cans, etc. (Figure 4). Interviews conducted with the waste reclaimers revealed the unavailability of data regarding the amount of recyclables collected per day.

Waste Transportation

A small portion of solid waste is collected from designated collection points by the Monrovia city corporation. Subcontracted private companies responsible for picking up

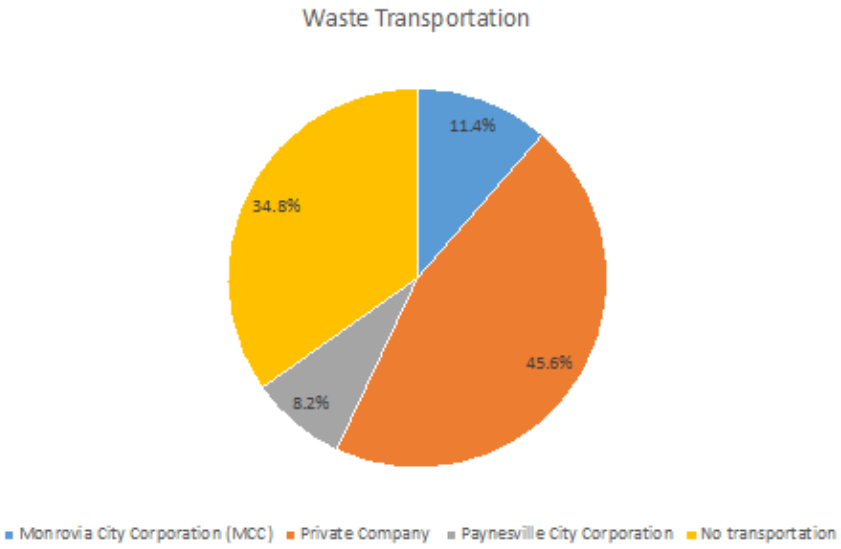
Source: Author's fieldwork 2017

FIGURE 4
Collection of plastics

litters pick up litter along the streets and finally dispose at the landfill. Waste collected is not sorted before disposal all disposed to the landfill. From the data gathered, 45.6% of waste was transported by private companies, 35% said their waste wasn't transported which explains the problem of open dumping in the city. 11.4% of waste was transported by the Monrovia city corporation (MCC) and 8% by the Paynesville city corporation (Figure 5).

CONCLUSION AND RECOMMENDATIONS

Waste management in the city of Monrovia is characterized by large-scale illegal dumping and of the burning of wastes. The collection of waste is carried out twice a week and usually is not followed. There's ineffective door-to-door collection of waste and insufficient communal bins at designated locations for collection of solid waste. The unavailability of communal bins and inefficient collection have resulted



Source: Author's fieldwork 2017

FIGURE 5
Entity responsible for waste Transportation

in the open dumping of waste in open spaces, streets corner, and swamps. The Monrovia City Corporation is the government arm responsible for managing solid waste within the municipality. Solid waste services in the city are rendered in an unsatisfactory manner. Challenges to solid waste management in the city range from, indiscriminate dumping due to the unavailability of communal bins, lack of treatment or recycling of wastes, lack of adequate technical and technological skills, lack of specialized vehicles, etc., and lack of public participation of the communities. The study also revealed the absence of comprehensive waste recycling and reuse programs in the sampled sites. However, there is still a chance that city of Monrovia could offer a sustainable waste management system to residents of the city. The situation in the city can be improved based on the following recommendations;

- By conducting adequate public awareness and encouraging community participation especially in the decision-making process as well as the planning and implementation of SWM programs (Demanya, 2009)
- Instituting educational programs geared towards increasing awareness on environmental and waste-related issues.
- It is recommended that that both the public and private sectors complement their efforts by ensuring adequate collection, safe and effective transportation, recycling, and disposing of wastes (Katusiimeh et al., 2013)
- Mechanisms for implementing 3R concepts Reduce, Reuse, and Recycle should be instituted.
- Ensure proper monitoring of waste management services (Chuen-Khee & Othman, 2010).

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