

Plastic Waste Management in Monrovia: A Potential for Environmental Sustainability & Economic Gains

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Abstract - Municipal solid waste management has sufficed as one of the most difficult challenges facing city governments, pollution consultants, and environment managers. Interestingly, plastic waste constitutes the most significant portion of municipal solid waste and come with far-reaching impact like drainage clogging, soil cover degradation, and surging of health-related issues (Idumah et al., 2019). This reviewed scholarly published papers on plastic waste management in Liberia's capital, Monrovia, to spotlight the potential for economic gains and environmental sustainability. Different Articles by other researchers on solid waste management and reports by NGOs on environmental management were thoroughly reviewed to identify gaps and opportunities. The research found that waste managers still treat waste management in Monrovia from a problem standpoint. Findings also suggest the absence of rigid legislation, over-dependence on donor support, lack of recycling technologies, and lack of financial resources, amongst others. However, there are a plethora of opportunities for a shift. The paper proffered recommendations like 1) incentivizing waste collection and disposal, investing in biodegradable polymer production, strengthening legal framework, and source control mechanisms.

Key Words: Solid waste, plastic waste technology, sustainable plastic waste, biodegradable plastic, benefits of plastic waste

1. INTRODUCTION

Municipal solid waste management has sufficed as one of the most difficult challenges facing city governments, pollution consultants, and environment managers. Plastic pollution is the amalgamation of plastic items and particulates (e.g., plastic bottles, bags, and microbeads) in the Natural ecosystem, harming animals, wildlife habitats, and people. Plastic waste, however, is the most difficult non-biodegradable solid waste to handle. Interestingly, plastic waste constitutes the most significant portion of municipal solid waste and come with far-reaching impact like drainage clogging, soil cover degradation, and surging of health-related issues (Idumah et al., 2019). Plastic blocking waterways is not the only water-related problem, but contamination of water bodies through the release of chemicals is another issue that needs attention. Plastic

wastes are polymers that cause severe poisoning to humans if the long-term use plastic is used mainly (Pan et al., 2020). In 2010, an estimated 4.8-12.7 metric tonnes of plastic waste across 192 coastal cities were generated and released to the ocean- causing significant biodiversity loss in the ocean habitat. Without introducing proper waste management technologies, this figure will worsen by 2025 (Jameberk et al., 2015). On average, about 8 million metric tonnes of plastic waste make it to the ocean each year. This poses a grave threat to aquatic ecosystems and destroys important biodiversity needed to create balance for our one planet.

1.1 Statement of the problem

Liberia is located in West Africa, with an estimated population of about 5 million people. Like all developing countries, Liberians are impoverished, with a human development index put at 0.480 and ranked 175 in the HDI ranking (UNDP, 2020). There is a rapid increase in urbanization, especially in rural-urban. In Liberia's most urbanized city, Monrovia, waste management remains a serious challenge. Plastic waste makes up over half of all solid waste in urban Liberia. The culture of recycling dominating significant parts of the developed world and some countries in the global south seems non-existent in Liberia. Primitive technologies of plastic waste recycling are emerging. However, these efforts are marginal and lagging in essential areas like process financing and incorporation of new and advanced technologies.

1.2 Significance of the study

As Monrovia stinks in filths of uncollected and untreated solid wastes, the need for improved waste management systems that offer economic benefits while ensuring environmental sustainability cannot be overlooked. The potential is enormous as it provides a financial return for waste management firms while raiding the environment of toxins like polytene produced by plastic waste. This research hopes to investigate current efforts in plastic waste management in Monrovia, assess strengths and weaknesses, and recommend cross-cutting waste management strategies and techniques that offer greater economic return while ensuring the sustainability of the environment.

1.3 Limitations and Delimitations

The surge in the health and environmental issues associated with improper waste management in Monrovia has prompted several types of research by the government, NGOs, and academics in the area. However, many said studies have focused on waste management as a problem rather than an opportunity. This paper considers waste management a solution to environmental degradation and an opportunity for economic gains. One significant limitation, however, is the lack of primary data. Data reviewed from published articles may vary and create room for error.

2.0 Literature Review

Plastic waste in the environment poses a danger to land, water, animals, and even human health. The environmental effect of plastic waste contamination is a fast-growing subject of interest for scholars, policymakers, corporations, and the general public, gaining substantial global attention (Chowdhury et al., 2020; Nielsen et al., 2020). Municipal plastic waste (MPW) accounts for a significant portion of both developed and developing nations' municipal solid waste (MSW) (Areeprasert et al., 2017). The chemical composition of plastic waste makes it contiguous for the environment's health and its inhabitants.

2.1 Plastic waste composition

The dangerous nature of the chemicals that constitute municipal plastic waste further justifies the relevance of this study. Plastics are composed of artificial organic polymers and are extensively utilized in various industries, including water bottles, clothes, food packaging, medical supplies, technological items, and building materials (Alabi et al., 2019). The release of these polymers in the environment contributes to soil cover degradation for agricultural production, contamination of surface and groundwater sources, clogging of drainages, destruction of biodiversity, and deterioration of human and environmental health.

2.2 Sources of Plastic Waste in Monrovia

Municipal plastic waste constitutes a significant portion of overall solid waste generation in Monrovia. The city's population has more than doubled since the end of the city due to the rural-urban migration of locals from the countryside. Garbage management in the city is insufficient, and a large volume of residential solid waste is created daily that is not collected and disposed of properly (David et al., 2019). Household plastic waste constitutes the most significant amount of solid waste in Monrovia. Local water manufacturing industries have been the primary producers of plastic waste lately. In the table below (Table 1), plastic waste makes up the second-highest amount (14.2%) of total solid waste in Monrovia, second only to organic reuse and vegetables.

Table -1: Solid Waste Distribution in Monrovia

Composition of Monrovia's solid waste	
Composition	Percentage
Paper	12.2
Plastic	14.2
Glass	10.5
Metal	3
Organic Refuse, vegetables	40.2
Rubber	10
Batteries	9.9
Total	100

2.3 Challenges of waste collection and disposal in Monrovia

Like most developing nations, Liberia has huge waste collection and disposal challenges. Part of the problems affecting waste collection and disposal in Monrovia are 1) the absence of proper zoning that underpins strategic city planning, high population density due to rapid urbanization, scarcity of cutting-edge technologies to collect and adequately treat waste, and lack of adequate infrastructure and financial capacities on the part of the requisite agency to handle the waste effectively.

2.4 The current method of waste management in Monrovia

From its inception, waste management in Monrovia has been the landfill approach. The city government collects wastes from the streets without separation and disposes them to a selected landfill area in a suburb known as Wein Town. Below (Figure 1) is a picture of the landfill outside Monrovia. On many occasions, residents of this neighborhood have staged protests that the leaks from the landfill contaminate their water sources and causes disease outbreak.



Figure -1: Wein Town Landfill in Monrovia

2.5 Potential for plastic waste management

Though the challenges facing plastic waste management in Monrovia seem enormous, the prospects are also high for environmental and economic gains. The table below (Table 2) shows a record of how the environmental science department at the Cuttington University in Suakoko has been using local technology to transform plastic (Low-Density Polyethylene) waste into floor tiles and slabs. This project has impacted environmental sustainability and economic gains on a small scale.

Table -2: Record of Pavement Tiles Produced from Plastic Waste at Cuttington University

Period	Qty of plastic (Kg)	Qty P. tile (pcs)	Unit Price (\$)	Amount (\$)
1 st Sem 2019/2020	200	100	3	300
2 nd Sem 2019/2020	220	110	3	330
1 st Sem 2020/2021	200	100	3	300
2 nd Sem 2020/2021	350	175	3	525
Total	970	485		\$ 1455.00

2.6 Evolving technologies for Plastic Waste Management

There are several known ways in which plastic waste can be treated to attain environmental and economic satisfaction. As plastic garbage continues to amass at alarming rates in the ocean, the demand for effective and long-term cleanup solutions becomes more critical. To combat plastic pollution, one possibility is the design and deployment of devices that either prevent plastics from entering waterways or collect plastic waste from the ocean and rivers (Schmaltz et al., 2020). Chemical recycling has been on the increase in most developed countries. However, this may seem unachievable for developing countries, including Liberia, due to high cost and energy demand. This process turns used plastic into

plastic and fossil fuel (CNBC, August 29, 2020). In Sweden, 1% of waste ends up in landfills each year. The country has demonstrated immense adept in waste recycling and environmental sustainability. Plastic waste is used to generate energy for Sweden. The country imports 10% of treated waste each year from the United Kingdom and creates money for that country's Gross Domestic Products (France 24 English, 2018).

3.0 Methodology

Monrovia is a coastal city with an elevation of less than 10m. The city is home to about 2M people. Since the end of the civil war in Liberia in 2003, the city has experienced rapid population growth, leading to a proportional increase in industrial activities. Waste generation has tripled for a municipality largely unplanned. The city's increasing population, accompanied by semi-industrial activities, poses severe environmental threats to its inhabitants.



Figure -2: Map of Monrovia

An Extensive Literature Review, ELR, was conducted on existing research in plastic waste management to inform new perspectives on how improvements can be made in theory to tackle the growing proportion of plastic waste in urban Liberia's healthy environment. The focus of the research was to finetune existing local technologies on plastic waste management that offer both environmental and economic gains.

4.0 Results and Discussion

Over time, solid waste management in general and plastic waste, in particular, have proved hectic for waste managers and city planners in the developing world. One of the major challenges to MSW management in Monrovia is the absence of adequate and accurate records regarding the physical and chemical composition of waste and the quantity of waste generated throughout the country, thereby restricting comparisons with developed and underdeveloped countries (David et al., 2020). Waste management is still at the problem stage in Monrovia. The city government is still considering waste as a problem with no sustainable solution. Part of the problems affecting waste collection and disposal in Monrovia are 1) the absence of proper zoning that

underpins strategic city planning, high population density due to rapid urbanization, scarcity of cutting-edge technologies to collect and adequately treat waste, and lack of adequate infrastructure and financial capacities on the part of the requisite agency to handle the waste effectively. The traditional landfill method has caused and will continue to create health and environmental issues. Unless carefully managed, landfills have a propensity to pollute soil and groundwater. In contrast, trash incineration has shown difficulties with smell and air pollution and maybe impractical due to the inherent properties of the solid waste (Idumah et al., 2019).

Additionally, the growth in mini water bagging industries has increased the city corporation's challenges in collecting and disposing of plastic waste. Due to the cheapness of plastic products, water companies do not care to recollect and reuse used water plastic. Waste management has been donor-sponsored since the end of the civil war. The current 'donor-fatigue' necessitated by the Covid-19 outbreak has taken a significant toll on resource mobilization for the city government as stockpiles fill the streets of Monrovia.

4.1 Absence of rigid legislations

Effective waste management comes with enormous responsibilities for city managers and city dwellers. The 2015 draft solid waste management policy outlines the roles and responsibilities of solid waste management. However, the documents lack clear-cut punitive measures for violators that would ultimately serve deterrence. Policies are not regularly explained to citizens to create awareness of the health and environmental dangers of improper waste disposal. The division in waste management activities amongst different government entities (EPA, MCC, and MPW) leaves no one taking full responsibility. The blame game continues while the city sits in filth.

5.0 Conclusion and Recommendation

5.1 Conclusion

A plastic-free society is impossible given the multiple uses it has. Plastic-derived products have evolved into a necessary resource for various applications in today's society (Mourshed et al., 2017). Plastic waste in the environment poses a danger to human and animal health. A massive volume of discarded plastic creates environmental concerns that endanger marine life, degrades soil fertility, and contaminate groundwater (Mourshed et al., 2017). Over time, solid waste management in general and plastic waste, in particular, have proved hectic for waste managers and city planners in the developing world. One of the significant challenges to MSW management in Monrovia is the absence of adequate and accurate records regarding the physical and chemical composition of waste and the quantity of waste generated throughout the country, thereby restricting comparisons with developed and underdeveloped countries (David et al., 2020). The absence of a rigid legal framework

to regulate and monitor waste creation and collection and over-dependence on donor funding are two major factors underpinning the waste management failure in Monrovia.

5.2 Recommendations

Though plastic waste poses an immense threat to the environment and the health of humans and animals, proper management offers potential opportunities for ecological sustainability and economic gains. An integrated approach to waste management can provide more significant opportunities for urban dwellers and city managers is necessary for waste management in Monrovia. A complex approach is required to address the global plastics issue, encompassing prevention, reuse, recycling, recovery, and disposal. Biodegradable polymers are a critical component of this approach (Flury & Narayan, 2021). The research recommends that the city government:

1. Incentivizes waste from collection to disposal to reduce donor-dependency
2. Invests in novel technologies in waste management to shift the problem perspective to opportunity
3. Develop and strengthen legislations that hold culprits accountable and impose fines for deterrence
4. Develop regulations that control plastic waste from the source (manufacturers)
5. Subsidize the production of biodegradable polymers to ensure the environmental health

ACKNOWLEDGEMENT

I like to acknowledge the almighty for his guidance and my dear mother and sponsor, Hawa Bility.

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