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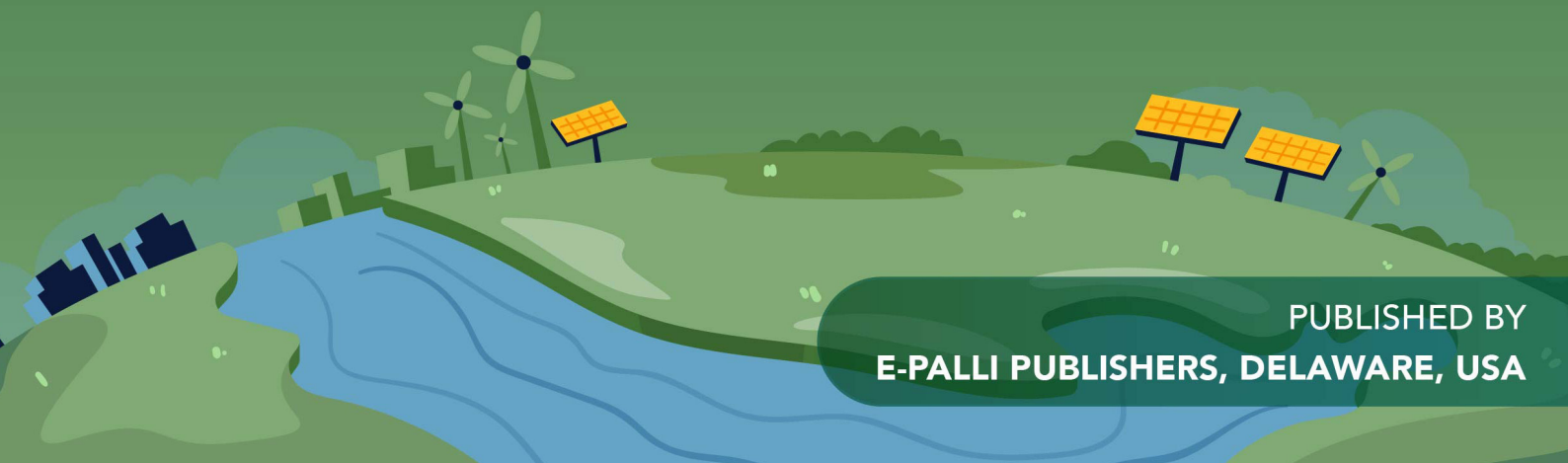

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Assessment of Policy Guidelines, Strategies, and Operational Processes Associated with Plastic Waste Management in Ghana

Derick Kwabena Mintah[1*], Rama Osei-Bonsu[2], Joseph Appiah[2], Loretta Obeng Mensah[3]

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ABSTRACT

The study sought to assess to assess the policy guidelines, strategies, and operational processes associated with plastic waste management in Ghana. A descriptive cross-sectional study design that employed both quantitative and qualitative procedures was used. The data was analysed using Statistical Package for Social Sciences (SPSS). Descriptive analysis was performed on the structured questionnaire whereas thematic analysis was conducted on data from the interview guided. The results revealed that there are guidelines, strategies, and operational processes for plastic waste management in greater Kumasi and there exist different activities of stakeholders (Recycling companies, KMA and Waste collectors) in plastic waste management in Kumasi. The extent of compliance with plastic waste management guidelines (National Plastic Waste Management Policy) is dependent on the different stakeholders. Plastic recycling companies are in the infant stage with their activities being centered on six processes with pelletizing plastics for export been their major activities whereas waste collectors are solely responsible for collection, transportation and final disposal of plastic waste from different places to either dump sites or plastic recycling companies. KMA and other government institutions involved in waste management must take steps by supervising the day-to-day activities of plastic recycling companies and waste collectors to regulate the activities of companies within the plastic recycling industry.

INTRODUCTION

Plastic use and especially the management of plastic waste has become one of the biggest and most complex challenges of this century, and as a complex challenge, it requires integrated solutions. Although plastics are a globally important material, there are many environmental concerns associated with their use. The hazards plastics pose are numerous and multidimensional and their impacts may transcend national borders. Global plastics production grew from 1.5 million metric tons (Mt) per annum in 1950 to 400 million Mt in 2017. Production during the last 10 years equaled production during the whole of the 20th century combined. It is estimated that global plastic production could triple by 2050. Furthermore, only 9% of the 9 billion tons of plastics ever produced have been recycled, with 8 to 12 million tons entering the ocean as litter every year (Ministry of Environment Science, Technology and Innovation (MESTI), 2020). The problem with plastic lies not in how it is used, which is generally harmless, but in end-of-life management of products made from it (Arnaud, 2019). Since 1950, close to half of all plastic has ended up in landfill or dumped in the wild (Geyer *et al.*, 2017)

Plastics entered Ghana in the late 1990s and facilitated the packaging of manufactured products and reduction of agricultural wastage. However, the waste stream over the years is changing from mainly organics to increasing proportions of plastics, whereas the attitude of indiscriminately disposing of (previously organic) wastes still remains widespread. Plastic waste has found its way into surface water and marine environments (MESTI, 2020). In Ghana, some 120 companies manufacture over 52,000 tons of various plastics and plastics products per year. Presently, the exact quantities and sources of origin of plastics imported into the country are not monitored and are therefore not known. More than one million tons of plastic wastes are generated every year. This suggests that domestic manufacturing accounts for less than 5% of all plastics entering the Ghanaian economy.

One primary driver of plastic waste management is legislation (Agamuthu *et al.*, 2009). Sustainable plastic waste management must be grounded in local legislation that is geographically and culturally feasible, reasonable, and far-sighted. Cooperation by various stakeholders is required to achieve sustainable waste management. Laws and regulations for plastic waste management in developing countries are mostly embedded in larger environmental laws or acts in solid waste management. However, this is not the case in Ghana where there is the existence of national plastic management policy. Despite the existence of this policy, there are no specific laws/ outlines detailing the plastic waste collection, sorting, disposal and recycling processes to improve the way plastic waste is managed in Ghana. The few embedded laws to improve plastic waste in Ghana are poorly implemented.

Again, most MMDAS in Ghana lack the needed logistics and often see plastic waste management as a poor service because operating costs for even Municipal Solid Waste Management are barely recovered and most of the municipalities are unable to provide the appropriate level of services. The guidelines and strategies outlined

[1] Kumasi Compost and Recycling Plant Limited, Ghana
[2] Akenten Appiah Menka University of Skills Training and Entrepreneurial Development, Ghana
[3] Kwame Nkrumah University of Science and Technology, Ghana
[*] Corresponding author's e-mail: dmintahk@gmail.com

in national plastic management policy in Ghana face the challenges of inadequate finance in supporting plastic waste management, untrained personnel at the local offices, political influences, lack of community involvement, inappropriate technology to suit emerging conditions, and unavailable data on plastic waste and many others.

Looking back over time, the Revised Environmental Sanitation Policy of 1999 stated Information, Education and Communication, Legislation and Regulation, Levels of Service, Sustainable Financing and Cost Recovery, Research and Development and Monitoring and Evaluation as its general policy focus with several broad policy principles relevant to improving environmental sanitation. This revised environmental sanitation policy seeks to address the limitations of the old policy published in 1999. In addition, the policy emphasizes the need to ensure a systematic collection of data on waste from all sectors of the economy and supports relevant research and development to meet the challenges of managing waste in Ghana. This gave rise to the enactment of the implementation programs to ensure the successful accomplishment of the policy focuses. Unfortunately, these programs have not been up to the task. Formulation, and most importantly, enforcement of government laws and regulations are vital for the attainment of sustainable solid waste management; however, developing countries have challenges with the implementation of laws and programs to attain proper plastic waste management.

Consistent with Ibrahim *et al.*, (2016) findings, Ghana has no national law binding the national plastic management policy for the management of plastic waste. Furthermore, Metropolitan, Municipal, and District Assemblies (MMDAs) are expected to come up with bylaws, which must be passed by parliament and monitored by the Heads of MMDAs. Key national policy documents that capture solid waste management in Ghana include the National Environmental Sanitation Policy (NESP) 2010 and the National Environmental Sanitation Strategy and Action Plan (NESSAP) 2010. These documents were prepared by the Ministry of Local Government and Rural Development to develop and sustain a clean, safe, and pleasant environment for human settlements. They are passed as the need to refocus the environmental sanitation sector in Ghana to meet Medium Term Development Policy Framework (MTDPF, 2010 – 2013) objectives to meet the objectives of the United Nations Millennium Development Goals (MDGs), and other recent international initiatives (Asase *et al.*, 2009). Conversely, the implementations of these documents have been poor.

In 2020, a revised National Plastics Management Policy (NPMP) was enacted to cater for the lapses and challenges faced over the years of previous policies. NPMP is Ghana's integrated response to managing plastics on sustainable basis to facilitate speedy national development. It has been prepared and designed within the context of national sustainable development priorities, including achieving the objectives of the governments Coordinated Programme of Economic and Social Development Policies (2017-2024): National Medium-Term Development Framework: Agenda for Jobs: Creating equal opportunities for all (2018–2021), AU Agenda 2063 and the Sustainable Development Goals. Though the policy existence is not long, however potency of the policy is doubtful to effectively address the growing plastic waste in cities in Ghana. The study sought to assess policy guidelines, strategies and operational processes associated with plastic waste management in Ghana.

LITERATURE REVIEW

Plastics

The American Chemistry Council (2015) defines plastics as materials that are obtained from various elements such as chlorine, sulfur, oxygen, nitrogen, carbon and hydrogen. Plastics are man-made organic materials produced from raw materials of oil and natural gas with molecular weights that can range from 20,000 to 100,000 mg/L. Plastics are generally divided into two parts based on their processing as either thermoplastics or thermosets. Thermoplastics are materials that soften easily when heated and hardens when cooled. They can also be melted down and transformed into a new plastic product. Due to the way they can be easily molded into different shapes, they are usually employed in food packaging (Ampofo, 2015). Thermosets do not undergo repeated heat treatments due to their complex molecular structure; as a result of this, they are not reprocessed into new products. They are durable in nature and are used in automobiles, construction and in applications such as adhesives and coatings (Ampofo, 2015).

The four types of plastics that are currently used and recycled in developing countries are polyethylene (PE), polypropylene (PP), polystyrene (PS) and polyvinyl chloride (PVC) (BBC, 2014). Polyethylene becomes hard and stiff when sterilized, it is therefore used as shrink wraps for products, and it is also used to make bottles. As compared with PE, polypropylene is more rigid and can bend sharply without breaking. It is used for food containers, chairs, ropes, pipes and crates. Polystyrene is brittle and mostly transparent in its unprocessed form, because of this, it can be used for light fittings and cheap transparent kitchen ware. Polyvinyl chloride is usually stiff, strong and scratch resistance and it is used in pipes and window frames (BBC, 2014). To recycle plastic waste, management of it must be effective.

Plastic Waste Management

The concept of waste hierarchy is the basis for waste minimization strategies, and refers to the 3Rs which are to reduce, reuse and recycle. According to Baud *et al.*, (2004) a more environmentally friendly and sustainable solid waste management strategy emphasizes on activities in relation to reduction, reuse and recycling. The application of the 3R concept in to the waste management minimizes

the amount of waste that goes in to landfills. Reduction is aimed at reducing the amount of waste produced by adopting or optimizing the production process of manufacturers and industries. As a result, natural resources will be saved. Reuse does not involve re processing or transforming from one type of material in to another. Rather reuse occurs when one material served its original purpose and reused for another purpose rather than being thrown away. Recycling is all about transforming or reprocessing of materials that served the original function in to new products. Otherwise, those products that served the original function will be considered as waste. Recycling is common among materials produced of virgin materials such as glass, plastic, metals and electronic waste. Recycling also involves organic materials for the production of compost. (Zhu *et al* 2007). However, despite its wide use, the 3Rs approach has failed to curb the problem of plastic waste, especially in less developed countries. An analysis of the 3Rs reveals its inadequacy in solving the problem of plastic waste.

Reduce

In a modern society that has become increasingly consumption-driven, a reduction in the use of plastic is illogical. Industry and commerce need to increase output to survive and grow, while consumers are constantly urged to consume more. Plastics have now replaced many natural materials such as cotton, wood, and leather. The growth in plastic products means that the strategy to reduce will not work.

Reuse

The reuse of plastic products can only postpone the increase in plastic. Plastic products are rarely durable and often rendered obsolete by newer products. For example, the useful life of computers, which contain a significant amount of plastic, is limited by capacity. Also, the reuse of many plastic products is limited by the presence of additives such as plasticizers and flame-retardants, which leach out of the plastic and pose hazards for reuse (Halden 2010).

Recycle

Many plastics are not meant to be recycled. Plastics can be divided into two general types: thermoplastics, which can be recycled; and thermosets, which cannot be recycled. There are over 20 types of thermoplastics but only six are identified for recycling: 1, PET (polyethylene terephthalate); 2, HDPE (high-density polyethylene); 3, PVC (polyvinyl chloride); 4, LDPE (low-density polyethylene); 5, PP (polypropylene); and 6, PS (polystyrene). The other types of recyclable plastics are classified as 7, OTHER. Clearly, the system for the recycling of thermoplastics leaves much to be desired. On the other hand, thermoset plastics, which account for a large group of important industrial and consumer plastics, are not recyclable. In addition, the use of additives makes it difficult to recycle plastics. It is, therefore, not surprising that less than 9% of plastic waste is recycled globally (d'Ambrières 2019).

Before plastic waste can be recycled, it must first be recovered. However, the recovery of plastic waste requires an efficient waste management system and most developing countries are unable to do this. The failure of the 3Rs to address plastic waste can be attributed to two things: first, this strategy requires an efficient recovery

Figure 1: Plastic Waste Management hierarchy.

of plastic waste, a system that is not present in most developing countries; and second, many plastics are not designed to be recycled. The inadequacies of the 3Rs can be addressed by the 5Rs: redesign, reduce, reuse, recover, and recycle. The 5Rs capture the key aspects of the Circular Economy, a strategy that is being promoted by the European Commission (EUR-LEX, 2018).

Study Type and Design

A descriptive cross-sectional study was conducted to assess policy guidelines, strategies, and operational processes associated with plastic waste management in Ghana. The approach employed both quantitative and qualitative procedures to achieve the topic of the study. The quantitative part of this study employed structured questionnaires to solicit the views on strategies and

policies for sustainable plastic waste management in Kumasi Metropolis. The qualitative study sought to know the inherent roles of stakeholders, plastic recycling processes, challenges and opportunities that existed in the management of plastic waste.

Sample

The target population comprised of plastic waste recycling companies, waste collectors and Kumasi Metropolitan Solid Waste management. These were selected because they are active players relating to plastic waste management in Kumasi. They are also responsible for all plastic waste management issues in Kumasi and hence the need to examine the effectiveness of these groups of people plastic waste management. For the waste collectors, a total sample size of 315 was used for the study. This was to ensure that the sampled mean was closer to the population mean and minimize errors.

Sampling Procedure

A purposive and random sampling technique was used to select respondents. The respondents therefore constitute the following; 5 plastic waste recycling companies, 315 waste collectors and official of Kumasi Metropolitan Solid Waste management. These groups of people were purposively selected because they are directly engage in all waste issues in the Greater Kumasi and have considerable knowledge in the subject matter of the study. Data was collected using both Primary and Secondary data collection technique. Purposive sampling was used to select the KMA and plastic recycling companies whiles simple random sampling was used to waste collectors.

Data Collection and Analysis

Data was collected by the usage of questionnaire and interview. The data was analysed using Statistical Package for Social Sciences (SPSS). Descriptive analysis was performed on the structured questionnaire whereas thematic analysis was conducted on data gathered by interview.

RESULTS

Plastic Waste Management Companies Operational Practices And Strategies

On the issue of knowledge and awareness of National Plastic Waste Management Policy, respondents from plastic waste management companies stated that;

"There is existence of policy document on plastic waste management and we are even aware about the launch of the policy document but have never gotten a copy and there has not been awareness creation and education on the policy document" (Field Survey, May 2022).

Furthermore, when plastic waste management companies were asked about the strategy they take plastic waste collected through, they stated that;

"The operation process of our recycling of plastic is guided by the type of plastic waste received and the machines available. The state of the plastic waste materials obtained is dirty and as such plastics waste obtained are sorted and washed before the next processes follow" (Field Survey, May 2022).

On the processes involved in plastic waste recycling, plastic waste management companies further stated that

"There are differences in processes used in recycling different plastic materials. The first group comprises of recycling HD, PE and PP plastics while the second group comprises of recycling PET plastics" (Field Survey, May 2022).

Plastic recycling companies in Kumasi described the process below;

In order to recycle plastic waste, plastic recycling companies go through a six-stage process of

1. Acquiring,
2. Sorting,
3. Washing,
4. Agglomeration,
5. Pelletizing
6. Sale of plastic pellets.

For companies who source their plastics from factory waste they omit the washing stage as the plastics are already clean. Some companies crush the plastics before washing them. Apart from these variations the process is similar for most of the companies.

The acquisition stage is made up of the collection or weighing and buying of plastic waste. Once the plastic waste has been acquired it is temporarily stored within the recycling plants and then the next stage which is sorting is carried out.

The plastic waste is separated/sorted into either HD or LD or PP and each type of plastic is processed differently. The separation of plastics is carried out both manually and mechanically. Once the sorting has been carried out the plastics are then put into machines in order to wash them to get rid of any impurities that are present in them. The next stage of recycling is that the clean plastics undergo the process of agglomeration. Agglomeration is a process in which the plastics are heated until they reach melting point.

Once the plastics are in a melting state the final stage of recycling process occurs. That is the pelletizing stage during which the plastics in a molten form are crushed into plastic pellets. Plastic pellets are the final product for some of the companies and these pellets are sold to plastic product manufacturing companies to be used in the production of plastic materials.

While some companies export the plastic pellets to Europe and Asia other companies used the plastic pellets to produce black polythene bags of different sizes. The polyethylene bags then become the final product which is sold to wholesalers for use in markets and grocery shops.

Operational Processes Carried Out By Kumasi Municipal Assembly (KMA)

When the official at the KMA was questioned about the Guidelines, strategies and operational processes for plastic waste management Kumasi, the officer

stated that;

"There are few players in the plastic waste recycling business due to the capital intensive of the business despite the existence of policy document on plastic waste management. However the usage of the guidelines in the National Plastic Waste Management by Plastic waste recycling companies is another challenge" (Field Survey, May 2022).

On the issue of plastic recycling by KMA, the respondents indicated that;

"The KMA is not involved in plastic recycling but responsible for the collection and final disposal of plastic waste to the Oti landfill through their Waste Management Departments (WMDs) and their Environmental Health and Sanitation Units. KMA charge for final waste disposal from waste collectors and only incur cost for the maintenance of the landfill site" (Field Survey, May 2022).

Knowledge level of Waste Collectors on plastic waste management in Greater Kumasi

Since the activities of waste collectors are mainly collection, transport and disposal, the waste collectors were tested on whether they have received training on their daily activities. Results on waste are shown in table 1. More than two thirds of the respondents 221(70.16%) indicated that they have not receive training on waste collection, transport and disposal. Of those who have received training, most of the respondents indicated that the source of their training was from KMA 55(17.46%). This was followed by friends 10(3.17%), educational institutions 8(2.54%), television 5(1.59%), family and radio was 4(1.27%) each and colleague 3(0.95%). Like waste collection, transport and disposal, majority of the respondents 210(66.67%) again indicated that they have not receive education or briefing on plastic waste management of the national plastic waste management.

Table 1: Knowledge of Waste Collectors on plastic waste management.

Knowledge	Sources	Frequency(n=315)	Percentage(%)	X2(P-value)
Waste collection, transport and disposal				
No		221	70.16	
Yes	Family	4	1.27	
	Colleague	3	0.95	51.20(0.000)
	Friend	10	3.17	
	Personal	5	15.80	
	KMA	55	17.46	
	Television	5	1.59	
	Radio	4	1.27	
	Educational institution	8	2.54	
Plastic waste management policy training				
No		210	66.67	
Yes	Brother	2	0.63	35.00(0.000)
	Friend	9	2.86	
	KCARP	17	5.40	
	KMA	53	16.83	
	Educational institution	11	3.49	
	Television	7	2.22	
	Radio	6	1.90	

Source: (Field Survey, 2022)

Similar like waste collection, transport and disposal, majority of the respondents 53(16.83%) who had education on plastic waste management did receive from KMA. This was followed by Kumasi Compost and Recycling Plant Limited (KCARP) 17(5.40%), educational institution 11(3.49%), friend 9(2.86%), television 7(2.22%), radio 6(1.90%) and brother 2(0.63%). There were significant differences (P=0.000) on the training on waste collection, transport and disposal and plastic waste management policy.

Evaluation of Stakeholders on Policy Guidelines and Strategies on Plastic Waste Management in Kumasi

Stakeholders used in this study were evaluated on the policy and strategies on plastic waste management based on knowledge, compliance and impact on the environment on a likert scale. KMA had high knowledge on policy and strategies on plastic waste management but low compliance and high impact of their activities on the environment. KCARP on the other hand, had very high knowledge on policy and strategies on plastic

Table 2: Stakeholders evaluation of policy and strategies on plastic waste management in Kumasi.

Stakeholder	Knowledge	Compliance	Impact
KMA	Very High	Low	Very High
KCARP	Very High	Very High	Low
Zoomlion	High	Low	Low
Premier Waste Limited	Average	Low	Average
FG Recycling Plastics Limited	Average	Low	Average
Sika Waste Management	Average	Low	Average
Waste collectors	Low	Low	High

Likert Scale: Very High (8-10), High (6-7), Average (5), Low (Below 5)

waste management, very high compliance and low impact of their activities on the environment. Premier Waste Limited, FG Recycling Plastics Limited and Sika Waste Management had average knowledge on policy and strategies on plastic waste management, low compliance and average impact of their activities on the environment. Plastic waste collectors had low knowledge and compliance on plastic waste management and their activities have high impact on the environment.

DISCUSSION

Guidelines/Policies, Strategies and Operational Processes for Plastic Waste Management

Plastic Waste Management Companies

While plastic waste recycling is generally acknowledge as the way to go in reducing this menace, the involvement of state institutions in this endeavour is lacking as seen in the case of KMA in this study. The general guidelines concerning the management of plastic waste in Ghana are embodied in the Local Government Act of 1994 (Act 462) and the Environmental Sanitation Policy (ESP) of 1999, revised in 2008 (Owusu-Sekyere *et al.*, 2013). This has further been revised. Nkwachukwu (2013) stated that the common types of plastics recycled in developing countries are polyethylene, polypropylene, polystyrene (PS) and polyvinyl chloride (PVC). The findings of the study show that PE, PP and PET are the types of plastics that are recycled in Kumasi. This is primarily due to the fact that the technology that is available in Kumasi can only recycle these types of plastics. The operational processes of plastic waste management companies in Kumasi in the plastic waste management are into six steps.

Operational Processes Carried out by Kumasi Municipal Assembly (KMA)

The KMA is not involved in plastic recycling but responsible for the collection and final disposal of plastic waste to the Oti landfill through their Waste Management Departments (WMDs) and their Environmental Health and Sanitation Units. KMA charge for final waste disposal from waste collectors and only incur cost for the maintenance of the landfill site. Environmental Protection Agency (EPA) has the regulatory authority however; general solid waste management in Ghana is the responsibility of the Ministry of Local Government and Rural Development, which supervises the decentralized Metropolitan, Municipal and District Assemblies (MMDAs). The MMDAs are responsible for the collection and final disposal of plastic waste through their Waste Management Departments (WMDs) and their Environmental Health and Sanitation Units. Owusu-Sekyere *et al.,* (2013) stated that the EPA Act 490 was the enabling legislation and, with regard to plastic waste management, it enables the Minister in charge of Environment to make regulations concerning the type, quality or conditions or concentration of substances that may be released into the environment; and the collection, storage, recovery, recycling or disposal of substances which may be hazardous to the environment.

Waste Collectors' on Plastic Waste Management in Kumasi

Waste collectors primarily are involved in the collection, transport and final disposal of waste. Waste and waste picking have thus been interpreted under different corpora of the literature, including: social movements,(4) environmental and sanitation engineering,(5) political economy,(6) informal economy,(7) urban anthropology,(8) sustainability studies,(9) participatory governance,(10) ecological modernization theories,(11) urban geography(12) and gender.(13) (Dias, 2016). Waste collectors in this study see their daily activities as a form of waste management purposely for environmental and sanitation engineering. Knowledge is important in waste handling. Waste management education for waste collectors was low as majority of them have not receive training on waste handling in terms of collection and transport in Greater Kumasi. The greater number of the waste pickers lacking knowledge on waste management implies that they are not aware of the existence of the national plastic waste management policy. This has detrimental effect on waste management in greater Kumasi as there would be poor handling of plastic waste leading to hazardous effect.

Stakeholders Evaluation on Policy And Strategies on Plastic Waste Management in Kumasi

Evaluation on policy and strategies on plastic waste management in Kumasi is important to reveal the level

of passivity on existing policies. Different stakeholders used in this study had different outcome from the policy and strategies. KMA recorded high knowledge on policy and strategies on plastic waste management but low compliance and high impact of their activities on the environment. The result of high knowledge on policy and strategies on plastic waste management is attributed to the level of educational background of KMA officials and engagement with government agencies such as Ministry of Environment and EPA on issues pertaining to plastic waste. Again the low level of KMA on compliance on plastic waste can be ascribed to the fact that KMA is not directly involve in plastic recycling and as such receives plastic waste on the Oti landfill in Kumasi. Such open dumping has high impact on the environment owing from chemicals from the plastic and non-degradable of plastics. Plastic waste recycling company like KCARP on the other hand, had very high knowledge on policy and strategies on plastic waste management, very high compliance and low impact of their activities on the environment. High knowledge like that of KCARP is attributed to educational level of workers at the company. The high level of compliance is due to plastic waste recycling activities carried out at the company to reduce the menace of plastic waste. This is thorough pelletizing of plastics receives from waste collectors and as such their activities had no impact on the environment. Other recycling companies such as Premier Waste Limited, FG Recycling Plastics Limited and Sika Waste Management had average knowledge on policy and strategies on plastic waste management, low compliance and average impact of their activities on the environment. the underlying reason accounting for this is due to some average level of education receive on plastic waste management and low level of engagement from government on plastic waste policy and strategies. Most of these waste collectors had not received training on plastic waste management and had low educational level. Their activities which involve the usage of tricycle to carry plastic waste somehow end some of the gathered and transported plastic waste on the highways since the vehicle used is not designed for waste transport.

CONCLUSION

Plastic waste management is a challenge in Kumasi one of the fastest-growing cities in Ghana and Africa at large. There is daily huge generation of municipal waste with plastic waste management improperly disposed in and around the city of Kumasi. The results revealed that the stakeholders were aware of the national plastic waste policy. Despite the existence of guidelines in the form of National Plastic Waste Management Policy, knowledge level on it is very low and the operational process for plastic waste management is based on the recycling machines. The results further revealed that there were different roles of stakeholders in plastic waste management. KMA and other government institutions involved in waste management must take steps by supervising the day-to-day activities of plastic recycling companies and waste collectors to regulate the activities of companies within the plastic recycling industry. This is to ensure that the activities that are carried out within this sector are legal and that companies comply with the entire regulated framework. Smaller-scale plastic recycling companies should consider creating an association for big players in the industry. This will enable them to communicate with a unified voice on issues that are of concern to them. By forming an association they will also be able to build a strong reputation for the plastic recycling industry in Ghana.

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