

# Environmental and Public Health Effects of Plastic Packaging Debris in Accra, Ghana: Assessing a Policy Role for Extended Producer Responsibility (EPR)

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## Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

## Article Information

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## ABSTRACT

Exponential growth in urban populations has steadily transformed the volume and composition of wastes generated in developing countries in the past few decades. One of the most visible aspects of such transformation is the ubiquity of plastic packaging residues in the waste stream. In many cities in the developing world, the use of polythene bags for packaging everyday commodities such as; food, drinking water and groceries is commonplace, resulting in the generation of massive volumes of plastic debris on a regular basis. In juxtaposition however, the waste management milieu is characterized by a myriad of inefficient practices including; poor collection; open dumping and rudimentary incineration practices. Against this backdrop, the present study examined the environmental and potential public health impacts of plastic packaging in Ghana. The study was undertaken in the Accra Metropolitan Area, the capital and largest city in Ghana which covers a

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total land area of almost 200 square kilometres and a population of over four million people including permanent residents and daily commuters. Data was collected by means of interviews, informal group discussions, site observation as well as a comprehensive review of official government documents. The findings depict an entrenched culture of plastic packaging resulting in the generation of debris on a regular basis. In juxtaposition, the management of such debris is characterized by a high degree of ineffectiveness, resulting in pollution of ecosystems in the study area. The consumption of water packaged in mini plastic sachets in particular raises major public health concerns around contamination and the possibility of transmitting infectious diseases such as cholera. Further, current regulatory arrangements were found to be vague and incomprehensive and fail to delineate the issue of plastic packaging debris.

*Keywords: Plastic packaging; waste management; pollution; public health; extended producer responsibility; developing countries.*

## 1. INTRODUCTION

Exponential growth in urban populations has steadily transformed the volume and composition of wastes generated in developing countries in the past few decades. One of the most visible aspects of such transformation is the ubiquity of plastic packaging residues in the waste stream. In many cities in the developing world, the use of polythene bags for packaging everyday commodities such as; food, drinking water and groceries is commonplace, resulting in the generation of massive volumes of plastic debris on a regular basis. In juxtaposition however, the waste management milieu is characterized by a myriad of inefficient practices including; poor collection; open dumping and rudimentary incineration practices (see for example: [1-11]. Under such conditions, the widespread use of plastic polythene bags as primary packaging materials aggravates an already precarious situation. By nature, plastics are inert, not easily biodegradable and can remain in the environment for protracted periods of time and therefore, mismanagement may have deleterious effects on ecosystems, biota and possibly human health.

The accumulation of plastic debris in aquatic ecosystems may for instance, obstruct the exchange of gas between the overlying waters and the pore waters of the sediments [12]. This may result in hypoxia or anoxia of the benthos and can ultimately interfere with normal functioning of the affected ecosystem and in the process, alter the make-up of life on the ocean floor [Ibid.]. There is also a risk of aquatic biota ingesting plastic residue resulting in blockage of gastric enzyme secretion; diminished feeding stimulus; lowered steroid hormones; delayed ovulation and; reproductive failure [13]. Particularly in small fishes and seabirds,

ingestion of plastic debris has a proclivity to result in reduced feeding, internal injury and death [14,15]. Overall, more than 260 species of mammals, invertebrates, turtles, fish and seabirds have reportedly ingested or become entangled in plastic debris, leading to death, lacerations, ulcers and other deleterious effects worldwide [16-18].

There is also a fair amount of scientific data pointing to a direct correlation between some chemicals used in the manufacture of plastic packaging materials and adverse effects on human populations, including reproductive abnormalities (see for example, [19-21]. Phthalates used in the manufacture of plastics has been reported to have a level of sensitivity to the male reproductive tract and in adults there is some evidence of a phthalate metabolites adversely affecting semen quality [22]. In some cases, detrimental effects may be caused by both chronic low-dose as well as acute exposures to higher doses [23]. Similarly, bisphenol A (BPA), a carbon based organic compound found in plastic storage containers used for the packaging of food, bottled water and other beverages has been linked to cardiovascular diseases, type two diabetes and abnormalities in liver enzymes [24].

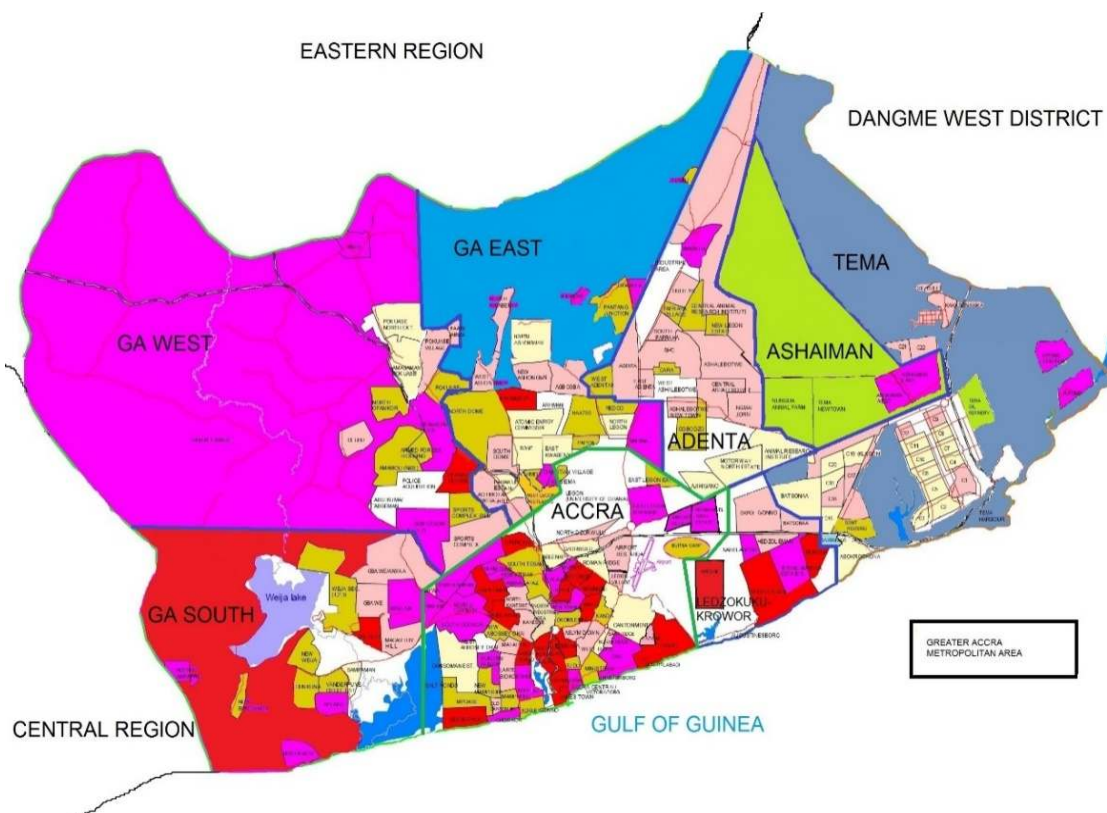
The current study examined the environmental and potential public health impacts of plastic packaging in Ghana with a view toward putting forward policy recommendations that might be used to ameliorate existing conditions in line with the concept of Extended Producer Responsibility (EPR). In the past few decades, usage of plastic polythene bags as packaging receptacles for a wide variety of products including food, water and groceries has gained traction in Ghanaian cities. Yet, effective waste management service delivery is severely lacking, resulting in the

elevation of risks to the environment and public health.

## 2. MATERIALS AND METHODS

The study was undertaken in the Accra Metropolitan Area, the capital and largest city in Ghana which covers a total land area of almost 200 square kilometres and a population of over four million people including permanent residents and daily commuters [22]. Data collection involved qualitative interviews, informal group discussions, site observation and a comprehensive review of official government documents. In total a number of 28 individuals representing government officials at both the local and national levels, street vendors, waste management personnel and producers of plastic packaging products were interviewed. As well, a total of 5 informal group discussions were undertaken during the course of the investigation. The objective of the interviews and focus group discussion were to collect data pertaining to sources and types of plastics in the waste stream,

modalities in place for the management of plastic wastes; risks to the environment, human health and wildlife and; ways in which the current situation might be ameliorated using EPR as a policy instrument. Site visits were made to a number of waste disposal dumps in the study area as a way of analyzing the composition and volume of plastic wastes disposed in the study area. Although this was not a formal waste audit, it nonetheless provided useful insights in regards to the volume and composition of wastes disposed of in dumps across the study area. Furthermore, a comprehensive review of public documents were undertaken as a means of identifying policies and programs pertaining to the production and management of plastic packaging materials. Documents analyzed include: The Revised Ghana Environmental Sanitation Policy (ESP); Ghana Environmental Action Plan; Ghana Landfill Guidelines and; Manual for the Preparation of District Waste Management Plans in Ghana. A topographical map of the Greater Accra region highlighting the study area is presented below.



**Fig. 1. Topographic map of the Greater Accra region showing the study area**  
 Source: Wikipedia Commons, 2016

### 3. FINDINGS AND DISCUSSION

The field investigation revealed major issues relating to: a) a culture of excessive plastic packaging; b) deleterious environmental effects c) public health risks and; e) major gaps in existing policies and regulatory arrangements.

#### 3.1 Culture of Excessive Plastic Packaging

There field investigation uncovered an entrenched culture of excessive plastic packaging in the study area resulting in the generation of massive volumes of debris on a regular basis. The main type of plastic debris generated is Polythene (PE) carriers used for packaging food, drinking water, groceries and almost every commodity sold in the study area. Prior to the year 1990, commercially produced ready-to-consume meals were served in large biodegradable leaflets and packaged in old newspapers and similarly, drinking water and other forms of liquid beverages were served in reusable metal or plastic cups. This trend begun to shift in the late 1980s and early 1990s ostensibly due to growing awareness regarding potential health risks associated with the use of reusable cups by multiple consumers. Subsequently, the packaging of drinking water in plastic sachets known locally as *pure-water* was introduced in the early 1990s and has since become entrenched in Ghanaian culture. Around the same period, most roadside food vendors shifted from the use of large biodegradable leaflets as primary packaging materials to the use of transparent and black polythene bags. Presently, there are 1,238 registered companies producing sachet water in Ghana, 54 of which are located in the study area. The combinative effects of a high urban population and demand for food and water products contributes to the generation of massive volumes of plastic packaging debris on a regular basis, the management of which constitutes a major problem for decision-makers. Only a fraction of the total volume of waste generated in the metropolis are actually collected and disposed in a designated dump due to the absence of a sanitary landfill. Resultantly, pollution by plastic packaging has become a common feature of the urban landscape, leading to a host of environmental and public health issues.

#### 3.2 Environmental Impacts

Large quantities of plastic packaging debris were found polluting aquatic ecosystems in the study

area in some instances resulting in significant alteration, degradation and even destruction of some water bodies, a notable example being the *Korle Lagoon*. Once a freshwater ecosystem that carried a variety of fish species and a source of thriving economic prospects, the *Korle Lagoon* is currently undergoing a major restoration exercise due to the polluting effects of urban wastes particularly, plastic packaging debris. The carrying capacity of the lagoon has been significantly diminished and it is doubtful whether a single fish species currently exists in the ecosystem. Efforts to rehabilitate and restore the lagoon's ecological integrity have been cost-intensive while providing very little benefits. On the whole, plastic packaging debris was observed to have lingering effects on every single aquatic ecosystem in the study area. Marine ecosystems and their shorelines in the study are heavily saturated with plastic packaging debris, a problem found to be more prevalent in heavily populated coastal areas including *La, Osu, Chorkor* and *Jamestown*. Fishermen in these areas reported persistent incidents of ghost-fishing, a phenomenon whereby nets trap volumes of plastic debris during fishing expeditions.

The study also uncovered significant volumes of plastic debris littering the urban environment, making the city aesthetically unappealing. This was also found to pose significant risks to terrestrial biota in the study area. Several informants gave accounts of free ranging domestic livestock ingesting plastic water sachets in some cases resulting in death. According to the informants, free ranging dogs, goats and cattle attracted to the wetness of the plastic water sachets end up ingesting debris in their effort to quench their thirst. This finding is key, given that ingesting of plastic debris is often only reported in terms of birds and marine biota [25].

The study further revealed that in many parts of the city, drainage systems constructed to facilitate the flow of storm and wastewater were found to have been inadvertently transformed into receptacles for solid wastes, mainly plastic debris. This phenomenon contributes to flooding which was found to be a major problem in the study area especially, during the rainy season [26,27]. In the past few years, flooding in Accra has killed dozens of people, displaced many thousands more and caused severe and costly damages to urban infrastructures leading to the disruption of economic activities and high financial costs for clean-up.

### 3.3 Public Health Risks

In addition to killing dozens and displacing thousands, flooding has also been linked to a rise in diseases such as cholera, dysentery and diarrhea due to contamination of drinking water sources. Likewise, the transformation of drainage systems into solid waste receptacles may provide thriving environments for disease causing vectors, particularly *Anopheles Mosquitoes* known to transmit the malaria parasite. In its acute form, malaria can cause anemia in children and reduce birth weights, ultimately leading to maternal and infant mortality [28].

The findings further exposed a direct correlation between the consumption of water packaged in plastic sachets and risk of contracting infectious diseases particularly cholera. Unsafe handling by vendors can cause contamination and possibly the spread of diseases. Of particular concern is cholera, an acute intestinal infection contracted through drinking water or food that has been exposed to the fecal matter of an infected person. Consequently, the hand-to-mouth practice of consuming drinking water packaged in plastic sachets elevates risks to the public given that most vendors lack ready access to sanitary washroom facilities, hand washing soaps and detergents. The disease caused by the bacterium *Vibro cholerae*, can quickly lead to severe dehydration and cause death if not treated promptly [29]. Since 2007 there has been over 20,000 reported cases of cholera in Accra resulting in scores of fatalities [30]. In 2014 alone over 6000 new cases of cholera was reported in Accra, claiming the lives of 45 individuals [30].

### 3.4 Policy/Regulatory Gaps

Contributing to the accumulation of massive volumes of plastic debris in Accra is the lack of effective policies. Regulatory arrangements pertaining to plastic packaging and urban waste management in Accra were found to be incomprehensive, vague and lacking clear means of effective implementation, enforcement and monitoring. The Environmental Sanitation Policy from which the local government derives its directives provides no specific frameworks for addressing plastic packaging although the document highlights the issue as a major problem. The policy makes no direct reference to the management of plastic debris and simply states: "To respond effectively to increasing waste volumes and changing waste streams due to growing and varying lifestyles, the Policy

proposes a need to: a) Provide services and facilities for primary separation of solid wastes at household, community and public levels; b) Develop and ensure provision of programme for incremental coverage of, and access to meet increasing population and growing economy; c) Ensure adequate systems for managing wastewater treatment, reuse and disposal" [31]. Evidently, the management of plastic packaging debris is conspicuously missing in the stated policy. This constitutes a major policy gap given the volume of plastic debris generated in the city on a regular basis.

Significant gaps were also found in local waste management bylaws and service delivery in Accra. The local government body vested with the responsibility of urban waste management was found to have no effective strategies in place for addressing the issue of plastic packaging and existing bylaws were found to be incomprehensive and inaccessible. In addition, there are no formal strategies geared toward waste minimization within the concepts of the 3Rs: *reduce, reuse, recycle*. The waste management process is predicated on a 'collect and dispose' approach, which was also found to be problematic on many accounts. Issues observed include: infrequent collection of wastes resulting in accumulation; littering and indiscriminate disposal due to adequate waste collection bins; open dumping practices due to the absence of engineered landfills and; crude burning of wastes as a means of reducing volume. In addition, designated dumpsites were found to be heavily saturated with plastic debris.

## 4. CONCLUSION

The current process of managing plastic packaging debris indifferently from other types of waste is ineffective and has to be overhauled. Despite the generation of massive volumes of plastic debris on a regular basis in the study area, there are currently no effective strategies in place for effective management. Consequently, the management of plastic packaging debris is facilitated within a 'collect and dispose' approach with significant volumes ending up polluting both the built and natural environments. An effective management approach requires a number of steps including a clear delineation of the issue. As an environmental management strategy, EPR contributes to the diversion of wastes from landfills and incinerators by encouraging the use of lesser materials in the design, manufacture and packaging of products [32]. EPR also requires producers to be financially and

physically responsible for their products at the end of its useful life. Essentially therefore, the underlying objectives of EPR include: 1) achieving high levels of reuse, recycling and other forms of recovery; 2) changing behaviour, especially to influence material use and product design decisions by manufacturers; 3) highlighting talents of producers for activities that recount their qualities as designers, marketers and distributors and; 4) earning financial resources to allow environmental and waste management goals to be consummated, rather than trying to accomplish them through public or taxed -based sources [33,25]. In conclusion, Plastic packaging has become part of the culture and therefore it has to be managed holistically due to its potential risks particularly to the environment and potentially to public health. A starting point might be offering incentives to both producers and users to switch to alternative means of packaging such as paper bags, refillable mugs, reusable water bottles and jute bags. An effective communication strategy aimed at raising awareness in regards to the environmental and public health ramifications of plastic packaging debris is also a sound policy consideration.

### COMPETING INTERESTS

Author has declared that no competing interests exist.

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