

Assessment of Extent to Which Plastic Bag Waste Management Methods Used in Nairobi City Promote Sustainability

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Abstract This study investigated sustainability of the methods used to manage plastic bag waste in Nairobi city, Kenya. Plastic bag waste appears in very high proportion in the municipal solid waste stream in Nairobi and is causing environmental problems such as choking of animals and soils; blockage of waterways; health problems, and resource depletion. Having knowledge of the methods used to curb this problem is one way of seeking lasting solutions aimed at sustainable development. The study adopted a mixed methods approach in which both quantitative data through a survey and qualitative data through focus group interviews and observations were collected. Results revealed that the problem of plastic bag waste is a consequence of ineffective by-laws on littering and illegal dumping; inadequate garbage collection by City Council of Nairobi (CCN), and throw-away culture by the public. It is recommended that CCN and reinforcing authorities such as National environmental Management Authority effectively enforce Solid Waste Management policies and guidelines and establish an elaborate recycling system for sustainable plastic bag waste management. The findings will shed more light on dynamic relationship of the variables and concepts involved in plastic bag waste production and management and promote proper planning and decision-making at CCN.

Keywords: *disposal, management, plastic bags, solid waste, sustainability*

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1. Introduction

Solid Waste Management (SWM) is one of the important obligatory functions of any urban local authority. It refers to all activities pertaining to the control, collection, transportation, processing and disposal of solid waste in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations [1]. According to [2], the fundamental target of SWM is to protect the health of the population, promote environmental quality, develop sustainability and provide support to economic productivity through utilization of waste as a resource. This essential service, however, is not efficiently and properly performed by many cities in developing countries, such as Kenya. For instance, Nairobi city in Kenya is grappling with increasing piles of waste, particularly plastic bags, disposal technologies and methodologies, and overflowing dumping sites. We know that one of the most pressing and critical goal for the future of humankind is to ensure steady improvement in the quality of life for this and future generations in a way that sustains the quality of the earth's environment.

A combination of all of the factors including lack of resources - financial and personnel, institutional weakness, improper selection of technology, transportation systems and disposal options, public apathy towards environmental cleanliness and protection have made this goal unattainable in many of these cities. In this regard therefore, Kenyans have a high stake in the state of their environment for their livelihoods depend on its health. The 2003 state of Kenya's environment Report [9] indicates that her environment is facing an ecological crisis resulting from among other factors, the problem of plastic bag waste disposal despite the many initiatives and concerted efforts by several stakeholders to improve the quality of Kenya's environment. Sustainability can only be attained when the economic, social and political pressures that can inhibit or support the capacity of individual communities or the nation to properly care for the environment are identified and attended appropriately [2]. Hence efforts need to be directed towards integrating thinking, action, and systems such as ecological, social, political and economic which are critical in achieving sustainability [3,6].

Plastic bag waste disposal is one of the most critical problems that threaten the sustainability of the natural resources, life support systems, social harmony, human rights, economic growth and people's participation in

making decisions affecting lives. Plastic bag waste forms the largest proportion of municipal solid waste and this has been the focus of growing interest since the early 1990s and many Local and Regional Authorities (L/RAs) are confronted with a number of environmental, economic and social issues of solid waste in general [7]. Some of these problems include visual pollution, choked soils, blocked waterways/drains that lead to floods. Plastic bags of various sizes and all colors are found dotting the landscape. They are ingested by livestock endangering their health and even causing death, they choke soils and they are slow bio-degraders. The expansion of plastic production and consumption is having a significant impact, both visibly and invisibly on the socio-physical environment in Kenya. With the rising affluence and public's eager embrace of western consumerism, there is a staggering demand for plastic products in Kenya generally and Nairobi city in particular.

The convenience and cost effectiveness associated with plastics has translated into the throw-away culture in the Kenyan society. Furthermore, the increasing rate of urbanization in Kenya has led to increased use of plastics hence increased plastic bag waste generation [16]. The lack of eco-friendly methods of plastic bag waste disposal has become an increasing environmental and public health problem everywhere in the world but particularly in developing countries. Plastic bags now constitute the biggest challenge to SWM in Nairobi, the capital city of Kenya and home to more than three million people. The process of collection, transportation and disposal of waste is not systematically structured in any Kenyan city. According to [10], this dysfunctional administrative system has led to widespread indiscriminate waste dumping, and prevalence of casual littering due to lack of public education and non-enforcement of CCN by-laws. Furthermore, a UNEP, (2005) report indicated that in Nairobi, like in many developing country cities, the solid waste sector is largely characterized by low coverage of SWM services, pollution from uncontrolled dumping of waste, inefficient public services, chaotic or unregulated private sector participation, and lack of key SWM infrastructure (such as transfer facilities, sanitary waste disposal facilities, and systems for waste separation). Although the government of Kenya has now prioritized SWM highly over other environmental issues, such as housing, availability of safe and clean water, among others; the problem of plastic bag waste in Nairobi city still poses a major concern. Nairobi city faces huge SWM challenges. Many of its residential estates are littered with plastic bags. Dandora estate is a case in example. The magnitude and nuisance of the plastic bag waste management problem in Dandora estate of Nairobi motivated this study's choice.

Plastic bags waste has already become a serious environmental dilemma in Kenya in general and Nairobi in particular [10,11,12]. Concern has been expressed from many stakeholders including the minister for environment, various government organizations, environmental NGOs, and the public at large. Plastic waste manufacturers and importers have been challenged to provide alternative ways for disposing waste or face a temporarily ban on plastic manufacturing and importation. The earth's natural resources especially the non-renewable ones are fast dwindling. Finding a sustainable solution will save the available scarce resources from further depletion and

enhance environmental and human health [4]. Increasing urbanization, rural-urban migration, rising standards of living, and rapid development associated with population growth have resulted in increased solid waste generation by industrial, domestic, and other activities. This increase has not been accompanied by an equivalent growth in the capacity to address the problem. In 1992, from 800 to 1 000 tonnes of solid waste was generated in Nairobi every day, of which less than ten per cent was collected; by 2002, the amount had grown to 1,530 tonnes per day of which 40 per cent was either uncollected, or disposed of by burning or illegal dumping [5,19]. By 2010, over 24 million plastic bags are used monthly, half of which end up in the solid waste mainstream [10,11]. Uncollected solid waste is one of Nairobi's most challenging, visible, and pressing environmental problems [14,20]. The municipal service which seems to fail most strikingly is garbage collection and disposal especially in the outskirts of the central business district, such as Dandora estate and the slum areas.

To bring about a pattern of sustainable consumption and production of plastic products and plastic bags in particular it is necessary that an assessment of the current practices be done. It is against this background that this study sought to investigate the extent to which the methods used in plastic bag waste management in Nairobi City promote sustainability using mixed method design with a view to suggesting alternative approaches to sustainable plastic bag waste management. With many different methods being employed to manage plastic bags waste in particular and solid waste in general, each with different level of success or failure, this research aims to take an introspective assessment of such methods used in Nairobi, Kenya. The current methods include, burning, burying underground, incineration, dumping in landfills (both legal and illegal ones) and recycling. Most of these methods are not ecofriendly. Burning emits green house gases (GHGs) into the atmosphere that greatly contribute to global warming. Burying underground chokes the soil since most plastics are non-biodegradable and have a lifespan of up to 1000 years. Dumping in landfills that are not enough leads to health and environmental problems. To evaluate the extent to which the methods promote sustainability, the objectives for this study were:

1. To determine the types and sources of solid wastes in Nairobi City
2. To determine the factors contributing to plastic bag waste pollution in Nairobi city
3. To assess the extent to which the current methods to plastic waste management promote sustainability

2. Materials and Methods

2.1. Sample of Research

A sample of 380 participants from Dandora estate was purposively selected for this study by virtue of their living in an estate that is located in the Eastern part of Nairobi city close to a legalized solid waste municipal dumpsite. The population age ranged from 18–58 years. Dandora estate is a cosmopolitan estate comprising of a heterogeneous population in terms of tribes, socio-economic status, level of education, and occupation.

2.2. Instrument and Procedures

Both quantitative and qualitative data were collected. Quantitative data were collected using a 25-item questionnaire survey on a five point likert-type scale:

1 = Strongly Disagree, 2 = Disagree, 3 = Not sure, 4 = Agree, and 5 = Strongly Agree

The questionnaire was administered to all participants (n=380) from Dandora using the drop-and-collect approach. Demographic data was also asked at the end of the questionnaire. A specific transmittal/introductory letter accompanied the questionnaire clearly explained the purpose of the study and the importance of the results.

Qualitative data were collected through a 60-minute focus group interview from a selected sub-sample of residents of Dandora estate (n = 42). The interview was used for the purpose of collecting more information to corroborate the quantitative data collected. Through interviews, information such as; types and sources of solid waste in Nairobi city, role played by various stakeholders in management of plastic bag waste, and current methods used in plastic bag waste management was sought. An observation schedule was used to guide the researcher to observe incidences such as littering, dumping, collection of wastes, scavenging at the Dandora dumpsite, packaging of commodities in supermarkets, and selling of plastic bags.

To ensure validity and reliability of the instruments, there was pre-testing of the questionnaire and interview schedule in Korogocho estate. A Cronbach's alpha level of 0.7 on average was deemed good for this study. During participant observation, the researcher and the field assistant visited the following areas on different days and made very vital observations: Dandora dumpsite; Dandora Estate; and Nairobi Central Business District (NCBD).

2.3. Data Analysis

Quantitative data were then analyzed descriptively using frequencies and percentages. Photographs and pictures were taken for documentation (See appendices). Qualitative data were transcribed, categorized thematically, and reported in prose.

3. Results of Research

3.1. Types and Sources of Solid Waste Generated in Nairobi City

The researcher sought to find out the types and sources of solid waste generated in the city. All the 380 respondents were therefore asked to identify the types and sources of solid waste generated in Nairobi city. The results indicated that households contribute the bulk of the solid waste produced at all the sources in the city (Figure 1).

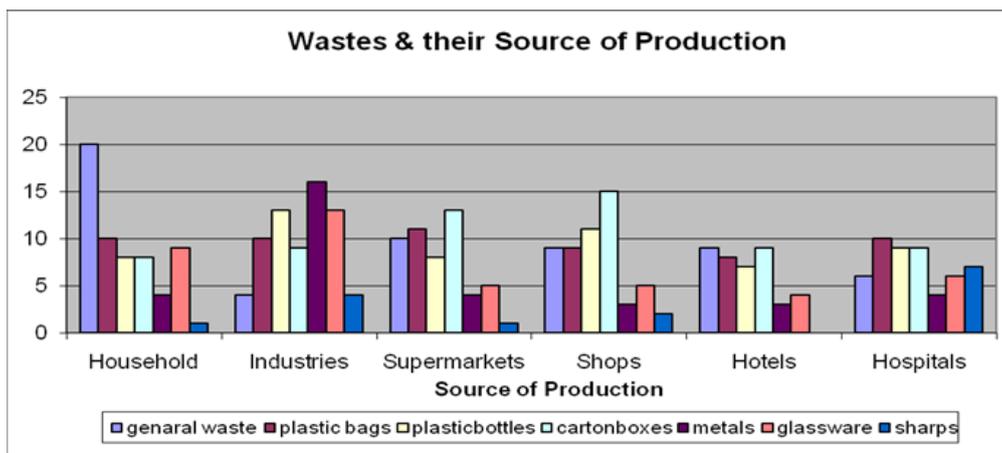


Figure 1. Wastes and Sources of Production

The other significant sources included industries, supermarkets, shops, hotels, and hospitals in that order. From all the sources, plastic bag waste forms the bulk of the total waste. Other wastes included plastic bottles, carton boxes, metals, glassware, and sharp objects. The study further revealed that the waste generated is not

separated at the source as evidenced by the photograph shown in appendix 1. With lack of separation at the source, all the waste is channeled to the dumpsite. It was revealed that 72.1% the Dandora residents, staff disagreed to the fact that there is separation of plastic bags from other wastes at the source.

Table 1. Factors Contributing to Plastic Bag Waste problem (N/%)

ITEM	SA	A	U	D	SD
1. Industries and Supermarkets have contributed greatly to the littering of the bags	112/47	70/29.9	0/0	11/4.7	30/12.8
2. CCN has failed to address the problem of plastic bag waste in Nairobi due to relaxed policies	167/71.4	22/9.5	22/9.5	11/4.7	0/0.0
3. Agencies that handle solid waste are discriminative, low-income estates being the most affected	132/56.7	47/20.0	30/12.8	9/3.7	11/4.7
4. CCN is overwhelmed by the large volume of plastic bags released into the general waste stream	94/40.0	70/30.0	23/10.0	12/5.0	18/7.5
5. The required guidelines on SWM are not adhered to	146/62.5	47/20.0	12/4.9	11/4.7	9/3.7
6. Inadequate landfills have aggravated the problem of plastic bag pollution.	111/47.5	64/27.5	6/2.5	35/15.0	18/7.5
7. Facilities for collection and transportation of plastic waste are inadequate.	131/56	53/22.5	6/2.5	29/12.5	12/5.0

3.2. Factors Contributing to Plastic Bag Waste Pollution in Nairobi City

To better understand the problem of plastic bag waste pollution it was necessary to find out the factors that contribute to the problem. All the 380 respondents were therefore asked to identify from among such factors those they believed contributed to the problem on a likert scale. Out of the 380 participants, only 234 responded to this question. However, this being a sufficiently high response rate, the responses from 234 participants are as outlined in Table 1.

These results show that the three main factors contributing to plastic bag waste problem are: (a) lack of adherence to the guidelines on SWM by stakeholders in Nairobi city due to their negative attitude toward plastic bag waste management (62.5 + 20 = 82.5%), (b) failure of City Council of Nairobi to address the problem of plastic bag waste due to relaxed policies (80.9%), and (c) industries and supermarkets that produce and release large volumes of plastic bags to the consumers have greatly contributed to the problem of plastic bag waste (77.7%). The other factors in order of seriousness include: Facilities for collection, transport, and disposal of plastic bag waste are inadequate (78.5%); Agencies that handle solid waste are discriminative, the low-income estates being the most affected (76.7%); lack of adequate landfills has aggravated the problem of plastic bag waste pollution (75.0%); City Council of Nairobi is overwhelmed by the large volume of plastic bags released into the solid waste stream (70.0%).

3.3. Extent to Which Plastic Bag Waste Management Methods Used in Nairobi City Promote Sustainability

The 380 respondents were also asked to identify the plastic waste management methods used in Nairobi City. Although only n = 133 responded to this item, a majority of the respondents (60.9%) agreed that recycling was the most commonly used method of plastic bag waste management followed by open dumping (59.6%) (Table 2).

Table 2. Disposal Methods

Method	Frequency	Percent Response
Recycled	81	60.9
Re-Used	41	30.9
Burning	3	2.3
Burying Underground	2	1.5
Dumping Outside Landfill	2	1.5
Incineration	4	3.0
Burning	3	2.3
Burying Underground	2	1.5
Total	133	00.0

When asked in an interview whether the dumpsite has any side effects, an overwhelming majority of the respondents (86.5%) agreed that the methods used greatly affected the social environment of the residents concerned. The respondents revealed that there are serious complaints about smoke, smell, and broken glasses.

Respiratory and stomach problems among children are common in the nearby clinics and were cited by the people interviewed. School children passing through the dumpsite often picked objects, which were dangerous to their health. Furthermore, through observation, the researcher noted that dumping and open burning at Dandora dumpsite are unhealthy because adjacent to the dumpsite are residential areas such as Dandora Housing Estate and Korogocho slums, schools, and a shopping centre, yet no facilities are provided to prevent secondary pollution. Photographs taken at study area attest to this (See Appendixes 2 & 3). There is therefore a high risk of environmental pollution, which affects the health of the residents. The dumpsite poses serious health and security problems to the people who live around the dumpsite. It towers about 10 feet high and located near schools such as Dandora secondary, and James Gichuru primary schools, clinics, churches and apartment blocks.

4. Discussion

The present study investigated the extent to which disposal methods of plastic bag waste promote sustainability. The study also examined the types and sources of solid waste and sought to find out the factors contributing to plastic bag waste menace in Nairobi city.

With respect to the first research question regarding the types and sources of solid waste, results showed that solid waste is generated from familiar sources which include households, industries, hospitals, business, and hotels. These sources are similar to those experienced in developed Western countries such as the United States where household and commercial refuse accounts for two-thirds of all waste [6]. Furthermore, it was revealed that solid wastes in the city are not segregated, with the exception of unstructured reuse of some waste materials at the household level. Consequently, the Dandora dumpsite is littered with all types of wastes from hospital wastes, manufacturing/industry wastes, paper and both bio- and non-biodegradable materials. This finding is consistent with research findings of Ikiara, et al., 2004, that revealed lack of waste segregation at the source of production.

The second research question addressed causes of plastic bag waste problem and the result showed that lack of enforcement of laws, inadequate facilities for collection, transport and disposal of solid waste, lack of knowledge and awareness by the public, overproduction, and overconsumption of plastics. This result confirmed the well-established research findings that the underlying causes of environmental damages due to production and consumption are mainly a combination of institutional, market, and policy failures [8,17,21].

With respect to the third research question regarding suitability of current disposal methods, this study revealed that methods such as open burning, land filling, dumping without separation among others were unhealthy and were associated with social, ecological, political and economical problems. The findings presented here are consistent with previous studies [11,13,15,21], which confirmed that uncontrolled dumping of waste in the city and open burning as a means of garbage removal are common and pose adverse impacts on the surrounding environment.

5. Conclusions

From the viewpoint of environmental health, disposal of waste is considered to be the responsibility of government and municipal institutions. Findings from this study indicate that CCN has not put in place stringent regulations to govern plastic bag waste. Until all stakeholders become full participants in SWM, a fully sustainable SWM system is not possible. Generally it can be concluded that the CCN is overwhelmed by the problem of plastic bag waste. Its resources are outstretched as a result of the high population of people in the city and the ever emerging unplanned settlement areas in the city. Therefore more emphasis is needed on policy aspects, besides having more landfills. Proper management of plastic bags will foster sustainable development through approaches such as recycling that promote material and energy recovery thus deriving value from the waste instead of regarding it as garbage or trash, minimization of plastic consumption hence reduced generation of plastic bag waste, and manufacture of biodegradable bags. These findings may have implications for other cities in Kenya as they also have the same problems with solid waste and thus face similar challenges.

It is important to note, however, that in spite of the findings that have been achieved in this study, some fundamental issues require a greater in depth understanding. Firstly, the analysis that has been used to determine the methods used to manage plastic bags waste in Nairobi city in the present study was not causal; hence any generalizations in this regard should be treated with caution. Secondly, the variables under study were very many hence leading to complexity of the study. Thirdly, the sample size was small and may not be representative of the whole of Nairobi city population, and fourthly, a comparison between a high income estate such as Muthaiga and a low income estate should have been made. Future researchers should attempt to resolve these issues so that understanding of plastic bag waste would, hopefully, achieve the ultimate goal of promoting sustainable development and ameliorating the quality of SWM in Nairobi city and other urban centers in Kenya.

This research is essentially meant to contribute to the ongoing endeavors in Nairobi to bring about a pattern of sustainable consumption and production of plastic products and plastic bags in particular. Future research should explore how environmental education in schools can promote sustainability with regard to solid waste management. This is because the youth form a significant proportion of the country's population. Inculcating environmental ethic in the youth will be a positive step toward Education for Sustainable Development. More research can be done in the area of recycling, which was identified by participants as a sustainable method of plastic bag waste management.

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Statement of Competing Interests

The authors have no competing interests.

List of Abbreviations

CBD	Central Business District
CCN	City Council of Nairobi
GHGs	Greenhouse Gases
JICA	Japan International Cooperation Agency
L/RAs	Local and Regional Authorities
MSW	Municipal Solid Waste
NCBD	Nairobi Central Business District
CCN	City Council of Nairobi
NEMA	National Environment Management Authority
NGO	Non-Governmental Organization
RAs	Residential associations
SWM	Solid waste management
UNEP	United Nations Environment programme

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Appendices: Photographs



Appendix 1. Unsegregated solid waste at Dandora dumpsite



Appendix 2. Open burning of waste at Dandora dumpsite



Appendix 3. Residential Areas around the Dumpsite