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Plastic Waste and its Challenges in Bamenda Urban Space, North West Region, Cameroon

Maurice TambeAgbor Ebai[1], Gordin Bah NdahAnyang[2]

[1]Department of Geography and Planning University of Bamenda & Regional Delegation of Environment, Protection of Nature and Sustainable Development, Northwest, Cameroon

[2]Department of Environmental Sciences, Faculty of Science University of Buea& Divisional Delegation of Housing and Urban Development Momo

Abstract: ***This study sought to access the quantity and types of plastic waste generated in Bamenda urban and its challenges; it further sought to compare the different types of plastics present in the waste stream in Bamenda. This research was prompted by the fact that plastic waste in Bamenda is still a call for concern despite the prohibition of plastic packages inferior to 61 microns in thickness by the government of Cameroon in a bit to minimize the quantity of plastic waste generated. The sampling technique used is the ASTM D5231-92 "Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste". Samples of 100 kg were collected every day for 4 weeks through random sampling from the waste dumped and quantify through manual sorting and measurement. The waste was characterized as follows: Polyethylene Terephthalate (PET), High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), Polyvinyl Chloride (PVC), Polypropylene (PP), Polystyrene (PS) and others (unclassified plastic materials). A total of 210 samples of 100kg each were analysed. Result shows that 18.575tons of plastics are generated in Bamenda per day. The mean plastic wastequantify during this period was 6.95kg in a 100kg solid waste stream. It was realized that LDPE had the highest percentage composition of 39.51 % while PS had the least with 5. 17%. PP, PET, HDPE, PVC and OTHERS registered 16.67%, 16.24%, 7.76%, 5.60% and 9.05% respectively. The government should increase effort in the fight against plastic waste generation on one hand and encourage plastic waste recyclers on the other.***

Keywords: Plastic waste, Plastics, Bamenda Urban, Cameroon

1. Introduction

Plastic pollution is one of the biggest environmental challenges of the 21st century, with plastics showing that there will be more plastics in the oceans than fish by 2050 (UN, 2018). Every year, 8million tons of plastic enter our oceans, threatening marine and human life, blocking waterways and destroying ecosystems (UNEP, 2018).

Pollution by plastics is a major environmental problem that has been since the 1950's. According to (Achu, 2017), plastics are one of the major achievements of the twentieth century. Today, they permeate peoples' daily lives in various ways. In fact, the African society in general and that of Cameroon in particular have become dependent on plastics. Their ability to be shaped to almost any form to produce articles of practical value has been one of the most important properties of plastics. Plastics can be stiff and hard or flexible and soft (Bashir, 2013). Because of their light weight, low cost, waterproof and desirable properties, their use has rapidly increased and they have replaced other materials, for example, metals and glass. Plastics are used in millions of items, including cars, as food packaging, toys, hospital equipment, and food containers, cosmetic products, straws. Due to the high use of plastics, it has nevertheless caused so many problems to the society known as plastic pollution, which according to (Gopal et al. 2014) is defined as the accumulation of the different types of plastic material on land, as well as in water bodies like rivers, oceans, canals, lakes. This form of pollution has caused problems such as stray animals eating these plastics that are improperly disposed leading to their deaths (Almaqtari, 2014), blockage of drains that would lead to over flooding (Vijaya et al. 2012, Fogwe&Asue 2016, Agbor Ebai, 2017), death of aquatic animals,health hazard and also littering of the plastics to the environment reducing urban aesthetics. Plastic does not naturally biodegrade in the environment, instead, it breaks down into small particles (micro-plastics) that can negatively impact human health by releasing toxins into the food chain and by poisoning wildlife and marine life (Su et al. 2015).Many countries have been taking up the fight against plastics such as Cameroon in its "Joint Order No.004/MINEPDED/MINCOMMERCE" of 24 October 2012, prohibition of plastic packages inferior to 61 microns in thickness. Other nations such as Rwanda, Mali, Mauritania, Bangladesh, and China have completely banned the use of plastic bags.Countries such as Ireland, Israel, Canada, Botswana, Kenya, Tanzania, South Africa, and Taiwan aregradually reducing the use of plastic bags because they destroy the environment (Ntawugashira, 2015).Discarded plastic waste contributes to many environmental problems in the city including the blocking of drains and gutters. Their light weight property and non-biodegradable nature causes them to be carried by wind to different locations of the city and persistent in the soil. Cameroon does not produce biodegradable plastics and the usage of non-biodegradable plastics remains high in the cities of Cameroon and Bamenda in particular.

To fight against plastics in Cameroon, the government through the Ministry of Environment, Protection of Nature and Sustainable Development (MINEPDED) and the Ministry of Commerce (MINCOMMERCE) signed a joint ministerial order to ban the production, importation and commercialization of non-biodegradable plastic packaging of less than 61 microns in thickness in October 2012. The ban became effective on the 24th April 2014 and since then the process is ongoing. This ban was limited only to light

weight plastic of less than 61microns in thickness but the other types still remain a major problem.

Despite all the efforts to stop these banned plastics, their circulation is still persisting and their effects to the environment are still significant in the country in general and Bamenda municipality in particular. This study therefore is to access the Quantity of plastic waste generated and distributed in Bamenda urban and its challenges.

2. Methodology and Materials

2.1 Study Area

Bamenda is the headquarter of the North West Region and doubles as the divisional headquarter of Mezam Division. It is the biggest metropolitan town in the Region and is located to the Southeast of the Region. It is made of three subdivisions (Bamenda I, II and III) with a surface area of 391 km² and a population of about 496 931 inhabitants in 2012 with 4.9% as annual growth rate (Saha et al, 2017). Bamenda is located 366 kilometers (227 miles) North-West of the Cameroon capital Yaoundé. Bamenda Municipality is located to the West by Mbatu, Nchomba and Bali, to the North by Bafut and part of Tubah, to the South by Santa and to the East by Tubah. It is situated between latitude 5°56'0 North. longitude 10.16° East and an average altitute of altitude of 1610 above sea level. See Figure 1

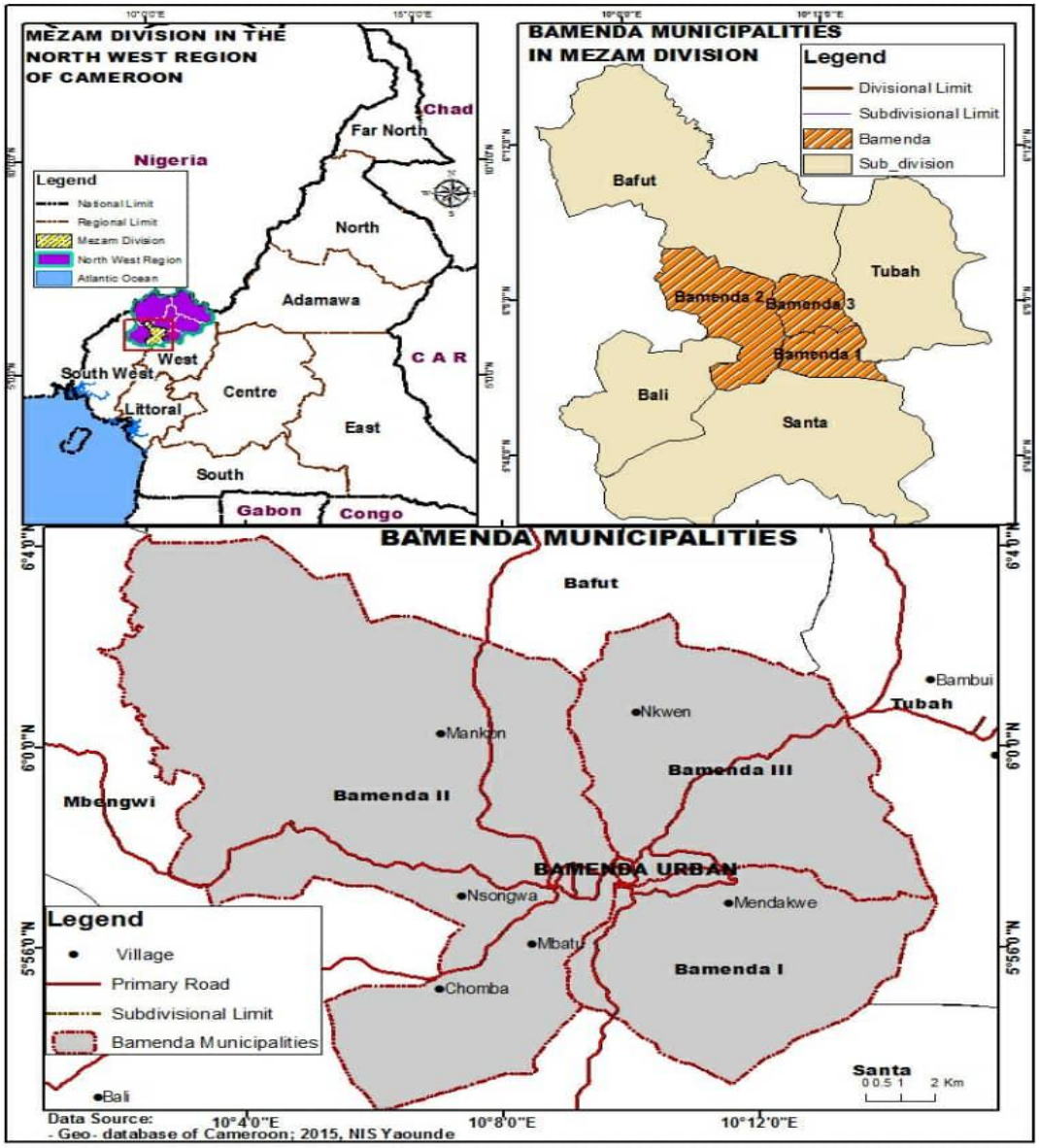

Figure 1: Location of Study Area

2.2 Data Collection

This research was carried out in the city of Bamenda. Data was collected using both primary and secondary sources. Secondary data was obtained from relevant literature from books, journals and other relevant materials on the internet. Primary data was collected at the HYSACAM waste dump sites, interviews and site observations. Plastic waste was quantified after sorting. 100kg scale balance was use to quantify the plastic waste.

2.3 Sampling Technique

This was done in accordance with ASTM D5231-92 "Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste". The process involved collection of the waste and sorting for proper evaluation. With this, sampling was done for a period of 4 weeks. Each week consisted of 6 sampling days from Tuesday to Sunday based on the frequency of dumping by the waste management company. Sampling of plastic polluted sites such as soils was done through digging and urban streams through visual observations.

2.4 Materials

The equipment used were a mechanical scale, which was the naval spring scale with a capacity of 20kg to measure the plastics and also a 100kg hand scale, Spades, wheel barrow, buckets. Each category of waste was weighed to the closest +50 grams using a sensitive spring scale balance and the values were registered in a data sheet.

2.4.1 Quantification of Plastic Waste

To quantify the amount of plastic waste produced, 4 week duration was set to collect the data on plastic waste generation. The per-day generation was calculated from the daily quantity of the waste arriving at the dumpsite which was obtained from the waste management authorities.

2.4.2 Plastic Waste Characterization

Plastic waste characterization was done so as to know the different components of the plastics present in the waste stream. Through random sampling, samples of 100 kg were collected every day from the waste dumped and quantifythrough sorting.

The waste was characterized as follows;

- Polyethylene Terephthalate (PET)
- Polyethylene (PE)
- Polyvinyl Chloride (PVC)
- Polypropylene (PP)
- Polystyrene(PS)
- Others(unclassified plastic materials)

2.5 Sorting

The sorting of plastics was a very essential step in the waste management technique. Manual sorting was carried out by separation of the plastics from the waste stream. The plastics were separated from the non- plastics, weighed and the non-plastics were discarded. The mean plastic waste composition was calculated using the results of the composition of each of the sorted samples

3. Results and Discussion

3.1 Number of Samples

From preliminary studies at the dumpsite, it was gotten that on average 15 dump trucks dumped waste every day from Tuesday to Sunday. 10 dump trucks were sampled per day. A total of 210 samples of 100 kg were evaluated

3.2 Mean of samples

Samples collected daily were computed and analysed so as to get their average composition in the sorted waste. We saw that the mean of plastics quantified during this period was 6.95 kg in a 100kg municipal solid waste sample. PET, HDPE and PP were more than a kg in MSW while PVC, HDPE, PS and others less than a kg. This is shown in Table 1

Table1: Mean mass of plastic waste generated

Plastic Types	Mean (kg) ±SD
PET	1.13±0.39
HDPE	0.54±0.37
LDPE	2.75±0.82
PVC	0.39±0.60
PP	1.16±0.80
PS	0.36±0.22
Others	0.63±0.83

Source field work

3.3 Mass fraction

The mass fraction of each plastic resin was gotten by the ratio of the average weight of the resin to the total quantity of the plastic waste

Table 2: Mass fraction of plastic waste types

Plastic Type	Mass Fraction
PET	0.16
HDPE	0.07
LDPE	0.395
PVC	0.056
PP	0.166
PS	0.051
Others	0.090

Source field work

3.4 Percentage composition of Plastic waste

This was to get the total composition of the plastic waste by the different resins. LDPE had by far the highest percentage (39.51%) while PS was the least (5.17%). The PET and PP all registered 16.24% and 16.67 respectively, PVC (5.60%) while, OTHERS had 9.05%. This is shown on Figure 2.

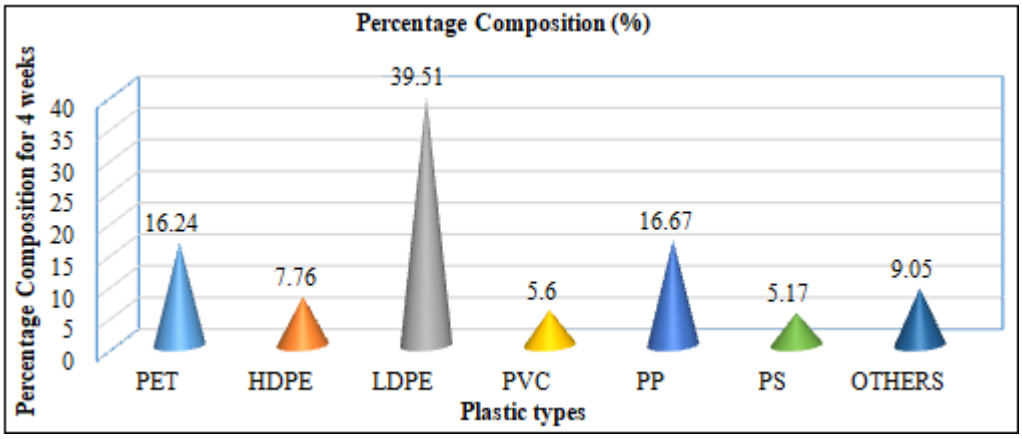

Figure 2: Percentage composition of plastic waste for 4 weeks
Source field work

3.5 Daily Variation of Plastic Waste

210 samples were collected for the 4-weekperiod; the daily variation of the total plastic generated was not really significant. Nevertheless, from our study Friday proved to be the day with the highest quantity of daily plastics waste generated, 7.26 kg, followed by Sunday with 7.14 kg and Wednesday being the least with 6.77kg. From Table 3, we can observe that the difference between the highest day and lowest daily value is only 0.49. This shows that there is really no significant difference within the days. Also from the table we see that LDPE was the most prevalent on Friday (2.64). The different resins and their mean daily generation are shown in Table 3.

Table 3: Daily variation of total average plastic waste generated (Kg)

Day	PET	HDPE	LDPE	PVC	PP	PS	Others	Total
tuesday	0.99	0.59	2.67	0.43	1.2	0.34	0.67	6.89
wednesday	1.07	0.53	2.63	0.47	1.1	0.34	0.63	6.77
thurday	1.17	0.58	2.69	0.48	1.04	0.36	0.59	6.91
friday	1.23	0.64	2.64	0.37	1.26	0.38	0.74	7.26
saturday	1.08	0.4	3	0.36	1.09	0.34	0.61	6.88
sunday	1.25	0.5	2.87	0.23	1.31	0.42	0.56	7.14

Source field work

3.6 Estimated plastics in waste stream

The estimated solid waste generated used in this study was projections by environmental NGO's. With the city of Bamenda generating an average of 270 tons of waste per day (Tawong, 2015), and with plastics being an average of 6.95% based on this study, we can say that the city is producing an average of 18.575tons of plastic per day which is really a huge quantity and with the waste collection company reportedly collecting about 132.285 tons of waste per day (HYSACAM Bamenda, 2018) which represents a collection rate of about 50% per day. So based on this statistics, 132.285 tons collected per day, provides 9.10 tons of plastic. These plastics eventually end up in the dumpsites which could be used as raw materials to be recycled.

3.7 Estimated per capita plastic waste produced

The city of Bamenda had an estimated population of 496 931 inhabitants and a total per day production of plastic waste was 18.575 tons. We assumed that the per capita plastic waste was: Per capita plastic waste = total plastic waste produced/total population
= 18,575kg of waste/ 496 931
= 0.037kg/person/day

3.8 Percentage of plastic waste

From this study, plastic waste constituted 6.95% of the MSWgenerated. This does not correspondwith the World Bank urban development series (2012), inwhich states that for a lower middle income country like Cameroon, the plastic waste composition in MSW stands at 12%.The same report also suggested that middle income countries collect MSW at a rate of 10.62% - 55%.For African countries, the rate of 17.5% - 55%,this fell in line with the discovery of this study. Other studies which quantified waste produced in a city such as Accra, Ghana (Miezah, 2015),showed that PET, HDPE, LDPE, PVC, PP, PS, OTHERS, were 20%, 22%, 24%, 3%, 4%, 12%, 15% respectively. Even though it did not correspond with these results, it still showed that the LDPE plastic was the most prevalent plastic resin in MSW.

4. Environmental Challenges of Plastic Waste

4.1 Soil pollution and its effects on Agriculture

The surrounding lands especially around the open dumpsitesites at Mile 6 Mankon and Mbelewawere heavily polluted with plastics. These plastic wastes had been dumped and burn for several years. Evaluation of 8 wheel barrows of dug soil at the dumpsite produced results as shown in Table 4

Table 4: Soil sample evaluation

Plastic waste type from soil	Mass (kg)
PET	0.5
LDPE	4.5
PP	9.5
Others	4.0

Source field work

From Table 4, we can see that more plastics were found in the soil than any other waste type because they do not biodegrade and they don't usually burn to ashes. Their light weight also implied that they could be transported by wind from other areas. Cultivation of crops around this polluted

area is difficult.Farmers complained of plastics in the soil making tilling of the soil difficult especially at floodplains were the streams have deposited plastic waste transported and deposited on these floodplains at the sphere of the city.

4.2 Water pollution by plastic waste

Many streams were visited around the Bamenda municipality. All the streams are a continuation of River Mezam that flows around the city. The river acts as the major medium of transmission of plastic waste around the town especially during the rainy season when quarters and gutters have been washed and are emptied in the streams. The most prevalent type of plastic polymer identified in these streams was the PET bottles as they were the major causes of pollution in these water bodies. The bottles usually block the passage of water and hence cause floods during the rainy season especially around Mbengwi Park a prominent quarter in Bamenda. Clean up campaigns were organized by the RD-MINEPDED, environmental civil societies and also communities.

Figure 3: Plastics on the surface of water (source field work)

Figure 4: Plastic waste collected from stream Source field work

4.3 Government Actions

In line with the ban, the Senior Divisional Officers issued Prefectoral Orders sanctioning defaulters with fines ranging from 4000FCFA – 25000FCFA for minor offences. In cases of larger quantities, offense statements were issued for greater fines determined by the central administration of the Ministry of Environment, Protection of Nature and Sustainable Development in Yaounde. The Regional Delegation of Environment for the North West Region through it partner organisations and academic institutions have organised several environmental campaigns to create awareness and educate the public on the negative impacts of Plastics especially single use plastics. The government has also taken repression measures with the Forces of Law and Order, the services of Brigade and Control in the Ministry of Commerce and Custom services at their various check points.

5. Conclusion

Despite the ban of plastic packaging of less than 61 microns in Cameroon, the negative impact of plastics in the environment is still very high in the Bamenda Municipality. The various markets are still flooded with different types of plastics and their impacts very significant in the environment. The Government banned only single use, light weight plastics packaging of less than 61 microns and the other types are still available in the markets. The unbanned plastics especially plastic bottles (PET) from mineral water and soft drinkscompanies are really a threat to both the terrestrial and aquatic environments in the Bamenda Municipality.

That local councils and government couldprovide financial and technological incentives for organisations or individuals recycling plastics in a bit to encourage plastic valorization and clean the environment in Bamenda. The Creation of a special fund by the local governments'authorities to manage waste can enhance proper waste management in Bamenda. Implementing the "polluter pays" principle in all the local councils and the city council will also curb plastic waste pollution.Government subsidies to plastic Companies to produces biodegradable plastics at an affordable price to the public will also reduce the generation of non-biodegradable plastics and it effects. Increase awareness and primary sorting of plastic waste could also enhance proper management and environmental sustainability.

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