

A FEASIBILITY STUDY ON THE USE OF PLASTIC WASTE FOR POWER GENERATION IN MUBI METROPOLIS

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Abstract

The paper aimed at ascertaining the nature and sources of plastic waste and using them for power generation in Mubi metropolis. It was undertaken in the seven wards of Mubi. Dump sites were visited as a method of data collection. Eleven major dump sites were visited and data were collected in each. After the data collection and analysis, the following types constitute the majority of plastics waste in Mubi. Polyethylene terephthalate (PET), High Density Polythene (HDPE), Polyvinylchloride (PVC), Low Density Polythene (LDPE), Polypropylene (PP) and Polystyrene (PS). However, the total plastic waste generated in Mubi metropolis is 12,283kg which is not enough to power Mubi because Mubi consume up to 10MW of electricity. In the light of this, it is recommended that plastic waste should be recycled to give other forms of products rather than electricity to avoid its continue increase, since it is not enough for the generation of electricity in Mubi metropolis.

Solid waste is being produced as a result of human activities (Kamala and Kanthrao, 1993). The quantity of this material is increasing due to increase in population and increase in standard of living. These waste includes, vegetables, plastics, minerals, paper, glass, e.t.c. This research concentrated on plastic waste since plastic waste can remain for thousand years without decomposing due to its non-biodegradable nature. An expenditure incurred on disposal of plastic waste throughout the world is around 2 billion US dollars every year (Zadgaonka, 2004). Plastic solid waste has become a problem when considering the disposal alternative following the sequential hierarchy of sound solid waste Management. This study was undertaking to access the quality and composition of household solid waste especially plastic to identify opportunities for waste recycling.

One month survey of 350 household was carried out in Mubi metropolis. Household solid waste was collected from each household and classified into ten physical categories especially plastic waste was sorted into ten categories. The average household solid waste generation rate was 225.27g per day. The combustible and recyclable show respectively accounted for high percentage as 80.74% and 11%. Regarding plastic waste generation rate was 17.24g per day. Plastic packaging and plastic containers dominated with the high percentage of 95.64% of plastic waste. Plastic shopping bags were especially identified as the major component accounting for 45.72% of total plastic waste. Household income and household size were found to have correlation to plastic waste generation. Household habit and behaviour of plastic waste discharge and aspect of environment impacts and sources of plastic waste disposal alternatives were also evaluated (Koach, 2011).

Plastic waste have an extremely high calorific value and are effectively frozen fuels which can be released into energy when burnt. Infact, mixed plastic have an energy content of 9585kwh/ton which is 37% higher than coal. Only 11% to 18% lower than natural gas and oil respectively (www.plasticgreen.com/biodegration). Presently Mubi metropolis is consuming 10MN of electricity.

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The purpose of this study is to find sustainable alternative of recycling plastic, to analyze the amount of plastic waste generated and to reduce expenditure incurred on disposal of waste plastic in Mubi metropolis.

A plastic is a synthetic material made from a wide range of organic polymer such as polyethylene, polyvinyl chloride, polyvinyl acetate, e.t.c. that can be moulded into shape while soft and then set into a rigid or slightly rigid form. Two types of plastic are thermoplastic and thermosetting. Plastics have the following properties; flexible, tough and slippery, soft and rubbery, hard and slippery, light weight, good conductor of heat and electricity, hygienic, non rusting, cheap and easy to shape and colour. Plastic contain much of the energy potential of the petroleum from which they are made (Adamu, 1991).

In the developed countries, a research has shown that the quantity of plastic waste produced per day is increasing as man advance in civilization (Arlington, 2002). From our local environment, the rate of generation of plastic is mainly from markets, homes, business centres and industries.

Description of the Study Area

Mubi metropolis is located in the northern part of Adamawa State in Nigeria. It has a land area of 50, 440 square kilometer and a population size of 245, 460 (according to population census of 2006) at a density of 160.5 persons per square kilometer. Its borders are Michika Local Government area to the North, Askira Uba of Borno State to the West, Hong Local Government to the South and Cameroon to the East. Mubi is located between latitude $9^{\circ} 26'S$ and $10^{\circ} 10'N$ and between longitude $13^{\circ} 1'S$ and $13^{\circ} 44'N$ (Adebayo, 2006). The predominant physical feature in the area is the Mandara mountain which extend through the length of Mubi (Adebayo 2004). Mubi is made up of seven wards which includes Lamorde, Kolere, Sabon Layi, Yelwa, Nassarawo, Lokuwa and Gude.

Methods and Materials

A random sampling method was used. The research instrument used for this study was manual sorting. Eleven major dumpsites in the seven wards of Mubi were visited to get the amount of various plastic waste disposed. In each dumpsite, wastes was collected and sorted out manually. Some percentages of the total combined wastes disposed were gathered and put in a pan and weigh, using weighing balance. Thereafter, plastic waste was separated using manual sorting method and weighed differently. This was performed in all dumpsites for accuracy.

The materials for data collection include the following; weighing balance, hand glove, nose mask and head pan.

In each dumpsite, after knowing the total amount of waste disposed, the various forms of waste were analyzed and grouping the data into tabular form.

Analysis and Discussions

There are six different types of plastics resins that are commonly found in Mubi metropolis. They are

- i. **Polyethylene terephthalate (PET):** - Examples are some water pfoof packaging materials, oil bottles e.t.c.
- ii. **High-Density Polyethylene (HDPE):** - Examples are food milk cans, detergent and oil bottles, toys and plastic bags.
- iii. **Polyvinylchloride (PVC):** - Examples are food wraps, vegetables, oil cans, blisters packages.
- iv. **Low-Density Polyethylene (LDPE):** - Examples are plastic bags shrink wraps, garments bags and grocery sacks.

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- v. **Polypropylene (PP):** - Examples are food wraps, carpets, e.t.c.
- vi. **Polystyrene (PS):** - Examples are utensils, meat package protective packaging.

It is obvious that some materials degradability varies from others. For instance, organic waste takes 1-2 weeks to degenerate, paper 1-3 weeks, cotton cloth 8-20 weeks, wood 10-15 weeks, tin, aluminium and other metal 100-500 years, while plastic takes even more than a million years.

Table 1 shows the nature of waste generated in Mubi metropolis. Fruits and vegetables formed the highest of solid waste with a total of 19.3%. Glass, crockery and bones formed the lowest of solid waste with a total of 1.4%

Table 1. Nature of Mubi Metropolis Waste

S/No	Typesof Waste	Yelw a	Lamrude	Nassarawo	Sabonlayi	Gude	Kolere	Lokuwa	Total	Percentage
1	Fruits and Vegetables	3	1	6	4	4	3	6	27	19.3
2	Leaves,Grass &Straw	3	6	1	1	4	6	5	26	18.6
3	Wood and Shell	0	1	0	1	0	3	1	6	4.3
4	Paper & Cardboard	3	2	4	3	4	0	1	17	12.1
5	Rags	1	1	2	1	1	0	0	6	4.3
6	Glass, Crockery & Bones	0	0	0	1	1	0	0	2	1.4
7	Metal & Tins	3	1	0	0	0	2	1	7	5.0
8	Dust asticinder	1	0	1	2	2	0	1	7	5.0
9	Plastic	3	3	4	4	1	4	3	22	15.7
10	Miscellaneous	3	5	2	3	3	2	2	20	14.3
	Total	20	20	20	20	20	20	20	140	100

Table 2 shows the average quantity (kg) of waste generated by each household per week. Average plastic waste generated by each household is calculated to be 12,283 Kg per week.

Table 2. Average Plastic Waste Generated Per Week

Settlement	Number of Household	Number of Plastic Waste Generated per Week	Total Waste Generated per Week	Average Waste Generated per Week %
Yelwa	111	78	8658	10.1
Lokuwa	160	96	15360	17.9
Kolere	95	28	2660	3.1
Gude	210	87	18270	21.2
Nassarawo	179	63	11277	13.1
Sabonlayi	150	102	15300	17.8
Lamrude	245	59	14455	16.8
Total	1150	513	85980	

Table 2 shows that the average plastic waste generated per week per each household within Mubi metropolis is 12,283kg. The total number of household in Mubi metropolis is 1150. Therefore, the weight of plastic waste generated in Mubi metropolis is 85,980Kg.

The pie chart in figure 1 shows the percentages of plastic waste generated in each settlement areas in Mubi metropolis.

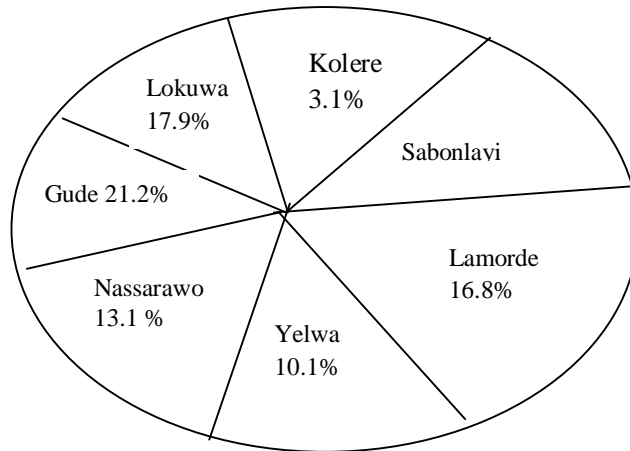


Fig 1 Proportion of sorted plastic waste in Mubi Metropolis

Fig 1 shows that Gude ward has the highest plastic waste generated while Kolere has the lowest percentages.

Figure 2 is showing the proportion of sorted plastic waste in bar chart. The results show that Mubi metropolis generated 12,283kg of plastic waste. But one metric ton of plastic waste can generate 9585 kwh and Mubi metropolis consume 10MW of electricity. Therefore, the plastic waste generated in Mubi metropolis cannot be able to power Mubi metropolis.

Conclusion and Recommendations

In conclusion, this research shows that plastic waste generated in Mubi metropolis were not enough to give 10MW electricity required since one metric ton of plastic waste can generate 9585Kwh. Therefore, this paper recommends recycling to produce other products instead of allowing all these waste littering the community. Other methods of waste treatment such as incineration, compacting and manual sorting should be adopted so as to reduce the size, volume and to get rid of waste completely.

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