International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Waste Characterization in the Bafoussam II Municipality of Cameroon

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Abstract: ***This research paper presents the findings of waste characterization in three residential neighborhoods (Tyo-Ville, Djeleng 3 and Petit Paris) in the Bafoussam II municipality of Cameroon. Primary data source involved field survey, direct observations, structured and unstructured questionnaires and interviews. Inventories of the different waste fractions, the quality and quantity were determined through pre-collect, sorting and weighing with a mechanical balance. The criteria for selecting 51 persons from 10 households during the random survey were based on the proximity of homes to wastes dump, access to collection services and economic and social status. The results showed a daily total of 777.5 kg of household waste generated giving a per capita household waste generation of 1.05 kg/persons/day. This value is high compared to municipalities in other developing countries. The study revealed that waste generation was significantly different amongst residents in the lower socio- economic class with more wastes being produced compared to the other two socio economic classes. Of particular interest is the biodegradable solid waste fraction (93.4%) by weight) with possibility of transforming it into organic compost for use in agriculture and aquaculture.***

Keywords: Characterization, Household solid waste, per capita waste generation, socioeconomic class

1. Introduction

One of the major problems on the African continent remains that of household waste and uncontrolled urbanization (Diabagate, 2009). Urbanization and economic development generally result in increased consumption and waste generation. This growth is accompanied by increasingly difficult economic conditions and the urban setting which develops there is a relatively small and densely populated space, presenting various constraints and factors which make hygiene and sanitation and pollution problems more acute (PNUB, 2013).

Hygiene and sanitation conditions are gradually deteriorating in Sub-Saharan African countries because since the 1980s, waste production has been steadily increasing, generating huge environmental risks such as pollution, floods and greenhouse gas emissions resulting in health problems to animal and plant populations (Ngambi, 2016). The immediate cause to all these is because many municipalities are unable or unwilling to provide waste collection services to all residents in their jurisdiction. On average, up to 50% of residents lack collection services in urban areas of low and middle income countries (Klundert and Ansch¨utz, 2001). It is for this reasons that source separation and separate collection of recyclables are today seen as necessary pre-resequite for sustainable waste management (Hornik and Cherian, 1995).

Several studies show that much of the municipal solid waste from developing countries are generated from households (55–80%), followed by commercial or market areas (10–30%) with varying quantities from streets, industries, institutions among others (Nabegu, 2010; Nagabooshnam, 2011; Okot-Okumu, 2012). Waste from these sources are highly diverse in nature (Valkenburg *et al.*, 2008) and have variable physical characteristics depending on their sources; notably in their composition are food waste, yard waste, wood, plastics, papers, metals, leather, rubbers, inert materials, batteries, paint containers, textiles, construction and demolishing materials and many others which would be difficult to classify. Several authors have found that, the quantity of waste produced per capita, is positively related to income levels of the people in the community (Amori *et al.*,2013; Qdais *et al.*, 1997; Emery *et al.*, 2003) while the composition varies with the income level of the community or residential area (Mbeng *et al.*, 2012).

The composition of household waste is an important aspect of solid waste management planning where information is required by local authorities to develop waste management strategies (Sha'Ato *et al.*, 2006). Notwithstanding, Cameroon lack reliable waste management data to provide sound evidence base essential for robust policy development for household waste management in Cameroon.

Reliable waste management data provides an all-inclusive resource for a comprehensive, critical and informative evaluation of waste management options in all waste management programmes (Chang and Davila, 2008; Hancs *et al.*, 2011; Qdais *et al.*, 1997). Unfortunately, these required fundamental statistics are lacking in many developing countries (Buenrostro *et al.*, 2001) and where they are available, they are inconsistent because they come from many sources which cannot be validated and are sometimes based on assumptions but not scientific measurements (Couth and Trois, 2011; IPCC, 2006; Ranjith, 2012). With available data, a well-designed municipal solid waste management scheme could promote the quality of urban environment, generate employment and income, protect environmental health and support the efficiency and productivity of the economy (Ogwueleka, 2009).

The aim of this research work was to carry out a waste characterization in the Bafoussam II municipality involving 10 households in three residential neighbourhoods (Tyo-Ville, Djeleng 3 and Petit Paris), chosen on the basis of their socio-economic status. The results obtained provided essential information to decision-makers to adopt management policies that will contribute to the improvement

of the solid waste management systems in the Bafoussam II municipality and Cameroon in general.

1.1 Importance of household waste

Human activities create waste, but it is the way in which these wastes are handled, stored, collected, and disposed of that can pose a risk to the environment and public health. In places with intense human activities such as urban centers, appropriate and safe solid waste management is of great importance in providing healthy living conditions for residents. Though most governments in developing countries acknowledge this fact, many municipalities struggle to provide even the most basic of services (Zurbrugg, 2003).

Household or domestic waste is a vital resource that, if well exploited, can go a long way toward improving the livelihoods of urban residents. According to Nzila *et al.*, (2010) biowastes could play a critical role in future energy supply, mainly through thermochemical, physicochemical, and biochemical transformation and conventional combustion. Furthermore, Cofie *et al.*, (2009) reported that the organic fraction of domestic waste can be exploited through composting, thus returning vital nutrients to the soil.

2. Materials and Methods

2.1 Overview of the study area

Bafoussam is a cosmopolitan town located in the West Region of Cameroon with Bafoussam II municipality (Figure 1) delimited to the Nord by Bamboutos, South by Bafoussam I, East by Noun and West by Bafoussam III (PDUB, 2013). The population is dynamic and the economic activity is principally agriculture and animal breeding with about 70% of its agricultural products consumed by the bigger cities of Douala, Yaounde and Buea (Neba, 1999).

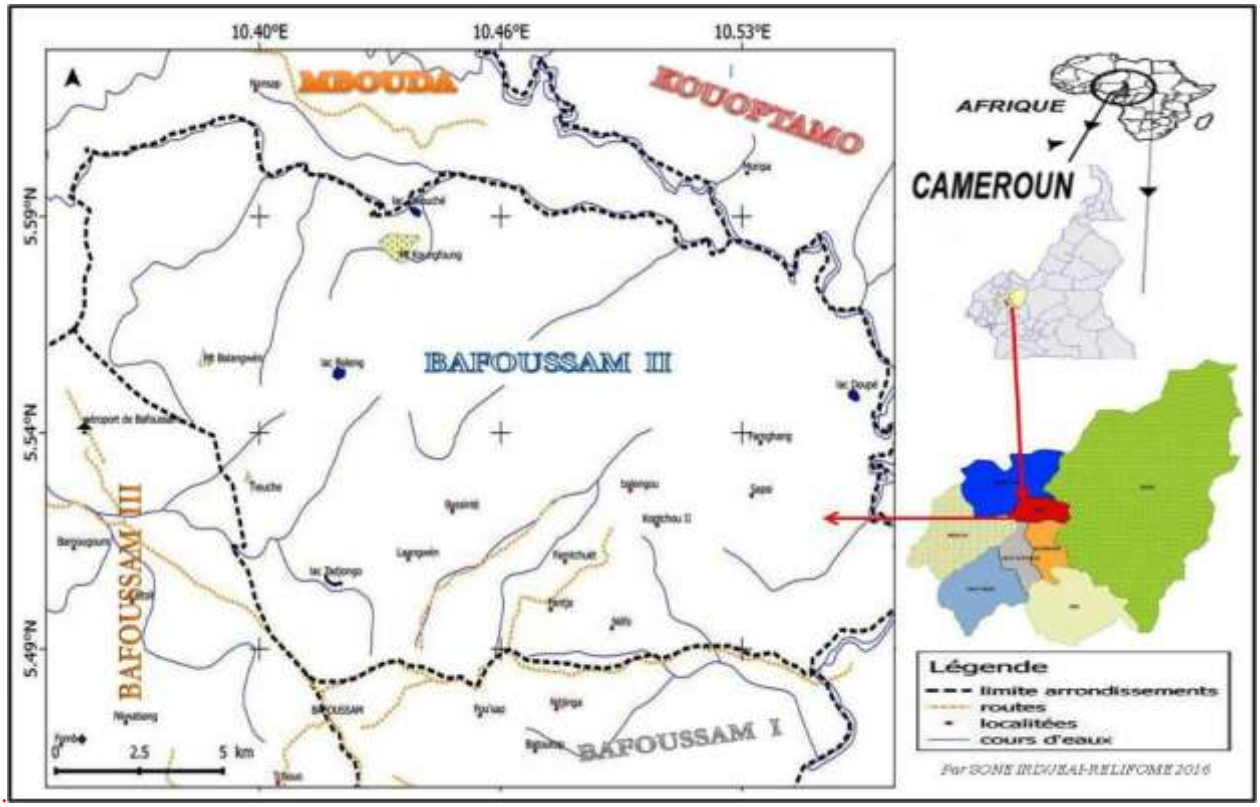

Figure 1: Map illustrating the location of Bafoussam II municipality (Source: PDUB, 2013)

2.2 Household survey

Primary data was collected from direct observations. This enabled us to see the different dump sites, households and waste management activities in Bafoussam II, waste management infrastructures and the state of the environment.

A household survey carried out involved selection of 10 households through random sampling from three residential neighborhoods. This included 3 households from Tyo-Ville, 3 from Djeleng and 4 from Petit Paris (Figure 2). The main criteria for selecting these households were proximity of homes to dumpsites, access to collection services and economic and social status. It was on this basis that three households designated as M2, M5 and M8 were randomly chosen in Tyo-Ville because the residents were of the upper income class (medical doctors, priests, journalists or business tycoons). Three households designated as M4, M6 and M9 of Djeleng 3 were of the middle income class (teachers, finance clerks and computer analysts) while four households designated as M1, M3, M7 and M10 of Petit Paris belonged to the lower income class (tailors, tradesmen and maintenance agents). A total of 51 individuals were found in the targeted households.

Structured questionnaires were administered to the public and HYSACAM staffs to get their perspectives on

household waste management systems in the Bafoussam II municipality.

Figure 2: Location of residential neighbourhoods in the Bafoussam II municipality (Source: PDUB, 2013)

2.3 Weighing of sorted waste

Wastes was collected from participating households and segregated into six categories (organic materials, plastics, glass, textiles, metals and paper) for 14 days. Weighing was done using a mechanical balance of marque NAVA (Figure. 3). The following aspects were taken into consideration during sorting, segregation and weighing which is in line with Pichtel (2005) and ASTM D5231-92 (2008):

1) Average per capita household waste generation;
2) Percentage composition of the different waste fractions.

Figure 3: Weighing of solid waste with a mechanical balance

3. Results and Discussion

3.1 Household waste generation rate

The per capita average waste generation irrespective of socio-economic status for all ten households chosen from the three residential neighborhoods was 1.05 kg/persons/day. This is high compared to many municipalities in sub-Saharan Africa countries which ranged from 0.2 to 0.8 kg/person/day (Friedrich and Trois, 2011; UNEP, 2013). According to Ngnikam (2000), the average production of domestic waste in Yaounde was 0.6 kg per capita/per day during the dry season and 0.98 kg per capita/per day during the rainy season.

3.2 Waste composition

The results revealed a higher quantity of organic waste (93.4% by weight). This was followed by glass (3% a non-biodegradable fraction), while paper was the lowest (0,4%) as shown in Figure. 4.

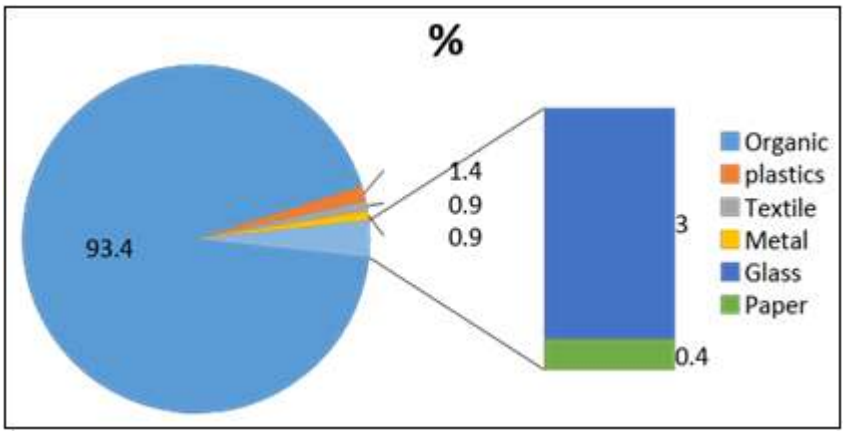

Figure 4: Average percentage composition of the household waste

3.3 Determination of quantities

Analysis in the distribution of the waste fractions shows disparities with regards to the average weight produced per household. For the ten households sampled, the average weights varied significantly between 3.35 and 6.2 kg (Figure 5), the smallest quantity produced by households in the high income class (M5), and the greatest quantity by the low and middle-income households (M7 and M9). The total quantity of waste produced was 777.5kg, with a per capita waste generation of approximately 1.05 kg / person / day.

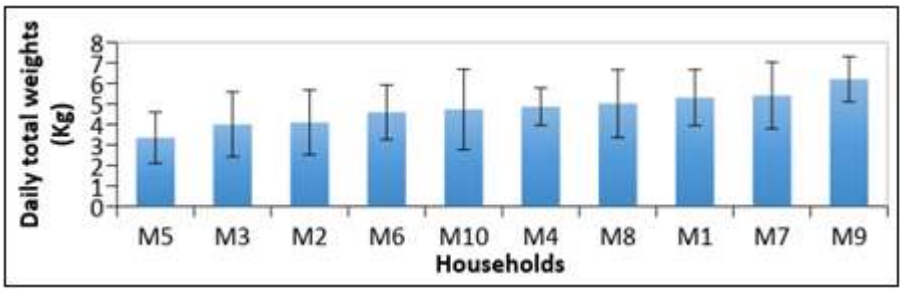

Figure 5: Average daily total weights per household

3.3.1Average daily weights of waste produced

The average daily weights of waste produced is highlighted in figures 7 to 12. This provides information on the irregular distribution of waste types in the residential neighborhoods of Tyo-ville, Djeleng 3 and Petit Paris belonging to the upper, middle and lower socio-economic classes.

The upper socio-economic class (M2, M5 and M8) had majority average daily weights of plastics (0.1 kg), metal (0.06 kg) and paper (0.03 kg). This could be associated to life style were a majority of households visit super markets where most of the packaging is done with plastics and paper.

In the medium socio-economic class (M4, M6 and M9), glass and organic material constituted a majority with an average daily weights of glass (0.3 kg). This was probably due to glass debris resulting from the lack of proper disposal measures for broken glasses and bottles. For the organic material (5.0 kg), this could be explained by the fact that this researcher found many average income farmers with large agricultural plantations as well as large household.

In the lower socio-economic class (M1, M3, M7 and M10), organic material (4.5 kg) and textile (0.05 kg) were the two wastes fractions with the highest average daily weights. Data from household survey revealed a large family size with low incomes. Farming was the most common occupation for men and seam stressing for women. With regards to their consumption habits, cocoyam, potatoes, banana, maize with different types of vegetables constituted their staple diets.

The small quantity of paper and plastics recovered was due to the fact that women in this socio-economic class use paper and plastics as a source of energy to cook food for the entire household. This is done out of ignorance with no knowledge of the environmental and human health impacts of burning plastics. Contamination of paper in the homes was a common scenario and according to Mason *et al.*, 2003, contamination of paper is a major challenge associated with recycling paper from mixed waste.

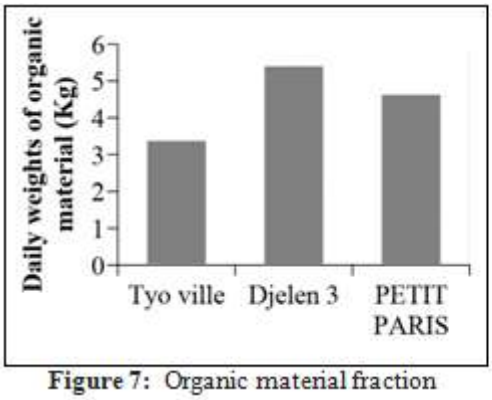

Figure 7: Organic material fraction

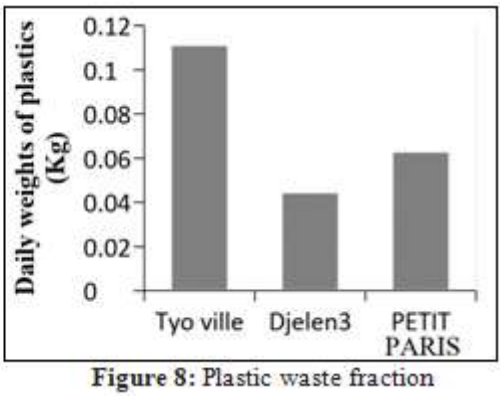

Figure 8: Plastic waste fraction

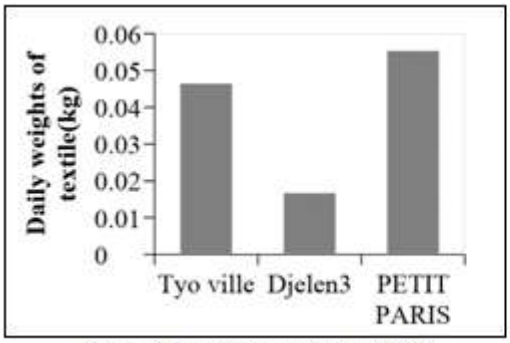

Figure 9: Textile waste fraction

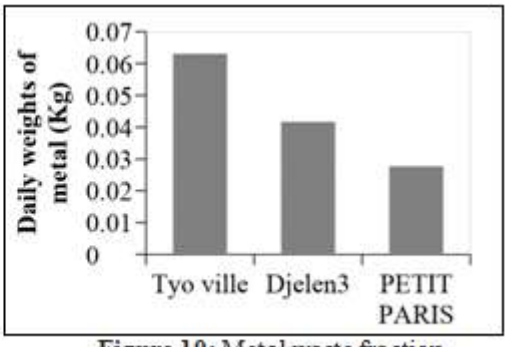

Figure 10: Metal waste fraction

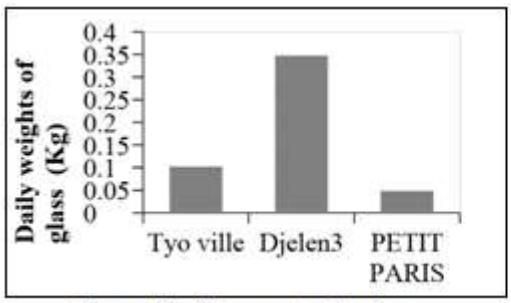

Figure 11: Glass waste fraction

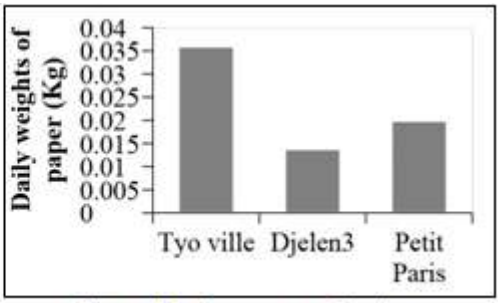

Figure12: Paperwaste fraction

4. Conclusion and Recommendation

Characterization of solid waste in the municipality of Bafoussam II shows organic material having a higher percentage compared to the non-organic/non-biodegradable material. This result is similar to that obtained by Oben *et al.*, 2016 in Banengo village. The high proportion of organic matter in our study area can be explained by the fact that agriculture is widely practiced in this area. This is in line with Westerman and Bicudo (2005) who indicated that for the effective management of organic waste, three different second life uses of organic waste must be identified : Compost production, energy generation and for soil nutrient. Optimized reduction of the particle food waste size and liquefaction are essential treatment needed for the food waste feedstock (Izumi *et al.*, 2010). It is estimated that 100 tones daily food waste could generate sufficient power for approximately 1000 homes (EPA, 2008).

The effective management of these solid waste actions must be driven by three types of actors:

- Regular sensitization campaigns to awaken the consciousness of the inhabitants of their negative attitudes in the production and management of solid waste leading to environmental and human health pollution. Education and sensitization campaigns should also include strategies and methods for the creation of a composting firm for compost production from biodegradable organic wastes e.g. Food waste and paper. Some of the compost can also be used as feed for fish ponds. This is an indigenous traditional knowledge that has been going on for a very long time
- At a very small scale in these three localities. Finally the municipal authorities should create a recycling unit for the non-biodegradable wastes e.g. Plastics, metal and glass;
- The scientific community should enhance waste management research with data made available to the municipal authorities and policy makers. This will help drive policies for the proper management of solid waste within and outside the municipality of bafoussam ii.
- The local population should change behavior such as uncontrolled dumping of waste in waterways and reduce the use of chemical fertilizers. The population should as well adopt environmental friendly methods in the management of solid wastes such as reduce, reuse and recycling. Waste reduction is a fundamental step towards an effective waste management strategy (zama and lehmann, 2011). The population should also cooperate with other stakeholders in the management of municipal solid e.g. Municipal authorities, the private sector and non-governmental organizations.

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