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Municipal Solid Waste Management,

Limbe Municipality Cameroon.

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Abstract:

The overview of this paper is about municipal solid waste management in Cameroon and suggested methods for improvement. Garbage bins for sorting has been mentioned in this paper as one of the major infrastructure needed in all the areas, particularly in the low standards areas. The installation of garbage bins for source separation, building of transfer stations next to paved roads have been mentioned as one of the primary solution for both the waste vehicles and households. This will increase the waste collection system and will reduce illegal dumping of waste. Population, urbanisation and industrial growth has also been mentioned in this paper as one of the main causes of increase waste generation that has lead to illegal dumping of waste in unwanted areas. Low level of education, inadequate financial standings or resources, poor enforcement of waste management regulations and governance has often led to major waste management problems in Cameroon. This paper also presents a vital analysis of the distance between garbage bins and households as well as possible solutions. The method used in this paper is both primary and secondary data's which has been explained below. The three filter theory and the waste hierarchy model have as well been used.

The case study of Limbe municipality has been used to bring out waste management related problems and recommended possible solutions for improvement.

Key words: Environment, municipal solid waste management, Limbe municipality, Cameroon, awareness.

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Dedication

This thesis is dedicated to the entire family of Ewoko and Iboh, more especially to my father Otto Ewoko who thought me that the best knowledge in life is that one which is been achieved for its own sake and my mother Magdalene Ewoko who thought me that there is nothing hard to be achieved in life if you follow them step by step. The thesis is also dedicated to Owen Holland who always thought me never to draw a line ahead of you in life, because the impossibility can be possible only if you have in mind that you can make it. Lastly to my supervisor and Anders Klang with his moral support and Monique Mutie who always admires my effort.

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1. INTRODUCTION

The sustainable management of solid waste streams is vital in order to minimize environmental and public health risks around the world today. Waste management is the collection, transporting, processing, recycling and monitoring of waste materials. Waste management involves different kind of waste like liquid, solid and gaseous substances. Examples of such waste in the Limbe municipality can be material like paper including magazines, glasses, bottles, metal cans, batteries, e-waste, light bulb, fluorescent tubes, spray cans, shoes polish, pesticides containers, motor vehicle spare parts etc. Waste will always be a cause for concern in the Limbe municipality because it is one of the highest populated cities in Cameroon, and have a mini sea port where most of electronic products from Nigeria are landing. (*Ebot et al 2007*)

The municipality of Limbe is lacking the knowledge of employing some social roles like, social welfare, public acceptance and political concerns that can help to create a positive impact to eradicate this environmental issue in other to have a sustainable environment. If these roles are put in place, there should be a respect of public opinions, social perspective when making decisions. (*Su et al 2006*)

One can say that, many villages around the municipality have little or no knowledge about waste management and this has been a very serious problem because most of their waste is been dump near bushy areas, farm lands, road sides, and in the sea water. This has caused lots of ill-health since most of these sites are used for other motives. Like for the sea, is a place where many teenagers go and swim in their leisure times and you can find solid waste in the water which can cause health infections like allergy. More to that, many rivers are also used as dump sites and this as well causes health infections. Furthermore, their limited dumped sites and garbage tanks for the deposition of solid waste and this has increased the indiscriminate disposal around the city sites, but the Limbe municipality is doing its best to solve this issue.

Preventing waste is a very fundamental part in waste management. It involves the designing products to be reuse, repair instead of buying new ones. Recycle of material is not so common but is been practice now a days in Cameroon. Incineration is another waste management practice that involves burning of waste materials into steam, gas and ash and is as well common in Cameroon. Opened dump landfill is a very common practice in many African countries and is mostly done in a very poor design; this of course causes impacts like economic, social and environmental impacts. Furthermore, landfill is been known as one of the least waste management option since in involve emissions of some gaseous pollutant that contribute to global warming. Certain hazardous waste like cables, screens, batteries and circuit cards are not well treated because of the cost involve in doing that in which they have hazardous substances like cadmium, lead and mercury in them. They are very dangerous to

human body and the environment, and they can be spread in the environment if not remove from the waste flows. There must be a proper legislation to be put in place in order to handle cases like this which is lacking in the municipality of Limbe. Most of these materials are poorly disposed in such a way that, they are mixed with other domestic waste and taken into open dump landfill site without any consideration since the laws are in theory and not in practice in many African countries especially Cameroon. In rule of laws countries where such actions are taxed at a very higher rate, it helps people to turn their attitudes towards sustainability and the taxes paid for that can help to increase the country's GDP. (Ngonhgo 2009)

Finally, sustainable waste management will remain a great challenge in most developing countries and some developed countries due to lack of enforcement of waste management policies and laws that govern waste management practices as well as income to finance these practices.

1.1 An Overview of Cameroon.

Cameroon is located in central Africa in the Gulf of Guinea and lies between latitudes 2° and 12°N and between longitudes 8° and 16° (Ebot et al 2007) (<http://www.infoplease.com/ipa/A0107382.html>). Cameroon is a country with a population of 18,879,301 as per 2009 statistical record and a growth rate of 2.2% and a life expectancy of 53.7 years. The capital is Yaoundé; the total surface area of the country is about 475,440 sq km and the country currency is CFA Franc. (<http://www.infoplease.com/ipa/A0107382.html>)

Cameroon is called “Africa in Miniature” and this is because of its rich cultures, ethnic groups, sunny beaches, mountains and its geographical landscape, and have more than 240 local languages. (Sociolingo september 10, 2004)



Fig.1 Map of Cameroon and its borders. (<http://www.infoplease.com/ipa/A0107382.html>)

1.2 An overview of the Limbe Municipality.

Limbe is a coastal city located in the south west province of Cameroon in the Gulf of Guinea. (*Ebot et al 2007*)

Limbe is situated between longitude 9° and 13° east of the 180 meridians and latitude 4° and 9° north of the equator. Climatically, Limbe is dominated by the equatorial climate of high rain fall and high temperature. The yearly average temperature is 26.5°C, yearly average rainfall is above 250mm, while the annual average related humidity is above 82.5%. (*Limbe, the city of friendship and opportunities*) It was formerly known as Victoria and later on changed to Limbe. It has a population of about 84,500 inhabitants with an estimated percentage of 2.9% growth rates. It constitute of 4 councils namely the Limbe city council which is been ruled by a government delegate, Limbe 1, Limbe II and Limbe III ruled by mayors. (*Ebot et al 2007*), (*Limbe city council*)

One can say that Limbe is one of the most industrialised city`s in Cameroon and a fish port which attract many people to migrate there and a very good and conducive environment which also influence many tourists, and it consider to be the best and cleanest city in Cameroon today.

1.3 Objectives

The aim of this paper is analyzing and looking into the state of solid waste management in the Limbe municipality in Cameroon, causes and effects on the entire environment and the goals that can be achieve when implementing environmental sound methods on solid waste management in the municipality. Furthermore, the main objectives looking forward will be:

- To investigate the cause of indiscriminate disposal of solid waste.
- To access the existing waste management practices and the situation of solid waste management systems in the city.
- To assess the impacts caused by this malpractice and suggest possible measures to mitigate these impacts by introducing new technologies.
- To investigate the role played by the government to mitigate these issues.
- To set up a means to reduce this malpractices.

2 METHOD

This report is based on both primary and secondary data's. Primary data's were collected from the stakeholders and some other council officials who are concern with waste management in the municipality and a visit was made on dump sites to see the present situation on how the waste is been handled.

Secondly, secondary data's were collected from the internet on googl.com, science direct, Scopus and greenflies, literature review to consult some articles and reports in relation to solid waste management in Cameroon and other African countries. Reading of text books in relation to solid waste management and the theory used in this paper.

By improving on environmental quality, some of the aspects that need to be done are more voluntary on environmental responsibility; most of these decisions are taken to move towards the environmental set goals. When it comes to environmental science, many theories have been developed relating to the implementation of the set environmental goals. Due to insufficiency of data`s, I tried to assume some figures to analyse the current problems that causes waste management nuisance in the Limbe municipality. One of them which is the three filter theory is been applied as the main methodology of the study.

Furthermore, the model of waste hierarchy is used to give waste management options from the highest best alternative to the least one to finalise the three filter theory.

2.1 The three filter theory.

This theory has widely been used in many years when it comes to environmental law research and communication. It involves moral or Ethics, Economic feasibility and Law and legal system. They are means of control of which they can work in different ways. This theory actually helps environmental detrimental projects not to be carried out in any society. It can also be referred as a policy instrument on environmental sustainability. This theory makes emphasis on actors and re-actors. The actors here are persons involved in an action plan or a project, whereas re-actor is the respond from the actors (the respond to the environment). (*Westerlund 2003*)

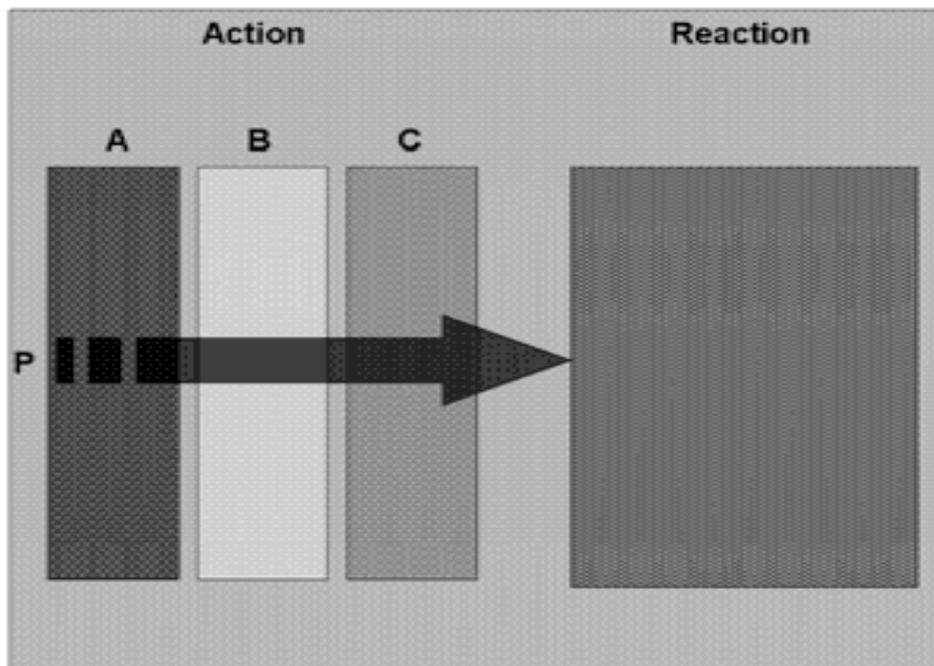


Fig 2, the three filters. (Westerlund 2003)

A represent moral or ethics, **B** represent economic feasibility, **C** represent law and the legal system and **P** represent any project, action, activity, and production of goods that an actor plans and that will eventually have environmental effects. (Westerlund 2003)

The first pillar or filter which is known as moral or ethics, drive the inner mind of people towards sustainability. This is because when an action plan is to be carried out, the actor thinks the causes of that project to the environment if is positive or negative. If that project has negative impacts to the environment, it will be a moral or ethic choice not to continue regardless of the economic gains and whether the particular activity is legal or not. Such ethical decisions are mostly influence by communication which can be information. This filter can only stop those who are ready to abstain voluntary from a project.

Economic feasible which is the second filter state that if an actor realised that a project is economically sound, he can now try to investigate if that particular project is bound by law or legally acceptable before he can proceed. The economic filter is based on that human attitude can be steered with economic forces. Some economic factors that can rejects harmful projects can be taxes implanted on them. (Westerlund 2003)

Based on the authors observation, under the economic filter the can also be the deposit and refund system where values are been added into plastics and bottles to recover the resource and money given back to the depositor to reduce environmental hazards.

The third pillar or filter is the legal system or law. This filter shows the situation were if a plan activity has passed the A and B filter, but that activity cannot proceed if is not legally acceptable or binned by law and obviously the actor will not be allowed to proceed. In a situation where the law is silence, and they're not substantive laws that are banning such activity, then the actor can legally proceed due to the rule of law and how the default functions. (*Westerlund 2003*)

These three filters in one way or another can help to hinder harmful projects to be carried out by steering people behaviour towards sustainability or better environmental performance. (*Person 2008*)

In understanding the relationship between these three filters theory is very essential when it comes to role of law in a rule of law order. (*Westerlund 2003*)

2.2 The Waste Hierarchy



Fig 3, Waste Hierarchy showing the most preferred option to the least preferred option.

(*Dacorum Borough Council*)

Waste hierarchy is simply a step-by-step approach on how waste should be handled in order of preference.

- *Reduce*: This step in the waste hierarchy based on the consumers and producers behaviour. In the consumer part, the consumer should buy products of less package weight more than that of higher package weight to reduce recycling. (*Dacorum Borough Council*)

Such a situation is not so common in the Limbe municipality since the majority of the people have limited knowledge about reducing environmental load by focusing on environmental sound products. For example, the purchase of refill items likes softener.

For the manufacturer they should use more sustainable packaging for their products. For example less weighted products to reduce waste.

- *Re-use*: Re-use simple means the use of an item for more than one use. When a product is re-used, then it brings more environmental benefit than when it is thrown. For example using shopping paper bags for shopping and to store waste or to re-use them again for another shopping also prevent the volume of waste. (*Dacorum Borough Council*)

This action is been practice in the Limbe municipality but not everybody is involve in it. Education and knowledge can make it wider.

- *Repair*: It means the transforming of an imperforming item so as to make it function again. This is because when something is bad the next thing we mostly have in mind is to throw it away. For example electronic products Is better to think about repairing them than buying new ones. (*Dacorum Borough Council*)

In the Limbe municipality as the case study, it is better to encourage people to do repair.

- *Recycling*: Recycling is the most important step in the waste hierarchy because it also deals with economy. This is because it creates already used materials into useful production. This action helps to reduce the cost of getting new materials and the energy used for extraction of new materials. It helps to reduce the amount of waste that can be taken to the landfill site and also to reduce emissions from methane gas which is one of the major contributions of climate change. (*Dacorum Borough Council*)

In Cameroon now more people and companies are improving on recycling, but better ways need to be developed in a more sustainable manner.

- *Disposal*: This is the final step on waste hierarchy. It involves landfill of waste materials. This is so common in the Limbe municipality because most of the waste is dumped on opened incineration. (*Dacorum Borough Council*)

More performance can be made when new technologies are introduced

2.3 Problem Statement: Case Study Limbe Municipality Cameroon

In many African cities, municipal solid waste management has been one of the major contributors of health and environmental problems today and especially in Cameroon which is the focus on the thesis. This is because only 20-80percent of the total waste is been collected and others are been dumped into vacant lot, seaside's and on roads sides. Most of these waste are been generated from house hold preparations, cooking and serving of food, sales and storage, market refuse, street sweeping, abandoned vehicles, industrial waste and construction and demolishing. Furthermore, there are other sources like second hand goods from

developed nations, public institutes and sewage treatments centers. Most of the goods from the developing nations that are being sent to most Africa cities especially in Limbe municipality are near the end of life cycle so they spend little time with the owners and finally became as waste. (*Achankeng 2003*)

When it comes to waste management in Africa cities especially Cameroon, there are many political issues and corruption, poor relationship between the general public and the government as well as stakeholders in the municipalities. They use command and control approaches. They are also problems such as low standard of living resulting from a poor economy, lack of finance in handling appropriate transportation methods, low level of education and archaic technologies in resolving waste management problems. (*Imam 2007*)

3 RESULT

The framework of the agenda 21 has help to usher better idea on aims and objectives of the regulations of solid waste management in Cameroon. More specifically the chapter 21 of the agenda 21 has helped in the promotion and transferring of environmental sound technologies on municipal solid waste management and the decisions taken by stakeholders in developing nations. (*U.N.E. P*) In Cameroon, the creation of the ministry of Environment and forestry in 1992, the national environmental management plan are better products of the new era on environmental sustainability. Some of this power has been designated to other ministries of which all have developed powers in waste management regulations. (*Ebot et al 2007*)

One can say that, the creation of the ministers to implement and regulate laws made in relation to solid waste management has help to reduce it ill effects and inefficiency. Also, a research and development strategy has also helped to open the mind of the people and education in regards to waste management and other waste management plants.

3.1 Indiscriminate Disposal of Municipal Solid Waste in Limbe, Causes and Effects

3.1.1 The first filter (Moral or Ethics)

The first pillar or filter which is known as moral or ethics, drive the inner mind of people towards sustainability. This is because when an action plan is to be carried out, the actor thinks the causes of that project to the environment if is positive or negative. If the projects have negative impacts to the environment, it will be an ethical point of view for the project not to be carried out. This also depends on the attitude and awareness of people towards environmental damages. If more people are aware, then less environmental damages will be realised.

If majority of the people in the Limbe municipality are more aware of the environmental loads of some activities, and by communication channels through campaigns and other mass Medias, then more people will abstain from such activities talk less of the economics gains by respect of the ethics or moral filter

3.1.2 Public attitude and awareness to waste.

Public attitude and awareness are very important when it comes to municipal solid waste management because it can affect the stages involve. There are impacts on storage, waste segregation, recycling, the frequency of collection, willingness to pay for waste management services and disposable facilities on household waste. In common, people in Limbe have poor attitudes towards waste management. This is because most of the people who handle waste are regarded as not been neat, poor and inferior and the issue of carrying waste to the dump sites has been like the duty of children in most developing nations like Cameroon. Much effort has been made to increase awareness to the private and public sectors in regards of solid waste management in Cameroon. Furthermore, most people still have not been looking into a better and appreciate environmental quality since because they think is the role and responsibility of the government and forgotten that individuals also have a very important role to play in order to have a healthier environment. (*Imam et al 2007*)

3.1.3 Driven forces behind the increasing waste management trend.

Population, urbanization, industrialization, gross domestic product (G.D.P) and technology is a correlation in the increased of waste generation. These concepts are interrelated in the sense that their associated with one another, for example population and urbanization. Evidence shows that as the urban population is increasing, so as the waste generation. (*Memuna 2009*)

Industrialization has as well leaded to increase in waste generation in a very high extern because an increase in industrial development, people turn to search for better and high standards of living and purchase more goods which leads to increase in waste generation. Furthermore, as influence as a city can be in recent development the more waste it generate. (*Memuna 2009*)

Urbanization increases the influence of people into urban areas leading to an increase in population and of waste generators in cities. Study shows that urbanization has been on increase since in the 1950s and is expected to continue in the next decades. As the days are coming and this actually occur, the urban population, the volume of waste generation, the demand for housing and the demand for dump sites will consequently intensify. If these intensify dump sites are established, it will lead to possible inadequate waste management services that municipal residents and the authorities hesitate on. Moreover, the possible outcomes will be illegal accumulation of municipal waste in unwanted environment resulting to environmental and ill-health in the city. (*Memuna 2009*)

Table 1, the population of Limbe from 2001 to 2010 from the Limbe city council.

Years	Population
2001	84500
2002	86559
2003	88259
2004	90200
2005	92184
2006	96285
2007	98403
2008	98403
2009	100568
2010	102780

Source: Author and the 2001 population from the Limbe city council.

The table above shows the increase in population growth in the Limbe municipality. From the year 2001 to 2010, the population has been on a constant increase of 2.2% growth rate every year. This has arisen because of the rapid economic growth in the city.

3.1.4 Consequences of the increase waste volumes and unstable waste management.

Waste is associated with hazards that are terrifying to human and the climate system if it is not managed in a more sustainable manner. Study by the United Nations (1992) point out that in a total of 5.2 million deaths that results annually from increases urban waste generation, over 4 millions are children who die of cholera, diarrhea, malaria etc in different parts of the world. Furthermore, the United Nations international children emergency fund (UNICEF) compels state parties to develop and carry out necessary steps and policies in the light of the well being of children who are both in the present and future generation. (*Memuna 2009*)

Children as human, entails good and healthier environment with safety measures. Although the relationship between solid waste and diseases are not well acknowledged, it has been

noticed that solid waste in a warm and moist condition can harbor vectors of diseases such as plague, typhoid and dysentery. In addition, the presence of human fecal matter and potentially hazardous substances in the municipal waste streams, decomposition of waste to GHG, the penetration of leachate into surrounding soils, the emission of heavy metals, pipe gases from incineration plants, fire hazards, and rubbish blown by wind (air pollution) resulting from the burning waste dumps are all associated with municipal waste management (EPA 2007) burning and dumping of waste are major sources of CO₂ and CH₄ that can cause ill-health problems to waste management workers as well as scavengers. These gases (CO₂ and CH₄) are consequentially results to decrease in water quality and increase atmospheric concentration of global warming. (*Memuna 2009*)

Methane emission is considered to be one of the most GHG emissions from a landfill; the content of this gas is depending on the carbon content of the waste which is eagerly biodegradable. The gas has significant negative effects on the environment and on human health if is not handled in a more sustainable manner. (*Couth and Trois 2010*)

3.2 Obstacles towards municipal solid waste management.

3.2.1 Financial obstacles.

Cities in Cameroon account for 60% GDP, only 1% goes for public investment. The government as well contributes about 40 to 60% (*Parrot et al 2008*). In Cameroon, most of the waste management taxes range from FCFA 30,000 to 50,000 (US\$60 to \$100) for private and public companies. These amounts are quite small in handling waste management services and this has turned the inefficiency of waste management practices. This amount does not involve households that mean all households have personal responsibility in handling their waste of which majority, about 90% of the people are unemployed. (*Parrot et al 2008*) It is more evidence that in the proper improvement of waste management, local communities in those areas, like in Limbe municipality need to be consulted. This is to help and introduce new systems that have been proven better in other places and of which they are more sustainable and cost effective since finance is a major obstacle when it comes to waste management in many African cities. (*Couth and Trois 2010*)

3.2.2 Institutional responsibility.

Due to the fact that many cities in Cameroon lack the responsibility lines between the various stakeholders, it has always been a conflict between the urban quarters and the community. The laws that create the assignment for the urban community to rule over hygiene and health, the urban quarters were in charge of domestic waste collection and processing. In the processes of upsetting municipal waste management, there was a conflict that came with disagreement between the stakeholders and politicians. These conflicts make the domestic waste collectors to suffer a lot since they were no laws to regulate waste management stages like pre-collection, collection and waste transportation to waste disposal dumpsites. (*Parrot et al 2008*)

3.2.3 Physical obstacles

In order for municipal solid waste management to be effective, there should be some factors to be taken into account in order to have efficient services. Like for example in most cities in Cameroon and more especially in Limbe, they are problems of paved roads in many areas, the distances to waste collection bins due to expansion of the settlement has led to inefficiency in the waste management systems in the city. In some cases, the distribution of the public bins does not take into consideration the number of people in that area and inaccessibility, this has also helped in the promotion of illegal dumping of waste in unwanted areas. (Parrot *et al* 2008)



Figs 5, waste dump at the seashore. (Brad & Saidou 2005)

This is an example of a picture showing how waste materials are being dumped along the seashore where many people go there for leisure. Also waste pickers go there to get valuable materials like plastic bottles that can be marketed.

3.3 Role of legislation

The legal system or the law (3pillar or filter). This filter shows the situation were if a plan activity has passed the ethic and the economic filter, but that activity is not legally acceptable or binned by law and obviously the actor will not be allowed to proceed. In a situation where the law is silence, and they're not substantive laws that are banning such activity, then the actor can legally proceed due to the rule of law and how the default functions. (Westerlund 2003)

Unlike in Cameroon were most of the laws are just in theory and not in practice, many people turn to go against the laws and perform unlawful activities. Since they are many ministerial departments concerned in waste management and it regulations in Cameroon better regulations can be done by enforcing the laws and implementing new laws and stronger regulations to improve waste management and it practices in Cameroon.

3.3.1 Role and responsibilities of ministerial departments

In Cameroon today, there are a number of ministerial departments that have mandate power in relation to waste management and it regulations. The supreme body today in Cameroon responsible for solid waste management, is the Inter-Ministerial Commission for municipal waste management (ICMWM). It was created under the auspice of the prime minister who is the head of government (Decree No.95/230/PM of 31/04/95) which entails policy development on suitable municipal solid waste management's strategies in the country. (Ebot et al 2007)

Table 2. Roles and responsibilities of key ministerial departments related to waste management in Cameroon

Ministerial department	Key responsibilities related to waste management in Cameroon	Statutory Order
Ministry of Territorial Administration and Decentralization (MINTAD)	Follow-up and implement regulations for organization and functioning of Councils; Oversees the execution of the budget of the government's council support fund (FEICOM); Restoration of hygiene and public sanitation; Supervises Urban Councils which are responsible for follow-up and control— industrial waste management, management of all public spaces and infrastructure; Sweeping of streets, collection, transportation and treatment of household waste	Circular letter No. 0040/LC/MINAT/DCTD of 04/04/00, Order No. 00072/MINAT/MINVILLE of 21/05/00, Law No. 714/23 of 5/12/74, Law no. 2004/18 of 22/07/04
Ministry of Mines, Industries and Technological Development (MINMITD)	Develop strategies for industrial development and the control of Classified and commercial installations for pollution, security, hygiene and industrial nuisance; Define norms for industrial pollution; List of dangerous, obnoxious and polluting facilities in order to inform the public; Develops regulations governing installation and exploitation of facilities classified as dangerous, obnoxious and polluting	Decree No. 99/818/PM of 9/11/99, Order No. 13/MINMEE/DMG/SL of 19/04/77, 02/MINMEE/DMG/SDAM of 4/01/9

Ministerial department	Key responsibilities related to waste management in Cameroon	Statutory Order
Ministry of Economy and Finance (MINEFI)	Financial control of organizations benefiting from supplementary budgets and autonomous public establishments, i.e. Councils; Responsible for managing the Finance Law as enacted by Parliament	Constitution Decree No. 2004/320 of 08/12/04
Ministry of Urban Development and Housing (MINDUH)	Develops and implement urban restructuring, management strategies, sanitation and drainage; Defines and enforces norms of hygiene/sanitation, collection and/or treatment of household waste; Liaises with international agencies for urban development	Order No. 00072/MINAT/MINVILL of 21/05/00
Ministry of Environment and Nature Protection (MINENP)	Collaborates with other agencies to define measures for the rational management of natural resources; Effective control of investigation and pollution in the field; Specifies the criteria (project specific) and supervises environmental impact assessments	Decree No. 2005/0577/PM of 23/02/05 7], Order No. 006/MINEP of 08/03/05
Ministry of Public Health (MINPH)	Creates Hygiene and Sanitation Units in Councils; Renders technical support to the Hygiene and Sanitation	Order No. D67/NS/NN/ST/SG/BMPHP/NNPA of 11/08/87, Circular letter No.

Ministerial department	Key responsibilities related to waste management in Cameroon	Statutory Order
	Units of Councils, Proposes norms for collection, transportation and treatment of industrial, domestic waste and emptying of septic tanks; Designs and implements public education campaigns on hygiene and sanitation	D69/N6/DMHK/SHPA of August 1980

Source (*Ebot et al 2007*)

Although these ministerial departments are of difference responsibilities, their general aim is to address issues related to all type of waste streams most specific on environmental and public health protection. (*Ebot et al 2007*)

One can say that in the municipal level, the council and the authorities are the ones responsible to make sure actions in relation to waste are put in place and are followed by everybody in the municipality.

Moreover, it should also be the role of individuals in the municipality to understand their role as human to help the environment to be clean and safe by combusting the waste at the right place.

Based on the author's observation about the Limbe municipality, there is hygiene and Sanitation Company called (HYSACAM) means 'Hygiene et Calibrate du Cameroun'. It is responsible for the collection and disposition of municipal waste in many parts of the country today and Limbe is one of them. This company have a fix time scheduled of visiting at different locations especially in collecting waste in villages.

In the Limbe municipality, there is a mandatory clean-up exercise by the municipality and other representatives of the ministry of territorial administration and decentralisation (MINTAD) for every first Wednesday of the month. On this day every neighbourhoods is

required to do a clean-up of all unauthorised waste dumps in public and private bins to reduce ill-health on the environment. (Ebot et al 2007)

Table 3. Key legislative aspects related to waste management in Cameroon

Legislation	Key elements related to waste management in Cameroon	Statutory Order
Law relating to Environmental Management (No. 96/12 of 5/08 1996)	National Environmental Management Plan related to the protection of the atmosphere, marine and continental waters, soils, sub soils and human settlements; Regulates installations that pose dangers to the public; Stipulates modalities for the conduct of Environmental Impact Assessments (EIA) and categories of operations subject to EIA; Specifies air emission and waste water discharge standards; Sets conditions for issuing authorizations for allotment and management of land for uses, i.e. industrial, urban etc; Conditions for waste handling (e.g. collection, storage, recycling, etc.); Prescriptions relating to waste elimination by persons producing or treating waste; Stipulates the terms of reference for the supervision of municipal dumps by the competent authorities	Decree No. 2005/0577/PM of 23/02/05, Order No. 006/MINEP of 08/03/05
National Environmental Management Plan	Five year amendable plan; set up environmental information system; Preparation of bi-annual reports on the state of the environment in Cameroon, e.g.	-

Legislation	Key elements related to waste management in Cameroon	Statutory Order
	identifying problems arising from urban pollution and devising suitable micro-projects to mitigate the problems	
Law relating to the installation of Classified establishments (Law No. 98/15 of 14/07/98)	Stipulates two types of Classified establishments (Class I and Class II). Dump sites are classified as Class II establishments for which operation and management must follow prescribed guidance. It sets out the regulations governing the installation and exploitation of facilities classified dangerous, obnoxious and polluting;	Decree No. 99/818/PM of 9/11/99, Order No. 13/MINMEE/DMG/SL of 19/04/77, 02/MINMEE/DMG/SDAMIC of 04/01/99
National Water Code (Law No. 98/005/of 14/04/98)	Provides framework for the exploitation of water resources including waste disposal, Specifies modalities for the protection of surface and groundwater from pollution (including from dump sites).	Decree No. 2001/165/PM of 08/05/01
New Urban strategy, 1999	Partnership among the state, local council authorities and civil society in urban intervention in areas such as solid waste management	-

Source (Ebot et al 2007)

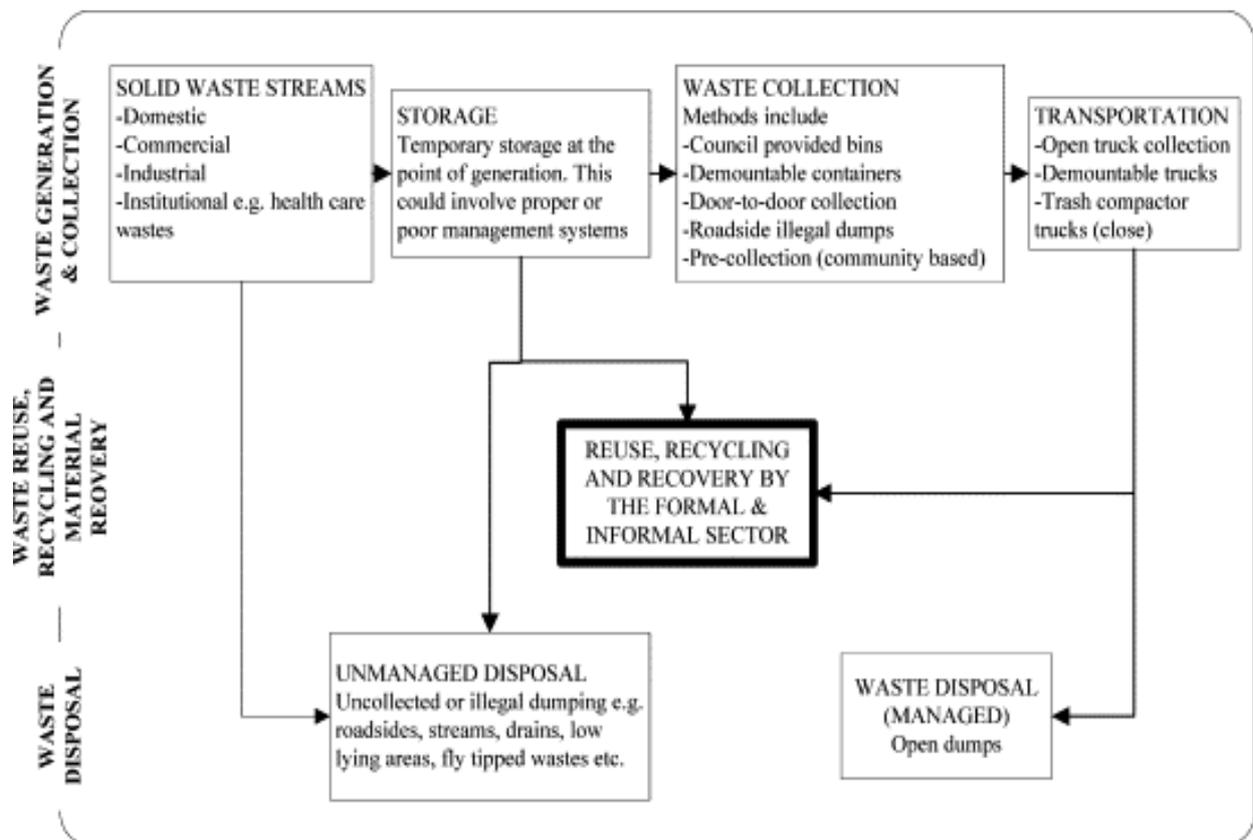


Fig6. Existing patterns of solid waste management processes in Cameroon.

Source (Ebot et al 2007)

3.4 Operational framework for Municipal Councils

The municipal council is responsible for the delivery of all waste management services. They are responsible for the provision and maintenance of all infrastructures which are like for example, waste disposal facilities, financing of all activities related to waste management, street sweeping, collection, transportation and disposal of household wastes as well as the management of all public spaces. These facilities are been finance by three main sources which are:

- Taxes and revenues generated by council activities.
- Subsidiary budgets from the state through MINEFI;
- Lending facilities from the Government's Council Development Fund (FEICOM). Supplementary budgets are subject to scrutiny by MINEFI which is responsible for allocation of government funds on the basis of projected fiscal revenue flows.

In Cameroon, related responsibilities on waste management like health and safety officers are under the jurisdiction of the Hygiene and Sanitation Units of each Municipal Council.

The main qualified staff in each authority is the supervisor who may be a health worker. The Council has the responsibility for creating and managing of these units with fractional responsibility for waste management or they may subcontract the responsibilities to third parties such as specialized waste management companies, (Hygiene et Calibrate du Cameroun)HYSACAM. (Ebot et al 2007) In the Limbe municipality, the Council plays a very limited role in solid waste management since they have subcontract the whole system to HYSACAM.

3.5 Waste volumes and its composition.

Waste generation in the Limbe municipality is estimated to be 20tonn per day and about 7300tonnes per year with it population of 84,500 inhabitants. These quantities are low as compared to other developing cities like Bamako where they have 176tonnes per day of a population of approximately 270,000 inhabitants. This waste comes from a very small population as seen above. This waste comes from sources like households, industries, hospitals, hotels, schools etc. (Ebot et al 2007)

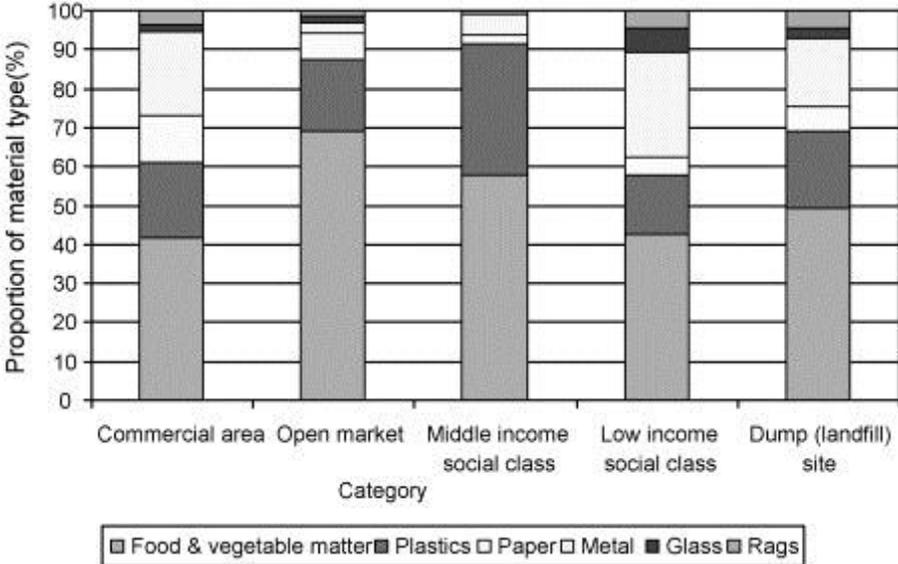


Fig 7. Typical waste composition, waste from different locations across Limbe

Source. (Ebot et al 2007)

The waste streams in the Limbe municipality have different kind of waste materials and other products whose composition varies with its generation sources, as well as the classification of the socio-economic in the municipality. The table above shows that proportionally, there are higher amounts of biodegradable and plastic waste arising from the middle income social class neighborhoods. Most of these affluence and increased use of packaged food is a convenient life style and the aspiration to be more developed. Most of these packaged materials arise from the increased use of packaging in the retail sector. Like in the middle income neighborhoods, there are unnecessary toys and electronic products besides the plastic packaging. In the middle income neighborhoods, there are large quantities of biodegradable waste which arise from garden yards in compare to low income class of people where most of it biodegradable waste is recovered for use in crop allocation. In the low income neighborhoods, there are relatively higher amounts of glass and metals as seen above. These wastes include broken glasses, broken bottles, motor parts, metallic containers, and so on which shows the diverse types of activities carried out within these neighborhoods such as little trading like the sales of kerosene, palm oil etc. Furthermore shops, bars, motor mechanics, garages which are mostly conducted at people's home. There are also commercial activities that modify the composition of waste found in these neighborhoods, targeting the reusable components which can be removed from waste streams since they have a market value. (Ebot et al 2007)

There is a wider recycle activity that is going on now in the municipality of Limbe and this has helped to reduce the volume of waste in the streams. Tins nowadays have a significantly higher economic value since most of it is being used by the local and middle class of people to crush cocoyam's and other food stuffs.

3.6 Collection methods

Waste collection and Disposal: Waste disposal is the final step on waste hierarchy. It involves landfill of waste materials. This is so common in the Limbe municipality because most of the waste is dumped on open incineration. (Dacorum Borough Council)

Based on the author's observation, most of the waste collection methods goes with their disposals, which means only the proper collection methods of waste are being disposed in the open landfill and the rest are dumped indiscriminately.

Collection methods should be well improved since indiscriminate disposal is one of the most dominant disposable systems in Limbe municipality and is not part of the waste hierarchy; this is because the major focus of the waste hierarchy theory is to improve the final treatment of waste. By doing this, it will help to improve the treatment of waste if better Collection methods are applied.

3.6.1 Waste collection methods in Limbe Municipality. (HYSACAM)

In the Limbe municipality, waste collection has been a very big problem in many years ago and today's life. This is because not all the waste generated that is been collected and there are no statistical records on collection efficiency. Furthermore, the waste streams are always mixed together in next to disposal. The municipal council have the entire responsibility of the treatment, collection and disposable of waste in the city, but these services has be subcontracted to another party. There are three main adopted approaches for the collection namely pre-collection, door-to-door collection and a fixed point collection. (*Ebot et al 2007*) In comparing the waste collection systems in the Limbe municipality with that of other African cities like Ibadan in Nigeria, Limbe have better waste management collection systems. If the Limbe city council can as well introduce the system of both the government and private sector to be involved in waste collection like Ibadan in Nigeria, more improvement will be achieved. (*Ayiminoula G.M and Muibi M.A 2007*)

Unlike in Yaoundé the capital city of Cameroon, in the year 1957, the municipality had to mange it waste disposable methods and collection. As the population started to increase, it was difficult for them to continue since they had limited infrastructures. These services were subcontracted to HYSACAM since they have quality services on waste management. (*Parrot et al 2008*) This is because they have higher efficient infrastructures and qualified staffs on waste management services of which are also operating in Limbe ,but they are no available data's for their impute and output in Limbe municipality.

This company started to operate in Yaoundé since 1969 but withdrew in 1991 since they could not be paid because of economic crises that affected the country. (*Achankeng 2003*)

In many developing countries, the informal waste management systems has actually help to reduce the cost of formal waste management systems since they reduce the quantities of waste from the point of collection. This has help to reduce the time and cost of transporting and collection. Void spaces at the point of disposal are preserved and they are spaces only for non recycled materials. It has also helped to provide jobs opportunities and a livelihood to reduce poverty. Most of the people in the informal sector are highly skilled to indentify waste of potential values. In many cases, these informal recyclers are often exploited from intermediate dealers since they trade locally. Furthermore, despite the adverse working conditions associated with informal recycling, it is a notice of important that those unemployed people especially in remote areas can survive. Most of them are persons who are more vulnerable like woman, children and elderly people who are more exposed to ill-health. These activities often prevent young children from going to school to have the chance of formal education, but on the other hand it provides economic and social support to most households. This is so common in most parts of Limbe municipality. (*Wilson et al 2005*)

3.6.2 Pre-collection of waste in Limbe Municipality

The legal system or law: This filter shows the situation were if a plan activity has passed the ethics and the economic filter, but that activity cannot proceed if is not legally acceptable or binned by law and obviously the actor will not be allowed to proceed. In a situation where the law is silence, and they're not substantive laws that are banning such activity, then the actor can legally proceed due to the rule of law and how the default functions. (*Westerlund 2003*)

If majority of the people respect the law filter, then indiscriminate disposal of waste will not be a call for concern. This will further improve the collection system and reduce the time taken in collection of the illegal fraction of the waste and will improve the ill effects caused by illegal dumping.

The pre-collection involves the movement of waste from the generation point which can be in the house up to the municipal collection bins. This can be developed through authorities at the municipal level and other initiative groups at the municipal level. (*Ebot et al 2007*)

About 80% of households waste to public bins movement is of children. (*Achankeng 2003*)

Most of the private companies with residential areas take responsibility for waste management in those areas. The National Oil Refinery Corporation (SONARA) based in Limbe, provides paid contractors to manage their waste services in their residential neighborhoods for its employees and others. By doing that, residents are provided with different kind of bins in which they can separate materials such as plastic bottles scrap metals which can be easily collected by waste pickers to be marketed and also to be carried to a landfill site. (*Ebot et al 2007*)

3.6.3 Door-to-door collection.

With the door-to-door collection method, they are mobile waste compacted or open trucks that go around the periphery with special hooting signals calling residents to bring out their waste which will be loaded directly to the truck and immediate transported to a waste stream for disposal. In many locations, this pick up exercises are on a fixed date to improve it efficiency. By doing this, is very important because waste generation from residence will not be for a long time before disposal. In some cases, trucks breakdown can occur which is going to disturb the service and this mostly depends on good roads to have accessibility since this sometimes use to be a problem to access some neighborhoods. (*Ebot et al 2007*) In comparing the door-to-door collection system of other African cities like Dar es Salaam waste management systems in Tanzania, it's more advance than that of Limbe municipality. This is because the government as well takes a direct responsibility of serving the high income people by providing a door-to-door waste collection system, but in Limbe the government does not provide such services. (*Kassim S.M and Mansoor A 2005*) Based on the authors

observation, only private companies with residential areas where high income people live takes care of their waste through a door-to-door collection since each house hold is provided with separate garbage bins to improve collection efficiency.

3.6.4 Fixed point collection

With the fixed point collection, there are large communal bins that are designated on specific locations for a scheduled pickup.

There are skip and portable bins with different sizes depending on the area and the activities that are being carried out in that particular location. The pickup scheduled will also be determined by the waste generated and the accessibility of that area. The fixed point collection is the most commonly waste collected method used in Limbe. Most often, waste is been stored along the road side for a long period of time by providing room for habitats like rats, vermin's and exposing it to the population which causes ill-health. Scavengers also visit this dumps to recover valuable waste materials that can be marketed. (*Ebot et al 2007*)

3.6.5 Disposable method of municipal solid waste in Limbe.

In the municipality of Limbe, waste is been disposed in an open dump area. This disposal dumps are operated with no environmental control or supervision. There have been establishments of six dumpsites over the last 15 years in different parts of Limbe. One of this established dumpsite is located near the Limbe new market and the slaughter house in a swampy land where flooding is common during the rainy season. This dumpsite is considered to be the most unfavourable because it is open to the population and the people seating at the market site. These dumpsites are not inspected or any environmental monitoring is carried out. Inadequate Leach ate and landfill engineering is not in existence. (*Ebot et al 2007*) (*Johnson 2005*) pointed out some issues that people living nearby landfill sites, are vulnerable to diseases like cancers and birth defects.

In unplanned and slums settlements, there is a high degree of indiscriminate disposal of municipal solid waste in vacant lots, streams, roadsides and low-lying areas are very common. In many areas where commercial activities are carried out especially in the market areas, there are stagnant rubbish-filled ponds which is also common especially behind the houses. In the rainy periods, floods always go along with some of the rubbish coupled with vermin and other nuisance hazards, but is hardly unaccepted by the management. When it comes to the environmental risks associated with these practices, there is no proper monitor due to lack of properly trained health and safety personnel. Reducing volumes of waste by means of burning is prevalent or widespread in several dumpsites around the Limbe municipality. Impacts potentials associated with this compostable practice that are emitted from these dumpsites have not been quantified or document to have clear figures. (*Ebot et al 2007*)

Analysis.

Table 4. Quarter standards and MSW management in Limbe.

	High standard	Average standard	Temporary housing	Peri-urban permanent	Peri-urban temporary
House next to a paved road (%)	62.4	30.3	14.1	16.3	12.2
House next to an unpaved road (%)	28.3	42.1	29.3	14.3	52.4
House next to a track (%)	9.3	27.1	55.3	67.3	35.4
Other (%)	0.0	0.5	1.3	2.1	0.0
Total	100	100	100	100	100
Waste disposal					
Truck/garbage bin (%)	72.2	69.2	70.1	73.6	56.3
Thrown away (rivers, sea, vacant lots forests, etc.) (%)	20.2	22.4	23.3	24.1	34.2
Buried/burned (%)	6.3	7.1	6.2	2.3	6.3
Recycled (%)	1.3	1.3	0.4	0.0	3.2
Total	100	100	100	100	100

	High standard	Average standard	Temporary housing	Peri-urban permanent	Peri-urban temporary
Average distance to the closest garbage bin (m)	199	150	154	223	565
Average number of 10 l buckets produced weekly per-capita	2	1	1	2	2
Domestic waste processing awareness (%)	4.7	2.3	2.3	1.9	2.9

Source: Author and the Limbe Municipality

The table above explains domestic waste disposal patterns and housing standards in the Limbe municipality. The table also shows how distance from households tried to affect the disposal of waste and its management. It further shows the volumes of waste that is dumped illegally in unwanted areas like rivers, vacant lots, sea and forest which is one of the major focuses of this report. Like in temporary peri-urban areas, the total populations that dump their waste in the municipal garbage bins are quite small because of the long distances. In other standard areas, the distances are approximately 200 to 300m away from household, this encourages the ethical disposal of household waste directly in the public bins. In other housing standards, the distances remain the same and the waste management companies try to move around on fixed date with hutting signals calling resident to come out with their waste and they only access paved roads. According to the study, distance should not be the only problem to deposit waste in a public bin, this is because most of the areas in Limbe have transfer stations if the ethics and the Law filter is considered. Finally the table shows that access to all houses in the Limbe municipality is difficult most especially because of the town planning and during the wet seasons.

The method used to come up with this table is a study on the Limbe city based on their housing and public awareness. Also, other studies were made as compared to the situation in Limbe with other cities in Cameroon and more especially Yaoundé which is the capital of the country. The figures were collected from the waste management statistical records of the Limbe Municipality and its population.

4 CONCLUSION

In Cameroon, many problems have been arising leading to poor municipal solid waste management. There are very poor formulated legislation responsibilities, poor collection efficiency, infrastructure, finance, population growth, poor education and awareness, poor recycling technologies, high city growth and poor disposable practices are all barriers in the waste management systems in Cameroon. (Ebot et al 2007; Parrot et al 2008)

Study shows that distance to waste dumps has been one of the biggest problems facing waste management systems in Cameroon and Limbe as the case study. Furthermore, poor infrastructure has led to a higher degree of poor collection and transportation efficiency. The number of garbage bins should be increased in many areas around the municipality to improve collection efficiency and should be placed next to paved roads. The recycling of waste materials should further be developed in order to reduce the quantities of pure waste. Transfer stations should be well established to improve people's efficiency on pre-collection and will significantly improve waste collection rate. Public awareness is highly needed more especially on household waste by targeting the low level of people who mostly have informal education. The municipality, householders and stakeholders need to come up on a good agreement for the need of proper monitoring and regulations to achieve the waste management objectives.

5 RECOMMENDATIONS

5.1 Voluntary instruments for municipal solid waste management.

Based on the author's observation, when firms and other waste generators are encourage and moving into environmental non-hazardous waste management choices like preventing and sorting, it limits the freedom of rubbish in streets and other waste polluted bodies. This can be achieved through education and awareness by raising campaigns at all levels of society. This will influence the effective implementation and enforcement of legal economic instruments to achieve a better waste management practices in developing nations like Cameroon and Limbe as a case study. This is because the three filter theory made emphasis on awareness in other to move towards sustainability. For example, different kind of campaigns can be made depending on the age, income and the social status of the people in their language of best understanding. This to an extern will help to increase voluntary waste management practices if well applied.

5.2 Source reduction and source separation.

Ethics or the first filter: This drives the inner mind of people towards sustainability. This is because when an action plan is to be carried out, the actor thinks the causes of that project to the environment if is positive or negative. If the projects have negative impacts to the environment, it will be an ethical point of view for the project not to be carried out. This also

depends on the attitude and awareness of people towards environmental damages. If more people are aware, then less environmental damages will be realised.

If majority of the people in the Limbe municipality are more aware of the environmental loads of some activities, and by communication channels through campaigns and other Medias then more people will abstain from such activities talk less of the economics gains by respect of the ethics or moral filter

Based on the author's observation, source reduction and separation is not a common practice in many households in Limbe municipality. This is because many people are not aware of this since all the waste is been dumped in the same public bin. The municipality of Limbe to provide different separation bins in other to separate the waste to improve recycling and recovery of valuable waste materials for the formal and informal sectors. It will also increase the valuable use of biodegradable waste to be used more appropriately for small technologies. Also, there should be a law to bind it so as to improve it efficiency. Source separation can also bring competition thereby increasing the quality of services by recycling companies. A very good example of source separation is providing separate bins for different kind of waste materials which can enable people to dump their waste and will as well encourage the level of recycling which in return, will reduce the environmental loads of indiscriminate disposal and the amount of energy use in the production of new raw materials for further production.

Unlike in China, where a survey was carried out to instructs and introduce source separation of different kind of waste materials like dry waste, food waste and harmful waste placing the containers in front of buildings by distinguishing them with different colors and different labels placing on them. The dry waste was materials such as floppy disks, metal cans, papers and so on of which can be separated and recycle very easy than when all the waste was placed on the same waste bin. The harmful waste which includes dangerous chemicals like batteries, thermometer, outdated medicine, pesticides and herbicides are delivered to companies that are responsible in handling waste of hazardous substances. Treating waste in this perspective is a better environmental choice to avoid ill-health to humans and the environment. (*Zhuang et al 2007*)

5.3 Market-based Policy instruments.

Their known as regulations that encourage people's attitude through market signals. These instruments are used in other to gain environmental goals and objectives especially on waste management and pollution control on industries. (*Whitten et al ND*) There are also for incentives and disincentives to reduce environmental impacts by actors. (*Parrot et al 2008*)

These market based instruments are of different type but my main focus is on price-based. There are for example emission charges, user charges, production charges, performance bonds, non-compliance fees, subsidies (materials and financial), taxes and deposit and refund systems. (*Whitten et al ND*) Studies have shown above that they are large amount of plastic and metal waste in the Limbe municipality of which they are mostly dumped illegal. If some

of these market based policy instruments can be introduced in Cameroon like user charges, deposit and refund systems, negative incentive like pay as you throw depending on the amount of waste volume, instrument for positive incentives like tax reduction or funding opportunities for those who proceed to waste minimization and recycling projects, will be a more better likelihood in improving the environmental goal and objectives in Limbe which are lacking. The law will finally enforce such project if people fail to follow after passing the ethics and economic filter.

A United state (US) example of market based policy instruments such as deposit and refund system, user charges have been successful in the sense that many state have adopted these systems in reducing their environmental loads. With the deposit and refund system, a higher number of states have employed it through a “bottle bills” in order to reduce the amount of solid waste in the waste bodies or waste streams. For the user charges, it has been carried out in the US through which certain environmental services have been funded like insurance premium taxes for the clean-up of hazardous waste sites. Moreover, another environmental tax was the sales tax which charges were made on ozone-depletion chemicals, low-mileage vehicles and on motor fuels in order to reduce their environmental impacts. (*Stavins R.N 2003*)

5.4 Public participation, campaigns and awareness

Based on the author's observation, there is a slow public participation towards waste management in the Limbe municipality. In achieving sustainable waste management, public campaigns and awareness are key drivers to a sustainable waste management. In Limbe municipality, the government should frequently organize successful community waste management campaigns which will create awareness more to the local people who have limited or no knowledge on waste management. This will help to change people attitudes and behaviors towards waste management which is accordance with the first filter (Ethics). The following factors should be considered when planning a public campaign and awareness:-

- Everybody should be aware of the problem in mind.
- Encourage the general community to propose ideas.
- The time and date of the campaigns should suit everybody as to serve its purpose.
- Provision of means by solving the problems in providing waste bins and vehicles for pick up.
- Publicized campaigns result to Media for the community will be aware of changes, improvements and the benefits. (*Waste management community awareness campaign 16 February 2010*)

All these factors are very important in the Cameroon waste management systems for future development on municipal solid waste management. Furthermore, it is of a quality point of

view if the general public plays an equal responsibility in solving waste management problems. Waste management should as well be introduced in schools from the primary levels so as to increase a wider range of awareness and as well as providing waste bins in schools and public institutions.

A Greek examples of achieving municipal solid waste management through public participation and campaigns were arranging long-term volunteer programs of training where reuse events, home composting and proper recycling practices are all introduced in helping the understand of people when it comes to managing waste. More to that, some programs were setup like comprehensive user-friendly, recycling programs, convenient waste minimization and some drop-out centers for old household waste. These programs are aiming in the understanding of proper waste management systems. (*Zotos G.et a 2009l*) All these integrated tools are to come up with possible impacts in solving the negative effects on municipal solid waste management. Some of these tools should as well be employed in Limbe municipality because they have proven some positive impacts in solving waste management problems. If these tools are introduced in Limbe municipality, it will actually depend on the ethics and the economic state of the people and not forgetting the law in binding such practices.

5.5 Integrated Municipal Solid Waste Management

Municipal solid waste management is a challenge of many factors including technical and socio-economic. Looking into the environmental impact, socio-cultural issues, knowledge, the organizational structure, policy decisions, legal framework, economic division, capacity building and awareness raising are all significant for planning and functioning of a sustainable integrated municipal solid waste management system. In achieving a reasonable level of sustainable municipal solid waste management systems, there should be a call for integrated municipal solid waste management within the levels of technical and management. The complete concept idea is simply to work more scientific on the collection, transport, processing and the disposal of waste. Looking into the achievement of the complete integrated municipal solid waste management, all the management's functions are of a great important. This is because since particular waste are managed with different options for example biodegradable waste can be better managed by composting rather than reuse or incineration meanwhile combustibles are better managed by incineration. An integrated municipal solid waste management should be able to provide better waste management disposal technologies on collection, transportation, and disposable technologies. Climatically, since Cameroon is on a tropical and low income country with less wealthy lifestyles with an increase number of population growth. These have increase organic waste generation since a limited majority of the population can own refrigerators and other storage facilities.

When we talk of integrated municipal solid waste management, the effectiveness depends on the level of awareness and participation of both individuals and the general public. This is because individuals need to reduce the waste from its source, material reuse and recycling from home in order to achieve an integrated municipal solid waste management. To achieve awareness, there should be a call for continuous training in municipal halls, television and radio information's. (*Memuna 2009*)

Based on the author's observation, when firms, non-governmental organizations, and people integrate, there is an increase in diversified knowledge and technological transfer. This can lead to the invention of appropriate technologies in rural areas. As mentioned above, in Limbe, there are limited storage facilities for perishable products and because of this, much organic waste is generated. These high volumes of organic waste can be used more appropriately in the production of small-scale biogas for energy consumption in households. This will be a better environmental choice since the climate is warm and leads to fast decomposition of organic matter and will also reduce environmental and health impacts associated with organic waste decomposition.

New technologies like better collection methods, treatment methods and source separation and reduction should also be introduced. By doing this, environmental impacts such as methane (CH₄) emissions, carbon dioxide (CO₂) and water pollution from landfill leakages will be reduced to a very high extent. Furthermore, some of these biodegradable wastes can be used as fertilizer to increase crop yield since many people in the Limbe municipality are farmers who get most of their income from farm harvest.

By reducing the environmental impacts of methane emission, a landfill gas collection system can be introduced in the Limbe municipality.

6 DISCUSSION

Municipal solid waste management is fundamental when it comes to waste management in most towns and cities in developing countries. This is because municipal solid waste generates the highest amount of waste volumes as is generally known. In Cameroon, waste management is an activity that is centered upon collection and disposal which can be in different places. Most of the environmental impacts associated with municipal solid waste have arisen because of the old and ill-adapted technologies for waste management. (*Ngongho 2009*) Furthermore, the economic provisions in Cameroon's waste management systems have not been able to match an equal effort in providing mechanisms for a proper policy implementation on environmental sustainability. (*Ebot et al 2007*). The present policy framework of rules are to set out strategies on poor waste collection, protection of environmental resources, promote material conservation through safe disposal, indiscriminate disposal of waste and improper disposal that has been dominating local municipal council practices in Cameroon. (*Ebot 2007*). Most of these problems are clear evidence in Limbe municipality

where one can find waste dumped in unwanted areas. One of these problems of waste dump has arisen because of the poor governance in the Limbe waste management systems.

In reality, poor urban structure and urban growth has been a major contributor of waste volumes and the indiscriminate disposal of waste in unlawful areas. According to the results above, is clear evidence that population is increasing in a fast rate in Limbe because of the increase rate of industrial development. Also, the urban structure of the city need more attention to create more spaces for the huge public skips bins so as to reduce the volume of waste dumps in unwanted areas as the population is increasing in a 2.2% growth rate from 2001. These indiscriminate disposals in many villages arise because of the distance of the public bins which many people feel reluctant in the movement of about 500 to 600 meter to dump their house hold waste. More development can be made if more than one skip bin can be allocated for one area and in an accessible place to increase its efficiency. In the Limbe municipality, poor handling and limited education on waste like reuse and recycling has increase it volume from 20tonnes per day to 45tonnes in all the 7 regions. Accessibility to paved road has as well increase waste dumped in unwanted areas since among the 7regions of collection, only one of them have a paved road which is the Limbe central where we have the high standard people.

In regards to the role of the government, they are far too many ministerial departments in the waste management systems and public sanitation in Cameroon. This has given the power to limited responsibility. A very significant higher amount of money is placed on these ministries in their salaries and allowances and very little is put in the management of waste infrastructures and maintenance cost to reduce truck breakdowns during transporting waste to landfills.

According to the data analysis, it shows that distance to public bins has been one of the major barriers on waste dump. Also, they are limited number of garbage bins in the peri-urban permanent and the peri-urban temporary. These areas are highly populated due to the low housing cost. The government pays less attention to this class of people because of their less contribution in the country's economic growth. The highest volume of waste dumped indiscriminately is from these areas also because of their level of education and awareness on waste management practices.

This report focuses mostly on the waste management systems with the implementation of the Cameroon laws and proposed solutions to key drivers to improve the waste management systems in Cameroon and Limbe municipal council as the case study.

In regards to the recommended tools on waste management and its practices in this report, tools like voluntary instruments are highly lacking because of the state structure were they are limited campaigns on waste management. Furthermore, source reduction and sources separation are not common practice in the limbe municipality there by limiting the amount of recycling activities. Also, market based policy instruments have not been introduce to

encourage companies and individuals to increase their waste management activities in a more sustainable manner with the influence of these policies like deposit and refund system, tax reductions on less fraction of pollution on positive incentives. Negative incentives like pay as you throw should also be introduced there by reducing the influence of high rate of pollution. Limited number of campaigns and public awareness is also a problem since less people are aware of environmental damages like those in the villages with limited or no infrastructures.

If all these tools are introduced and are implemented in the Cameroon waste management systems, more and more environmental gains will be achieved and a better and healthier environment.

6.1 Strategies to Improve Municipal Solid Waste Management Systems

The Economic filter or the second filter: It states that if an actor realized that a project is economically sound, he can now try to investigate if that particular project is bound by law or legally acceptable before he can proceed. The economic filter is based on that human attitude can be steered with economic forces. Some economic factors that can reject harmful projects can be taxes implanted on them. (Westerlund 2003)

Since many people want to evade tax from their projects or activities and end up doing them unlawfully, economic forces can be introduced to steer their attitudes towards sustainability by introducing positive incentives to encourage them and educate them on their activities in which they can have some economic gains by respecting the laws in return.

The Republic of Cameroon has been placed under the Heavily Indebted Poor Countries (HIPC). This has provided a greater opportunity to improve municipal solid waste management in Limbe and other cities in the country. In order to have a proper waste management system like targeting the remote areas, there should be a provision of transfer stations and pre-collection. There should be the involvement of nongovernmental organizations and community based organizations. (Parrot et al 2008). All sectors of the society need to be involved in solving waste management problems, intensive efforts, meaningful and lasting solutions are needed. (Parrot et al 2008) Furthermore, other strategies like market based policy instruments like positive incentives where funding opportunities are given to those who try to minimize waste volumes and instruments for negative incentives like pay as you throw can be used to improve municipal solid waste management if only they are well enforced. (Jones et al 2009)

6.2 HYSACAM, pre-collection and transfer stations.

In the Limbe municipality, there are problems with inaccessibility with the collection vehicle in some neighborhoods especially where agriculture is highly practiced. Since paved roads and the distance to access waste disposals, transfer stations can be very useful in this situation because it will reduce cost of transportation and the environmental impacts associated with municipal solid waste management. The transfer stations could be positioned near paved

roads and underserved areas where farmers and city dwellers can deposit their waste materials. When transfer stations are established, it will help to enable sorting of waste to promote and improve recycling of waste materials. The inhabitants of that area will also benefit from composting opportunities through the transfer station like the use of biodegradable materials for energy generation. (Parrot et al 2008) With the use of a transfer station, good disposable practices of municipal solid waste will be encouraged and this will improve the participation of the local people and the level of awareness on waste management. (Bolaane 2005)

HYSACAM now is responsible for the direct collection of waste in municipal public bins and other garbage bins. When waste management services are well improved from the initial stage of waste collection, this will increase the quantities collected with the appropriate use of transfer stations in highly populated areas that are not accessible to vehicles to promote the reuse of large amounts of waste materials. In inaccessible areas, HYSACAM work in partnership with NGOs and CBOs in the collection and dumping of municipal solid waste in transfer stations. Jobless people could turn to become a potential in the labor force for NGOs and CBOs by collecting domestic waste near households and transfer to the HYSACAM garbage bins and this will increase awareness of domestic waste treatment methods by the inhabitants. (Parrot et al 2008)

6.3 Education and Awareness.

Education and awareness are major or important tools when it comes to sustainable management of solid waste in developing countries. Education can be use in promoting awareness of sustainable development and to address environmental issues to improve the capacity of people on environmental issues. The government should make sure that the general public is aware of the benefits that can be achieved on sustainable management of municipal solid waste. (UNCED 1992) Many of the people living in rural areas in Cameroon have little or no education; because of this they may not see the reasons for acting towards sustainable management of solid waste. When education campaign on waste management can be develop and targeting this group of people, then the will be an awareness of the benefits of sustainable solid waste management. For the effective use of education and awareness as a tool to improve waste management in Cameroon, target should be made in secondary and primary schools to target the youths, trashcans of different waste dumps in classes for source separation, education should be extend to remote communities and educate illiterates using their own language for a better understanding, and finally the media should also play a very important role through a constant program on sustainable management of solid waste. (Ngongho 2009)

6.4 The role of the law

The legal system or law filter: This filter shows the situation were if a plan activity has passed the ethics and the economic filter, but that activity cannot proceed if is not legally acceptable or binned by law and obviously the actor will not be allowed to proceed. In a situation where

the law is silence, and they're not substantive laws that are banning such activity, then the actor can legally proceed due to the rule of law and how the default functions. (*Westerlund 2003*) Introducing this filter in waste management regulations in Cameroon, better waste management practices will be realised.

Laws are very important instruments when it comes to improving environmental quality standards and sustainable development. In Cameroon, most of the laws on waste management regulation are on paper and are not enforceable. Corruption has made most of the laws to be in silence. Their legislations that have put in place related to sustainable management of solid waste and environmental protection is not efficient because of the current policy frame work. (*Ebot et al 2007*) In other to achieve a sustainable development, everyone should surfer the law of the situation when it comes to environmental quality standards.

List of Reference

Reports:

Achankeng Eric 2003. Globalization, Urbanization and Municipal Solid Waste Management in Africa. Proceeding from the 26th Annual Conference AFSAAP. Flinders University. Available at: <http://www.afsaap.org.au/Conferences/2003/Achankeng.pdf>

Ayininuola, G. & Muibi, M., 2008. An engineering approach to solid waste collection system: Ibadan North as case study. Waste management, Volume 28, Issue9. Pages: 1681-1687. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/17714930>.

Bolaane, B. 2005. Constraints to promoting people centred approaches in recycling. Habitat International. Volume 30, Issue 4, December 2006, Pages 731-740. Available at: <http://www.sciencedirect.com/science/article/pii/S0197397505000433>

Couth R. and Trois C 2010. Carbon emissions reduction strategies in Africa from improved waste management. Waste Management, Volume 30, Issue 11, November 2010, Pages 2336-2346. Available at: <http://www.sciencedirect.com/science/article/pii/S0956053X10002229>

Ebot V, M. , Tenning O, F. and Adam D, R, 2007. Waste management in Cameroon: A new policy perspective? Resources, Conservation and Recycling, Volume 52, Issue 4, February 2008, Pages 592-600. Available at: <http://www.sciencedirect.com/science/article/pii/S0921344907001607>

Imam. A, Mohammed B. Wilson D.C. and Cheeseman C.R, 2007. Solid waste management in Abuja Nigeria. Waste Management, Volume 28, Issue 2, 2008, Pages 468-472 . available at: <http://www.sciencedirect.com/science/article/pii/S0956053X07000359>

Johnson B.L 2005. A review of the effects of hazardous waste on reproductive health. Am J Obstet Gynecol. Volume 181, Issue 1 July 1999. Pages S12-S16. Available at: <http://www.sciencedirect.com/science/article/pii/S0002937899704667>

Jones N, Evangelinos K, Halvadakis C.P., Iosifides T. and Sophoulis C.M. 2009. Social factors influencing perceptions and willingness to pay for a market-based policy aiming on solid waste management. Resources, Conservation and Recycling. Volume 54. Issue 9 July 2010. Pages 533-540. Available at: <http://www.sciencedirect.com/science/article/pii/S0921344909002341>

Kassim S.M and Mansoor A 2005. Solid waste collection by the private sector: Households' perspective—Findings from a study in Dar es Salaam city, Tanzania. *Habitat International*. Volume 30, Issue 4 December 2006, Pages 769-780. Available at : <http://www.sciencedirect.com/science/article/pii/S0197397505000469>

Memuna S.S, 2009. Evaluating the status of implementation of chapter 21 of the Agenda 21. A case of municipal solid waste management in Bamenda- Cameroon. October 2009. City of Östersund.

Ngongho 2009. Ngongho A. G, municipal organic waste management impacts and sustainable methods, Yaounde, Cameroon. 2009. City of Östersund.

Parrot L, Sotamenou J and Dia B. K, 2008. Municipal solid waste management in Africa: Strategies and livelihoods in Yaoundé, Cameroon in developing countries. *Waste management*. Volume 29, issue 2, February 2009, pages 986-995. Available at: <http://www.sciencedirect.com/science/article/pii/S0956053X08001633>

Stavins R.N 2003. Market-Based Environmental Policies: What Can We Learn from U.S. Experience (and Related Research)? Harvard University. August 2003 Discussion Paper 03–43. Available at: <http://www.rff.org/documents/RFF-DP-03-43.pdf>

Su J., Chiueh P., Hung M and Ma H, 2006. Analyzing policy impact potential for municipal solid waste management decision making. A case study of Taiwan. *Resources, Conservation and Recycling* 51 (2007) 418–434. Available at:

<http://ntur.lib.ntu.edu.tw/bitstream/246246/96898/1/28.pdf>

United Nations Conference on Environment and Development (UNCED), sustainable development and international environmental issues. Rio de Janeiro, 3-14 June 1992.

Westerlund S, 2003. Environmental law methodology, the three filter theory. Upsala 2009.

Whitten, Van Bueren, Collins. Whitten S., Van Bueren M., and Collins D. An overview of market-based instruments and environmental policy in Australi. Retrieved on the 13 December 2010. Available at: http://www.ecosystemsproject.org/html/publications/docs/MBIs_overview.pdf

Wilson D, Valis C and Cheeseman C, 2005. Role of informal sector recycling in waste management in developing countries. Habitat international. Volume 30, Issue 4, December 2006, Pages 797-808. Available at:

<http://www.sciencedirect.com/science/article/pii/S0197397505000482>

Zhuang Y, Wu S, Wang Y, Wu W and Chen Y 2007. Source separation of household waste: A case study in China. Waste management. Volume 28, Issue 10, 2008, Pages 2022-2030. Available at: <http://www.sciencedirect.com/science/article/pii/S0956053X07002619>

Zotos G., Karagiannidis A., Zampetoglou S., Malamakis A., Antonopoulos I.-S, Kontogianni S. and Tchobanoglous G. 2009. Developing a holistic strategy for integrated waste management within municipal planning: Challenges, policies, solutions and perspectives for Hellenic municipalities in the zero-waste, low-cost direction. Waste management. Volume 29, Issue 5, May 2009, Pages 1686-1692. Available at: <http://www.sciencedirect.com/science/article/pii/S0956053X08004029>

Web page:

Brad & Saidou 2005, Cameroon 2005, page 9. Viewed 14 February 2010. <http://www.bradward.net/world.of.brad/cameroon05/page9>,

EPA 2007. <http://www.epa.gov/climatechange/ghgemissions/>

John Nanguiri I 2009, Limbe city council community. Viewed 17 February 2010. <http://sites.google.com/site/limbecitycouncilcommunit/Home>

Limbe, the city of friendship and opportunities. Viewed 16 Feb. 2010. <http://www.limbecity.org/index.htm>

Sociolingo 2004, Cameroon - Africa in miniature. Viewed 15 february 2010 <http://www.igougo.com/story-s1223714-Cameroon-Cameroon - Africa in miniature.html>

Dacorum Borough Council.The waste hierarchy. Google sites. Retrieved on Wednesday 3 march 2010. <http://www.dacorum.gov.uk/default.aspx?page=4130>

Queensland Health 2010, waste management awareness campaign.

Viewed 13 May 2010

http://www.health.qld.gov.au/ehworm/waste_management/awareness.asp

Viewed 12 february 2010 <http://www.infoplease.com/ipa/A0107382.html>

Viewd 12 february 2010 <http://www.infoplease.com/ipa/A0107382.html>

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