

Recycling and Material Recovery in Cameroon: Implications for Poverty Alleviation and Ecological Sustainability

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Dedication

To:

- My lovely wife Lekeaka for her constant support and endurance for the years I have been away.
- My Dad (Zisuh) and Mum (Ajoache) for academic and moral upbringing. It has always been their dream to see me reach this level.
- My mother-in-law, Mama Grace Fonkeng for the lessons of endurance and commitment I have learned from her.

Declaration

I, Fred Zisuh Asong, do hereby declare that this doctoral dissertation entitled **“Recycling and Material Recovery in Cameroon: Implications for Poverty Alleviation and Ecological Sustainability”** carried out at the Chair of Industrial Sustainability and submitted to the Faculty of Environmental Sciences and Process Engineering at Brandenburgische Technische Universität Cottbus, Germany in partial fulfillment of the requirements for the award of a “Doktor-Ingenieur” (Dr.-Ing) is my original research.

The thesis was supervised by Prof. Dr. rer. nat. Jürgen Ertel, Head of the Chair of Industrial Sustainability at BTU Cottbus (main supervisor) and Prof. Dr. rer. nat. Hans-Jürgen Voigt, Head of the Chair of Environmental Geology at BTU Cottbus (co-supervisor). The thesis was defended on 27th January 2010 before an examination panel comprising Prof. Dr. Jur. Albrecht (Head), Prof. Dr. rer. nat. Jürgen Ertel, Prof. Dr. rer. nat. Hans-Jürgen Voigt and Prof. Dr. rer. nat. habil. Albrecht Gnauck.

While part of this dissertation builds on the conceptual framework from some of my previous studies at the above mentioned Chair and under the supervision of Prof. Dr. rer. nat. J Ertel, I do also declare that the contents of this doctorate dissertation have never been submitted in part or whole to any other academic or awarding institution for the award of an academic degree.

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Summary

Recycling and material recovery are gaining more grounds in applicability as viable options to sustainable solid waste management especially in Municipal Solid Waste Management (MSWM) schemes. In this dissertation a critical analysis is made of the MSWM problem in Cameroon and an assessment of the role Small- and Medium-Size Enterprises have been playing in the area of recycling and material recovery. The main research methods applied in this research include: fieldwork, administration of questionnaires, interview and literature review.

Using two case study localities (Limbe and Buea municipalities), the various practices in MSWM are elaborated, the constraints and challenges faced by management discussed and proposals for either expanding/upgrading existing schemes to be more sustainable as well as strategies to initiate new systems presented. Innovations within collection systems such as the introduction of household bins and specialized collection of specific waste could be quite beneficial to existing schemes.

Waste Electrical and Electronic Equipment (WEEE) which constitute one of the fastest growing waste streams presents greater management challenges. Two case study localities (Buea and Kumba) are used to analyze the problem of WEEE in Cameroon. An overview of the handling of Electrical and Electronic Equipment (EEE) at end-of-life (EoL) in Cameroon is made with special focus on households and repair units. At household level, WEEE is disposed of alongside other waste arisings in the available disposal facilities for given household. Repair units represent a very vital connection between dysfunctional EEE and EoL forms as all users of EEE tend to bring these devices to these units for repairs. An inventory of the various EEE at repair units for these two localities shows that above 40% percent of such equipments are totally out of use. In Kumba, Classes 1 and 4 EEE (according to EU WEEE directive classification) dominate while class 3 is almost absent. In Buea, Class 3 and 4 are dominant. These results show that socio-cultural, economic and even climatic factors influence the choice of EEE that people in this area acquire. The intense level of repair activities and recovery of useful parts by repair units show that there exist adaptable options to handle WEEE in especially economically and environmentally beneficial ways.

The recycling of aluminum for production of household utensils represents a very basic

and adaptive industrial set-up, which can easily be operated and run at very cheap cost and with a little manpower. While this venture seems apparently successful in economic terms as an option to poverty alleviation through income generation, it is plagued by some problems which, if given due consideration will render it a prospective option for poverty alleviation (through small enterprise business development) and environmental sustainability (as an option to sustainable MSWM). In this dissertation, a model is thus presented, which can be utilized by stakeholders to improve on the sector.

An assessment of efforts and constraints to implementing comprehensive recycling and recovery schemes in Cameroon was also carried out. Results show that there are existing practices on which comprehensive recycling and recovery can be built upon that would be beneficial to both councils and engaged schemes – mostly SMEs and NGOs. The challenges faced and likely to be faced and the way forward to implementing any broad scale recovery and recycling are presented. If municipal councils choose to operate existing MSWM schemes without significant changes, then collective collaboration will be highly required. Such collaboration will present benefits to both waste collection and disposal. On the other hand, if they wish to expand schemes or create new schemes, adaptive innovation would be highly recommended. Such adaptive innovation would have to incorporate local practices and approaches of MSWM as well as socio-economic considerations so as to ensure new or expanded schemes survive within local socio-economic context. A greater challenge in enhancing recycling and material recovery in particular and MSWM in general, in Cameroon is on the role the government takes on designing appropriate policies and legislative frameworks to cover such activities in economically and ecological beneficial ways. In the absence of these, SMEs, councils and NGOs (working in partnership with other specialized groups) concerned with activities related to recycling and material recovery may be left with the option of regulating activities within their sectors as such activities stand to alleviate poverty and also present ecological benefits.

Zusammenfassung

Recycling und Wiederverwertung in Kamerun: Auswirkungen auf die Armutsbekämpfung und ökologische Nachhaltigkeit

Recycling und Wiederverwertung gewinnen bei der Realisierung einer nachhaltigen Abfallwirtschaft insbesondere in Systemen für ein kommunales Abfallmanagement kontinuierlich an Bedeutung. In dieser Dissertation ist eine kritische Untersuchung dieser Problematik in Kamerun durchgeführt worden und eine Beurteilung, welche Rolle kleine und mittelständische Unternehmen bei Recycling und Wiederverwertung gespielt haben. Als wesentliche Untersuchungsmethoden sind Feldstudien, die Auswertung von Fragebögen, Interviews und Literaturlauswertung zum Einsatz gekommen.

Am Beispiel von zwei Fallstudien (der Gemeinde Limbe und Buea) werden die unterschiedlichen Praktiken herausgearbeitet, die Hemmnisse und Herausforderungen mit dem Management diskutiert und Vorschläge für einen Ausbau bzw. eine Verbesserung der existierenden Maßnahmen in Richtung stärkere Nachhaltigkeit sowie Strategien zur Initiierung neuer Systeme präsentiert. Innovationen bei Sammelsystemen wie der Einführung von Hausmülltonnen und getrennter Sammlung von besonderen Wertstoffen, können die bestehenden Maßnahmen ergänzen und die aktuellen Systeme verbessern.

Waste Electrical and Electronic Equipment (WEEE, Elektro-Altgeräte) ist einer der am schnellsten wachsenden Zweige des Abfallaufkommens und stellen eine besonders hohe Herausforderung an das Management dar. Zwei Fallstudien (Buea und Kumba) werden herangezogen, um die Problematik des WEEE in Kamerun zu untersuchen. Es wird ein Überblick über die Handhabung von elektrischen und elektronischen Geräten in Kamerun am Ende des Lebenszyklus gegeben, der einen speziellen Fokus auf Haushalte und Reparaturwerkstätten hat. Elektroaltgeräte aus Haushalten, werden WEEE neben anderem Müllaufkommen in den verfügbaren Entsorgungseinrichtungen eingesammelt. Reparaturwerkstätten spielen eine entscheidende Rolle bei der Verlängerung des Lebens von Elektrogeräten, da diese häufig vor einer Entsorgung in die Werkstatt zu einer Reparatur abgegeben werden. Der Bestand dieser verschiedenen Elektrogeräte in den Reparaturwerkstätten dieser beiden Gemeinden

zeigt, dass über 40% dieser Geräte veraltet sind. In Kumba dominierten die Klassen 1 und 4 (nach EU Klassifikation), während die Klasse 3 nahezu nicht vorhanden war. In Buea herrschen dagegen die Klassen 3 und 4 vor. Die Ergebnisse zeigen, dass das sozio-ökonomische Umfeld und sogar klimatische Faktoren das Anschaffungsverhalten von Elektrogeräten in einer Region beeinflussen können. Der hohe Grad an Reparaturaktivitäten und die Rückgewinnung von Bauteilen durch die Reparaturwerkstätten zeigt, dass anpassungsfähige Optionen zum Umgang mit Elektrogeräten insbesondere unter ökonomisch und ökologisch sinnvollen Gesichtspunkten vorhanden sind.

Das Recycling von Aluminium zur Herstellung von Haushaltswaren erfordert ein einfaches und anpassungsfähiges System, welches einfach und kostengünstig betrieben werden kann und nur wenig Personal benötigt. Während dieses Vorhaben unter ökonomischen Anforderungen als eine Option zur Verminderung der Armut aufgrund der Einkommenserzielung offensichtlich erfolgreich scheint, treten auch Probleme auf, die allerdings bei entsprechender Berücksichtigung zukünftig die Grundlage zur Verminderung der Armut (aufgrund der Entwicklung von Kleinunternehmen) und für ökologische Nachhaltigkeit liefern. In dieser Dissertation, wird ein Modell aufgezeigt, das von Interessengruppen für Verbesserungen in diesem Bereich genutzt werden kann

Eine Beurteilung der vorhandenen Anstrengungen und Hemmnisse, flächendeckende Recycling- und Verwertungssysteme in Kamerun einzuführen, wurde ebenfalls durchgeführt. Die Ergebnisse zeigen, dass es bestehende Methoden gibt, auf denen flächendeckende Recycling- und Verwertungssysteme mit einem Nutzen für Gemeinden und den engagierten Beteiligten - vorzugsweise kleine und mittelständische Unternehmen oder nichtstaatliche Einrichtungen (NGO) aufgesetzt werden können. Die sich stellenden Herausforderungen und der Weg, eine breite Wiederverwertung und ein hohes Recycling einzuführen, sind entsprechend dargelegt worden. Sofern sich Gemeinden entscheiden, die vorhandenen Systeme ohne signifikante Änderungen zu betreiben, ist eine Abstimmung und Zusammenarbeit unbedingt erforderlich. Eine derartige Zusammenarbeit wird Vorteile sowohl bei der Müllsammlung als auch bei der Müllentsorgung liefern. Sofern ein Ausbau der bestehenden Systeme oder die Einführung eines neuen Systems angestrebt wird, sind anpassungsfähige und flexible

Innovationen nötig. Derartig flexible Systeme sollten lokale Ansätze für ein kommunales Abfallmanagement sowie die sozio-ökonomischen Rahmenbedingungen berücksichtigen, um sicherzustellen, dass die neuen oder erweiterten Systeme im lokalen, sozio-ökonomischen Umfeld bestehen. Eine hohe Herausforderung zur Verbesserung von Recycling und Wiederverwertung im speziellen und kommunales Abfallmanagement im allgemeinen wird in Kamerun an die öffentliche Verwaltung gestellt, die angemessene Richtlinien und den gesetzlichen Rahmen für derartige Aktivitäten unter Berücksichtigung vom ökonomischen und ökologischen Nutzen geben muss. Beim Ausbleiben dieser regulatorischen Grundlagen, werden SME's, Gemeinden und NGO's (in Zusammenarbeit mit weiteren, spezialisierten Gruppen), die sich mit Aktivitäten in Bezug auf Recycling und Wiederverwertung beschäftigen, allein gelassen, wobei diese innerhalb des Sektors bei der Verringerung der Armut unterstützen können und auch noch ökologische Vorteile erbringen können.

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List of Abbreviations

ADV	Association des Volontaires du Developpement
AEC	ARC en Ciel
BAN	Basel Action Network
BETA	Bamenda Electronic Technician Association
BfdW	Bread for the World
CBWM	Community-Based Waste Management
CCME	Canadian Council of Ministers of the Environment
CREM	Consultancy and Research for Environmental Management, Amsterdam, the Netherlands
CID	Centre for International Development
CIG	Common Initiative Group
CIPRE	International Centre for Promotion and Recycling
CORDAID	Catholic Organization for Relief and Development Aid
CRT	Cathode Ray Tube
CVN	Club de Volontaires de Nvog-Ada
DED	German Development Service
DVD	Digital Versatile Disc
EAA	European Aluminum Association
EC	European Commission
EEE	Electrical and Electronic Equipment
ENDS	Environmental Data Service, United Kingdom
ENICAM	Entreprise de Nettoye Industriel au Cameroon SARL
EoL	End-of-life
EPA	Environmental Protection Agency
EPR	Extended Producer Responsibility
ERA	Environment Recherche Action
EU	European Union
FEICOM	Government Council Support Fund
HDPE	High Density Polyethylene
HIPC	Heavily Indebted Poor Countries Initiative
HIV/AIDS	human immunodeficiency virus / acquired immunodeficiency syndrome

HYSACAM	Hygiène et Salubrité du Cameroon
IFAD	International Fund for Agricultural Development
IT	Information technology
ITU	International Telecommunications Union
LCD	Liquid Crystal Display
LUC	Limbe Urban Council
MINPMEEESA	Ministry of Small and Medium-Sized Enterprises, Social Economy and Handicraft, Cameroon
MFP	Microcellular foamed plastic
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NOWECA	North-West Craft Association
MRF	Material Recovery Facility
NGO	Non-governmental Organization
OECD	Organization of Economic Co-operation and Development
PET	Polyethylene Terephthalate
PP	Polypropylene
PS	Polystyrene
R&D	Research and Development
CASS	Centre d'Animation Sociale et Saniatires
SEC	Secretariat of the European Commission
SME	Small- and Medium-size Enterprise
SONARA	National Oil Refinery, Cameroon
SWM	Solid Waste Management
UNEP	United Nations Environmental Program
VCD	Video Compact Disc
VHS	Video Home System

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Chapter One

Introduction

The main motivations for undertaking this research and structure of the dissertation are presented in this chapter. Thus a background of the main thesis of the research is presented, the research problem and questions stated, research objectives and rationale outlined and the research method briefed. A synopsis of the contents of the different chapters in the dissertation is presented.

1.1 Background

The increasing amount of Municipal Solid Wastes (MSW) in developing countries presents greater challenges with respect to proper and sustainable solutions to managing such generated waste. With increasing population and economic activity and rapidly changing lifestyles, Cameroon like many developing countries, is faced with greater challenges towards managing solid waste. More so, failure to embark on better approaches to Municipal Solid Waste Management (MSWM) and/or negligence of the issue gets to compound the problem. While waste may be land-filled or reprocessed for energy, other options like recycling and material recovery for subsequent reuse also present enormous opportunities for waste management with economic and ecological benefits. Whether a given community operates a standard MSWM scheme or not, there exist some operations and practices, which characterize how such a community goes about the waste problem. Thus an understanding of environmental behavior (Oskamp, 2000) and an assessment of existing MSWM schemes can be very vital in not only the enhancement of such schemes but in designing more sustainable options. Analyzing the MSW stream for a given community or region over time as well as choosing appropriate approaches is also useful in MSWM studies. Two approaches in use include: 'material flow approach' and the 'output method' and both have their merits and demerits. The material flow approach in estimating waste stream percentages within various categories of waste considers waste as an end result of production thereby incorporating production and expected lifecycle of products (McCauley-Bell et al., 1997). This approach has the advantage that waste stream can be estimated over broader

geographic scales hence good for country basis and not local studies (Reinhardt and McCauley-Bell, 1996). However, a main criticism of this approach is that it focuses on product categories thereby excluding waste components not consequent of production. The output method is best applied to waste composition studies often at disposal sites and involves sampling, sorting, and weighing of individual categories of waste stream (Tchobanoglous et al., 1993). The output approach is very good for localized studies as it provides information unique to local planning for collection, recycling, treatment and disposal. However, a disadvantage of this approach is the cost associated (see Reinhardt and McCauley-Bell, 1996).

Within the past two decades, there has been growing concern on environmental related issues in Cameroon. A gloomy picture of such growing concerns can be vividly grasped from the number of small-scale local environmental groups that has sprung up within this time. The main goals of these groups basically have to do with enhancing environmental sustainability/improving agricultural yields on the one hand and helping local communities in reaping some economic benefits on the other within socio-culturally accommodating conditions. The increasing amounts of MSW, which is fast attracting the attention of these groups as well as the government, require that appropriately sustainable solutions be sought. Industries also generate significant amount of waste of which some are recyclables. In MSW generated within cities in Cameroon plastics, paper and ferrous/nonferrous metals occur in significant amounts (Achankeng, 2003) that serve as a pointer to investigating possibilities for recycling and recovery of such components.

Although developing countries like Cameroon still face several challenges in managing commingled wastes, recovering and recycling individual components of the waste stream for reuse and production of recycled-based products is economically plausible. Despite the fact that suitably organized collection systems may be lacking, individual components can still be recovered through locally adaptable designed approaches. Such individual components that can be recovered and recycled include: aluminum, plastics, paper and other components of Waste Electrical and Electronic Equipments (WEEE). Electronic waste generation is also on an increase in Cameroon and most of such waste stays longer within households (Asong and Nkemnkeng, 2006). Such wastes for example, constitute a major contributor of lead to landfills (Saphores et al.,

2006). Of great importance in a collection scheme is the role played by consumers or the public. Although this group is critical to success in recycling, it may not be the question of how many people do participate but how well they do (Thomas, 2001). Thus the values people place on and the attitude they show towards environmental issues can be seen as a measure of how well they may participate in recycling and recovery.

This study seeks to investigate the MSWM problem from the view point of recycling and material recovery. And for such options to make meaning in a MSWM system the generation and characteristics of waste have to be known since any attempts towards recycling would involve material from waste stream. Local practices in waste management as well as recovery of components can also give clues to expanding existing schemes as well as creating avenues for innovation. Thus this research sought to investigate the MSWM problem in Cameroon in general and using three localities as case studies. The localities are Limbe, Kumba and Buea – all three being located in the Southwest Region¹ of Cameroon namely. The first two are City councils² and the last, a rural council (as per administrative classification in Cameroon). Limbe is a coastal town surrounded by hills and mountains save the side bordering the Atlantic Ocean. It is also host to the country's national oil refinery (SONARA). Kumba can be described as the economic capital of the Southwest Region characterized by rapid economic growth especially in Small- and Medium-size Enterprises (SME) sector (Ngoasong, 2007). Buea is the administrative headquarter of the Region, which is smaller in size and population to the other two localities. Of the three localities, only Limbe council operates a more elaborate MSWM scheme. Despite the basic efforts that are being put in by the respective councils, most of the residential areas are not served with collection facilities, which is not uncommon for developing countries (Klundert and Anschütz, 2001). And as Wilson et al., (2001) note, many municipalities are usually faced with the constraints of time, finance and technical resources to make reasonable decisions about preferred MSWM options. Thus for such communities, data on waste generation (quantification and source identification) and characterization need to be investigated as elements of good management planning. An understanding of household characteristics (socio-economic) can be quite valuable not only in understanding their contributions to the

¹ Region is new geo-political name for the former Province as from 2009. Cameroon has ten Regions.

² City Council is new name for some designated urban councils with state appointed Government Delegate as Council Chairperson.

waste stream but also as an indicator to households' willingness to participate in MSWM programs or Community-Based Waste Management (CBWM) schemes (Parizeau et al., 2006).

The conceptual framework for this research builds on the premises that there is a strong interconnection between socio-cultural, ecological, economic and technological factors on MSWM. Despite cost and technological know-how involved in establishing broader-scale operations to handle a greater bulk of waste, traditionally adaptable approaches can still play significant roles in recycling and material recovery. An example is the case of the Zabbaleen in Egypt, which despite its associated problems and difficulties faced, still created a huge impact in waste management services to wider communities. The Zabbaleen, an Egyptian community of Coptic Christians, operated an informal community waste management collection and recycling system. Despite problems of reliable of figures, it is estimated about 20.000 people are involved in recovery and picking activities (CID, 2001). Basically, most of the collected organic waste was used to feed donkeys and pigs. The Zabbaleen performed waste management services almost for free (or at very cheap rates) and they make their living from the processes of re-use and recycling. It is estimated that the Zabbaleen recycle about 80% or more of the waste they collect (Bushra, 2000; CID 2001) and that each ton of household garbage in the city of Cairo generates job (in collection and sorting) for about 3.5 person (CID 2001). The problems faced by the Zabbaleen include: social recognition (as a Christian community within a predominantly Muslim country); challenge to upgrade system from labor-intensive to mechanized; difficulty to put up with the Egyptian government's move of contracting foreign and other bigger companies to replace the Zabbaleen. On the other hand there have been strategies to enhance the Zabbaleen through programs targeting social issues such as improving on the livelihoods (see Hossam Aziz, 2004).

A big challenge looms when the overriding operational and motivational determinants to enhance better management are not known for particular case studies. But once these determinants are known, even small scale efforts towards the recycling of and material recovery for MSW can be rewarding as operations will then be done based on sound and informed basis. This line of argument is the basis of this research. Thus it is contested in this research that despite setbacks (in appropriate research areas to enhance sustainable MSWM) in developing countries like Cameroon, there exist

opportunities that can be exploited in the area of MSWM through recycling and recovery, which likely beneficial outcomes

1.2 Statement of Problem

Preliminary investigations into the possibilities of material recovery for Waste Electronic and Electrical Equipments (WEEE) in Cameroon reveal that a range of adaptable opportunities exist, which can be exploited for both economic and ecological benefits (Asong and Nkemnkeng, 2006). Another study on the recycling of aluminum by small private schemes in Cameroon mainly for the production of household utensils by Asong (2006) show that such schemes represent a small yet significant sector with enormous socio-economic and ecological benefits and can be operated at low cost. The above two studies discuss the issue of material recovery and recycling in Cameroon, identify problem areas and present options. They however do not provide greater details on production and recovery, test the level of a wider public participation and motivational determinants of participation, and investigate the effect of existing policies (or lack of policies) on these activities.

Achankeng (2003) also discusses the MSWM in Cameroon from a characterization study of Bamenda and Yaounde municipalities and the impact of globalization and urbanization on MSWM. While using two case study localities in Cameroon, his study is presented within a broader reference to Africa. Although he makes recommendations for improving on MSWM African in general and Cameroon in particular, he does not provide specific details on issues like the different local technologies that could be expanded to improve on MSWM as well as details on the way forward to embarking on aspects like recycling. Parrot et al (2009) investigated the MWSM problem in Yaounde (the political capital city of Cameroon) from a more socio-economic perspective, discuss obstacles to management and present some strategies to improve on management. Manga et al (2008) carried out an evaluation of waste management in Cameroon from a policy perspective in which case they presented an analysis of the state of Solid Waste Management (SWM) regulations in Cameroon and the constraints on delivery of sustainable waste management solutions. A more detailed discussion on previous studies in MSWM in Cameroon is presented in the last section of Chapter Two. The ones mentioned in this chapter, however, are quite relevant in setting the premises for

stating the research problem. Some other studies too, which constitute references for building up relevant arguments in Chapter Three and other subsequent chapters, they have been left out here to reduce duplicity.

Although most of the previous studies on MSWM in Cameroon present some way forward or strategies to enhancing existing schemes none has focused on WEEE, which is presently a very important sector of the entire MSW stream. There has also been the absence of studies into local activities (by SMEs) that can be expanded with enormous benefits as agents of sustainable MSWM as well as a source of income generation (as an economic activity). Such an argument becomes even more valid when one considers the difficulties and challenges facing the centralized schemes in Cameroon and the role small local groups can play especially in areas with poor accessibility.

A number of small schemes in Cameroon are also involved in recycling of plastics (CIPRE, in Yaounde) and paper. Others are as well nursing plans to take on recycling and material recovery initiatives. Not much information exists on the recycling of waste generated by larger industries and the effectiveness of their recycling and recovery efforts as well as other options to be exploited. Some local councils that engage in organized MSW disposal would be interested in participating in recovery and recycling especially as these may off-set disposal costs. A regular characterization of household waste is also necessary in order to investigate or assess potentials for recovery/reuse and recycling. Thus alongside characterization study, a household survey to investigate socioeconomic variables that determine waste production as well as trigger interest in participating in waste management need to be carried out for the case study communities. A major setback, however, is the lack of convincing data for informed decision making and for understanding the mutually beneficial outcome from the joint involvement and participation of both administration and the public.

Although material recovery and recycling activities are not on a wider operation in Cameroon, convincing evidence on the economic and ecological benefits as well as public perceptions and values associated with the ventures would constitute a stepping-stone for implementation as well as greater enhancement of existing schemes. More so, seeking other options for MSWM other than the highly practiced land filling would be very useful as it will lead to reduction not only in quantity of what goes to the landfill but

also landfill space.

1.3 Research Questions

This research will seek to address the following questions:

- What are the major challenges facing MSWM in Cameroon and which are some existing local MSWM practices that can be expanded upon to ensure ecological and economic sustainability of existing schemes
- Given existing condition of MSWM in Cameroon, what are the possible options for introducing or rejecting broader scale recycling and recovery into such systems?
- Which strategies can be used to design appropriate MSW collection systems to direct consumer behavior in desired directions?
- What are the likely economic and socio-cultural motivations as well as non-motivational behaviors that can spur both the public and other groups to participate in developing solid waste recycling and material recovery in Cameroon?
- What impacts do the lack of, or existing policies have on the above motivations?
- Do present state-of-the-art in technology and methods applied by small recycling schemes as well as industries in Cameroon meet up with both the economic and ecological objectives of recycling and recovery?

1.4 Research Objectives and Scope

The general objective of this research is to evaluate aspects of MSWM by municipal councils in Cameroon on one hand and the conceptualization and operation of recycling and material recovery especially by small- and medium-size industries (SME), businesses and some municipal council in Cameroon and the roles they play in the important areas of poverty alleviation and ecological sustainability.

The specific objectives are:

- To critically review the existing MSW handling and collection schemes in Cameroon and how they may affect operational considerations for material recovery and recycling.

- To evaluate the level of recycling/reuse of some components of solid waste by SMEs in Cameroon as well as to characterize production within the sector. Hence their contributions to poverty alleviation and ecological sustainability will be assessed.
- To assess possible opportunities for material recovery by small-scale schemes in Cameroon thereby testing if recycling and recovery could be preferred options for MSWM.
- To investigate the socio-economic determinants and other motivational and institutional aspects involved in recycling and recovery/reuse as perceived by households (i.e. public) and also how these determinants may affect the viability of SMEs concerned with solid waste recycling and material recovery.
- To design appropriate strategies for the sustenance, enhancement and implementation of recycling and material recovery schemes in Cameroon

This research presents the MSWM issue in Cameroon and assesses the plausibility of implementing greater recycling and recovery from an adaptive standpoint. Attention is given to aluminum, EEE at end-of-life in order to address the main thesis of this research. Public willingness to participate in recycling and recovery as well as their perceptions, attitudes and values were also investigated. The effect of policy (existent or non-existent) options is also presented.

1.5 Research Method

The following research techniques have been used in this research: fieldwork, administration of questionnaires, direct verbal interviews, phone interviews and literature analysis. Chapters Three to Six represent four different studies thereby making them independent in their own standing yet forming a significant part of the whole research. Due to this structure, the method used in each of these studies is described in the given chapter.

1.6 Rationale of research

As earlier stated, small/medium-scale recycling and material recovery schemes exist in

Cameroon. More so there are some plans to set up pilot plants for MSWM³. However, there is the general lack of or availability of insufficient data for informed decision-making on such projects and operations. This study would serve to bridge this data and knowledge gap. It would also be a pioneer contribution to the understanding of public perception and attitudes towards the recycling and recovery in particular and MSWM in Cameroon in general. Based on the argument that there is a direct link between poverty and environmental condition (Bdilya and Lyam, 2002), this study will have significant implications for economic development and ecological sustainability.

According to the IFAD rural poverty report (2001),

'Poverty has many dimensions and efforts to reduce it therefore must be multi-targeted'.

The activities of existing small/medium-scale schemes for recycling and material recovery represent some economic operations. Thus development of this sector implies positive economic development. Governments as well as local councils in Cameroon address to some extent the problem of MSWM. Yet they are often faced with the issue of lack of data for enhance informed decision-making. This research serve to fill to a considerable extend the data gap in the area of MSWM, recycling by SMEs and also to present strategies for greater stakeholder participation in MSWM in Cameroon.

1.7 Thesis layout

This dissertation is divided into two main parts: Roman numeral pages and the main research work. The Roman numeral pages consist of title pages (English and German), listings of figures, tables, abbreviations used, acknowledgments, certification page and abstract. The main research work is divided into seven chapters. Each of Chapters three to six represents individual studies in their own standing with standard divisions like chapter objectives, study methods and results and conclusion. Chapter seven then is a summary of the different conclusions and recommendations from the preceding chapters.

In chapter one, the research is introduced and in it aspects such as the research problem, objectives and methodology are described. The theoretical underpinnings of

³ Personal communication by myself and other researchers

the research are presented in Chapter Two. This involves a discussion on the concepts of sustainable development and poverty alleviation and how environmental management relates to these concepts. The MSWM situation in Cameroon is presented using case studies in chapter three. The major constraints and challenges faced are discussed and strategies to implement sustainable MSWM are proposed. In chapter four, the role of especially SMEs in the recovery and recycling of EEE at end-of-life is presented. The recycling of Aluminum and other metals by SMEs is presented in chapter five. A description of processes involved is made and other socioeconomic as well as technological concerns are highlighted. In chapter six the roles of the different stakeholders in ensuring recycling and recovery become incorporated into MSWM is assessed. A case is thus presented for recycling and recovery as options for sustainable MSWM in Cameroon based on the results from the preceding chapters. Then a list of references of cited articles, texts and appendices are presented at the end.

Chapter Two

Theoretical Framework of Research

Chapter Abstract

This chapter presents a theoretical overview of the issue under investigation of this research. It begins with a basic argument for the rationale of the research. Then key concepts embedded in the research are briefly examined from the viewpoint of their relevance to this research. The bigger problem of MSWM in developing countries is broadly discussed. The chapter ends with a brief recount of previous studies on MSWM in Cameroon, which serve to justify why this present study focuses on recycling and recovery as vital options for MSWM.

2.1 Overview

This research builds on the basic argument that in the sustainability discourse, human activities impact in some significant way on the quality of the environment they inhabit. Such an impact may either be positive or negative in the short or long run. Irrespective of the nature of the impact, the overriding tenets should be that present activities should not compromise future ones. The sustainability debate has rallied ever greater public concern in the area of environmental and natural resources use. If one takes the case of mineral exploitation, it has often been predicted that the present state of exploitation of some minerals compared to the time for such original minerals to be formed would imply a likely depletion of such a mineral resource. Also, arisings from several of man's activities (such as waste) may constitute a serious environmental problem if such arisings are not disposed of in environmentally friendly ways. Thus to tackle the resource depletion problem effort is being made in recovering, re-using and recycling some or all arisings although efforts at the moment are not void of some setbacks. In cases where arisings can be handled as just mentioned, effort is made either to greatly reduce arisings or to dispose of arisings in an environmentally sound manner.

In this research, the issue of environmental and resource management is discussed with particular attention to the problem of MSWM. The choice of MSWM is based on the fact that it has a direct linkage to ecological sustainability and poverty alleviation. More,

the research sought to make a case for greater implementation of recycling and material recovery as part of MSWM schemes in Cameroon given these are appropriate options to offset landfilling costs and to rally greater stakeholder involvement. Also, recycling and material recovery stand among the most appropriate options for handling the fastest growing waste stream at the moment – i.e. WEEE. In the foregoing parts of this sections, a theoretical appraisal of the fundamental concepts embedded in this research are examined. This research advocates sustainable management approaches to MSWM – which has social, economic and environmental dimensions situates the research within the realms of sustainable development.

2.2 Sustainable Development and Poverty Alleviation in Environmental Management

2.2.1 Sustainable Development

The term sustainable development was first coined by the Brundtland commission (United Nation, 1987) to mean development that:

“meets the needs of the present without compromising the ability of future generations to meet their own needs”.

The concept of sustainable development encompasses three core dimensions: social, economic and environmental, which of course do intersect. The implementation of the sustainable development paradigm into different agendas a few years after the concept was coined was faced by some difficulties. Ten years after the introduction of the term, came the emergence of Agenda 21, which laid a solid foundation for the promotion of sustainable development in terms of social, economic and environmental progress. Agenda 21 has 40 chapters but its recommendations can be divided into four main areas summarized in UNEP's Global Environmental Outlook handbook 3 (UNEP GEO 3, 2002) as follows:

- social and economic issues such as international cooperation to accelerate sustainable development, combating poverty, changing consumption patterns, demographic dynamics and sustainability, and protecting and promoting human health.
- Conservation and management of resources for development, such as protection of the atmosphere, combating deforestation, combating desertification and drought, promoting sustainable agriculture and rural development, conservation of biodiversity, protection of freshwater resources, and the oceans, and the sound management of toxic chemicals and

hazardous wastes.

- Strengthening the role of major groups, including women, children and youth, indigenous people and their communities, NGOs, local authorities' initiatives in support of Agenda 21, workers and their trade unions, business and industry, the scientific and technological community, and farmers
- means of implementation, including financial resources and mechanisms, transfer of environmentally sound technology, promoting education, public awareness and training, international institutional arrangements, international legal instruments and mechanisms, and information for decision-making.

Based on the three core dimensions, sustainable development can further be conceptually viewed as environmental sustainability, economic sustainability and socio-political sustainability. There are indigenous arguments however for a fourth dimension to sustainable development, which is cultural. The concept of sustainable development has over time faced some disagreements in the need for its implementation. More so, based on a multidisciplinary perspective, there has been a lack of a comprehensive theoretical framework for understanding sustainable development and its complexities (Jabareen, 2004). Jabareen's conceptual analysis identified seven distinct concepts (figure 2.1), which composed the theoretical world of sustainability: the concept of ethical paradox, the concept of natural capital stock, the concept of eco-form, the concept of integrative management, the concept of utopianism, the concept of political global agenda (Jabareen, 2008).

Although, several authors have expressed contentious views on the subject of sustainable development (Redclift, 1994; Villanueva, 1997; Berke and Conroy, 2000; Mazaffar, 2001), it is obvious from the several applicability of sustainable development that there are several good sides to it although Beatley and Manning (1998) states the term needs better definition and elaboration. One of the conceptual bases of this dissertation builds on ecological sustainability or ecological sustainable development. One of the broad conditions of sustainability builds on the claim that waste should only be produced within the ability to process or assimilate them. Such a claim would, under ideal consideration, imply zero waste state i.e. waste may be reprocess to useful materials as well as energy or assimilated through reuse and recycling programs.

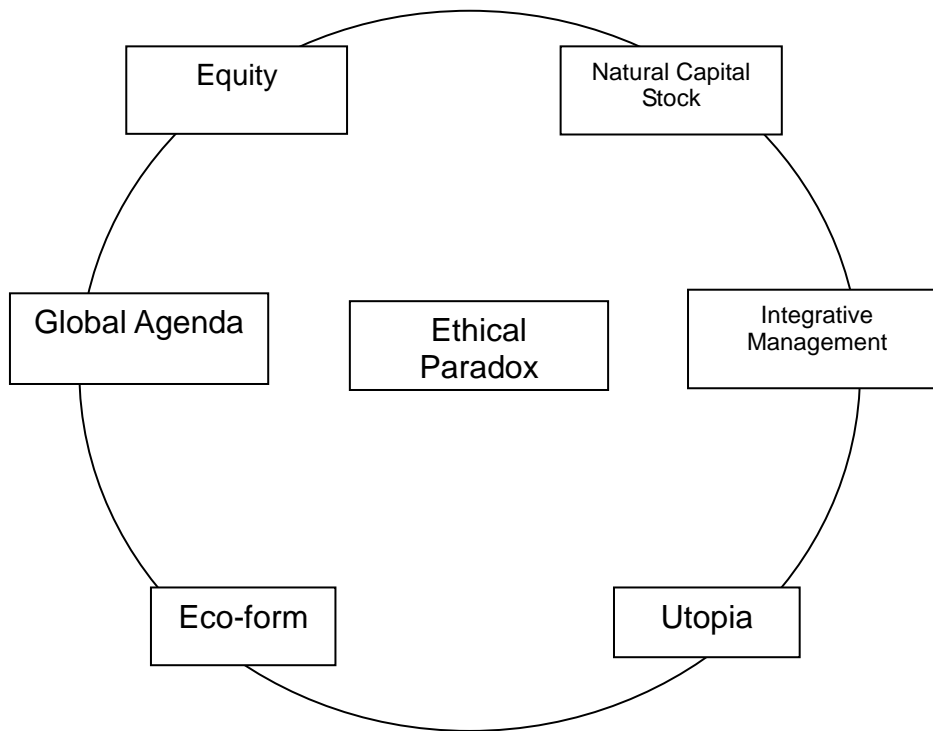


Figure 1 A conceptual framework for sustainable development
(Source: Jabareen, 2004)

2.2.2 Poverty Alleviation

Poverty and extreme poverty are conditions that have for long been ascribed to developing countries and more especially the rural areas of such countries. Given poverty is observed more in rural areas, focus in alleviating it has also been on stepping up development in such areas. In the past decade, rapid rural exodus has resulted to increasing poverty conditions in urban communities too. There is no unambiguous definition for poverty but however, it could be described in terms of income per person, social indicators, and human development and human poverty. Poverty has also been characterized in terms of: geographic location, household size and head, education, health, conflict, gender, and production and income (IFAD 2001). In Table 2.1, poverty incidence for both rural and urban cases for some West and Central African countries is presented. Although rural poverty predominates, the converse is true for Cameroon, which has a vibrant agricultural production that generates some satisfactory income for rural population. On the other hand, rural exodus, results in overcrowding in cities with little job opportunities thereby increasing the poverty level.

Table 1 Rural and Urban poverty incidence in selected countries (various years)

Country	Poverty incidence (% of Rural, Urban, Total population)		
	Rural	Urban	Total
Benin	33	31	32
Burkina Faso	65	13	56
Cameroon	32	44	40
Central African Republic	77	33	61
Chad	67	63	64
Cote d'Ivoire	70	30	33
Gambia	73	21	49
Ghana, The	45	26	39
Guinea	52	51	52
Guinea-Bissau	65	29	54
Mali	81	52	73
Mauritania	59	19	37
Niger	66	52	63
Nigeria	36	30	34
Senegal	78	21	55
Sierra Leone	74	36	56
Rural/Urban shares^a	74	26	100

^a Shares are weighted by population

Sources: World Bank, CASIN 1997:43; World Bank (2000b), Poverty Assessments, IFAD COSOPs

Because poverty has many dimensions and strategies to combat it can vary in scale, it suffices then to admit in addition to several efforts towards poverty alleviation that have focused on agricultural development and health, shifts to other areas such as empowering SMEs to be innovative in business and hence development can be quite beneficial. The case for poverty has been rallying massive support from the international community and development partners have had to redirect their actions in a bid to address this fundamental problem. While efforts by development partners have to be carried out with three key contextual issues in mind: globalization, HIV/AIDS pandemic and Armed conflicts (IFAD, 2001), there are indeed some spots for which assistance

may still flow without all of the above three contextual parameters in play. An example is the improvement and expansion of local technologies and practices by some SMEs which positively impact on poverty alleviation. The activities of existing small/medium-scale schemes for recycling and material recovery represent some economic operations. Thus development of this sector implies positive economic development. Governments as well as local councils in Cameroon address to some extent the problem of MSWM. Yet they are often faced with the issue of lack of data for enhance informed decision-making. This research serves to fill to a considerable extend such a data gap.

SMEs represent a major contributor to economic development in most developing countries. Although SMEs in Sub-Saharan Africa employ between 17 – 27% (Sandy, 2004) of adult work force, their socio-economic benefits: provision of income for individuals, reduction of rural exodus and promotion of industrialization are quite significant. According to Reynolds et al., (2002), entrepreneurship theoretically contributes to economic growth, which consequentially reduces poverty.

As early as 1960s, SMEs started emerging in Cameroon mainly in the craft sector. And as reported in Awa (1993), the government motioned the establishment and promotion of private enterprises in the mid-1980s. Thus SMEs have been operating and emerging for a while in Cameroon but conspicuous efforts by the government to booster this sector was in 2004 during which decree No. 2004/320 of 8 December 2004, creating the Ministry of Small and Medium-Sized Enterprises, Social Economy and Handicraft (MINPMEESA) was passed. This ministry became charged with the role of defining and implementing government's policy relating to SMEs thereby enhancing economic growth through the promotion of the private sector. Ngoasong (2007) in an empirical study of some SMEs in Kumba, Cameroon, reveals that while economic profit is a priority for most entrepreneurs, SMEs exists mainly to alleviate poverty through income generating activities and contribute to economic development by providing employment for job seekers and household income for the poor. He further asserts that the SMEs studied focus on adapting, imitating and modifying existing innovations rather than pursuing genuine Schumpeterian⁴ (Schumpeter, 1942) innovation. This suggests that innovation

⁴ Schumpeter in his book "Capitalism, Socialism and Democracy," first published in 1942, pioneered a discussion on the concept of "creative destruction". This is an economic growth theory in which old ways of doing things

is not yet a priority for the SME sector and therefore policies aimed at catching up with modern technology should be the central focus in providing assistance for indigenous entrepreneurs.

2.2.3 The interconnection: Poverty Alleviation, Sustainable Development and Environmental Management

Bdilya and Lyam (2002) assert a direct linkage between poverty and the state of the environment. Such a poverty-environment link is also described in Bojo et al., (2001) and Bosch et al., (2001). It is also considered that there are inter-linkages between poverty alleviation, environmental degradation and attaining sustainable developing. In a study to investigate such inter-linkages (from a case study of Pakistan), Khan (2008) found out that there is a common belief that poverty leads to environmental degradation, which is not clearly supported by evidence. However, a stronger evidential support exists for the fact that environmental degradation affects the poor more. The dependence on natural resources by poor rural communities makes them vulnerable to environmental degradation (Cavendish 2000).

Although the above assertion on linking poverty, state of environment and economic growth is seen as true for rural communities, the underlying causes of problems related to the three dimensions may not necessarily be sparked by the rural poor. If one takes the case of solid waste management, one finds out that there are generators of waste who are not the poor and because such wastes are poorly managed, the poor may stand to suffer the likely detrimental effects on the environment and health. From another perspective like forest resource exploitation and agriculture, the connection between poverty and the state of the environment is very direct. In such cases, increase poverty only leads to increased dependence on natural resources, most often in unchecked ways.

An interesting aspect of the linkage between the three dimensions that applies to especially developing countries and which constitutes a basis for this research is the case of MSWM. Normally poor MSWM leads to environmental degradation;

within industries or business are endogenously destroyed and replaced by new ones entrepreneurs innovate not just by using exiting inventions but also introducing new ways of organizing around production and distribution (i.e. new means of production, new products, new forms of organization)

environmental degradation affect human health conditions for communities, and poor health conditions affects economic growth (as both human and economic resources, which could be used for growth are at stake). Given the established poverty conditions of developing country communities, income generating activities of any sort cannot be minimized especially when carried out in a safe way. Thus the recovery and recycling of items or components from the waste stream by communities in developing countries have both economic and environmental benefits. The beneficial aspect of this inter-linkage can in most cases be better exploited in developing countries through SMEs and other private or community-based organizations as these get to impact directly at grassroots community levels.

2.3 MSWM in Developing Countries

MSWM in developing countries has most often been the responsibility of the public sector (government) and/or municipalities. The municipal solid waste problem, becoming of alarming proportion due to exponential population growth, changing economic activities, and inadequate management and financial resources, presents greater challenges to developing countries. Until the 1980s, MSWM constituted a major problem for most municipalities given it entailed huge cost and received scant attention (Bhide and Sundersand, 1983). Within the past decade, some developing countries have been giving greater attention to this problem thereby redefining approaches to improve on the situation. Research into the MSWM problems in developing countries show some similarities in results especially with respect to solid waste composition and management constraints faced. Despite these similarities, socioeconomic variables, which may differ significantly for different countries greatly account for observed differences in generation and composition (Buenstro et al., 2001a). Despite generalized similarities in MSW composition and challenges for management in developing countries (i.e. problems), Shimoura et al., (2000) attest that such problems in detail terms are quite country specific and that solving them requires the construction and installation of essential facilities and machinery, based on a suitable management plan. They further attest that for management to be successful, the plan must be formulated with a full understanding of the problems involved.

A very common characteristic structure of MSWM systems in developing countries has

to do with collection, transportation and disposal of waste while other options as recovery, recycling and reprocessing for energy still remain highly underdeveloped. As Klundert and Anschütz (2001) put it, waste collection in developing countries is an issue of growing concern whereby about 50% of residents in urban areas of these countries lack collection services. Given that many municipalities are still to implement comprehensive MSWM plans that will have a wider scale of operation, it therefore implies in practice, however, a lower proportion of residents (compared to the 50%) do indeed have access to any collection facilities. Coupled with lack of collection facilities, the frequent lack of hard data on MSW generation and composition in developing countries (Shimura et al., 2001) constrains the decision to design and adopt alternatively suitable strategies for better collection. Thus knowledge of the waste generation and composition may give an indication on whether to embark on recycling for example or not. In a survey of solid waste generation and composition in rapidly growing urban area in Central Nigeria, Sha'ato et al., (2007) reject recycling as a preferred management option. Such a rejection may only hold stronger validity if recycling is considered only in the light of large scale operations or when components of wastes such as WEEE are absent (or there is lack of information on their composition). Aside such surveys like the afore-mentioned, Shimura et al., (2001) state that developing countries do not generally conduct a MSW stream analysis due to inadequate knowledge of the proper methods involved, and a lack of the considerable manpower, time, and funds required. Transportation of waste to final disposal site is another area of concern for developing countries. There is always the problem of insufficient and inadequate transport facilities, which could be as a result of financial constrains in acquiring proper and sufficient facilities, rapid generation for which collection is not met up, and lack of will by municipalities to acquire facilities.

Sustainable and environmentally friendly waste disposal poses the greatest challenge to developing countries when one considers the activities of most existing schemes. First, there is the problem of illegal household disposal as well as varied choices of disposal options at the level of households. Second, selecting appropriate sites for disposal of MSWW based on geotechnical, sanitary and environmental considerations have been problematic. Third, there is the lack of policies and regulations on the operation of disposal facilities or in case where such instruments exist there is poor implementation of them. Despite increasing patterns in waste generation, handling the problem of

disposal, as in the case of developing countries where most of the waste is bound for disposal (Das et al., 1998 - for the case of India) has become challenging (Idris et al., 2004). A common economic and administrative problem with MSWM in developing countries is that of insufficient private and public funds to sustain existing schemes and corrupt management systems (Gupta et al., 1998; Buenstro et al., 2001a). According to Kumar et al., (2005), MSWM is influenced by a complex interrelationship of political, legal, socio-cultural, environmental and economic factors as well as available resources.

2.4 Managing the WEEE waste stream

The WEEE waste stream is now considered the fastest growing waste stream. The rapidly growing market for EEE, the fast changing designs and short equipment live-span all compound on the problems created by WEEE and thus call for effective management. Effectively managing WEEE may present different challenges to different countries as well as regions. In most cases, the WEEE waste stream has been treated as a separate waste stream rather than together with the MSW stream. Thus in recent times there have been efforts towards formulation of policies and regulations aimed at effectively managing WEEE in a sustainable way. A very important strategy in the management of WEEE is the Extended Producer Responsibility (EPR). According to Thomas Lindhquist (who first used the term EPR in 1990), EPR is:

“an environmental protection strategy to reach an environmental objective of a decreased total environmental impact from a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal of the product”

The implementation of EPR based on the Swedish context bears on some key attributes articulated therein: liability, economic responsibility, physical responsibility and informative responsibility. The Organization of Economic Co-operation and Development (OECD) define EPR as:

“an environmental policy approach in which a producer’s responsibility, physical and/or financial, for a product is extended to the post-consumer stage of a product’s life cycle”.

There are two key features of EPR policy: (1) the shifting of responsibility (physically and/or economically, fully or partially) upstream to the producer and away from municipalities, and (2) to provide incentives to producers to take environmental considerations into the design of the product and with the producer bearing responsibility for such products at EoL (OECD, 2000). Approaches to implement EPR

may be regulatory, negotiated and voluntary. In an expanded form, EPR serves the role of shifting responsibility for WEEE from government to private sector, requiring producers and importers/sellers to internalize waste management prices in their product prices (Hanisch, 2000) with such responsibility applying to post consumer stage. Thus EPR extends traditional environmental responsibilities to include management at post-consumer stage. EPR also ensures borne responsibilities apply both in downstream (i.e. treatment and/or disposal of product) and upstream (material selection and product design) operations.

In the EU, the WEEE Directive 2002/96 EC is one of the major regulatory instruments of the EU waste management policy. The directive is designed to address a series of issues on WEEE in terms of variety of products, association of different materials and components, contents in hazardous substances and growth pattern. It also seeks to induce design modifications that make WEEE easier to dismantle, recycle and recover. Finally, it plays an important role in reducing the dispersion of hazardous substances in shredder residues which are problematic waste streams if they are contaminated by such substances (the review of the EU WEEE Directive 2002/96 EC http://ec.europa.eu/environment/waste/pdf/review_2002_96_ec_directive.pdf).

In Canada, management of WEEE is imbibed in the national stewardship principles for electronics products (including consumer access, product mix, the designation of responsible parties, performance targets and recycling standards), adopted by the Canadian Council of Ministers of the Environment (CCME) in June 2004. These principles provide a framework to develop and set up WEEE programs in each province and the harmonization of the key elements that are necessary for balancing environmental and economic considerations (Festzy and Calder, 2007). Many Canadian provinces have developed, or are in the process of developing, their own schemes and legislation. Alberta launched a take back program for WEEE in 2004 with the collection of advanced discharge surcharge on designated electronics. In 2004, Ontario filed a WEEE regulation under its Waste Diversion Act with the designation of 7 categories and more than 200 items on target. Saskatchewan launched a WEEE regulation in 2005 that designates mainly PCs, Laptops and their related peripherals, and TVs for collection and recycling. Most of these pioneer efforts in Canada are limited in scope to computer monitors, laptop and notebook computers, CPUs, printers and televisions.

Unlike in the EU where a special directive on WEEE is in place, in the US, there are a number of electronic waste Bills that are under consideration in relation to managing WEEE. Such Bills may be applicable to a limited or specific range of equipments such as the National Computer recycling Act. Waste laws may also cover WEEE although range of coverage may differ from state to state. Laws concerning the handling of particular components of WEEE such as batteries also exist (an example being the 1996 Mercury-containing and Rechargeable Battery Act). Some states in the US have made significant efforts in implementing legislation on WEEE. In some cases, there has been complete ban on WEEE disposal to landfills (Arkansas, 2001; California, 2003; Massachusetts, 2000 and Minnesota).

According to Osibanjo and Nnorom (2007), the challenges facing the developing countries in e-waste management include: an absence of infrastructure for appropriate waste management, an absence of legislation dealing specifically with e-waste, an absence of any framework for end-of-life (EoL) product take-back or implementation of extended producer responsibility (EPR). However, there exist some practices in the handling of e-waste upon which expanded and comprehensive recycling/recovery programs can be built (Asong and Nkemnkeng, 2006). Thus while there is the need for developing country governments as well as other sectors to face up the challenges involved in the management of e-waste, there is also need for them to re-examine ongoing practices in the handling of such waste.

2.5 Recycling and Material Recovery

Recycling comprises the collection of recyclable material (considered waste), the sorting and processing of these into raw materials (such as fibers) and the manufacturing of these materials into new products (EPA, 2006). Because recycling involves several different activities, technological and institutional aspects may vary for the process with respect to materials and communities. The recycling process represent a cyclic loop which may have either all components on the loop being undertaken in a given locality or components spatially separated (for example, recyclables collected in one country may be transported to another country for reprocessing into new products). Recycling presents enormous opportunities as a means to municipal solid waste management (MSWM) in general and enhancing equilibrium within the material cycle in particular.

According to EPA (2003) reports on MSWM, recycling recovered 30% (68 million Tons) of MSW generated in 2001 and the number of community curbside recycling programs had increased 5% more than in the previous year. The report also shows that MSW recovered through recycling in 2001 was 29.7%, land disposal 55.7% and combustion 14.7%. Thus there is still the need for optimization of recovery. Recycling may be a major or minor consideration in a SWM plan depending on the design of such a given plan.

Recycling generally begins at the point of waste generation, through the several methods of collection and subsequent transportation to a resource or material recovery facility. This facility, however, may be part of a disposal facility or an independent entity intended for a particular purpose. Although the term recycling is being thought by some to be synonymous to reprocessing, it may differ in some respect to the latter. The significant difference between the two lies in: 1) the basic definition; 2) cost and capacity implications; 3) origins of waste; and 4) while in recycling items are recovered in forms which can be reused, in reprocess the waste is reduced to one or more materials from which completely new products are made (Manser and Keeling, 1996). Thus recycling involves selective recovery for reuse and reprocessing involves general reduction of component for alternative uses. Landreth and Rebers (1997) use tertiary recycling as a synonym for reprocessing although the use of such a term can be highly contested and may invite some ambiguity. Despite such specification in usage, reprocess as stated above is an aspect of recycling because recycling is basically the process whereby waste is put into some new use (hence whereby waste becomes resource).

In terms of cost and capacity, a recycling venture by implication will involve lower cost and capacity than for reprocessing. When one gets to look at the two in terms of income generated, one notices that depending on context, a recycling venture may be economically accommodating than a reprocessing one. It requires much capital cost to set up a reprocessing plant given all sorts of wastes may be brought in without any prior separation by generator. But recycling may be something involving just a few pickers to bigger scale operations like a recovery facility. Manser and Keeling (1996) ascertain a reprocessing facility worth \$8 million may yield at least \$1.8 million a year while orders of costs in a recycling scheme may range from zero to \$3.5 million. Thus as a means to waste management, feasibility studies are essential to decide which may be appropriate

for a particular situation – recycling or reprocessing. In all, the decision to choose which of the two (recycling or reprocessing) is to be used for a given situation depends on the cost to be tolerated. While recycling suffers a greater financial burden on collection with a resulting cheaper disposal, the converse holds for reprocessing. Hence unless there is external support or subsidies such as funding by some public authorities, the decision on whether to reprocess or recycle waste can be very crucial.

The recycling process in its entirety defines a loop or a cyclical pattern (figure 2.2) involving three basic steps: collection of recyclables, manufacturing of recycle-based products and marketing of products. Any other steps or activities involved in a recycling

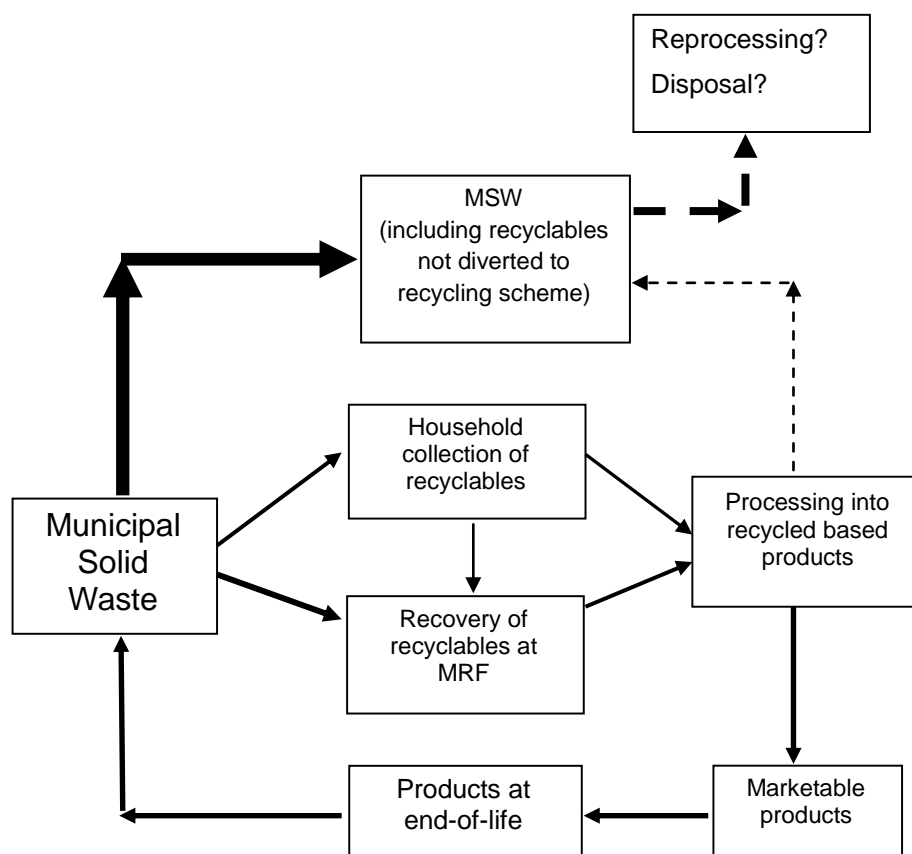


Figure 2 Schematic representation of recycling of household waste within MSWM stream (source: author's construct)

venture build upon from these basic steps or may have to do with checking on the successful implementation of these steps. These additional steps may involve the formulation of institutional tools and business approach for different recycling programs. The need for any organized MSWM stems from the very basis of what quantity of waste

is being generated and at what rate. It may also be backed up by the characteristics of the waste and its consequent impacts on the environment. Thus from information on the characteristics of a waste stream, the decision on whether to recover and recycle, reuse, discard or incinerate waste can be made.

Table 2.2 presents some data on the quantity of some specific materials (paper and cardboard, aluminum and plastics) recovered in the US from 1960 to 2001. Safe for aluminum, the other two components show a significant increase in recovery from 1960 – 2007. But in terms of percent of total recovery of each material, it is observed that there has been an increase for aluminum. Narrowing the focus to aluminum, a more vivid picture on the state of material aluminum waste generation, recovery and discard

Table 2 Material Recovery* from MSW stream in the US, 1960 – 2007 (in thousands of tons and percent of total recovery of each material)

Material	1960	1970	1980	1990	2000	2004	2005	2006	2007
Paper and Paperboard	5,080	6,770	11,740	20,230	37,560	40,730	41,960	43,380	45,240
Aluminum	Neg.	10	310	1,010	860	710	690	690	730
Plastics	Neg.	Neg.	20	370	1,480	1,720	1,760	2,050	2,090
Percent of total recovery of each material (%)									
Paper and Paperboard	16.9	15.3	21.3	27.8	42.8	47.1	49.5	51.4	54.5
Aluminum	Neg.	1.3	17.9	35.9	26.9	21.6	20.7	20.3	21.8
Plastics	Neg.	Neg.	0.3	2.2	5.8	5.8	6.0	6.9	6.8

* Recovery of post-consumer waste; does not include converting/fabrication scrap

Neg. represents proportions <5,000tons or 0.05%.

(Source: author's adaptation from Franklin Associates, In: EPA report 2008. p35, 36, and 37)

in the US from 1960 – 2001 is presented in figure 2.3. It is observed that in relative terms, there was a significant rise in recovery between 1980 and 1990 and a subsequently gradual drop after 2000. Generation and discards seem however, to have been on an increase. The simple inference that can be drawn from figure 2.3 is that the gap between discard and recovery seems to have been expanding in favor of discard. One explanation could lie in the difficulty of recovering aluminum from other waste

streams like furniture. When one takes the case of aluminum in MSW in the US in 2000, one notices it is not from all available sources of aluminum that the metal can be recovered. Aluminum from durable as well as non-durable goods (such as appliances and furniture), food and other cans were not recovered. It is thus apparent that the recovery of aluminum from these three sources can be described as still inefficient. The main source of recovery was beer/soft drinks cans with a 49.0% recovery. In summary, the total aluminum recovery from aluminum products in waste stream in 2007 was far to lower than what is discarded (i.e. 1.010 tons to 730 tons). On the other hand, a greater ratio of recovery to discard was achieved for the container and packaging sector – 40.0% to 60% (EPA, 2001). Hence recovery is good for some sectors and not others. At the moment efforts are being put to increase recovery rates but these are working well for UCBs than for food and other cans

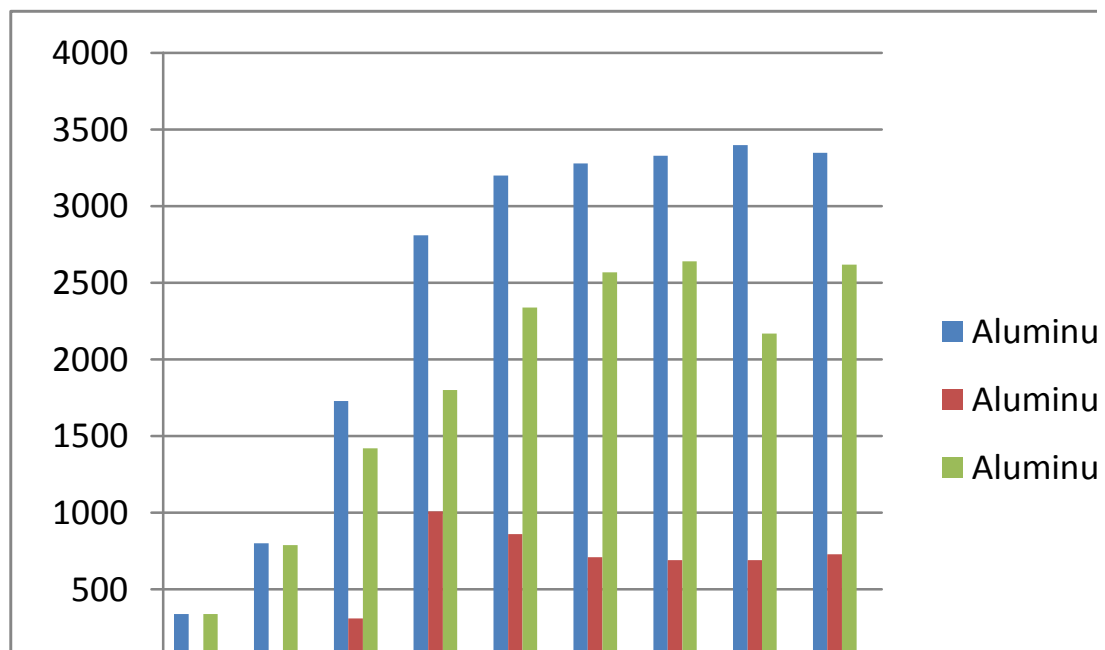


Figure 3 Aluminum in products in MSW generated, recovered and discarded in the US, 1960 – 2007 (Source: adapted from Franklin Associates, In: EPA report 2008).

Collection is in itself, the most costly operation in recycling as well as waste MSWM. Thus there is the problem of full cost accounting and cost analysis in any collection. In any case, the cost of a collection plan is dependent on the system used. Diaz et al., (1993) describe three factors essential to the design of a collection system and thee

include: 1) degree of source separation; 2) type of container(s) for storage of recyclable until collection; and 3) accessibility to containers by collector. Collection systems may fall in one of the following categories: curbside collection, containerized collection, drop-off collection, and buy-back collection. In curbside collection, recyclables are kept along the sides of streets for onward collection by collectors. This collection system is considered the most convenient collection method for residential areas as residents have just a short distance to place recyclables along the street. In containerized collection, provision is made for storage and collection of separated recyclables given there are containers allocated for particular recyclables. In such a case, recyclables are already sorted before being brought to the collection unit. A containerized collection system can be quite useful in collecting recyclables from commercial establishments, public and private institutions, and multifamily residential units. In a drop-off collection system requires the generator transports recyclables to a recycling facility while in a buy-back system, the generator receives remuneration for bringing waste to recycling facility. Hence the difference between the drop-off and buy-back lies in the fact that in the former there is no remuneration to the generator is remunerated while the generator is remunerated in the latter.

Whether recyclables are separated or not by generator, they are later collected from storage and transported to a recycling facility. Transportation is done using specialized vehicles or trucks. Different approaches may be employed. Two commonly used approaches to collection are: co-collection and dedicated collection. The Co-collection approach is useful for situations where a relatively small volume of recyclables is generated or where a large vehicle fleet is operational and the use of such a fleet dictated by cost efficiency. With a larger availability of recyclables and in the case of a large scale recycling, dedicated collection is a suitable approach. Thus co-collection may be suitable for smaller communities and operations at beginning stages while dedicated collection is suitable for operations that have gone past formative stages and ones in which large volumes of recyclables exist.

The location and definition of a market for recycled products is of major concern in any recycling venture. When one looks back into the history of recycling and reprocessing one notice that at some points where failures were being recorded, most of these failures can be attributed to inability in meeting market conditions. Although one could

build such an argument on technology and failure to ascertain the characteristics of products, both still indirectly boil down to market issues as bad products may not be tolerated in the market or production cost not being recovered. However as Pearson (1984) puts it:

“.....as the cost to recover valuable resources from the waste stream are reduced by lowering the cost of collection and lowering the cost to separate and refine the resources, the markets for the refined products will expand rapidly”.

In the US, market prices for recycled aluminum range from \$350 - \$800/ton from local recyclers while these may be in values greater than \$1000 on the West Coast (Aluminum Can Recycling, 2003).

Public, governments and private sectors may play vital roles, both on individual or joint basis, in managing recycling programs. The efforts of these groups, despite held optimism, may be challenging. According to the BioCycle Guide to Maximum Recycling (edited by the staff of the *BioCycle Journal of Waste Recycling*, 1993),

“...as recycling has become a reality for waste management , the challenges and pressures to implement and operate programs as economically as possible have also increased dramatically. Pilot programs that indicate strong participation and volume reduction must be modified to cut collection and processing costs. Private firms need to be profitable in order to be sustainable”.

Pilot programs as well as fully operating recycling programs are widely in operation in the US with remarkable success.

A characteristic institutional aspect of recycling is the market structure typified by two tiers: intermediate and end user tiers (figure 2.4). The intermediate market serves as a bridge between the generators of materials (recyclables) and the manufacturers (products). The intermediate market consists of different groups which may differ with respect to specific function. Some institutional determinants, however, have to be described and determined for different recycling programs to ensure successful execution. The existence of a market is a very important institutional aspect for any recycling program. Despite its ecological benefits, cost recovery must be at the center of any recycling program thus making recycling a highly economic venture. Therefore cost borne by the public or community and the private sector ought to be reclaimed. In some way cost is reclaimed by the economic approach of offsetting cost for alternative disposal such as to landfills and incineration plants. Different countries have designed several legislations relating to recycling but there are some similar aspects in these

legislations. Examples of such legislative measures that encourage recycling include:

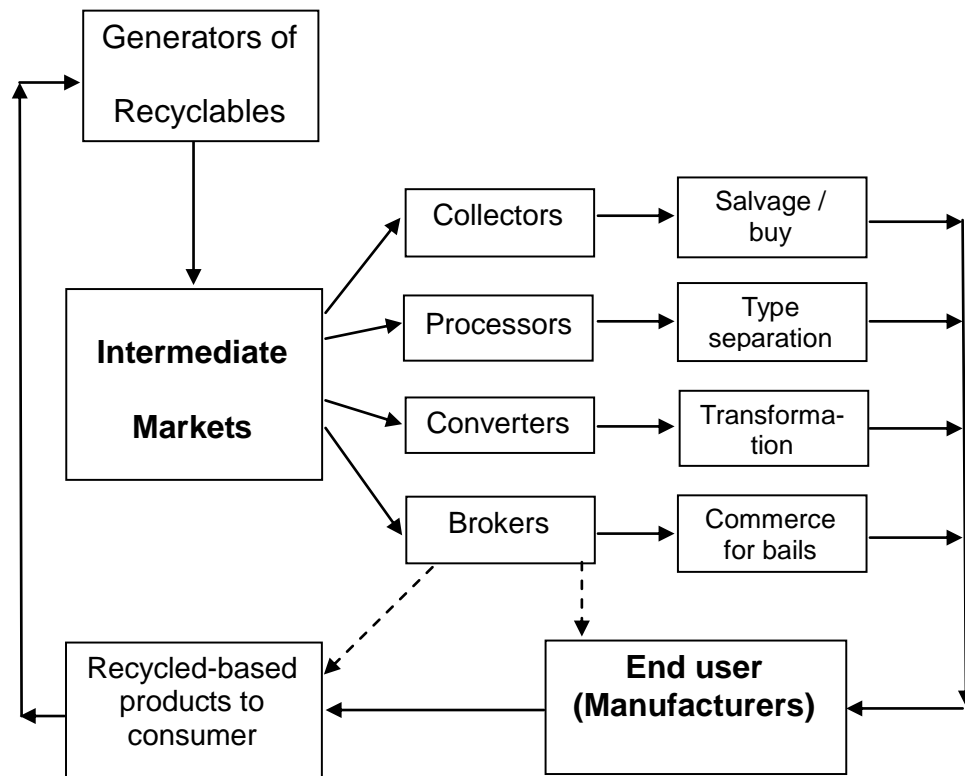


Figure 4 Structural set up of market for recyclables (source: author's construct)

Waste Management Paper 28, 1992, Environmental Act 1995, and Making Waste Work 1995 in the UK; “bottle bill” legislation in the US; the ‘pfand’ collection system in Germany (similar to the ‘bottle bill’ legislation) to name a few. These legislative measures place some restrictions and motivations on industry, consumer and waste collector as well as public and private institutions to prepare and implement plans for recycling of generated waste. The measures generally place some targets on waste generation and recovery; impose costs of some sort on waste generator and/or collector; and specify conditions for safe disposal if such be the case. More so legislation may dictate upon the recycled content of products.

In the UK, several Environmental Acts have been designed since the 1990s, which have significant bearings to recycling. According to the 1990 Act, places some responsibilities and powers on Waste Collection Authorities and Waste disposal Authorities (who may be the recycler or not). This Act emphasizes on need for recycling plan, waste sorting

into different categories, availability of amenities for waste disposal, recycling credits system. Efforts by waste collection authorities and waste producers may be futile if consideration is not given to the nature of products at the level of production with respect to material used as in the case with packaging consumer products. It is in this light that the 1995 Environmental Act had to put a burden on the part of the producer by means of the 'producer principle', which covers several waste sectors like packaging and electrical/electronic products. This Act unlike the 1990 Act is aimed at increasing re-use, recovery and recycling of products through the setting of targets by Secretary of State in consultation with industry or business sectors involved. Thus producer bears part of disposal cost by introducing measures to re-use and recycle waste to set targets. The introduction of the Landfill Tax has also been an incentive to recycle as this is greatly reducing the amount of waste going to landfills (ENDS, 1997a).

In the US, mandatory and comprehensive legislations have been adopted by different states and at the federal level, which significantly impact on recycling of waste. A typical example of mandatory legislation is the bottle bill legislation, which mandates that a deposit be placed on some specific beverage containers. This deposit which is paid by the consumer is refunded when container is refunded to point of purchase. Curbside collection is a comprehensive program that has proven quite effective in the reclamation of beverage cans and has been on a competitive edge with bottle bill. Thus states that initially adopted the bottle bill legislation find it difficult to adopt comprehensive programs for the same purpose and the converse holds (Glass Packaging Institute, 2001). In state without deposit legislation, recycling programs of beverage cans are for example, sustained based on revenues generated by MRFs. And because such revenues may not meet costs, some public funding is quite necessary. Individual states may adopt both comprehensive and mandatory legislations. Some states with mandatory residential recycling legislation include: Minnesota, Pennsylvania, West Virginia, Virginia, North Carolina, and New Jersey. Those with bottle deposit legislation include: Mississippi and Massachusetts. And those with both legislations include: New York, California and Connecticut.

On a regional scale, efforts are being put to encourage recycling especially with focus on the consumer industry. In Europe, the EU Packaging Directive of 1994 stipulates that a recovery of 50 – 65% of all packaging waste, of which 25 – 45% must be recycled and

a minimum of 15% of each material. Aside legislative specifications as per percentage recovery, other legislative recommendations exist to guide transactions of recycled products or scrap intended for recycling between industries in particular and the market in general. An example of such a guideline is the Institute of Scrap Recycling Industries' 'Guideline for Metal Transactions' which took effect from May 3rd 2006. It gives standard specifications for recycled aluminum from different potential sectors. Specifications contained there are applicable to several other products such as copper and zinc. Another institutional aspect of recycling that is quite crucial for a recycling program is a description of the 'life-cycle cost' of the program. A number of elements, which involve capital investments and processing equipments, are being considered in this case such as described by Kirshner (1990).

2.6 Previous Studies on MSWM in Cameroon

There is a general paucity of sound research in the area of MSWM and related aspects of it in Cameroon. More so, research work has and is being carried on only for a relatively smaller number of municipalities. Consequential to this is the fact that concrete data and information to enable sound decision-making of improved MSWM becomes a major setback. Despite this problem, a few authors have carried out significant research in this area, which do present deeper insights in the MSWM issues, though not exhaustive in the same.

Achankeng (2003) presents MSWM in Cameroon from a globalization and consequent urbanization perspective using Bamenda and Yaounde as case studies. He identifies globalization to be playing a negative role in solid waste management. He also examines the stages of MSWM in which case he discusses options for better management, yet from a general perspective and proposes some solutions. Ngnikam (2000) assessed options for MSWM systems in Yaounde using Life-Cycle and ELECTREIII⁵ decision support systems. And based on environmental and social considerations, he recommended landfilling and accompanied biogas extraction as most preferred option for MSWM for the city.

⁵ ELEKTRE III method (Roy, 1991) is one among the ELEKTRE family methods. It is a multicriteria decision-making tool to evaluate alternative policy strategies based on successive pairwise comparisons of two alternatives to establish out ranking relationships with respect to a predetermined set of criteria. Some advantages of ELEKTRE III lies in its flexibility as described in Hedel and Vance.

Manga et al (2008) provide an evaluation of waste management in Cameroon from a policy perspective. In this study, they assert that current regulations pertaining to solid waste management are not adequate for addressing existing waste handling and disposal problems, and that inefficiencies in implementation of existing policies are a result of devolved responsibilities between several governmental agencies and the local councils. Parrot et al., (2009) provide an overview of MSWM in Yaounde (the political capital city of Cameroon) from a more socio-economic perspective, discuss obstacles to management and present some strategies to improve on management. Their study examines present MSW collection scenarios in the capital city of Yaounde, the role of NGOs and CBOs and the impact the heavily indebted poor countries (HIPC) program could have on MSWM. An assessment of the present scenario these authors and the strategy they proposed especially for inaccessible residential quarters point to disposal as the main option for MSWM.

Preliminary investigations into the possibilities of material recovery for Waste Electronic and Electrical Equipments (WEEE) in Cameroon reveal that a range of adaptable opportunities exist, which can be exploited for both economic and ecological benefits (Asong and Nkemnkeng, 2006). Another study on the recycling of aluminum by small private schemes in Cameroon mainly for the production of household utensils by Asong (2006) show that such schemes represent a small yet significant sector with enormous socio-economic and ecological benefits and can be operated at low cost. The above two studies discuss the issue of material recovery and recycling in Cameroon, identify problem areas and present options. They however do not provide: quantitative details on production and recovery, test the level of a wider public participation and motivational determinants of participation, and investigate the effect of existing policies (or lack of policies) on these activities

Although all the above studies have made evaluation of some MSWM schemes in Cameroon, examine the problems they face and propose strategies, it is worthy of mention that these studies have been more generalized and considered MSW in bulk. Thus a significant contribution this present research seeks to make in the area of MSWM in Cameroon is by examining scenarios of MSWM in municipalities for which much has not been done, then reduce the focus to two waste streams (Aluminum and

other metals, and WEEE) for which recycling and recovery can be highly encouraged. By so doing, the conviction would be that instead of disposing of all collected waste, municipalities could be offsetting collection and disposal cost through recycling and recovery. Also the increasing rate of consumption of EEE and the complexity of its resulting waste stream calls for urgent actions.

Another study with findings quite relevance to this research is Ngoasong (2007). He makes an empirical study of SMEs in the city of Kumba, Cameroon based on the key question: Does innovation matter for economic development? He investigates the potential for indigenous SMEs in Cameroon to successfully emerge as agents of economic development through innovation. The analysis includes the personal characteristics that make up an indigenous entrepreneur as well as the contemporary environments in which SMEs operate. The theoretical framework builds on Schumpeter's notion that entrepreneurship contributes to economic development through the interplay of three variable – new firm creation, innovation and competition. The results reveal that while economic profit is a priority for most entrepreneurs, SMEs exists mainly to alleviate poverty through income generating activities and contribute to economic development by providing employment for job seekers and household income for the poor. The SMEs studied focused on adapting, imitating and modifying existing innovations rather than pursuing genuine Schumpeterian innovation. This suggests that innovation is not yet a priority for the SME sector and therefore policies aimed at catching up with modern technology should be the central focus in providing assistance for indigenous entrepreneurs and these are suggested in this paper.

Chapter Three

Municipal solid waste management in Cameroon: practices, constraints and options

Chapter Abstract

This chapter presents an overview of MSWM practices as well as an evaluation of existing MSWM schemes in Cameroon from using two case study localities (Limbe municipality with an expanded and relatively better developed management schemes and Buea municipality with a quite rudimentary scheme), which represent a reflection of the general situation in the country. In this chapter, the various practices in MSWM are elaborated, the constraints and challenges faced by management discussed and proposals for either expanding/upgrading existing schemes to be more sustainable as well as strategies to initiate new systems presented. Innovations within collection systems such as the introduction of household bins and specialized collection of specific waste could be quite beneficial to existing schemes. The lack of appropriate waste management policies and regulatory directives, lack of research and development initiatives (through which systems can be evaluated), inadequate funding, lack of motivation towards appropriate action due to socially held perceptions (continued failure to change from the paradigm of just collect and disposal for the purpose of hygiene and sanitation or keep the community clean) are some of the significant problems plaguing management. The adoption of Integrated Solid Waste Management (ISWM) may be quite vital for delivering sustainable MSWM solutions as this will involve all stakeholders, given the problems faced by management cuts across different stakeholder concerns.

Keywords: MSWM, MSWM policies, ISWM and Stakeholders, Limbe, Buea

3.1 Introduction

Municipal solid waste (MSW) generation is an inevitable fate of communal activities within any given human community as long as humans engage in the creation and use of goods and services. The rate of generation may, however, differ for different communities based on certain factors, which may be economic, technological and socio-cultural or fundamentally institutional of some sort. Important factors with direct relationship to rate of MSW generation include both growth in population and changing consumption pattern, which are of course related to economic aspects (Buenrosto and Bocco, 2003; Idris et al., 2004; Ojeda-Benite et al., 2003; Sha'Ato et al., 2007; . According to the editorial on the Alchemist's Dream Resource (*in Waste Management*

26, 2006: 1203-1204), mankind is confronted by two questions in a bid to evaluate suggestions for improving solid waste practices: 1) How much will it cost? and 2) Is the proposed change worth the cost? It thus becomes obvious that a Cost-Benefit Analysis (CBA) of Municipal Solid Waste Management (MSWM) activities is as essential requirement for such activities to be sustainable or at least to attract further financial inputs to run operations. Wilson (2007), from a historical context identifies six development drivers in waste management for both developed and developing countries: public health; environmental protection; resource value of waste; closing the loop; institutional and responsibility issue; and public awareness.

Poor management of MSW or the absence of management remains a very challenging task especially for developing countries. In cases where some forms of MSWM exist, operations may be chaotic, poorly organized and prioritized, and even complex. The intrinsic complexity in MSWM is not only unique to developing countries but also to developed ones. Some research show that complexity arises due to significantly different problems, which frequently conflict with each other (Conn, 1993; Hasome et al., 2001). Achankeng, 2003, asserts that the need to manage MSW in an environmentally effective, technologically feasible, economically affordable and socially adaptable manner poses problems to all nations in the world and he does not only link the problem to conflicts but also to the paradox of sustainability. The level to the problem of MSWM poses challenges may differ greatly from country to country, but being greater for developing that developed countries. According to Shimura et al., (2001), proper MSWM in developing countries would require the construction and installation of essential facilities and machinery, based on a sustainable plan. Given the economic constraints to fulfill such requirements, a more plausible aspect of management should be one that considers adaptability to location specificities.

From a historical perspective in most developing countries, municipal solid waste management (MSWM) practices in an organized manner have experienced some positive changes only for a few municipalities. Such changes include the design and implementation of schemes for collection and disposal of MSW at landfill locations. These have shifted focus from the common practice of surface yard dumping behind individual household to organized, though commingled collection and disposal to a common disposal facility. In Cameroon much waste is disposed of mainly on land

surface as well as shallow pits. MSW constitute a serious environmental problem with varying degrees of direct as well as indirect negative effects on the environment and its ecosystems.

In Cameroon, some coordinated municipal solid waste management (MSWM) schemes are operated by some municipal councils, contracted agents in the form of Non-governmental Organizations (NGOs), Community-based Organization, (CBOs) and Common Initiative Groups (CIGs). For example, alongside some municipal councils, exist: two NGOs namely HYSACAM (Hygiene et Salubrité du Cameroon) which operates in some municipalities namely Douala, Yaounde, Limbe, Mbalmayo, Soa, Njombe and Penja, and CIPRE (International Centre for Promotion and Recycling) which operates in Yaounde; and CBOs like TAM-TAM mobile, GIC-JEVOLEC, ERA (Environment Recherche Action) Cameroon and Sarkan Zoumountsi, which all operate in the capital city of Yaounde (see table 3.1 for a list of some organizations/groups working in the area of MSW collection in the Yaounde municipality). There has also been some collaboration with French partners INSA Valor and Equipe PLDEN with some NGOs, councils, CBOs to develop an integrated MSWM scheme for the city of Yaounde. Despite the lack of research and informative data on MSWM issues in Cameroon, a few authors (cited in the previous chapters) have carried out significant research in this area, which do present deeper insights in the MSWM issues, though not exhaustive in the same. In these previous studies, however, the implications of existing waste management schemes on recycling and resource recovery/reuse have not been addressed. More so, suggestions presented have not focused on the issue of offsetting cost within existing schemes. MSWM is one of such areas where transfer of strategies may not yield much of expected results i.e. a management strategy may work for one location and not for the other. Thus the concept of adaptive approach becomes necessary in the enhancement of existing schemes or in the planning of new schemes. This aspect has not been addressed in most of MSWM literature in Cameroon. A survey of literature on MSWM in Cameroon also show that while the inclusion of all stakeholders in planning and operating a scheme is recommended, the role of gender is not being considered. Detail studies on public participation and cost-benefit analysis (CBA) for existing schemes is generally lacking. Thus this study seeks to address some of the lapses in MSWM as presented above.

In this chapter, MSWM in Cameroon is presented through the use of case studies. Two case study localities used are Limbe and Buea municipalities. The municipal councils of these two municipalities operate to some degree a MSWM scheme with the Limbe council having a contracted agent (HYSACAM) to facilitate MSWM.

Table 3 List of organizations and groups involved in MSWM in Yaounde alongside municipal council and HYSACAM

No	Organization	Type	Created	Members	Area(s) of operation	Major activities
1	Association des Volontaires du Developpement (AVD)	AT	1997	20	Mfoundi market	Collection of market waste
2	Association des Jeunes de Merlin (ASOJEM)	YA	1999	31	Merlin V (near Gendamerie Nationale)	Fight against dirtiness through daily human investments
3	Association TAM-TAM Mobile	YA	1997	40	Mvog-Beti	Reflection of youth misery and unemployment; cleaning and clearing streets and roadside
4	Association des jeunes dynamiques de L'EMIA	YA	2001		Merlin I	Clearing around the American centre
5	Dream team Association	YA	1999		University residential area	Students' experience exchange
6	Association pour la preservation de L'environnement et les progres social SAEKAN ZOUMOUNTI	YA	1994	13	Briqueterie	Collection of waste and gutter cleaning
7	Association des residents de Mbenda	QA	1990	40	Mbenda (Nsimeyong II)	Residential quarter cleanliness
8	GIC Jovelic	GIC	1997	5	Zibi, Nkolzie, SIC Mendong	Door-to-door waste collection, composting and agriculture
9	CIPRE	NGO	1996		Etoug-Ebe	Recycling of plastic waste; public sensitization plastic separation
10	Circle des jeunes de Merlin Polytechnique	YA	1995	25	Merlin 4	Encourage quarter cleanliness through daily human investment

11	Club de volontaires de Nvog-Ada (CVN)	NGO	1993	6	Mvog-Ada	Cleaning of streets, gutters and water courses
12	FOCAFRE	NGO	1992	7	Elig- Essono	Waste collection, canal and water courses cleaning and MSW composting
13	CAID	NGO	1984	10	Mballa I	Composting of waste and cleaning of water courses
14	Carrefour de la vie	NGO	1992	20	Biyem-assi	Urban cleanliness
15	ARC en Ciel (AEC)	NGO	1999	7	Anguissa quarter	Consultancy and training towards primary waste collection
16	Centre d'Animation Sociale et Saniatires (CASS)	NGO	1978	36	Nkolndongo	Youth training for micro-employment projects and sports
17	ACADE PRO	NGO	1983		Mimboman	House-house waste collection to public bins
18	Entreprise de Nettoyage Industriel au Cameroun SARL (ENICAM)	SME	1991	40	Elig Essono	Cleaning industries; collection of waste from particular individuals
19	Ets BOB Foundation SARL	SME	1987	36	Nkoufoulou Road (near SAPLAIT)	Waste collection from household, enterprises; clean industries
20	Ets MEIDO	SME		1	Mvog-Mbi	Hires hysters
21	Yaounde Propre	SME		2	Bastos	Waste collection for specific households in Bastos quarter

(Source: after Achankeng, 2003)

The following abbreviations in the table represent: AT - Association of Traders; YA – Youth Association; GIC – Common Initiative Group; NGO – non-governmental Organization; QA – Quarter Association; SME – Small and Medium-size Enterprise

The aim of this study is to critically review the existing MSWM schemes in Cameroon. Aspects of generation, handling, collection, transportation and final disposal reviewed and analyzed. The impact of existing management operations on recycling and recovery is discussed. The roles played by municipal councils and other contracted organizations

in MSWM are assessed. Proposals towards sustainable and adaptive schemes are proposed. To attain the aim of this study, a field survey was conducted that comprised: field observations, interviews and administration of questionnaires. Observations were made in the field to have a clearer picture of the processes of waste handling, collection, transportation and disposal. Telephone as well as verbal interviews were conducted for some municipal authorities and organizations involved in MSWM. A total of 100 questionnaires were administered separately to the public in Limbe and Buea municipality respectively. The sample population for each community comprised of students, households and small businesses. The questionnaire contained mainly close-ended questions intended to provide insights into the MSWM practices. The questionnaire recovery rate for Limbe was 100% while that for Buea was 83%. The data derived from field survey, questionnaire and interviews were analyzed using descriptive and exploratory approaches (Yin, 2003). Relevant data from previous studies constituted secondary data source for this study.

3.2 MSWM Issues in Cameroon

3.2.1 Country Overview

The geographic area of Cameroon approximates a triangular surface with a total area of 475,650 sq. km (fig. 3.1). It has a population of about 16.6 million inhabitants. Its geopolitical boundaries are as follows: to the west by the Federal Republic Nigeria; northeast by the Republic of Chad; east by the Central African Republic; south by three countries namely Equatorial Guinea, the Republic of Gabon and the Republic of Congo-Brazzaville. It is also geographically bounded to the southwest by the Atlantic Ocean, which forms a coastal line that stretches the entire southwest length of the country and to the north by Lake Chad. The strategic location of Cameroon puts it at the crossroad between Central and West Africa. Geopolitically, the country is divided into ten Regions⁶, headed by presidential appointed Governors. The regions are further divided into divisions, sub- divisions, all with appointed administrative heads. All divisions and sub-divisions have a municipal council headed by an elected Mayor (all of whom belong to some political party).The councils of cities and major towns are referred to as urban councils with the rest being municipal councils. Some urban councils were upgraded by

⁶ Region is new geo-political name for the former name Province in Cameroon.

a presidential decree in 1993 to the status of city councils headed by appointed government delegates who play the role of council chairman.



Figure 5 Map of Cameroon showing regional headquarters and major towns and bordering countries (source: <http://www.mapsofworld.com/cameroon/cameroon-political-map.html>)

The country's climatic setting consists of three major climatic zones: (i) the Equatorial zone in the southern half of the country characterized by abundant rainfall (about seven

months) and forest vegetation; (ii) The Sudanian zone in the northern central half of the country characterized by a mixture of grassland and scanty forest vegetation; (iii) The Sudano-Sahelian zone in the north of the country characterized by mainly grassland vegetation. Rainfall as well as the duration of the rainy season generally decreases from south to north across climatic zones. It is endowed with natural resources (rich flora and fauna, mineral resources, petroleum) and a very rich traditional/cultural heritage for which the country is referred to as 'Africa in Miniature'. The productive agricultural land resources coupled with diverse climatic conditions make Cameroon one of the most self-sufficient in agricultural food production in Africa. The economy of the country experienced a significant boom between the 1970 up to the middle 1980s from revenue generated from the agricultural and oil sectors. The rapid economic growth rate at this time placed Cameroon among the twenty safest countries in the world for foreign investment (Ndongko, 1986). The country was struck by an economic crisis from the 1985/86 fiscal year and since then things have not been any better for the country in economic terms as it later experienced devaluation in the 1990s and a series of International Monetary Fund and World Bank reforms, which have not been enacted up to expectation.

Being a signatory to the Rio del Janeiro convention on Sustainable development, Cameroon has been making some progress in the area of biodiversity conservation, improving agricultural yields and provision of safer drinking water to some communities through especially international organizational support and NGO initiatives. However, some socio-economic issues are in a decline or not receiving adequate attention such as in the area of road construction.

3.2.2 MSWM in Cameroon

MSWM constitutes one of the areas of greater challenge to the government of Cameroon, local councils, organizations, businesses and the public at large. The institutional/administrative framework for waste management in Cameroon comprises different tiers (fig. 3.2): the national assembly that drafts laws (bills) and other regulations which are subsequently ratified into law by the president of the country; the responsible ministries that draft different policies, plans, programs and follow-up guidelines to implementation of the law and regulations; the local municipal councils

(urban and rural) responsible for the direct management of waste within their respective municipalities alongside contracted agents to councils and other institutions (like NGOs) and the public at large. While one cannot assume a top to bottom approach may be void of contention, it is quite clear that local councils play a greater and direct role in managing especially MSW waste generated within their municipalities.

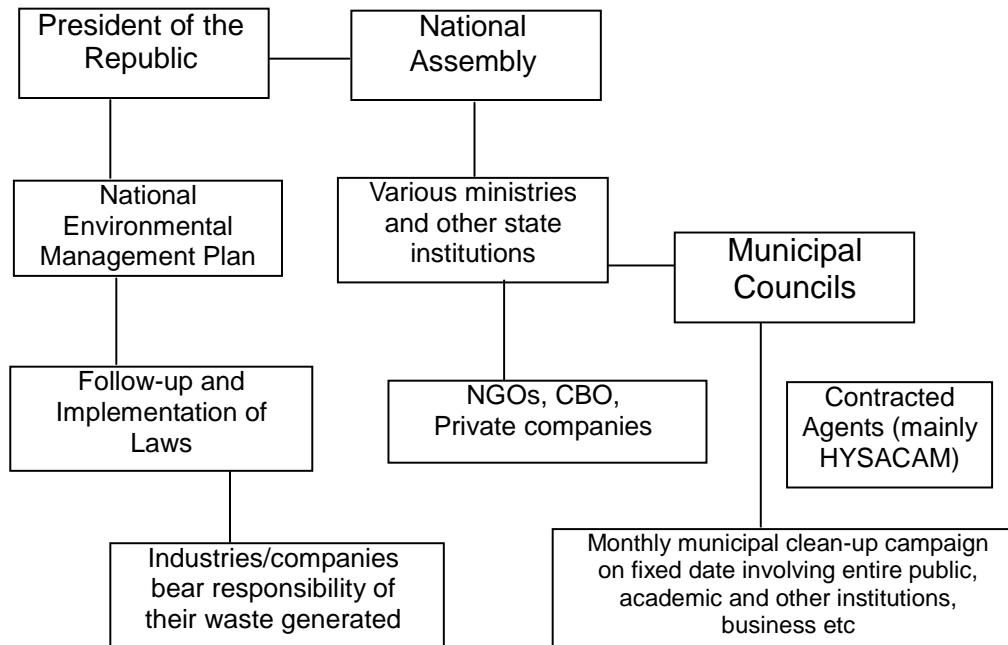


Figure 6 Hierarchy of administrative framework for MSWM in Cameroon.

(Source: author's construct)

From a historical perspective, aspects of environmental management in Cameroon have been enshrined across a broader range of institutions with bare details on issues like definitions, legal frameworks and responsibilities of stakeholders. Ministries and other state establishments whose activities could lead to environmental degradation drafted texts to enhance environmental management and protection in which cases aspects of solid waste management were only implied therein. Hence not until the late 1980s, there were no defined legal frameworks or acceptable standards for environmental management (MSWM inclusive). Two earlier legal documents with provisions related to MSW include: Decree no 76/372 of 2nd September 1976 to regulated establishments classified as dangerous, unhygienic and obnoxious and Law No. 89/027 of 27 December 1989 on Toxic Wastes. Manga et al., (2008) present some an overview of roles and responsibilities of ministries related to waste management as

well as some key legislative aspects involved in Cameroon.

Cameroon, being a signatory to the Rio del Janeiro Summit on Sustainable Development in 1992, embraced the need for a more detailed and broader perspective on environmental management. Hence Law No. 96/12 of 5th August 1996 providing the legal framework for environmental management in Cameroon was promulgated. Section I article 4c defines wastes as “all residues from a production process, transformation or utilization, all substances or materials produced, or more generally, all abandoned properties and furniture destined to be abandoned or disposed”. Article 4j defines elimination of waste as “a group of operations comprised of collection, transportation, Storage and necessary treatment for the recuperation of useful materials and or energy, the recycling of such materials, or all disposals or reject in appropriate manner in a condition not to evoke nuisance and environmental degradation”. Article 4q defines waste management as “the collection, transportation, recycling and elimination of waste, which comprise a surveillance of the elimination site”. This law also lay down some fundamental principles (as related to environmental protection and resource depletion/degradation) including: the precautionary principle, the principle of active prevention and correction, the polluter pays principle, the principle of responsibility, the principle of participation and the subsidiary principle (see Luken et al., 2002, for a detail analysis). Thus the provisions in this law on waste management include: a definition of waste, how they have to be managed and incentives for management as well as penalties for failure to manage properly.

A common problem observed in the area of MSWM is that while the quantity of solid waste generated and consequent negative impacts keep going on the increase, management seem not to be rallying appropriate strategies and approaches to efficiently handle the problem. UNIDO (United Nations Industrial Development Organization) country assessment report for Cameroon for 2006 on industrial production and resultant waste for some 9 sectors presents some important facts for consideration: ii) total waste (in term of weight) from production processes in the 9 sectors considered is approximate thrice the production; ii) of the resultant waste, about 3% is considered dangerous. One thing than cannot be fully justified is how these resultant wastes are effectively managed in a sustainable and environmentally friendly way. It is also not very clearly established what proportion of generated waste can be

recycled or recovered as well as ongoing or probable options for recycling or transformation of such wastes. MSW is generated as a result of the fact that products, goods and services are consumed by the public. The principal generated sources are domestic/community, commercial and administrative units. Community is placed here under domestic because in most localities, households may have surface refuse dumps in the back yard while still making use of the community disposal sites as well. Not much is known about the actual composition and generation of MSW in Cameroon and such information in most cases is rather qualitative. In any case, the MSW stream in for Cameroon is not too different compared to other developing or less industrialized countries. Organic waste would constitute a fairly large share of the waste.

Achankeng (2003) reports generation rates of 0.3 – 1.4kg per capita for two cities in Cameroon namely Bamenda and Yaounde. Other studies report average per capital generation for Yaounde to be in the range of 0.60 – 0.98 kg per capital (Parrot et al., 2009; Tanawa and Ngnikam, 2002; Ngnikam, 2001; Monkam et al., 2000) and total daily generation ranging from about 700 – 1200 tones (Achankeng, 2003; Tanawa and Ngnikam, 2002; Ngoma, 2001) The above reported per capita daily generation would be similar for most of the larger cities and towns with a significant difference being in total generated amount due to population effect.

An analysis of the non-biodegradable component of MSW for Bamenda is presented in figure 3.3. From the figure it is observed that plastic, bottle/glass and paper/carton constitute significant fractions. In a study by Ngoma (2001), MSW compositions of 80% organics, 7% paper and carton, 4.7% glass, 4.3% plastic and rubber, 2.2% textile and leather and 1.7% iron and metal are reported. Parrot et al present a comparison of MSW generated and collected (for disposal) in Yaounde for the period January 2005 to July 2005 (fig. 3.4). From the diagram it is observed that seasonal factors affect generation and collection in opposite ways. Thus in the rainy season with very poor accessibility to residential areas, collection is poor against a higher generation rate due to high agricultural production at such times.

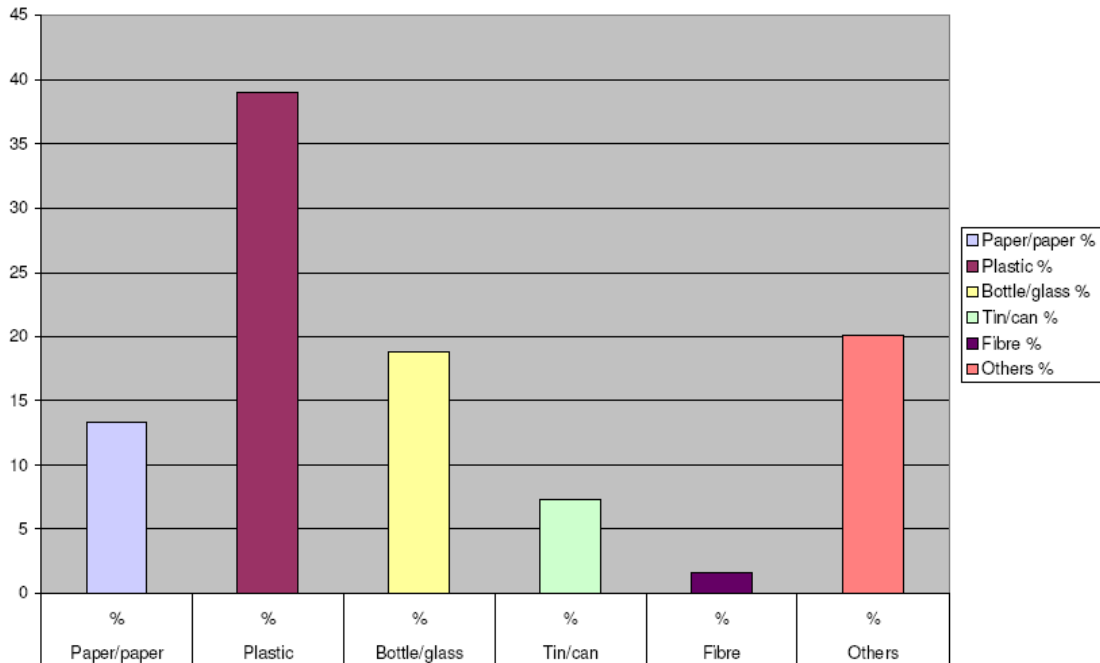


Figure 7 Non-biodegradable components of MSW for Bamenda municipality. (Source: Achankeng, 2003)

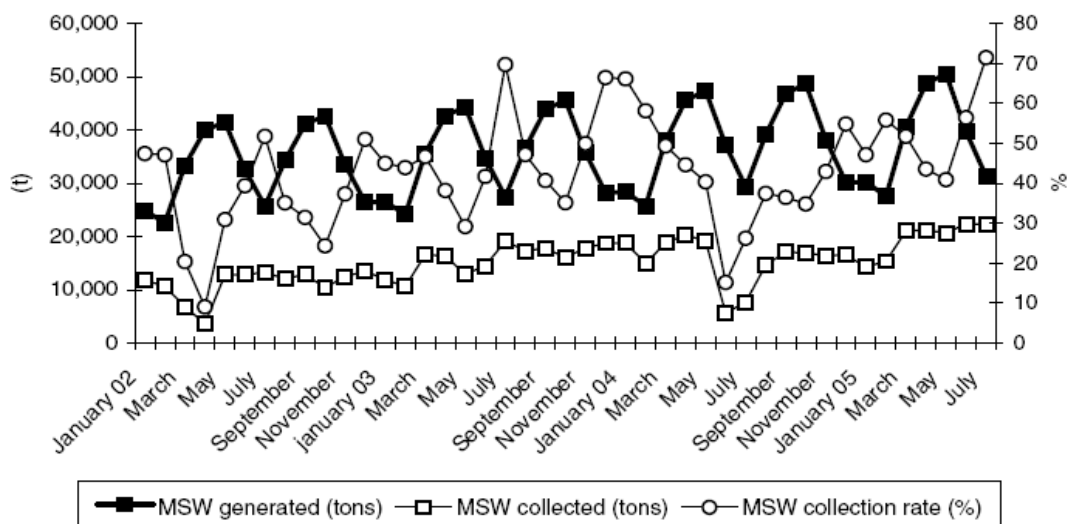


Figure 8 Comparison of MSW generation and collection in Yaounde between January 2002 and July 2005. (Source: Parrot et al., 2009).

In Cameroon, the number of municipal landfills is still very small, talkless of sanitary ones. Yaounde, the capital city for example, has only one Sanitary landfill, at Nkoulfoulou (about 56 hectares) created in 1998 that receives about 7.000 – 8.000 tons

of waste daily. Bamenda has an open dump northwest of the city on the Mezam River Valley. Douala, the economic capital of Cameroon, also has a large open dump along the Douala-Yaounde motorway where there is surface dumping and subsequent volume reduction through pressing with heavy duty machines.

MSWM in Cameroon at the level of municipalities and communities are basically the responsibilities of the municipal councils. Councils are faced with two likely options (separately or jointly) towards enacting waste management activities: 1) create a service within the council charged with collection and disposal of waste and/or 2) contract an external agent, who may be an NGO or private organization (the main agent in the country being HYSACAM) to be charged with the role of managing MSW. These councils and contracted agents are expected to design waste management plans in conformation with existing legal and other framework requirements, at least in theory.

3.3 MSWM Practices for case study localities

In this dissertation, an overview of MSWM practices in Cameroon is presented on a case study basis using two case study localities namely Limbe and Buea. The first is an urban municipality with a contracted agent, HSACAM to take charge with the collection, transportation and disposal of municipal solid waste. Limbe is also a major economic city of the southwest province of Cameroon and host to the country's main oil refinery (SONARA - Societe Nationale des Rafines, Cameroon) as well as many SMEs. The second is the provincial capital of the southwest province and host to the country's lone English-speaking state university as well as many administrative institutions. The presence of the University has led to a rapidly growing population and consequent booming local economic activities, which have impacted on waste generation and management. These two case studies represent a fair picture of the MSWM situation in Cameroon.

3.3.1 Limbe Municipality

Limbe municipality is one of the two municipalities in the Southwest region of Cameroon that had the status of an Urban Council. Due to Cameroon government reforms on council set-up in the 1990s (decree No. 93/322 of 21/11/93), some urban councils

received the special status whereby government delegates were appointed for each of such special status council to perform the role of council chairman. In January 2008, and by decree, Limbe Urban Council was changed to Limbe City Council with the creation of three sub-divisional councils: Limbe I (POH), Limbe II (Munkundange Council) and Limbe III (Bimbria Council) each administered by a Mayor and 2 deputies. Limbe has a population of about 120.000 inhabitants. It is a major coastal town of Cameroon with rich touristic attractions. The major economic activities in the municipality include: fishing (along the Atlantic coast), plantation and peasant agriculture, and commercial activities. The topography of the town is defined by a bay and headline structure along the coastline. Thus along the coast, the topography is quite low-lying and this increases gently towards on-land and the increase becomes sharp peripherally landwards. Such a topography accounts for the recurrent floods in the town during the rainy season months (specifically around June – September). Although the Limbe City Council now has three sub-divisional councils, MSWM still remain in the charge of the contracted agent HYSACAM, and all containers and skips still carry the inscriptions of either the LUC (Limbe Urban Council) or HYSACAM. Just like other special status councils that have been subdivided (or expanded), the problem of allocating previous infrastructures to the new councils as well as acquiring new ones still looms.

3.3.1.1 Generation and Storage

The main sources for MSW generation in the Limbe municipality include: residential/household, commercial, industrial and administrative. Industrialization is, however, limited to the level of SMEs which operate within the city. Thus waste originating from SMEs constitutes part of the MSW stream given resultant waste from this sector is disposed of within municipal disposal units. Waste generated by households with yard disposal facilities (such as surface dumps) are not generally stored (in storage containers per se) prior to disposal. Most of the generated waste is immediately disposed of at such sites. At any time the volume of such waste is considered too much by residents, it is burnt *in situ*. In residential areas served with collection containers, household wastes may be stored in items within households such as: basket, old buckets, plastic and nylon bags (fig 3.5a, b, and c respectively) and cartoon boxes



Figure 9 Different waste storage facilities within households in the Limbe municipality (a. old basket; b. bucket; c. bags). (Source: author's fieldwork, 2007)

Field observations show that the choice of storage item varies over time based on either durability or availability. Generally metal containers and wooden baskets and cartons are the mostly used storage containers. Storage period varies from 0 – 5 days before depending on the rate at which the storage containers get full or the readiness of households to empty them into secondary collection devices. For households with children, the children are mainly responsible for implementing primary collection of waste i.e. from storage to collection skips and containers or into collection trucks. For commercial agents as well as SMEs, generated waste is disposed of into any public collection or disposal units as need be although daily disposal is common. Such generators also make use of yard disposal facilities if such are available at their location. There is no prior sorting or separation of waste before either storage or disposal thus MSW is always commingled. The act of retrieving materials or items from the waste for reuse or scavenging for metals or bottles is common. Common materials being scavenged for include, body lotion bottles, plastic bottles, rubber slippers, aluminum and other metals like iron. Most of these recovered items are sold to retailers.

3.3.1.2 Collection and Transportation

MSW collection and transportation to final disposal site (from either households or roadside collection containers) is the responsibility of the municipal council/HYSACAM (contracted agent). Both the council and HYSACAM serve some residential areas with skips and containers for collection of waste (fig 3.6). The skips (with inscription LUC for

Limbe Urban Council) placed by the council prior to its engagement with HYSACAM. Presently HYSACAM is responsible for distribution of both skips and containers within the municipality. Some skips bear inscriptions representing both the council and HYSACAM. About 75% of the municipality is supplied with a collection facility. Stating that collection facilities are supplied to residential quarters does not in any way imply sufficiency in number. Rather, it implies that there is at least a bin within a major residential quarter. Along major streets in residential area served with skips, such skips are irregularly placed. The number of skips or containers per residential area varies and depends on factors such as availability of skips and containers, accessibility of area, population density and economic activity within the area. However, for most areas, dropping of waste into skips by public is a matter of individual willingness i.e. choosing between disposing at household facility or walking up to the skips or containers. Walking distances to collection facilities range from a few meters to about 300m and in some cases even more.

In terms of logistics, the following collection facilities are in use by HYSACAM: 30 skips each of volume of 6 cubic meters; 30 smaller containers each of volume one cubic meter; two 12-tonne specialized vehicle trucks for door-door waste collection; one 5-tonne vehicle truck, one 3-tonne vehicle truck for transportation of bins; a pick-up for control/supervisory activities as well as administrative duties and travels; two motorcycles. A labor force of about 104 workers is employed. Households may also leave waste along transportation routes in small storage containers (as described earlier) for pick up by transportation vehicle operators. For residential areas without containers and skips, there are specified days that collection vehicles pass around and residents drop in their waste into these vehicles (door-to-door collection). Collection of waste from containers and skips along main roads and areas with economic activities is done after every two days. Collection from peripheral residential areas is done on a weekly basis in which case each area has an assigned day per week. However, collection may be regular depending on the availability of collection vehicle (given with only a few, broke down of any is severely felt).

The larger skips do not have lids hence remain open throughout. The smaller skips, though with lids are rarely found covered. Collection skips and containers are most



a)



(b)

Figure 10 Collection devices for MSW secondary collection in the Limbe municipality:
a) skip and b) container. (Source: author's fieldwork 2007)

often overfull hence common to find waste littered around such facilities thereby

creating a problem of aesthetics as well as nuances. Common characteristics around such open and overfull collection facilities include: bad odor, mosquitoes, cockroaches, domestic animals and rats. Thus handling conditions of waste during rainy periods can be quite nasty. Because available collection facilities may not cope with rapidly increasing waste volumes, and given some members of the public are so naughty in throwing waste on around bins, it is a normal exercise for collection workers to pick up the litters around container before it is mounted on collection truck. It is not uncommon to find collectors without appropriate clothing and protective devices (such shoes, gloves and air masks) required for such activities. Based on some social perceptions, it is equally not uncommon to find a collector working bare hands while he has a pair of gloves in the hind pocket.

On a contractual basis, it is estimated that HYSACAM has to collect up to 120 tons of waste daily for onward disposal. In practice only about 90 tones is collected. Thus weekly collection could be estimated at 540 tones. Reasons for difficulty in meeting target collection include: poor accessibility to residential quarters (due partly to poor town planning) especially during the rainy season; lack of logistics to caretaker for the generated waste volumes; financial constraints; lack of good maps to define preferable and plausible collection routes.

3.3.1.3 Disposal

The disposal of MSW in Cameroon depends on the source of the waste (generator) and the collector. Household wastes may be disposed of via the following means: i) by individual households either on surface dumps or household disposal facilities (dug pit) within the vicinity of the household; ii) disposal in passing-by streams within residential quarters; iii) disposal on a common public surface disposal unit (common in plantation communities); iv) by depositing household waste in public skips and containers for onward collection and disposal by appropriate authorities. Commercial solid waste is generally collected and disposed of by local councils and its contracted agents. Industrial waste may either be disposed of within the industrial facility (as case of households) or collected by council or contracted agents for onward disposal.

In the Limbe municipality, MSW disposal is the responsibility of HYSACAM. There exist

four disposal sites for this municipality. Three have been abandoned, which were located in the following areas: around the Limbe botanical garden, dockyard (on a wetland) and Karata residential quarters. The disposal site which was located on a wetland was situated south of the Limbe market and about 400m from the Atlantic coast. This disposal site has now been abandoned after an operation period of over 15 years. The present disposal site is located along the Limbe - Idenau motorway. The general disposal practice is that of dumping and compression with heavy-duty machines and later burning to reduce volume. Waste from collection trucks are tipped off at disposal sites almost daily. They are then spread over the surface by heavy-duty machines which in turn compress them. A layer of soil is later spread above waste, which forms the base for the next dumping. Fire is then set upon the sealed layer. Burning is usually a slow process especially during the rainy season. Environmental and engineering aspects are given little concerns in siting disposal facilities.

3.3.2 Buea Municipality

Buea is the administrative headquarter of the Southwest region of Cameroon. It has a population of about 57,000 inhabitants. It is a very historic town. It has been the capital of the former German Cameroon and former Southern Cameroon. Remnants of some historic infrastructures of these political systems serve as touristic sites. The annual Mt Cameroon race of Hope is also a major touristic event in the Buea. The town is located on the eastern flank of Mount Cameroon (an active volcano along the Cameroon Volcanic Line) at elevations above 400 – 1000m above sea level and characterized by very rocky terrains. Plantation agricultural activities within the municipality and environs include Tea (at Tole) and Banana at Molyko and Muea. Peasant agriculture is also vibrant due to the very fertile volcanic soil. Crops grown for sales at local markets and for household consumption include: cocoyam, plantain, cane sugar, various local vegetables. Economic activity was highly boosted in Buea after the creation of the only English-speaking state university in the municipality.

3.3.2.1 MSW Generation and Storage

Sources of waste generation for the Buea municipality are not any different as is the case for Limbe. However, a basic difference may be in terms of quantities for different

waste types. The main sources for MSW generation in Buea are households, commercial sources (markets and other businesses) and administrative (academic and other institutions). Given just a few skips are served residential areas in Buea, the practice of yard as well as other forms of wanton disposal is quite high in Buea. Storage practices at the level of households are similar for Buea and Limbe. For student residential areas, most of waste generated may be stored for up to three before disposal (depending on amount and storage device). Waste is generally stored for a longer period prior to disposal within family households than student residents. A major advancement in construction of most student residential blocks in Buea is the provision of a hand-dug pit for waste disposal. Most such pits are protected from rainfall and stray domestic animals. When the waste gets to a desired level, a common practice requires it being set to fire. Here the issue is about getting waste out of sight without any second thought to other impacts the activities may have on health and environment.

3.3.2.2 Collection and Transportation

Within the Buea municipality, waste collection is being done at a very low level. The sole waste collector is the local council (Buea Rural Council). A relatively small proportion of residential areas is served with council collection facility. In Buea, unlike in Limbe, the council skips/containers are located only in areas with high commercial activities. Thus most of the wastes that go into the skips constitute commercial waste, which is likely to be highly organic. Residents around the vicinity of such skips equally drop in their waste into such skips. These skips are later picked up by a specialized collection vehicle. The collection schedule for pick up of skips and containers is not very regular, at least, in practice. From public interview, it seems residents are barely informed of frequency of collection by the council.

3.3.2.3 Disposal

Primary disposal of solid waste at the level of source of generation within Buea municipality are not any different to the cases in Limbe. A slight modification can be observed in the advancement in construction of yard facilities for some student residential housing. In such cases, the facility consist of a hand-dug circular pit ranging in depth from about 2 – 4 meters at the top of which a concrete embankment may be

constructed to prevent stray animals as well as a safety measure for humans and above which is a small roof to prevent precipitation. After some period of dumping and when waste has reached a certain level, coupled with dryness as a result of prevention from precipitation, the waste is set on fire to reduce volume. This process produces strong scented smoke which may last for more than a day depending on degree of dryness of the waste. In terms of getting rid of waste volumes, avoiding the aesthetic impact of waste (as in surface yard disposal facilities) and to check presence of pest and pathogens around waste dumps, such a design proves effective. Disposal of municipal solid waste in Buea by the municipal council was previously done in a valley in the Buea Town residential area. This disposal site had been abandoned due to that fact that it was full and at the moment grass and shrubs now cover the surface. The present council disposal facility is located in the sand-pit residential area, also in a valley. Thus in Buea, the basic consideration for landfilling is the location of a valley which is sizable enough to accommodate waste for a considerable period of time. Little or no geo-technical specifications are met but for the fact that Buea is on a relatively volcanic terrain whereby the effects of weathering is extremely low thereby limiting chances for leachate movement into groundwater systems.

3.4 Implications for Material Recovery and Recycling

Material recovery and recycling present enormous benefits for MSWM. These two options not only ensure material availability and sustainability within a material chain, they are also a source of income for waste management institutions. For successful implementation of material recovery and recycling within any MSWM scheme, the scheme has to exhibit some degree of efficiency in operations and clarity in structures. Looking at structural and operational aspects of MSWM for both Limbe and Buea municipalities, it is clear these aspects impact in some negative way on any endeavor to recover or recycle. At the level of households, recovery of some materials/or items from the MSW stream is practiced. Common items recovered include: plastics in the form of rubber slippers and plastic bags; bottles, mainly beer and body lotion bottles; metals, mainly aluminum. Such practice, nonetheless are considered by residents as a strategy towards sustainable MSWM. Rather it represents a means of saving cost as well as obtaining that which one cannot afford especially in the time being. Recovery, at the level of households is done both from within and without residential confinements.

Scavenging at public waste dump sites is not common in both Limbe and Buea as well as for the entire country, Cameroon. In the case of plastics and aluminum, scavenging is practiced most mainly when buyers of such items come to a given community to purchase. This practice, which never began as a waste management approach has been quite significant in redirecting materials from the waste stream to other useful sources.

In formulating the municipal waste management plan by both the Limbe and Buea councils, management in both cases seem not to have envisage any need for recovery or recycling. Their present operations as per MSWM may impact on any emergent move to recycle. Thus from waste management plan conceptualization, collection, transportation and disposal, consideration is not given to public scale recovery and recycling. Thus almost all MSW collected by the council or through its contracted agents is bound for final disposal.

3.5 Discussion

MSW generation, handling and disposal practices are quite similar for a broad range of communities in Cameroon. Thus the systems reported in this study are quite similar to those reported for similar studies at different localities. Differences may only lie in the level of participation of the different stakeholders involved and the participation or response of the public to the operating management system in their locality. Demographic factors, economic activities and the types of administrative and commercial set-ups within a locality have an impact on the composition of the waste stream. For example, taking the case of Buea, the creation of the University in 1993 and with its present population standing around 7.000 students has not only led to increased population but has invited vibrant economic activities. Thus the presence of many administrative and academic units (or institutions) in Buea implies that this sector could be a relatively more significant contributor to MSW (especially waste like paper and WEEE) than in Limbe.

The composition of MSW waste from most developing countries has the common characteristic of high proportion of organics (Yhdego, 1995) especially as such countries have predominantly agricultural-based economies. Such waste with high

organic content is generated at the level of household and commercial market. Thus with respect to handling generated MSW, focus on ways to handle this organic wastes such as composting should be encouraged. Composting of organics on a larger economic scale may depend on the demand for compost. Although trials for composting at an industrial scale in Senegal and Ivory Coast were aborted to failure to yield expected results due to very low demand for compost (as reported in Achankeng, 2003), Mbuligwe et al., (2002) assert it can still be a viable MSW recovery alternative. The presence of rich and fertile soils as well as the predominant application of N- and P-fertilizers impact negatively on the demand for compost. Thus composting may seem at best to be encouraged at the level of households for use in gardening or other larger scale farming activities especially in places with soil fertility problems. Hoornweg et al., (1999b) reports on the benefits of domestic solid waste composting in developing countries and the reasons why composting does not receive more widespread application. Logistics and financial constraints are the main limiting factors to any large scale composting in Cameroon.

Due to changing economic trends and lifestyles, observed growing quantities of WEEE constitute a significantly emerging solid waste stream that requires greater attention and of course different approaches to management than the conventional disposal option. Existing data on MSW characteristics in Cameroon show composition of some generalized categories. Thus data showing proportions of components like WEEE are lacking, which of course would be vital for informed decision-making in handling such waste. Metals too represent components of the MSW stream that can also be easily isolated from bulk waste prior to disposal. Over several decades, there has been small scale recycling of metals for production of household utensils and farming equipments. Thus while collection of metals has been going through scavenging, mainly by children at disposal sites, a more coordinated form of collection could be initiated. With the increased bilateral south-south cooperation with China, there has been an increased collection of various sorts of metals from the waste stream for export. Unlike in bigger cities like Yaounde and Douala, options such as creation of transfer stations are not urgent requirements for waste collection/transportation for both Limbe and Buea. Reason being given the available logistics and the distance to disposal facilities, creation of transfer stations may only result in waste staying longer than normal prior to disposal. Thus the creation of transfer stations has to be in line with the availability or

acquisition of certain logistical facilities. The disposal of waste in an environmentally friendly manner still remains a problem for most municipalities in Cameroon. In residential areas not served with collection containers or skips, disposal practice depends on what option a household considers as best especially within its vicinity. The absence of community-based waste management also makes it difficult to mobilize residents to act in a desired way towards MSWM.

Although inadequate funding is available for MSWM by councils and contracted agents, a major issue that still looms is the fact that councils do not seek to explore and exploit any available options that can off-set present expenditures to collect and dispose of MSW. Thus in addition to a model proposed by Parrot et al, (2009), this study recommends the introduction of recycling schemes as presented on figure 3.7. The introduction of recycling can be seen as an innovation within existing schemes (collect and dispose approach), which in the long will have significant positive impacts on MSWM.

This study reveals that MSWM in Cameroon has generally been designed on the basis of ensuring MSW is collected from residential areas and entirely disposed. In such an entirely collect-and- dispose set-up, the overriding paradigm is that of “keep the town clean”. Hence a long-held practice in most municipalities is the assigning of a special day within the month whereby workers of all sorts (safe hospitals and a few) are temporarily halted on such day and the entire community takes part in some clean up exercises. On such days it is normal to find numerous fire points whereby collected or gathered solid wastes are burnt. The Hygiene and Sanitation department of municipal councils was the main driver of this approach. While it is not uncommon to have cases where the hygiene and sanitation department coordinates MSWM, it is worth mentioning that in some cases where this was the case, focus has shifted over time from just to collect and dump to more diverse forms of management including Integrated Municipal Solid Waste Management (IMSWM). Thus focus shifted not only from re-energizing waste for reuse options (as recycling, reprocessing) but also the broadening in the definition and inclusion of different stakeholders.

When one looks at the present situation of MSWM in Cameroon, two basic questions arise: 1. how effective have the present schemes been in meeting their desired goals

and 2. given the fact that there is an obvious need for sustainable MSWM, what challenges need to be overcome to transform existing schemes into sustainable ones? The councils have been doing a great job in clearing public skips and containers. Thus collection for areas served with collection facilities has been encouraging to some extent. However, factors such as inadequate infrastructure and logistics, and a poor knowledge of generation rates coupled with the councils / contracted agents' (in)ability to respect schedules on a regular basis renders most schemes inefficient. Thus innovations and transformations are needed for existing schemes to become efficient in meeting desired or set goals. The main challenges that need to be overcome to address the second question lie in the area of policy formulation and implementation, and increased stakeholder involvement. Through these, other options like introduction of recycling schemes, take-back approaches for waste like WEEE etc can be achieved.

3.5.1 Constraints and Challenges

3.5.1.1 Infrastructure and logistics

The infrastructure and logistics available for MSWM in Limbe can barely enable the scheme meet up with desired targets. It is desired that an estimated daily collection rate of about 120 tones be achieved in Limbe but only about 90 tones is actually collected⁷. Should all residential quarters be served with collection containers and skips, then a higher collection target is obvious. Specialized skips are absent hence there is basically commingled collection. In Buea, there is the dire need of more collection facilities as only a few are in service for the entire municipality. Thus a very large proportion of waste still remains unattended with likely proliferation of accompanied negative environmental and health impacts. The lack of comprehensive maps of the Limbe municipality presents a problem for planning of collection and for the definition of efficient collection routes for collection vehicles

3.5.1.2 Urban planning and geomorphologic aspects

Urban planning within some economically active parts of Limbe is quite good and hence accessibility. Poor access to several residential quarters by collection vehicles

⁷ Personal interview with management staff.

constrains on the distribution of containers and skips as well as on rate of collection (in the case of “door-door collection”). Poor access may be due to: i) poor urban planning in which case housing construction is not carried out according to established city plan; ii) bad road conditions especially during rainy season or as may be the result of poor maintenance/failure to repair. Limbe being a coastal city has a geomorphologic setting defined by a bays and headlands. Thus it has a low lying land surface that grade into hilly peripheral setting landwards. Most of the low-lying areas are characterized by episodes of some degree of floods during intense rainy season as well as the presence

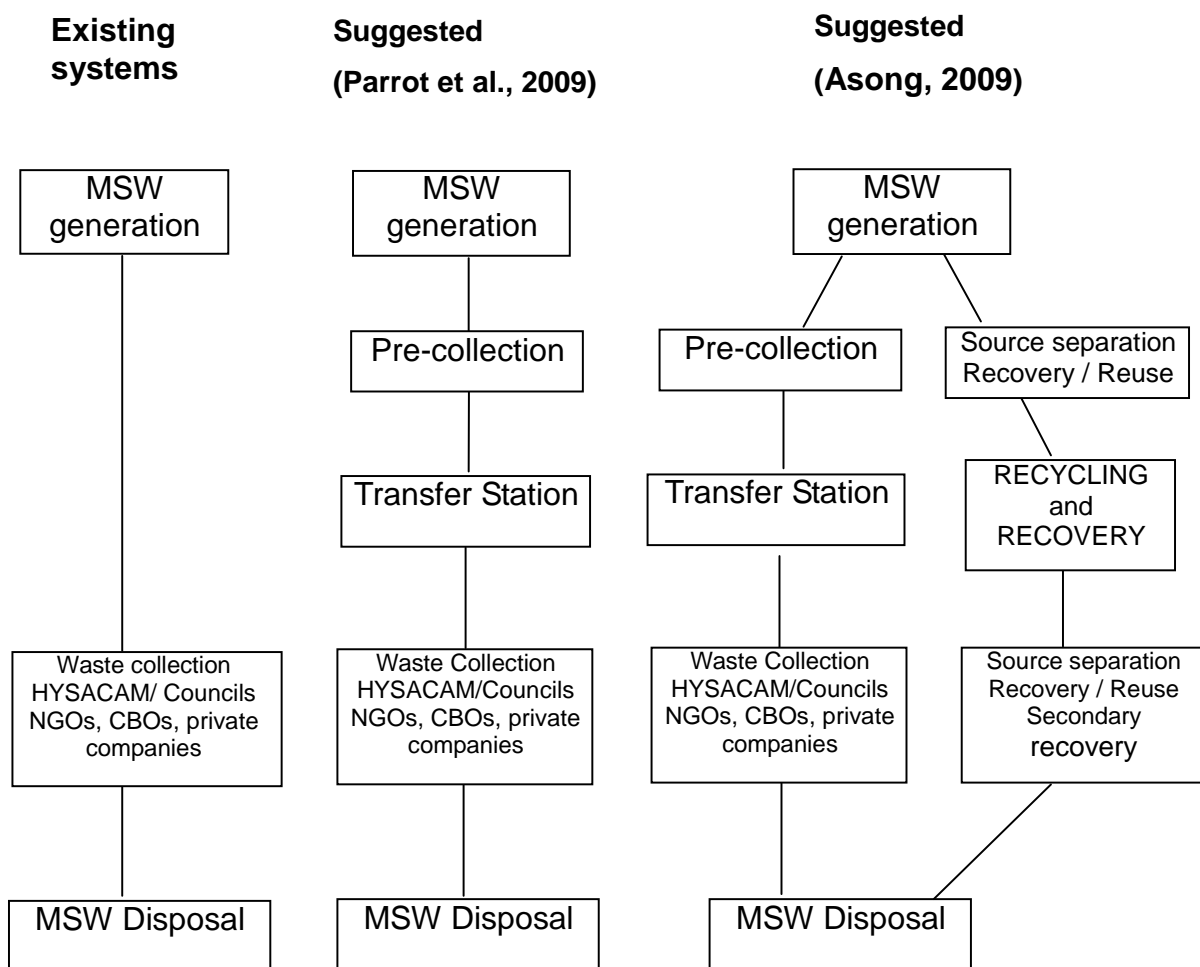


Figure 11 Proposed improvements for existing MSWM systems in Cameroon. (Source: adapted from Parrot et al., 2009; and author's analysis).

of swamps and wetlands. Intermittently, torrential rains results in overflows of small streams within city and also the triggering of several voluminous torrents from highland areas towards the coast. Due to the fact that some residents dispose waste within such

flows, the consequences after episodes of floods are quite negative. In wetlands and swampy areas, where residents dispose of waste in such areas, the chances for leaching of substances from waste are quite high. Such is the case too with one of the disposal facilities was operated upon by the council. These problems may greatly constrain on management especially when assumes management has to be done in compliance with any set standards.

Buea on the other hand, has a different geomorphologic setting from Limbe. It is located on the eastern flank of Mt Cameroon. Both localities do experience the occurrence of severe intermittent torrents during the rainy season. In Buea, these torrents leave waste along roadside drainage, which negatively impact of the aesthetics of the city. And with lack of infrastructure to handle waste within this municipality, such waste may stay within drainage for very long periods of time. With the pressure on housing due to increasing university population and economic activity within Buea, the housing sector has become a lucrative investment area in Buea. As a consequence several constructions do not respect to established city plan. Thus should the municipal council wish to embark on expanded and concise MSWM, poor housing construction will have negative impacts.

3.5.1.3 Inadequate funding

Inadequate funding becomes a major constraint to waste management especially when mechanisms or options to off-set operational costs are lacking. These include subsidies, recycling and reprocessing for energy. With its limited budget, the council gives priority to other sectors (such as, health and urban development) than on waste management. Thus should management wish to embark on other options for MSWM, success may be limited by budgetary constraint. A monthly cost of about 10 million francs CFA (about 15.000 Euro)⁸ is incurred by HYSACAM (in Limbe) for waste operations mainly for the collection and transportation of waste and to cover salaries for its workers. However, this cost is serviced by the council through its budget unlike in the case of Yaounde; a waste removal tax was instituted in the late 1970s (although this tax represents a very small fraction of the budget for MSWM). In addition to government subsidies through FEICOM (Government Council Support Fund), a description of the different sources of

⁸ As per exchange rate at time of study (December 2008)

council finance is presented in Nkemnkeng (2007). Interesting to note is the fact that there exist no structures or options for offsetting cost of collection and disposal. Thus money is regularly spent to collect and dispose of waste with no gains to plough back into the system as would have been if expanded programs like formal recycling were operational.

3.5.1.4 Political and other Institutional aspects

While there exist some regulations, laws, decrees relating to MSWM in Cameroon, implementation of stated provisions especially at the level of municipal councils is still a problem. It remains incumbent on local councils to formulate their strategies to manage their generated waste. Hence aspects such as compliance to regulations or laws are usually lacking. Given the hygiene department of councils has a charge to design waste management implies councils lack specialized waste management structures as well as personnel. Thus attempts to manage waste stay focused only on keeping the community clean.

The common problem of administrative frictions or conflicts in functions of different ministerial and other bodies in Cameroon is quite glaring in the area of MSWM. Aspects of MSWM are only implied and partly included in some laws and regulations. However, a concise legislation on waste management is lacking. While the law on environmental management requires waste generators (mainly industries) to take responsibility for the waste they generate, a standard framework for such management, which sets specific criteria and standards, is lacking. Another institutional aspect with significant effect on MSWM in Cameroon that cannot be overlooked is corruption. Corruption, which has gone down deep in the Cameroonian society may make even the small available funds being mismanaged or may lead to issues like recruitment of inefficient or unqualified staff. Corruption may also lead to neglect in taking required actions or may paralyze motivations towards required actions.

3.5.1.5 Held perceptions

Socially held perceptions (especially over long time periods) can be quite an obstacle to making progress or change during any time period when such held perceptions are

considered valid by those who hold them. There is a commonly held perception in Cameroon that “dirt does not kill a black man”. Such and similarly held perceptions affect the level to which people may give attention to waste in their vicinity. Imbibed within such perception is the obvious myopic tendency to appreciate issues like effects of leachate from waste on groundwater, heavy metal impact in both soil and groundwater etc. Again such held perception may have an influence in the drive for MSWM on a “keep-the-town clean” basis. Public campaign can, however, greatly change public perceptions and attitudes towards waste management in a positive way as it is the case reported in Bortoleto and Hanaki (2007).

3.5.1.6 Lack of Research and Development initiatives

Research and Development (R & D) provide a substantial basis for progress in many areas of life in today's world given through such a channel creates a platform for informed decision-making. R and D would require progressive evaluation and assessment of both past and on-going efforts in MSWM in both the entire country as well as in given case studies. Management schemes are suppose to Research in scientific, technological and socioeconomic aspects of MSWM in Cameroon is still wanting and hence an obvious consequent difficulty in developing the sector. The several problems and constraints on MSWM in Cameroon present enormous challenges to management. The main challenge for management is to transform existing schemes into ones that meet sustainability criteria. Thus there is the dire need to either upgrade existing systems to meet desired standards or to strike new frontiers of MSWM thereby transforming schemes to new levels. Strategies to attain such goals are discussed in subsequent sections of this chapter.

3.7 Proposals for Sustainable MSWM in Cameroon

MSWM in Cameroon constitutes one of issues in the environmental protection and sustainable development debate that is still wanting of deserved attention. While some municipalities have been embarking on it, there is the need for concerted efforts at all levels – government, councils, NGOs, CBOs, international organizations, businesses, and the general public. As earlier stated, two basic questions may arise in a bid to

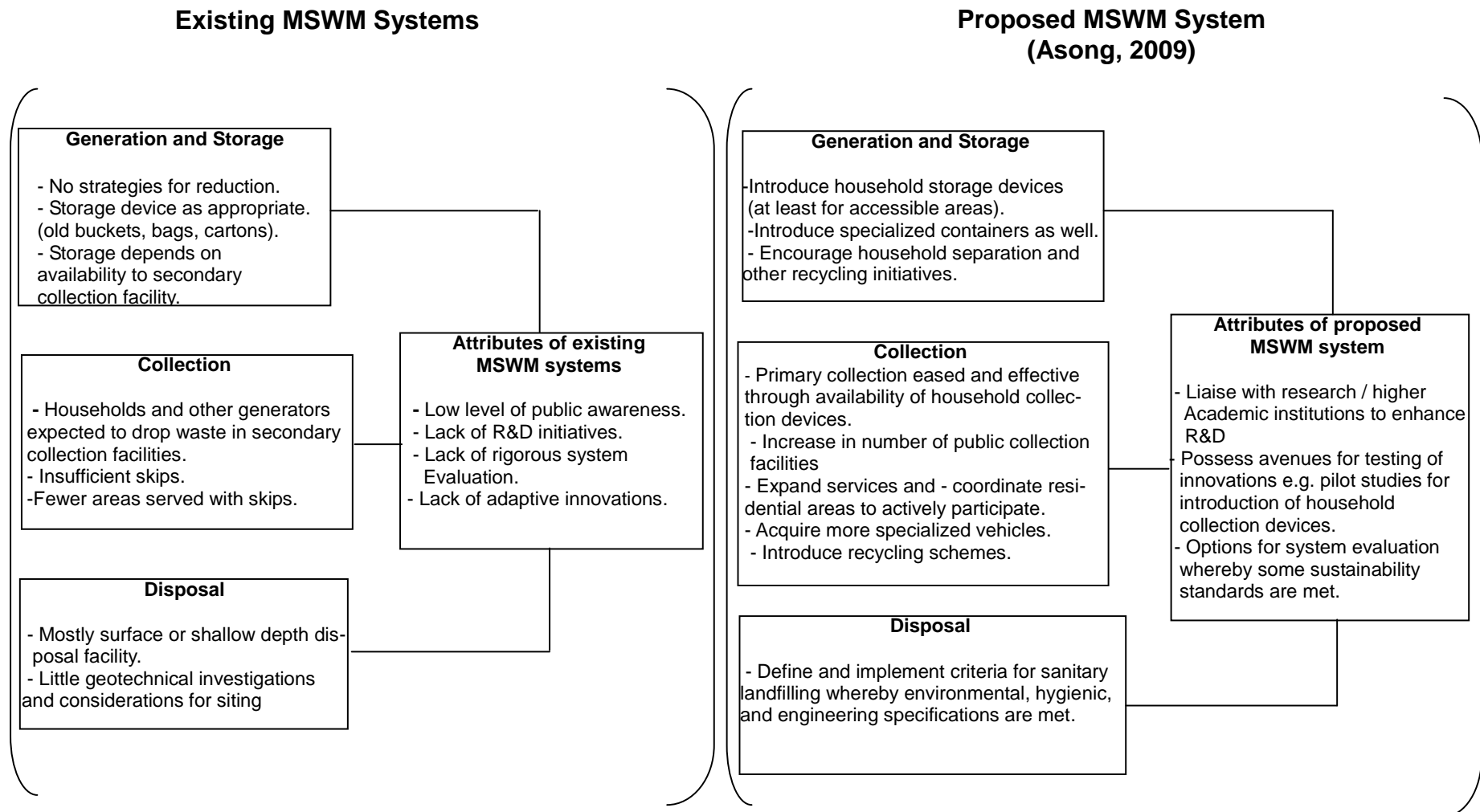


Figure 12 Comparison of existing MSWM systems to proposed system. (Source: author's analysis)

propose strategies for sustainable MSWM in Cameroon. Appropriate answers to these questions would form a sound basis for improvements in MSWM in the country. Addressing the first question implies evaluating the various stages in the MSWM systems for example the case studies vis-à-vis the municipalities' set goals for waste management. A snapshot of the existing MSWM system and a proposed system to upgrade the existing systems (like Limbe and Buea) are presented in figure 3.8.

3.8 Conclusion and recommendations

3.8.1 Conclusion

In this chapter, an analysis of MSWM practices as well as evaluation of some existing MSWM schemes in Cameroon was carried out. The results show that public involvement in MSWM has been largely based on household preferred options. Existing management schemes are jaundiced of sustainable practices. Management has been built over a long time on the basis of “keep communities clean” thus focus has always been placed on collection and disposal. The constraints and challenges that confronts management and which limits management from becoming sustainable includes: infrastructure and logistics; poor urban planning and geomorphological factors; poor landfilling practices, inadequate funding; political and other institutional aspects; long held perceptions about waste; and lack of R&D initiative.

3.8.2 Recommendations

The following recommendations need to be enacted for MSWM schemes in Cameroon to become more efficient in delivering desired services as well as meeting sustainable goals:

- Continuous efforts in research and development. Such efforts would seek to better analyze the existing problems faced by management, assess effectiveness of management approaches, create avenues for innovations within management systems, pave way for collaborative inclusion of stakeholders and creates opportunities for informed decision-making due to reliance on derived and reliable data. This recommendation can be achieved through collaborative arrangements with academic and research institutions.
- Strengthening approaches to policy and other regulatory framework formulation.

While commitment to implementation of existing policies and regulations has to be increased on the part of government and other institutions related to MSWM, there is need for more comprehensive frameworks. Any comprehensive framework will exclude issues like friction administrative roles for different actors as well avoid duplication of roles.

- MSWM authorities (mainly councils, private agents and NGOs / CBOs) are limited in their operations due to financial constraints. The nature if financial of councils does not allow them to impose taxes or fees for MSWM activities (for example a collection fee). Thus the fiscal system in relation to councils needs to be readjusted to enable councils garner more financial resources.
- Partnerships between different stakeholders especially public-private partnerships are highly desirable in delivering sustainable MSWM. Such partnerships need to be fostered in Cameroon. More so, the creation of CBO may be quite useful in rallying residential support and participation in any waste management scheme. But at the heart of all these is awareness and information. The use of the media to increase awareness of the public and hence their involvement in MSWM is of huge importance.

Chapter Four

The Role of SMEs in the recycling and re-use/recovery of components of WEEE at-end-of life in Cameroon

Chapter Abstract

The rapidly changing consumption pattern of EEE (high consumption) and their associated short product life span in the last few years has resulted in waste arisings from this product chain being the fastest growing waste stream worldwide. While developed countries are putting in place appropriate measures to handle this waste stream, the converse holds for developing countries whereby outdated as well as obsolete forms of EEE still enjoy greater affluence. In this chapter, an overview of the handling of EEE at end-of-life (EoL) in Cameroon is made with special focus on households and repair units. At household level, WEEE is disposed of alongside other waste arisings in the available disposal facilities for given household. Repair units represent a very vital connection between dysfunctional EEE and EoL forms as all users of EEE tend to bring these devices to these units for repairs. An inventory of the various EEE at repair units for two localities, Kumba and Buea, in Cameroon shows that above 40% percent of such equipments are totally out of use. In Kumba, Classes 1 and 4 EEE (according to EU WEEE directive classification) dominate while class 3 is almost absent. In Buea, Class 3 and 4 are dominant. These results show that socio-cultural, economic and even climatic factors influence the choice of EEE that people in this area acquire. The intense level of repair activities and recovery of useful parts by repair units show that there exist adaptable options to handle WEEE in especially economically and environmentally beneficial ways. The problems of lack of policy and regulatory framework, low level of awareness in recycling ventures and lack of stakeholder engagements impose greater challenges for management of WEEE in Cameroon. The low developments in waste disposal practices in the country also imply the attenuation of toxic effect of WEEE due to unsafe disposal still remains a big problem.

Keywords: Recycling, recovery, WEEE, SMEs, and End-of-life

4.1 Introduction

There is the need for a complete rethinking of “waste”- to analyze if waste is indeed waste. Given waste may be considered matter of zero energy level; it therefore implies re-energizing waste thus makes it become a resource. Waste has in the long past been a problem to man and the environment, and in the past few decades it has received

even greater attention. Of greater importance at the present time in both developed and developing countries is e-Waste. This is due to the fast growing nature of this waste stream. Finlay (2005) discusses the drivers of e-Waste in South Africa, which is similar to many developing countries. Despite significant efforts to reduce waste especially at the level of industrial production, recycling and material recovery systems play the vital role in ensuring products at their end-of-life could still be re-processed or otherwise diverted into other resource opportunities. Given the assumption that there is an increasing global demand for Electrical and Electronic Equipments (EEE) in this age of globalization, it becomes quite attracting that recycling and material recovery represent two great opportunities for management of waste emanating from the EEE material stream. This is due to the fact that a significant proportion of this waste stream is being disposed. Households and commercial groups discard an estimated 1 million tons of WEEE every year in the UK (Waste Online, last updated Aug 2005). More so, it is estimated that WEEE generation will hit 12 million tons by 2010 (Darby and Obara, 2003). In 1998, a total of 0.134 million tones of consumer electronics were disposed in the Netherlands (CREM, 1999). The WEEE waste stream in the EU produced 8.3 – 9.1 million tons of waste and is forecast at 12.3 million tons by 2020 (Commission of the European Community, Brussels SEC (2008), 2934). In 2003, China generated about 1.6 million obsolete EEE with TVs constituting over half this total amount (Liu et al., 2006). Waste computers generated in South Korea was expected to reach 2.2 million tons by 2005 (Oh et al., 2003); Taiwan generates about 300.000 scrap PCs a year (Lee et al., 2000).

EEE span a range of devices from the level of personal, household, industrial, commercial, information and communications technology (ICT) appliances for which the resultant wastes comprise obsolete or breakdown forms of the these appliances. Given that a large percentage of EEE are being wasted at end-of-life (EoL) there is need for both the development of appropriate strategies to regaining useful materials from this waste stream and to improve on the recovery of certain types of WEEE. Some of the challenges faced by WEEE management are not only consequences upon growing quantities of waste but also the complexity of WEEE. It is one of the most complex waste streams because of the wide variety of products from mechanical devices to highly integrated systems and accelerating technological innovations (EEA, 2003). The lifespan of EEE in recent times is becoming shorter and coupled with increasing use,

consequent broken down devices or obsolescence, handling waste from such a sector becomes even difficult. A common example of EEE that has been experiencing shorter life-span is computers. For normal computer users, the device could serve a longer time span both as new brand product or second-handed product. But for power users, there is need for keeping abreast with state-of-the-art cutting edge technology (Williams 2003). Due to increasing requirements for application of regulatory frameworks for handling EEE coupled with the increasing export of second-handed equipments to developing countries, there is need to address the handling of these equipments too in the developing countries in environmentally safe and economically sound ways.

Another problem resulting from waste generation in this sector (just like in many waste sectors) is that of resource depletion (Plepys, 2002) as increasing amounts of raw materials are needed to cope with increasing demand and production. In the process of discarding obsolete equipments, some components that can be recovered from the waste and reused/recycled are generally dumped into landfills (especially when there is a poor waste management plan). Technological and economic considerations within a life-cycle perspective may also influence the move to recycle WEEE (Hischier et al., 2005). Thus handling WEEE presents greater challenges to sustainable development. A major approach to safe the source material depletion problem is the application of the paradigm of the 3Rs (Reduce, Reuse and Recycle) to WEEE, which has additional resultant benefits in the areas of energy saving and business enhancement.

EEE are known to comprise components containing substances that are hazardous to human health and the environment thus appropriate measures have to be taken as to the safe handling at their end-of-life. Some components arising from WEEE include: printed circuit boards, cathode ray tubes and mercury switches and these may contain substances such as mercury, cadmium, arsenic, lead and others, which are known to have adverse effects on humans health particular and the environment in general (Li et al., 2006; Saphores et al., 2006). Individual materials which can be recovered from WEEE for recycling and reuse include: ferrous metals, non-ferrous metals, glass, and plastics in varying proportions depending on the type of equipment. Thus when one considers the likely contribution of this waste sector to the entire waste stream, it becomes obvious that significant materials are lost due to bulk disposal. In Ireland for example, 72% of total municipal wastes generated ends up in landfills and a greater

bulk of WEEE fall, end up in this lot.

The handling of WEEE requires that some legal, institutional and technological considerations be met. A good example of such a legal requirement for handling WEEE is the EU WEEE directive 2002/96/EC, which was enforced in 2003 and builds on the concept of producer responsibility and improved product design. Due to the fact that a greater amount of WEEE were being lost to landfills, the EU WEEE directive was developed to tackle the problem of increasing waste volumes and the potential negative impacts of such waste as well as encouraging re-use, recycling and reduction in amount of WEEE. Include stipulations in directives as per role of producers and consumers.

Developing countries in Africa are not only faced by the pressure from rapidly increasing imports of EEE (especially second-handed ones) but are faced with the greater challenge of handling them at EoL. To escape some financial burdens imposed on the handling of EEE at EoL, several companies and organizations (some as good Samaritans) have been actively involved in shipping enormous amounts of EEE to Africa as well as other developing countries. Others do ship consignments of EEE to developing countries as a strategy to enhance recovery and reuse thereby getting rid of disposal or handling at EoL problems while helping to provide for the needy. A Basel Action Network (BAN) and STVC study (BAN, 2005) show that about 500 container loads of PCs enter Nigeria monthly through the Lagos port with each container containing about 800 monitors or CPUs. Lombard (2004) reports that 1.2 – 1.5 million computers enter South Africa in one year. The International Telecommunications Union (ITU, 2004) projects the number of mobile phone subscribers in Africa to stand around 100 – 200 million by 2010.

The need for and acquisition of electronic devices such as mobile phones, PCs and household appliances has been on an increase in Cameroon and other African countries the last decade. The acquisition of outdated PCs as well as second-hand versions of electrical and electronic products has been quite common too. The handling of such products at the end-of-life still remains a big problem (health and environmental wise) for the country as most end up in landfills as well as open-pit disposal. There is the need, therefore, to assess the possibilities of recovering valuable materials from such waste as well as recycling. Given consumers may most of the time persist in the habit of discarding especially smaller WEEE at end-of-life, it is very important that

appropriate and plausible strategies be designed to engage public to participate in recycling of WEEE. Appropriate strategies to enhance effective collection on the part of both public and other institutions involved need to be formulated based on an informed knowledge base. It is important to note that although legal instruments and policies are lacking in the area of recycling of WEEE in Cameroon, there exist on-going practices through which recycling schemes for this waste stream can be built. Although the concept of recycling/material recovery has been quite advanced in some developed countries, this has not been the case with most developing ones. The increasing influx of EEE, however, sparks concern on the fate of any resultant wastes. In this chapter, an evaluation of recycling and recovery of WEEE is presented. An analysis is carried out on the role of SME in recycling and recovering valuable materials from WEEE in Cameroon as a case study. Thus the practices in the handling of both EEE and WEEE are reviewed.

4.2 Objectives of study

The specific objectives were:

- To make a review and analysis of the situation on the use of EEE and the handling of them at their end-of-life in Cameroon especially at the level of SMEs.
- Identify strengths and barriers to implementing appropriate material recovery, reuse and recycling schemes especially through SMEs for the management of WEEE in Cameroon.
- To investigate to what extent the lack of or existence of insufficient policies may affect the sustainable management of WEEE especially in line with the application of the extended producer responsibility concept.

4.2 Method and scope of study

Two case study localities were chosen for this study: Buea and Kumba. Buea is the capital city (administrative headquarter) of the Southwest ⁹Region of Cameroon, with a population of about 57.000 inhabitants. It has a population of about and its host the country's lone Anglo-Saxon university, the University of Buea. The creation of the

⁹ Region is new geopolitical name for the administrative set up previously referred to in Cameroon as Province

University in 1993 has led to a very rapid development of the town. Such development has been facing a consequent problem of urban planning as people are competing for any available land for construction purpose. The presence of the university community has also come a long way to influence the consumption patterns in the city with a strong demand for EEE. Kumba with a population of about 120.000 inhabitants is one of the most economically vibrant towns in the Southwest Region of Cameroon. It is the capital city of Meme Division. Its geographic location makes it a connecting town to three other divisions (Fako, Ndian and Kupe-Muanenguba) of the region as well as serving as a major departure town to the other two divisions of the province (i.e. Lebialem and Manyu). This position thus enables economic activities to flourish within the city. Its vibrant economic status and strategic location also makes the city a melting point for traders from Nigeria, Gabon and Equatorial Guinea, who do businesses within a larger area of the Southwest Region.

In a field survey carried out in these two towns, an inventory of the various types of EEE found in EEE repair stores was developed through on-the-spot identification and counting of the different EEE. Because not all EEE found in such units can be considered out of use, an estimate of those considered out of use were gotten through direct questioning from units' personnel. Two phases of this survey were carried out: the first survey in January 2006 and the second in January 2009. Questionnaires were administered to: owners of EEE repair units (i.e. SMEs), the general public and some businesses, institutions and organization. For the general public, sample population was randomly selected and comprised three different age groups: 14-20, 21-35 and 35+ years. For the last group, personnel with knowledge about the business, institution or organization was chosen for interview. Total number of questionnaires administered per locality was: 63 to repair unit owners, 100 questionnaires to members of the public, and 20 to businesses, institutions and organizations. The responses and inventories were evaluated and statistically analyzed to attain the objectives of the study. Also direct deductions and inferences were obtained from personal communication and field observations.

4.3 Recovery and Recycling of WEEE

4.3.1 Overview

The worldwide revolution in electronics and information technology in the last decade has been quite rapid placing the sector amongst the largest and fastest growing manufacturing industries in the world today. As a result of this remarkable growth, combined with the phenomenon of rapid product obsolescence, discarded electronic equipment is now recognized as the fastest growing waste stream in both the developed and developing societies. The recycling rate is low, and electronics contain various chemical and heavy metals that could pose environmental risk if not handled appropriately at end-of –life. Despite the growing waste stream of electronic products, organized material recovery/recycling rate is low and in some developing societies it is completely absent and the focus is on repairs. Government, customers and the public are increasingly interested in the proper disposal or reuse of used electronics. Product donation, reuse and recycling divert waste from landfills and can result in recovered materials being reprocessed into other products or reuse, for example in the refurbishing of other products. Hence, product design is crucial, since design choices affect the ability to reuse or recycle used products efficiently and economically at end-of-life.

Due to the inadequate financial resources available to most people in developing countries to afford new EEE as well as other problems imposed by international trade barriers, much of the growth in information technology sector in the developing countries has been fuelled by the importation of hand-me-down used equipment from the developed countries. Such products may be received as donations from some good Samaritans, imports by business dealers specializing in such second-handed products or gifts from migrants living in the developed countries to their relations and friends back home. A significant amount of them also get to developing countries as items from migrants living abroad to their relations purposefully for sale. The rate of recovery/recycling of WEEE vary across countries and success, however, lies in the design of recycling schemes. Ravi et al., (2005) reports that an estimated 20 million computers enter the US market every year and with 12 million being disposed of too every year, out of which only about 10% is re-manufactured or recycled. Unlike in the developed countries where the regulations governing the reception, collection, recycling

and other proper handling/treatment of scrapped EEE have been put in place, there exists no specific waste management collection or recycling programs in most developing countries for this waste stream. A very common practice in the handling of EEE and EoL forms is repairs and reuse. Where repairs and reuse have completely become unattainable most of the equipments are put in parts and stored for a 'hopeful' reuse or thrown away during a municipal clean-up campaign. The waste later on have nowhere to go other than where all waste go; to the dump site at the backyards and street corners, where they are routinely burnt to reduce the volume.

4.3.2 Components of WEEE

The European Union's WEEE Directives (2002/96/EC) defines ten categories of electrical and electronic equipments categorized as follows:

1. Large household appliances (e.g. refrigerators, freezers, washing machines)
2. Small household appliance (e.g. toasters, iron, hairdryers, coffee machines)
3. Information technology (IT) and telecommunications equipment (e.g. personal computers, telephones, mobile phones, laptops, printers, scanners)
4. Consumers equipment (e.g., televisions, stereo equipment, electric brushes)
5. Lighting equipment (e.g. fluorescent lamps)
6. Electrical and electronic tools with the exception of large-scale stationary industrial tools (e.g. hand-held drills, saws, screwdrivers)
7. Toys, leisure and sport equipment (e.g. play stations, game boys,)
8. Medical devices with the exception of all implanted and infected products (e.g. radiotherapy equipment)
9. Monitoring and control equipments (e.g. smoke detectors)
10. Automatic dispersers (e.g. for hot drinks or monies).

These wide array of EEE also incorporate in them different components, among which include, printed circuit boards, cathode rays tubes, wires and cables, mercury switches, batteries, light generators, capacitors and resistors, sensors and connectors, plastics containing brominated flame retardants. Some electronic equipment and/or their components contain substances that are considered dangerous to the environment and human health if they are disposed of carelessly. Although these dangerous substances are usually only contained in small amount, they have great potentials of causing

serious environmental damage. Examples are Mercury, Cadmium, Lead, Hexavalent Chromium, Polybrominated diphenyl ethers, Arsenic, Chlorofluorocarbons, etc. Recyclable materials such as Ferrous and non-ferrous metals, glass and plastics, are also important components of the WEEE. Electronic goods are also composed of hundreds of different materials, often-high value too. Gold, Platinum, Silver, Copper, etc. are valuable materials, which recyclers recover from electronic waste.

4.3.3 Institutional efforts towards Recovery and Recycling of WEEE

The WEEE waste stream is now being considered the fastest growing waste stream. It does not only pose a problem of managing the absolutely huge emanating volumes but also a problem of handling the rapidly changing composition. Several attempts are being made at regional, national and international levels to curb the management problems WEEE present. At the level of the EU, efforts to handle the problem led to the formulation of the EU WEEE Directive (Directive 2002/96 /EC on Waste Electrical and Electronic Equipment). This directive, which (together with the Directive on the Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipments - RoHS Directive 2002/95 EC) became law in 2003, seeks to reduce the amount of WEEE going to landfills by encouraging re-use and recycling. It also sets target for collection, recycling and recovery of WEEE. By this directive, producers are responsible for financing the collection, treatment and recovery of WEEE. Producers are also expected to put in place appropriate infrastructure for collection, whereby household consumers may have the possibility of returning WEEE at least free of charge. It is understood that member countries were expected to transpose the directive into national laws and regulations by 13 August 2004. The implementation of the directive at national levels has met with problems of effectiveness and efficiency (Commission of the European Community, Brussels SEC (2008), 2934). The problem of effectiveness has to do with the reporting on organized and separate collection, environmental and economic issues while that of efficiency has to do with uncertainty in the scope of the directive and the requirement for producers to register and report in all countries they sell in. There is a predicted forecast of the WEEE waste stream in the EU27 to reach 12.3 million tons by 2020 with an increase in the range of 2.5 – 2.7 % annually. A breakdown of the situation as at 2005 is presented in figure 4.1. It can be observed from the figure those large household appliances, cooling and freezing

devices, CRT TVs, CRT Monitors and IT and telecommunications excluding CRTs constitute as very significant proportion of WEEE within the EU27. The amount of WEEE collected and treated for different treatment categories as a percentage of Arising is presented in Table 4.1. It is also observed that collection for lighter and smaller WEEE is less than for bulkier and larger ones. A likely reason may be due to the fact that smaller ones are easy to get mixed with other household waste and collected in household collection facilities.

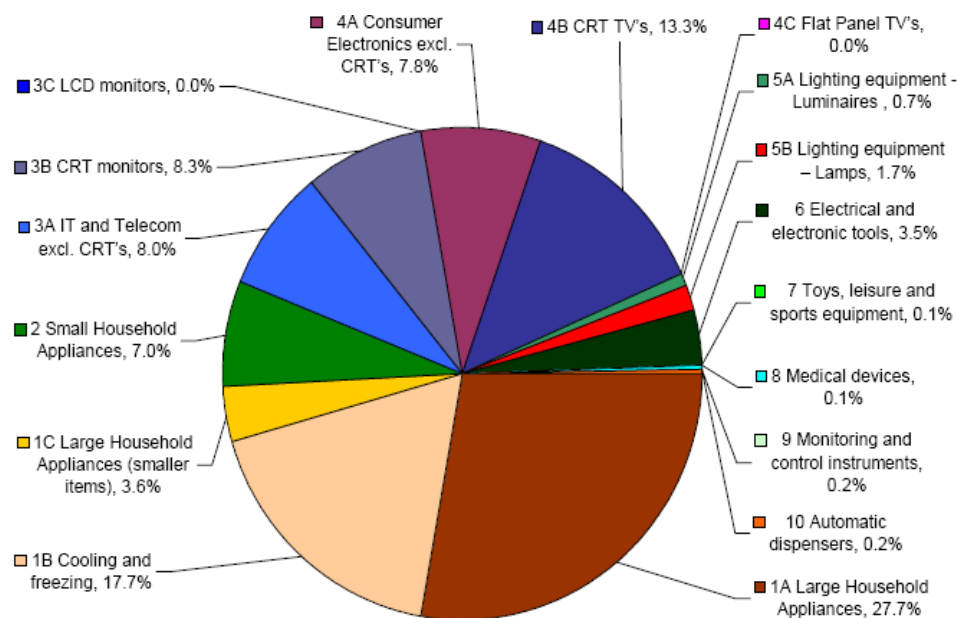


Figure 13 Breakdown of WEEE arising within the EU in 2005. (Source: United Nations University 2008 review of Directive 2002/96 /EC on Waste Electrical and Electronic Equipment)

4.4 Results

4.4.1 Handling EEE at end-of-life Cameroon

4.4.1.1 Public

In Cameroon EEE are acquired as either new or second-handed/used products. New products may be acquired from wholesalers, retailers and petty trader in local markets and along streets (street vendors). Second-handed may as well as may not have been serviced before sales thus leaving them with higher chances of getting out of use within

Table 4 Current amount of WEEE collected and treated as percentage of arisings

Number	Treatment Category	Current % collected of WEEE arisings
1A	Large household equipment	16.3%
1B	Cooling and freezing	27.3%
1C	Large household appliances (smaller items)	40.0%
2, 5A 8	Small household appliances, lighting equipment, luminaries, and “domestic” medical devices	26.6%
3A	IT and Telecom excluding CRTs	27.8%
3B	CRT monitors	35.3%
3C	LCD monitors	40.5%
4A	Consumer electronics excluding CRTs	40.1%
4B	CRT TV's	29.9%
4C	Flat Panel TVs	40.5%
5B	Lighting equipments – lamps	27.5%
6	Electrical and electronic tools	20.8%
7	Toys, leisure and sports equipments	24.3%
8	Medical devices	49.7%
9	Monitoring and control equipments	65.2%
10	Automatic dispensers	59.4%

(Source: United Nations University 2009 review of Directive 2002/96 /EC on Waste Electrical and Electronic Equipment)

a short period after acquisition or purchase. A minor source of acquisition of EEE by the public is in the form of gifts. For the 2006 survey, 92.5% of respondents in Buea and 86.7% in Kumba indicated that they have at least an EEE at home. In both cases, above 70% indicated at least one of such possessed EEE is out-of-use and for which their best option is to take it/them to a repairs unit to see if it/they could be repaired. In most cases if the repairer is not successful in fixing the items, they are abandoned at repair units. Some EEE which are out of use and are not taken to repair units for some reasons may be kept indefinitely at home. In some cases they become objects of play for kids as well as just standing in the home for posterity. A higher number of

respondents in Buea (82.5%) compared to Kumba (68.3%) believe wanton disposal of some WEEE is harmful to the environment. In cases of some harm (especially physical harm) from handling WEEE, home treatment is administered like for any other physical injury.

The public plays a significant role in any organized schemes for the collection of WEEE. In Buea, 67.5% of respondents think they are willing to participate in such programs with 52.5% indicating they may only do so if they receive some compensation. In Kumba, 71% of respondents are willing to participate in any organized schemes and their mode of participation is fairly balanced among the different options like: receiving compensation, paying for collection, or free depositing items at a collection point.

4.4.1.2 Repair unit owners

Repair stores represent a major route for which there is a high likelihood of WEEE to pass through some reuse, recovery process or a transit route to final disposal. An inventory of the various EEE found in some 40 repair stores in Kumba and 20 in Buea was compiled and the results are presented in tables 4.2 and 4.3 respectively. In both cases, TVs, VCD/DVD/VHS players and radio/cassette recorders are the most common EEE. Audio-visual appliances in both cases represent about 70% and 38% (by number) of EEE in both localities. An interesting observation from the two tables is the difference in types of EEE that dominates in repair units. While there is a relatively greater number of TVs, VCD/DVD/VHS alongside radio-cassette players in Kumba than in Buea, there is an apparent absence of computer and its related accessories in Kumba unlike in Buea. Buea being the provincial capital of the south west province of Cameroon, it is obvious that computer and its related accessories are bound to be in greater use. Kumba on the other hand though a bigger town than Buea, is a commercial and farming dominated community with connected trade links to Nigeria. Hence inflows of appliances like TV and radio, for entertainment is quite common. In the above two tables, the inventories give an indication of quantities of EEE as well as waste forms of them. A significant proportion of all WEEE at repair stores are abandoned products by customers in which case repairs cannot be done. Due to the later emergence of mobile

Table 5 Inventory of WEEE for some 40-repair stores in Kumba, Cameroon

Device	Total number (40 stores)	% representation (by number)
TV sets	825	21.2
VCD/DVD/VHS players	807	20.8
Radio/cassette recorders	402	10.4
Motor cassettes	306	7.9
Stabilizers	216	5.6
Amplifiers	291	7.5
Speakers	154	4.00
Mobile phones	150	3.9
Monitors	12	0.3
Fridges	210	5.4
Electric irons	181	4.7
Fans	288	7.4
Table lamps	41	1.1

Source (Asong and Nkemnkeng, fieldwork report, 2006)

Table 6 Inventory of WEEE for some 20 repair stores in Buea, Cameroon

Device	Total number (40 stores)	% representation (by number)
TV sets	46	9.2
VCD/DVD/VHS players	35	6.9
Radio/cassette recorders	58	11.6
Speakers	50	10.0
CPUs	69	13.8
Monitors	46	9.2
Laptops	23	4.6
Printers	16	3.2
Photocopiers	18	3.6
Blenders	43	8.6
Electric cookers	15	2.9
Fridges	41	8.2
Electric irons	24	4.8
Fans	17	3.4

Source (Asong and Nkemnkeng, fieldwork report, 2006)

telephone repair shops, just a few of such units were operational in 2006. Mobile phone repair units most often specialize only in these items hence they can have a lot of phones within units. A characterization of the various EEE repair units for the two towns (based on the WEEE scheme of the EU WEEE directive) is presented in Table 4.4 below. From the table it can be observed that: i) the classes 1 to 5 are the most dominant types of EEE found in repair units in Kumba and Buea; ii) Class 4 is the most dominant in both cases (77.3% and 37% respectively) although higher for Kumba than Buea; iii) Classes 2 and 3 are significantly greater in Buea than in Kumba (13.3% and 34.3% to 4.7% and 4.2% respectively).

Table 7 Relative proportions of various classes of EEE at repair units in Kumba and Buea, Cameroon

Equipment Class	Kumba		Buea	
	Total counts	% representation	Total counts	% representation
Class 1	498	12.8	73	14.6
Class 2	181	4.7	67	13.4
Class 3	162	4.2	172	34.3
Class 4	3001	77.3	189	37.7
Class 5	41	1.1	-	-

Source: author's construct.

A more detailed inventory was developed for 10 repair units in Buea, in January 2009 (Table 4.5). In this case, specific units were targeted as noted below the table. There is a likely tendency of encountering about 40% of out-of-use forms of the various equipments for equivalent expected-to-be repaired forms. One notices of course that for some repair units the chances of finding end-of-life forms of EEE are relatively lower than for others. This may be due to the following: i) the state of the equipment prior to bringing to a repair unit; ii) the expertise of the repairer in getting the equipment operational or the specific fault rectified; iii) the level of efficiency and duty consciousness of the repairers; iv) the attitude of the owner of the device towards to repairer; v) the perception the repairer holds of a device owner. The owner of a broken

down device may bring such a device for repairs at a repair unit and gives the impres-

Table 8 Inventory of EEE and end-of-use (or -life) forms in 10 repair units in Buea, Cameroon

Equipments	Repairs Units (U)																			
	U1		U2		U3		U4		U5		U6		U7		U8		U9		U10	
	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W
TV sets	25	8	30	18	3	0	8	3	--	--	--	--	--	--	8	2	--	--	--	--
VCD/DVD/VHS players	20	12	25	15	8	6	15	7	--	--	--	--	--	--	6	0	3	2	--	--
Radio/cassette recorders	15	5	15	8	16	5	9	5	--	--	--	--	--	--	--	--	--	--	--	--
Speakers	--	--	8	5	2	0	--	--	--	--	--	--	--	--	--	--	5	2	--	--
CPUs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15	5	18	7	--	--
Monitors	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	3	13	8	--	--
Laptops	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	0	12	7	--	--
Printers	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	5	8	3	--	--
Photocopiers	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Blenders	10	4	6	--	2	0	8	2	20	12	--	--	--	--	--	--	--	--	--	--
Electric cookers/heater	4	1	--	--	--	--	6	4	--	--	--	--	--	--	--	--	--	--	--	--
Fridges	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	9
Electric irons	4	2	5	--	6	3	5	2	6	1	--	--	--	--	--	--	--	--	--	--
Fans	8	7	6	--	1	1	6		15	8	--	--	--	--	--	--	--	--	--	--
Mobile phones	--	--	--	--	--	--	--	--	--	--	35	25	60	30	--	--	--	--	--	--
Other minor appliances e.g. Wall clocks, I-pods, mini MP3 players, etc	--	--	4	3	--	--	--	--	--	--	2	0	5	2	--	--	--	--	--	--

(Source: Author's fieldwork, January 2009)

U represents repair unit (hence for e.g. **U1** represents repair unit 1); **T** represents total counts for equipments; **W** represents equipments beyond repair (hence bound for disposal or some parts may be retrieved). U1 to 5 constitutes TV, etc, repair workshops, U6 and 7 are mobile phone repair workshops, U8 and 9 constitutes computer and accessories repair workshops U10 is a fridge/refrigerator repair

workshop.

sion of someone who is hard with money and hence cannot pay the desired price demanded by repairer for repair of such a device. In return the repairer may leave such a device standing for long at his unit. Social held stereotypes are also significant in such cases. Some social groups have been known to be stingy with money. When typical persons of such groups bring broken down devices to repairers, the repairer may already predict the client's attitude towards paying for the repairs and this affects how long the device may stay there in its broken down condition. Thus for such reasons some devices intended for repairs end up not being repaired.

The highest of such tendency to find a greater number of end-of-life forms of EEE is observed for class 1 EEE (Table 4.6). It can be inferred that almost half of EEE found at repair units may be bound for disposal.

Table 9 Comparison of proportions of EEE to those considered at end-of-life for some repair units in Buea

Equipment Class	Total EEE (T)	Total at end-of-life(W)	% representation (W to T)
Class 1	60	40	66.7
Class 2	72	26	36.1
Class 3	89	38	42.7
Class 4	221	103	46.6

Source: author's construct

*Table is based on data in table 4.5.

A whole lot of EEE or components of them exist which have not been classified in any of the groups such as batteries for cell phones. More so in the process of retrieving parts or complete components, some end up as litter around repair stores such a resistors and display / circuit boards (figure 4.2). Some retrieved components may be placed on display within units as items on sale and which may also be used by the repair unit itself. This group, if quantified cannot be less significant. A listing of some common components or items retrieved from WEEE is presented in Table 4.7. Components or individual items may be retrieved for one of the following reasons: i) for use as an immediate replacement for another equivalent component or item in a similar

equipment during repair process; ii) to be sold to other repairers in need of any such



Figure 14 Circuit boards and other components of out-of-use EEE at repair unit in Cameroon (source: author fieldwork)

materials; iii) to be kept for any future uses as need may arise. In an interview with one repair unit owner, he indicated that some retrieved components or items from WEEE kept within unit for some future use may end up not being used because the fast changing pace of technology renders them obsolete. In such a case, the material may stay longer in the units until a point in time it gets disposed of. In a few cases, some repairers buy WEEE in order to retrieve some useful parts to use in repairing another device. They are usually packed inside the repair stores as well as outside depending on the available functional space within a given repair unit (fig. 4.3 a, b, c, d and e). 70% of the repair unit owners think these equipments are of no threat both to humans and the environment. Over 80% keep the equipment in their stores as long as there is space for them and in cases where they have to be discarded it is done on surface refuse dumps. Most repairers hardly put on protective kits when handling WEEE. More than 70% of the repair unit owners are interested in the formation of an organized scheme where these devices could be collected and useful parts retrieved for reuse but are not

interested in the introduction of a collection fee for WEEE. They also claim that there are no laws that bind the handling and operation of WEEE as no authority come to check their business with respect to safety control and environmental sound handling of such equipments.

Table 10 List of some common components retrieved from WEEE by repair units' operators in Cameroon

Class of equipment	Type of equipment	Components or items retrieved
Class 1	Fridges	gas, Freon , (cooling components)
	Fans	Rotating devices like motors
Class 2	Blenders	Rotating devices like motors
Class 3	PC / CPU	Hard disk from system unit of computer RAM chips from system unit of computer Processor from system unit of computer Power unit from system unit of computer CD ROM from computer
	Laptop	Keyboard from laptop Hard disk from laptop
	Photocopiers / Printers	Lamps from photocopiers Drums from photocopiers Cleaning blade from photocopiers
	Mobile phones	Camera Keypad Screens Batteries Small screws
Class 4	TV	CRT from TV
	Video devices	video card/board from DVD/VCD player head pin from VHS player lens from DVD/VCD/stereo player
	Speakers	● Magnets



a



b



c



d



e



(f)



(g)

Figure 4.3 WEEE at repair stores in Cameroon: computer components in inside store; and c) WEEE outside stores; TVs from which useful components have been retrieved; e) abandoned fridges and other WEEE. (source: author's fieldwork)

4.4.1.3 Other sectors

Apart from households (public) and repair stores, WEEE is also generated from other sources as businesses and administrative units. When EEE in some administrative units becomes dysfunctional or considered as waste, they are either packed in a store (waiting a time when some decision will be taken on their fate) or taken to repair units (within or outside the municipality). In some cases where the equipments are considered out of use, they are disposed of in garbage dumps like other commingled waste. Small retail shops that deal in EEE also handle these equipments in both functional conditions as well as obsolete forms. Unlike wholesalers, there is a great tendency to find a very great proportion of second-handed goods in retail shops. Some of these dealers acquire their products through connections with an agent abroad. In some cases the agent may be the owner of the retail shop, although living abroad. Such good are sent to Cameroon by the following means: i) as paid luggage to agents who own containers and run regular shipping business for logistics; ii) as loaded items during the transportation of a purchased car to Cameroon. Home based retailers may acquire products from some intermediary home based agent or from those who have business links with countries like Nigeria. A common practice in the acquisition of second-handed good by retailers is that any dysfunctional or nonfunctional appliances are taken to repair units for servicing before selling. In some cases retailers strike a direct deal with repairers whereby they acquire all sorts of EEE, which are later serviced by repairers to add market value. Retailers deal with both whole equipments as well as components of them. It is believed, however, that the rising number of WEEE in the towns of the Southwest Region of Cameroon is partly due to large illegal transport of used devices from Nigeria, that enter the country through the Port of Lagos, and later on undergoes some repairs and maintenance at the warehouses and are later on smuggled in to the Electronic stores in Cameroon as newly manufactured products.

4.5 Discussion

The increasing demand and use of EEE as well as continuous rapid changes in design and short product life span has in the last decade invited greater attention to the handling of EEE at EoL. Such attention has been quite significant in relation to managing waste arisings from EEE. An effective management of WEEE, just like any other waste stream require informed decision on a number of issues that may be social,

environmental, economic and even political.

In this study a very simple methodology has been employed to investigate the handling of EEE at EoL in Cameroon. Developing countries like Cameroon are generally faced with the problem of lack of data for many issues requiring investigation. The results on the analysis of handling EEE by various sectors in Cameroon clearly present a picture of the problem of arisings from EEE. From the results, one notices the effect of socio-cultural / economic factors on generation of WEEE. The difference in types of EEE in repair units in the two towns reflects this assertion. There is a greater amount of ICT equipments in Buea than Kumba. Buea, being the administrative capital of the Southwest region of Cameroon, is also host to the country's lone Anglo-Saxon state university. The presence of the university has brought significant changes in consumption patterns within the municipality. Unlike in the developed countries, where most students as well as households can boast of at least a PC, in Cameroon, most students as well as workers (university lecturers inclusive) have to rely on commercial documentation services for typing of assignments, photocopy of notes and Internet services. This high demand for documentation services coupled with the practice of acquiring second-handed equipments results to an increasing WEEE waste stream in this town than in other towns in the region. Kumba on the other hand is a more commercial town with strong business links with Nigeria and with a stronger agricultural-base economy. Proliferation of Classes 1, 2 and 4 EEE are thus common in Kumba. These equipments are easily brought in from Nigeria.

The absence of the other Classes of EEE in repair units does not imply their total absence in the MSW stream. Their absence rather reflects the handling of such devices by the public and other sectors, the value attached to them, and the ability to repair them. A good example is Class 7 EEE (i.e. Toys). Given their lifespan can be quite short, and any attempts to repair dysfunctional forms may not be economically beneficial, households prefer to dispose of them alongside other waste. Class 6 EEE (like hand drills etc) are most often used by technicians. Most of these technicians are contented they can fix them in case of malfunctioning. Thus such equipments at EoL are only disposed of directly from the user.

It is obvious that repair units represent a very important channel for which any attempt

to manage WEEE must focus. The common practice of repairing dysfunctional equipments enhances the process of reuse. Also, the practice of retrieving parts for reuse for purposes similar to the original purpose of the retrieved parts or other adaptable uses enhances the process of recovery. The basic problem which looms however is the fate of WEEE. All handlers of WEEE have just the one option of disposing of them like any other waste through the different disposal practices in Cameroon. At the level of household disposal, they may be dumped on yard surface dumps and later burnt with other waste or dropped in municipal collection facilities for onward landfilling. Repair units are mostly within residential households. Hence they too dispose their WEEE in the same process like households do.

4.6 Applicability of recycling and recovery of WEE in Cameroon

In the past two decades, technological advancement, institutional commitments and public awareness in relation to handling waste of all sorts have been on a general increase for developed countries. The contrary may hold true for developing countries like Cameroon. One is not left, though, with the impression that nothing can be done. Rather, for anything constructive to be achieved, there must be a basis and such intentions must be applied with practicability that focuses to the particular situation under study. The current situation of handling practices for e-waste in Cameroon is presented in Table 4.8.

In Cameroon, EEE are in broad range of uses and by several users, involving individual persons, entire household, businesses and other administrative units. For economic reasons, most of these EEE are acquired as second-hand products with a likelihood of shorter life spans to the owner. Thus at end-of-life they are either bound for repairs and subsequent reuse or dumping with little or no attention paid to the dangers these equipments may pose to humans and the environment. Although some instances of injury or poisoning from WEEE are reported, a greater part of the inhabitants hold that WEEE poses no significant threat to man and ecosystem. While the traditional or classical approach to material recovery (from waste) involves a coordinated system from collection, transportation and selective separation of different components, the application of the concept may vary from place to place. Here we present an adaptable approach based on the context we are dealing with and keeping in mind the strengths

Table 11 Current situation of WEEE in Cameroon

Issue on WEEE	Current practice / case	Remarks
Generation / storage	<ul style="list-style-type: none"> - Generally stored longer at generation points e.g. household and repair units. - Some kept longer at households for aesthetic value. 	Repair units storing most as WEEE from different sectors are brought to units for repairs.
Collection / disposal	<ul style="list-style-type: none"> - No specialized means of collection, commingled with MSW. - Disposed (mainly smaller equipment) as part of MSW stream. 	<ul style="list-style-type: none"> - Loss of potentially recoverable materials. - Source of pollution due to uncontrolled disposal. - Major businesses like mobile phone operators may initiate take back programs.
Recovery/Recycling	<ul style="list-style-type: none"> - Individual attempts at households to fix dysfunctional equipments. - Repair units fix dysfunctional equipments as well as retrieving useful components and parts. 	<ul style="list-style-type: none"> - Recycling/recovery not quite comprehensive. - After recovery, remaining components disposed alongside MSW (often uncontrolled).
Cost of managing	<ul style="list-style-type: none"> - Absence of defined management schemes. - Repair units may freely or for a small payment take back dysfunctional equipments from consumers for purpose of fixing or component recovery. 	<ul style="list-style-type: none"> - Recycling / recovery may be profitable to small existing schemes (SMEs). - Financial sustainability especially on a large scale not yet investigated under present condition.
Potential recyclers	<ul style="list-style-type: none"> - Repair units represent potential link in a recycling / recovery chain. - Units are found in almost every locality though of varied sizes and scale of operation. 	<ul style="list-style-type: none"> - Need for comprehensive management schemes. - Repair units can handle a significant proportion of WEEE with respect to recycling / recovery but not disposal.
Public awareness	Little awareness of both the significant contribution of WEEE to MSW stream and environmental pollution.	<ul style="list-style-type: none"> - Difficulty in coming to terms with fact that EEE becomes waste especially after short span of use. - Several attempts to fix.
Import	High rate of import of especially used EEE, which may have shorter span thereby increasing MSW problem.	Problem difficult to handle as even used EEE are valuable to consumers based of use-value considerations.
Export	No export schemes.	With good recycling / recovery programs initiated, recovered components or items may find external markets.
Policy and Legislation	No specific policy and regulations on WEEE.	<ul style="list-style-type: none"> - National framework legislation on WEEE necessary. - Sectors may also regulate their operations.

Source: author's analysis

and barriers to implementation. WEEE is not the only group of waste for which component materials can be recovered. Aluminum based products have been recovered in a local way and sold to manufacturing firms and industries. The socio-cultural context of communities in Cameroon makes it quite easy to rally public concern and support for initiatives that may seem beneficial to them. Although no coordinated waste collection schemes exist for local communities (like community-based organizations) the implementation of collection schemes of some sort for WEEE is quite plausible. Through NGOs, private, municipal and government initiated schemes; a coordinated effort could be made towards the handling of WEEE in Cameroon. Because a lot of people follow radio programs, a first stage in implementation will be sensitization. Common collection points may be created for communities. At such collection points, people are expected to drop their WEEE, which would be subsequently transported to a central collection unit by trucks. This is quite possible given the willingness of the public to participate in such a program. At the central collection point, WEEE could be dismantled to retrieve different components. Components that are still useful especially to repair units will be sold in return to these units. Thus business transactions may be entered between repair units and such a central collection and dismantling unit. Such operations must be made between the central collection/dismantling firm with industries that make use of the different retrieved component materials like plastic and glass. With the emerging patterns of business relations between Cameroon and countries like China, retrieved recyclable components of WEEE may find some markets. Such markets already exist for especially for scrap metals.

Repair units for broken down EEE serve a very vital channel for which efforts to recycle WEEE can be focused. They present greater opportunities to establishing collection services and recovery of components. There exists some coordinated union of EEE repairers in the Northwest Region of Cameroon. The basic aim of such a union has been for information sharing and training in repairing EEE. Such aims could be expanded and partnerships established between them and councils or other private or public schemes. On the other hand, the councils who have been responsible for managing waste generated within their municipalities could start off collection programs for WEEE in areas with good accessibility. The existing practices in handling of EEE both in use and at end-of-life, and the fact that a considerable amount of WEEE are

reported, constitutes a basis for the implementation of a coordinated material recovery scheme in Cameroon.

4.6.1 Strengths to applicability

A major strength in the above move is backed-up by the existing practices in the handling of WEEE. Most repair stores retrieve useful parts or components from WEEE and use for subsequent repairs of broken-down ones. Because such retrieval is done uncoordinated, a lot of material may not be recovered. Thus a coordinate material recovery scheme would ensure a coordinated recovery and assembly of useful parts and components whereby repairs technician could buy as appropriate. Based on the compiled inventory of WEEE and interviewees' responses, it is obvious that a considerable quantity of WEEE is available in the two areas studied. Projections based on such results for other areas of Cameroon will imply instituting a material recovery scheme would be a beneficial move. When such materials are disposed of in garbage dumps, it creates as imbalance in the ideal material cycle and hence loss of material.

A greater majority of respondents (both repair store owners and the public) indicate they would be quite willing to participate in a coordinated material recovery program either financial or otherwise. Such a scheme could be operated under local councils, Common Initiative Groups (CIGs), Non-Governmental Organization (NGOs), or other private groups with some government support. They would not only have the advantage of preventing material loss, they could be a source on employment and income generation for communities or businesses. It becomes easy to ensure recovery under such schemes, as it would be done with environmental safety measures enhanced and enforced.

There exist major mobile phone network companies (MTN and Orange) in Cameroon with strong connection to similar companies in the developed world as well as major dealers in electronic and electrical equipments. These businesses could initiate "take-back" schemes for people wanting to acquire new equipments as well as those wishing to get rid of out of use ones. Although such schemes only makes sense after a cost-benefit analysis has been carried out, defining adaptable conditions under which such a scheme may operate could be quite beneficial.

4.6.2 Barriers to applicability

Barriers to the implementation of appropriate material recovery schemes in Cameroon include knowledge gap, awareness, economic and institutional set-backs. The knowledge gap involves both technology and human resources. Since the material recovery concept has evolved amidst a significant technological set up, the technology gap in Cameroon may make it difficult to set up an MRF with the required precision. If technology is to be bought or transferred, the necessary human resources must be in place to sustain the technology. This may be lacking in Cameroon as the concept of environmental sustainability and its related concerns are still new at least in practice in the country. Environmental awareness and education are still at very low ebbs in the country. However, the technological and human resource problem is not one that cannot be overcome.

The economic resources to enhance the take-off of schemes and programs for material recovery in Cameroon may be quite lacking when such initiatives are to be undertaken by the public or small groups. This problem may also be compounded when economic incentives like subsidies are not provided for such schemes. The inadequate or lack of appropriate legislation on recycling and handling of WEEE in Cameroon is a serious problem from the view points of the material cycle, health and environmental safety. The main law on the environmental management in Cameroon (Law No.96/12 of 5th August 1996) has some stipulation on waste management concerns yet not too detail and with practical follow-up/implementation problems. The present practices in the handling of WEEE are usually not in compliance with safety requirements and pregnant with a lot of ignorance. The lack of specific policies, legislation and regulatory framework on WEEE may also make options like “take-back” mechanism difficult.

4.7 Conclusion

The quantity of WEEE in Cameroon is on an increase due to the increasing demand for used or second-hand equipments whose conditions are not very certain to the consumer. The desire to live to the taste of technology (though with meager resources) in the recent past has also boosted the acquisition of EEE implying at end-of- life the problem of managing waste from this equipments will be even greater. The WEEE differs in types with location based on the major activities in the area and the

educational institutions. However TVs and related acoustics form the greater bulk of WEEE in the localities studied. Although there is a general lack of material recovery facilities in Cameroon, traditional approaches of management such as recovery and reuse of functional components of WEEE are quite plausible. Based on public willingness to participate in management programs, recovery schemes could be implemented, which would be quite adaptable in context though drawing from the experiences of developed systems. Thus we content that such schemes would greatly reduce the impacts of WEEE both to humans and the environment while adjusting to some degree the disequilibrium in the material cycle (where natural materials are exploited when existing products could be recycled and reused).

Chapter Five

Recycling of Aluminum and other metals SMEs in Cameroon: Challenges and Prospects

Chapter Abstract

In this chapter, a critical assessment of recycling of aluminum has been presented. Through the use of questionnaires, interview and field observations, recycling of aluminum for the production of mainly household utensils by small-scale private schemes in Cameroon and also the recycling of other metals have been investigated. The recycling of aluminum for production of household utensils represents a very basic and adaptive industrial set-up, which can easily be operated and run at very cheap cost and with a little manpower. While this venture seems apparently successful in economic terms as an option to poverty alleviation through income generation, it is plagued by some problems which, if given due consideration will render it a prospective cause for poverty alleviation (through small enterprise business development) and environmental sustainability (as an option to sustainable MSWM). The lack of defined institutional structures also compound the problems and results in losses on the part of the stakeholders involved in the entire venture i.e. governments, producers or recyclers, public and the market. In this chapter, a model is thus presented, which can be utilized by stakeholders to improve on the sector. Recommendations on areas for further research are equally presented.

Keywords: Aluminum, Recycling, SME, Poverty alleviation

5.1 Introduction

Recycling comprises the collection of recyclable material (considered waste), the sorting and processing of these into raw materials and the manufacturing of these materials into new products (EPA, 2006). According to Jo Ruiz Jr. (2001), recycling presents enormous prospects and hence stands out clearly as the most preferred method of Solid Waste Management (SWM). And recycling is done for three reasons: altruistic, economic imperatives and legislative reasons. Because recycling involves several different activities, technological and institutional aspects may vary for the process with respect to materials and locality. In the past, solid waste was bound for landfills or burnt. A shift in ideology has been experienced in the past three or so decades whereby the

reuse and recycling of solid wastes (or at least some fraction of solid waste) has become a top priority for Solid Waste Management (SWM) programs. Thus there has been to some extent, a reduction in quantity of solid waste that goes to landfills or incineration plants (at least for materials that can be recycled). Recycling presents enormous opportunities as a means to Municipal Solid Waste Management (MSWM) in general and in enhancing equilibrium within the material cycle in particular. According to EPA (2003) reports on MSWM in the US, recycling recovered 30% (68 million Tons) of MSW generated in 2001 and the number of community curbside recycling programs had increased 5% more than in the previous year. The report also shows that MSW recovered for recycling in 2001 was 29.7%, land disposal 55.7% and combustion 14.7%. Thus there is still the need for optimization of material recovery from waste. Recycling may be a major or minor consideration in a SWM plan depending on various factors which may be in line with economic, technological and administrative frameworks considerations.

Recycling generally begins at the point of waste generation, through the several methods of collection and subsequent transportation to a resource or material recovery facility. This facility, however, may be part of a disposal facility or an independent entity intended for a particular purpose. Although the term recycling is being thought by some to be synonymous to reprocessing, it may differ in some respect to the latter. The significant difference between the two lies in: 1) the basic definition; 2) cost and capacity implications; 3) origins of waste; and 4) while in recycling items are recovered in forms which can be reused to manufacture recycle-based products of original material, in reprocessing the waste is reduced to one or more materials from which completely new products are made (Manser and Keeling, 1996). Thus in this view recycling involves selective recovery for reuse and reprocessing involves general reduction of component for alternative uses. In terms of cost and capacity, a recycling venture by implication will involve lower cost and capacity than for reprocessing. When one gets to look at the two in terms of income generated, one notices that depending on context, a recycling venture may be economically accommodating than a reprocessing one. It requires much capital cost to set up a reprocessing plant given all sorts of wastes may be brought in without any prior separation by generator. But recycling may be something involving just a few pickers to bigger scale operations like a recovery facility. Manser and Keeling (1996) ascertain a reprocessing facility worth \$8 million may yield at least

\$1.8 million a year while orders of costs in a recycling scheme may range from zero to \$3.5 million. Thus as a means to waste management, feasibility studies are essential to decide which may be appropriate for a particular situation – recycling or reprocessing. In all, the decision to choose which of the two (recycling or reprocessing) is to be used for a given situation depends on the cost to be tolerated. While recycling suffers a greater financial burden on collection with a resulting cheaper disposal, the converse holds for reprocessing. Hence unless there is external support or subsidies such as funding by some public authorities, the decision on whether to reprocess or recycle waste can be very crucial. Despite the issues above on what recycling should mean, the following definition of recycling is adopted in this thesis: “the separation, collection, processing into new or similar products and the reuse of material that is considered at the time prior to subjection of the above process as waste or of almost zero use-value”. Recycling thus represents a cyclic loop with huge material gains.

It is following this line of argument that this thesis presents a case for the recycling of aluminum and other metals in Cameroon for the manufacture of basic home utensils. Thus considering recycling may involve quite lower costs and the scale of these business involved start-off at smaller scales, it is worth re-examining such existing schemes in Cameroon and evaluate the enormous potentials they present as agents of sustainable development. The recycling of aluminum and other metals for production of mainly cooking utensils and other works of craft has been going on in Cameroon for a long while. Recycling of metals for the production of works of craft is mainly concentrated around traditional palaces and in localities where such crafts constitute potential business. However, the recycling of especially aluminum for the production of cooking utensils, mainly cooking pots, is concentrated within economically active areas in Cameroon. In such economically active areas, there is the likely advantage that such a business may have opportunities to obtain start-off capital, materials may be more available and easily transported and subsequent purchasing of final product can be more assured.

Prior to the start of the year 2000, the collection, transportation and production of recycled-based products were mainly in the hands of Small-scale/Medium Enterprises (SMEs). After the year 2000, there has been a growing market for aluminum and other metal wastes, some of which are transported abroad to countries like China, Ghana and

Nigeria. The main raw material chain for these SMEs is waste aluminum and other metal products gotten from waste disposal sites (public and household dumps, car/vehicle garages, etc) by mainly children and adolescents and sold to these small-scale businesses. These industries play a great role not only in the transformation of waste into reusable products (an economic motive) but also a significant means to enhance equilibrium in the material cycle by reducing resource depletion through landfilling.

Although recycling may serve enormous advantages as an approach to MSWM it also poses several challenges. Such challenges lie in working out economic ventures that go in line with other institutional arrangements and for which a massive public involvement can be rallied. The experiences of recycling from different countries also show that an operational strategy may work well for one region and not for another. Thus it is very necessary to examine different recycling programs for different localities or regions and deduce useful information from them that can be used in designing new programs or for the effective and efficient continuity or sustenance of existing ones.

Enormous literature exists on the subject of recycling from scientific, technological and socio-economic perspectives. Such literature can be found in documents of several environmental agencies and organizations like the Environmental Protection Agency (EPA) in the US, European Aluminum Association (EAA) to name a few. Despite lots of work already done in the area of aluminum recycling, gaps still exist on the development of strategies to maximize collection of scrap, increasing public involvement and impacting on industrial design of products to minimize waste and encourage recycling. In developing countries like Cameroon on the other hand, there exist a big problem of data availability on the subject. Some studies on environmental issues are being carried out by students of the Department of Geology and Environmental Science of the University of Buea, but more focus is usually on issues such as geo- and natural hazards, environmental education and administrative and public aspects of MSWM. Thus there is need for more comprehensive data generation on aspects of waste management like recycling to produce simple and useful household items. This thesis thus constitutes a pioneer work on the subject of recycling of aluminum scrap in Cameroon by small private schemes. Given little or apparently scanty data exist on the subject, the thesis is intended to supplement the data bank on the subject.

In Cameroon relatively little is being done in the area of recycling MSW. Much concern is however being put in the areas of biodiversity conservation and water and land resources. As the massive effort in biodiversity conservation and water/land resources issues keeps growing and rallying both national and international support, a basic environmental problem still looms with diverse adverse environmental effects – the problem of municipal solid wastes. Aside the massive primary production of aluminum from bauxite in Edea, private schemes exist that operate smaller facilities that recycle aluminum scrap for production of mainly cooking pots. Little is of course known of these schemes with respect to their organization, operation, challenges faced and prospects. Thus for the growth of such sectors, information needs to be generated relating to their activities from which strategies to get both government and public involvement may be designed as well as cost effectiveness determined. Thus given the important role such a sector may play in MSWM in particular and environmental sustainability in general, the sector demands some valuable studies

The operations of these small private schemes have, however, been characterized by some problem which fall in the broad range of socio-economic, industrial/technological and environmental. It is in this respect that this study sought to make an overview of this small, yet significant sector, assess the challenges and highlight the prospects for such a sector. In this study, it is hypothesized that “the recycling of aluminum and other metals by small private schemes in Cameroon represents a significant approach to environmentally friendly MSWM and whose socio-economic benefits can be maximized with increased stakeholder involvement. This study seeks to address the following research questions:

- What are the major forces that have driven the quest to recycle aluminum?
- What state-of-the-art technology and institutional structures exist for aluminum recycling by small scale private schemes in Cameroon?
- What prospects does the existing situation present?

5.2 Objectives and Rationale of Study

5.2.1 Objectives

The general objective of this study is to make an evaluation of the recycling of aluminum

and other metals for the production of recycle-based market products in Cameroon with special focus on the Southwest and Northwest Regions of Cameroon. The specific objectives include:

- To make an analysis of the different stages (i.e. collection and processing) involved in the recycling of aluminum waste by small holder schemes in the south west province of Cameroon.
- To evaluate the contributions of the activities of these schemes to solid waste management in general and the material cycle of aluminum in Cameroon in particular.
- To develop appropriate strategies and options for effective and sustainable operation of these schemes based on socioeconomic and environmental considerations.

5.2.2 Method and Rationale of study

Two data sets - primary and secondary - comprised the basic materials used in this study. Administered questionnaires and responses from interviews (generated from field work) comprised the primary data set. During field studies, the various stages of metal waste generation, collection and transportation alongside the process of melting and molding of aluminum into pots and other household goods was fully described. The economic ramifications involved in the recycling process in this sector (SME) were evaluated based on interviews and personal communication. Available literature on aluminum recycling, MSWM for Southwest province and other literature relevant to the study comprised the secondary data set and was used to compliment primary data in attaining the objectives of the study. Based on the findings of this study, appropriate options have been sought where lapses exist based on socio-economic, technological and environmental considerations.

The first part of this chapter introduces a discussion on aluminum recycling from a broader perspective drawing examples from different developed countries. This does not only serve to highlight on the successes and failures of the move to recycle, it provides a partial but significant socio-economic and technological lens through which the same issues can be viewed in developing countries. An assessment of the existing small-scale private schemes involved in the recycling of aluminum in Cameroon is

made. It evaluates the different stages involved in this activity. Hence results of the study will serve as a significant working document not only for individuals and groups involved in the recycling of aluminum into commonly used household products, but also a valuable asset to government, local councils, NGOs and CBOs as it may constitute some basis for sound and informed decision-making on MSWM.

5.3 Aluminum within MSW stream

Since the 1960s, aluminum has constituted a relatively small proportion by weight, of the waste stream compared to other commonly recycled components of MSW like paper and plastics. However, the trend in generation of aluminum waste has increased during this period though not very sharp. An EPA report in 2001, show a significant increase from 340 – 3,190 thousand tons from 1960 to 2001 of aluminum in the waste stream. In terms of material recovery from MSW, a very small proportion of aluminum in MSW was being recovered prior to the 1990s. Thus compared to the 1960s when only a very small amount of aluminum was being recovered from MSW, 35.9% was being recovered in 1990. While the range in values for percent of total discards and recovery for paper/paperboard have a smaller variation from 1960-2001, that of aluminum is quite large. Hence although more aluminum is discarded than is being recovered, recovery with respect to other components of waste stream is quite significant. Generation and discards seem however, to have been on an increase. When one takes the case of aluminum in MSW in the US in 2001, one notices it is not from all available sources of aluminum that the metal can be recovered. Aluminum from durable as well as non-durable goods (such as appliances and furniture) and food and other cans were not recovered. It is thus apparent that the recovery of aluminum from these three sources can be described as still inefficient.

5.4 Institutional aspects of Recycling of Aluminum

Public, governments and private sectors may play vital roles, both on individual or joint basis, in managing recycling programs. The efforts of these groups, despite held optimism, may be challenging. Pilot programs as well as fully operating recycling programs are widely in operation in the US with remarkable success. Interestingly, a number of these programs are build around communities. In these cases the

communities run community collection systems and Material Recovery Facilities (MRF). Private and governmental bodies are also involved in recycling programs and may work in partnerships with the community directly or indirectly in such programs. By 1992 there were about 900 MRF in the US (Steuteville and Goldstein, 1993).

A characteristic institutional aspect of recycling is the market structure typified by two tiers: intermediate and end user tiers as illustrated in figure 2.5 in Chapter Two. The intermediate market serves as a bridge between the generators of materials (recyclables) and the manufacturers (manufacturers). The existence of a market is a very important institutional aspect for any recycling program. Despite its ecological benefits, cost recovery must be at the center of any recycling program thus making recycling a highly economic venture. In some way, cost is reclaimed by the economic approach of offsetting cost for alternative disposal such as to landfills and incineration plants. The economic forces may play a significant role in sustaining a recycling program but if the design at the level of industry is poor, profitability then is in doubt. Technological design should strive at ensuring a far greater proportion of material that is not economically viable becomes viable. The existence of appropriate legislation is a very important institutional aspect of any successful recycling program. Such legislative actions help significantly in both the development and operation of recycling programs (see Chapter Two for examples of such legislations). Thus for aluminum recycling (just like any other recycling programs) to be sustainable, due consideration has to be given to the following aspects: socioeconomic, legislative/policy and technological aspects.

5.5 Recycling of aluminum in Cameroon

5.5.1 Background

A significantly large scale industrial operation in Cameroon dealing with aluminum production is ALUCAM, which is operated at Edea for the smelting of bauxite into aluminum. Thus there has been more of primary resource material usage than recycling. Over historic past, traditional blacksmiths have been involved in either the smelting of raw metals or the recycling of waste metals for manufacture of traditional weapons and utensils. Such traditional activities are quite widespread in Fouban in the Western Region as well as the most parts of the grassland regions of Cameroon. Of

interest in this study however, is the role of SMEs in the recycling of metals mainly aluminum, in the manufacture of household cooking utensils.

In the past decade, much interest is being put by government and communities in encouraging growth and development of small scale industries. There exist a ministry for the growth of small businesses and enterprises. However, this ministry is yet to explore the full range of activities going on in the country in terms of its mission. Lots of small scale businesses do operate in the country unknown to (or not registered with) governments and municipal authorities. Thus the benefits these businesses could have from the government such as economic incentives, funding, and training may hardly come by. And on the hand, the businesses by operating in the black market, evade taxes, which are equally beneficial to the government. Given the way these small privately owned businesses operate, it can be quite difficult to know precisely how many of them exist. They are not very open structures to the public and state authorities. And the owners too are conscious of the fact that when their activities become fully uncovered by the government, they may be expected to start paying taxes. They do undermine the benefits they may get from the government. From a very general perspective, these businesses have been successful and do represent prospective targets for the fight against poverty alleviation through entrepreneurship and environmental sustainability through appropriate approaches to waste management.

5.5.2 Perspective of Aluminum Recycling in Cameroon

Recycling, generally speaking, is still at a low level of operation in Cameroon especially when considered as an alternative option in MSWM. In this study, focus is, however, on small-scale private schemes for recycling of aluminum into usable/marketable products. At the level of households and commercial areas, most aluminum waste is bound for disposal. The fate of aluminum in Cameroon is shown on the flow diagram in figure 5.1.

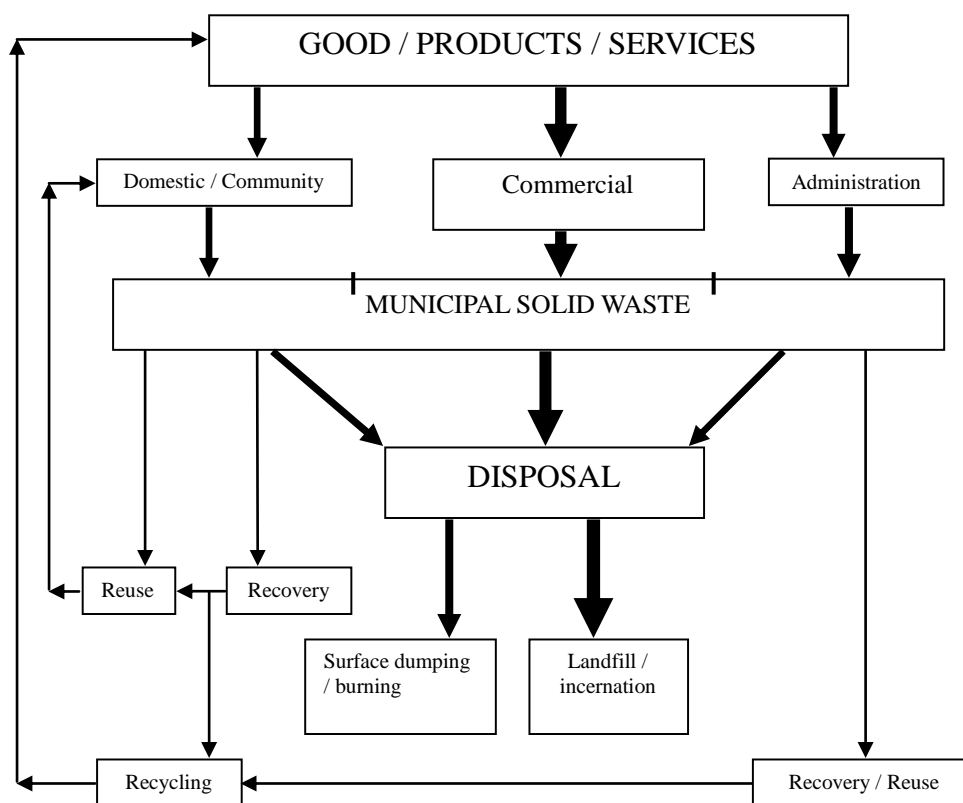


Figure 15 Fate of Municipal Solid Waste in Cameroon

Products with aluminum as main material (such as pots) or component material at end-of-life are generally bound for disposal. In some cases may be reused by some individuals although they were out of use to others. While in surface dumps and landfills, aluminum scrap may be picked up (recovered) and sold for recycling while some that are not accessible remain in the disposal sites. The scraps are either sold to local private recycling services or to neighboring Nigeria. Aluminum based products like packaging and container materials (foils and cans) are rarely used in recycling. Mainly damaged aluminum roof sheets, used aluminum pots and aluminum components of used devices constitute materials that are recovered and recycled.

At a very local but significant scale, aluminum recycling has received greater attention in Cameroon. Some individuals as well as small groups have been over the past 30 years or so involved in the collection, processing and marketing of aluminum recycled market products. The commonest of these recycled products is a model of cooking pots generally referred to as “macocot”. They are very much valuable to locals as they can last longer than aluminum pots made from primary bauxite. They also have the

advantage of extra resistance to physical damage. These small private schemes for recycling of aluminum are located in several communities in the country. Most often they are not operated as registered businesses. More so there is little stock taking (lack of administrative procedures). Hence records on production as well as materials used are hard to find.

5.5.3 Recycling of aluminum for production of cooking pots

A series of steps are involved in the recycling of aluminum by small private schemes in Cameroon. These steps can be grouped into i) material collection, ii) material processing and transformation into new products and iii) the marketing of the recycled-based products.

5.5.3.1 Collection of Raw material

The first step in the recycling of aluminum in Cameroon is the collection of the waste aluminum materials. Aluminum waste, which constitutes the raw material (which may be described as secondary) for the aluminum recycling industry is obtained through the following means:

- 'Pick-ups' from municipal and household waste disposal sites mainly by children, which are then sold to agents who may/may not be directly linked to the processing unit.
- Direct collection from a business unit that generates aluminum wastes such as vehicle repairs garages. Alternatively the aluminum waste may be purchased.
- Purchase of aluminum waste by producer from an agent.

Most houses are roofed with aluminum sheets. Wind destruction events on roofs are common as well as leaky spots for which case sheets have to be replaced. The damaged or leaky sheets are disposed of as waste. In vehicle repairs garages, parts considered useless are disposed of around garage premises. Some of these discarded items are aluminum-based products. Mostly children, pick up aluminum materials from household dumps and community waste disposal sites. This involves picking up of scraps that are usually stuck in smelly refuse and obnoxious substances although some may be relatively free of these substances. In these cases, the dirt is usually cleaned up by just shaking it off the scrap or hitting on the ground to get it off the scrap. Hence the

pick-ups of scrap by children may involve the handling of very smelly materials with bare hands, which may be dangerous. An improper practice by children is to get useful aluminum products at home to sell to buyers of scrap aluminum.

In some communities, small commercial businessmen who trade with other localities may buy scrap aluminum at any time from children at a slightly cheaper rate. And when they have obtained a reasonable quantity of material they may then take them to localities where “macocots” are produced and sold to producers. In this way the producers benefit from the quantity of supply. Upon purchase, the materials are compressed using sledgehammer so as to maximize space and enhance the transportation of larger quantities. Most often purchase of aluminum from pick-ups is not based on any particular reference standard for which one can correlate price to weight. Such scrap aluminum like damaged building roof sheets or car parts, etc, does not have a fixed price, since one cannot fix a price on material full of impurities. The buyer prices the scrap by eye inspection and feel of weight by hand thus prices vary. Pure aluminum is sold at per kilogram 0.60 – 0.80\$ (black market), but normal price is 1.00 - 1.40\$ per kilogram in Douala. The pure aluminum is gotten from bigger industries in Douala as by-products of some manufacturing process. The scraps are packed in nylon bags and are then transported mainly by road transport to the processing unit. Normally, vehicles are used in transporting especially pure aluminum, since it is heavy especially when many kilograms are bought. Scrap metal is carried in trucks (or wheelbarrow), or depending on the type by hand to processing unit once around the vicinity of household housing the unit.

5.5.3.2 Manufacturing

Most of the small private schemes for recycling of aluminum present a gleaming picture of some primitive industry. For example environmental issues are not considered, health and safety measures not/poorly enforced and there is the use of adapted devices. In this study, two main issues are described in the transformation of aluminum waste into usable products i.e. a) the production unit and b) the steps involved in the processing.

a) The Production Unit

The production unit is usually located around households as an extension to kitchens

(since most kitchens in Cameroon are outside and separated from main accommodation building because of the profuse use of wood for cooking). The burning wood for cooking is associated with the generation of smoke which is a main reason why most kitchens are separated from living section of households. The production unit requires a relatively small surface area and thus they can be located as extension to normal household kitchen blocks. Most of these units occupy land surface areas ranging from 25 – 50m². The unit may be divided into three sections: section to store wood or fuel; another for building the molds and a section with the production devices. The production devices, which may be termed the processing unit comprises the following main components: i) the air generation unit, ii) ventilation pipe, iii) heating/melting unit, iv) molds

i) Air generation Unit

The air generation unit consists of a bicycle wheel (or a similar circular rotary device) with a chord placed along the middle of its outer surface. The chord is stretched out at one end and attached to a motor (with a fan) to the ground surface (figure 5.2). At the hub of the wheel is fixed a metal handle, which enable the wheel to be hand driven into spins (based on the same principles like a bicycle pedal). Thus the hand-driven spins from the wheel, through the rotary belt, are amplified by the motor which causes the fan to turn at a speed far greater than the wheel thereby generating a stream of air which passes along the ventilation pipe to the heating chamber. Air generation in this case is generally a labor intensive exercise and may run for a few to several hours. Often more than one person is involved whereby they swap roles in spinning the wheel from time to time. Depending on the quality of the wood or charcoal, the process may be either continuous or with short breaks.

ii) Ventilation Pipe

The ventilation pipe is usually a metal pipe (1.5 - 3m) through which air generated from the air generation unit moves to the heating/smelting unit where it keeps the wood or charcoal burning. It is generally buried a little below the ground surface to avoid contact with body when it gets heated and to ensure it blows air to the heating chamber from the bottom. One of the two ends is wider than the other. This wider end encloses the fan so as to accommodate all air stream generated and the smaller size of the end below the heating chamber enhances higher pressures for air release thus enhancing the

fanning role for heating.



Figure 16 Air ventilation unit components of local macocot pot production plant in Cameroon. (Notice chord fixed both round the wheel and motor in front of wheel) Source: author's fieldwork.

iii) Heating Chamber

The heating chamber consists of a truck wheel (or other cylindrical iron or steel device), part of which is placed below ground surface (figure 5.3). The ventilation pipe is connected to the base of the device. During production, charcoal or wood is first placed in the cylindrical device up to a desired level. Then another cylindrical device (the melting pot), in which the scrap metals are placed for melting, is placed in the fixed chamber. The diameter of the melting pot is always such that there is considerable space between it and the melting dish so that charcoal/wood can be put in between the wood to increase the heating effect. The volume of the melting pot depends on the scale of production but is generally 10 - 20 liters. The smelting dishes are replaced when they become faulty i.e. leaky and this may be after about a year or more.



Figure 17 Heating chamber constituting a cylindrical metal device into which charcoal or wood is used for energy generation. Note in a) ventilation pipe on surface and b) ventilation pipe buried. (Source: author's fieldwork)

iv) Molds

The molds are made by using well sieved soil with considerable cohesive and elastic properties and wooden boxes of different sizes (figure 5.4). The boxes are designed such that two opposite surfaces are left open. In order to form a mold, a pot of a given size is filled with the fine soil and pressed upon carefully with both the hands and short wooden pestle. The pot filled with the pressed soil is then overturned and the pot gently pulled leaving behind the soil. Finely sieved ash from burnt wood is then sprinkled on the surface of the internal mold. Putting the ash in a cloth or sock and shaking it above mold to have fine particles is a common practice. A spoon or spatula is used to rub on the mold surface to obtain a surface that is smooth to feel. The same pot is then placed overturned on the ground and a rectangular wooden box of a size in proportion the pot is placed over the pot such that there is ample space between pot and box. The finely sieved soil is then poured into the box and pressed in the same manner as above. A rod, about 2cm diameter and about 4cm length is placed at the center of the box such that its base touches the pot within. The outer part may be widened into a funnel shape to ease pouring of melted tenor. Before overturning the box, this rod is first removed leaving a vent through which melted scrap will then be poured. Finely sieved wood ash

is again sprinkled on the created external mold and the smoothing process carried on. This is then carefully placed on the earlier created mold. Marks are made on the wooden boxes which serve to ensure that both molds are placed in appropriate positions. The process of making the molds can be quite delicate and time consuming. Because the pots are given numerical size names (sizes 1,2,3,4, etc), the same too applies to the mold.



Figure 18 Construction of molds for production of household cooking pots (Source: author's fieldwork)

b) Steps involved in the Processing

Three basic steps are involved in the processing of the aluminum wastes at the processing plant: i) melting ii) pouring of melted tenor into molds iii) pulling out mold to have pots iv) correcting for errors in shapes v) cleaning of entire unit (figure 5.5). Little is done in terms of preparing the aluminum scraps for smelting. However, removal of large impurities on metals surfaces and size reduction may be done to reduce contaminants and ease the placing on scrap into the melting pot. In cases where wood is used, the wood has to be split into smaller pieces so they can conveniently be placed in the heating chamber. Depending on how fast and crafted the producer is, melting begins

after all molds have been prepared or may go on simultaneously.

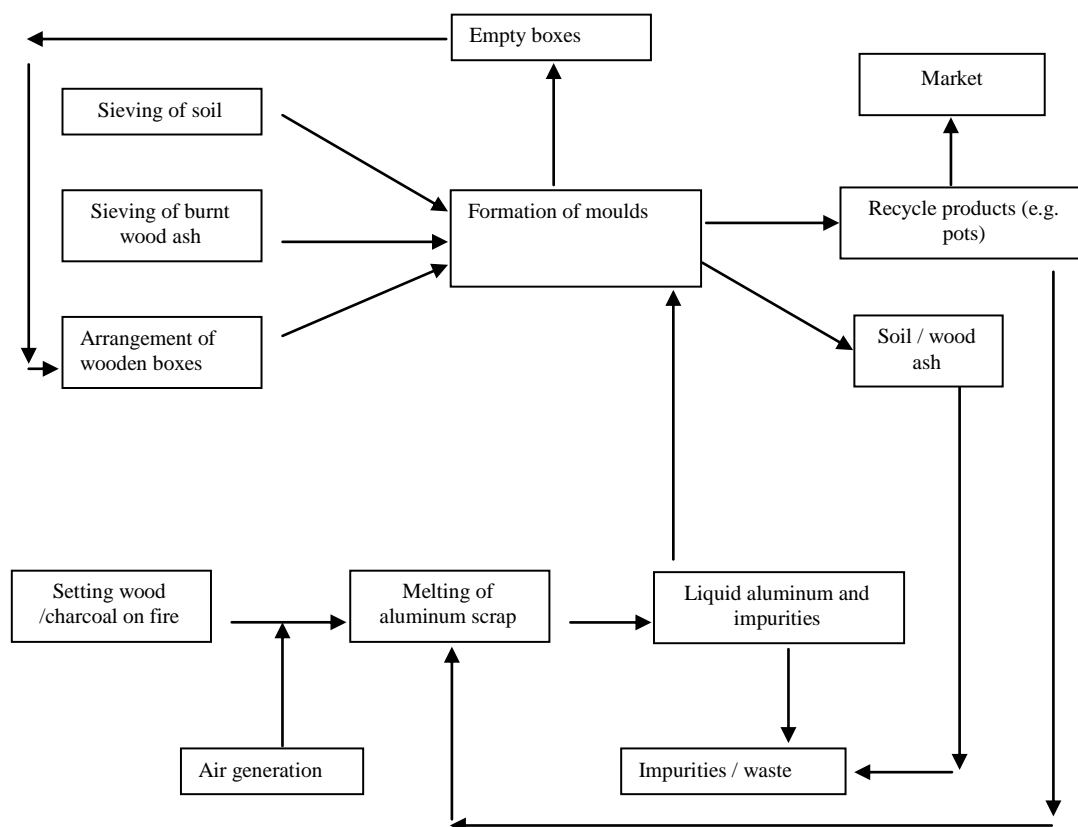


Figure 19 Steps involved in the recycling of aluminum at a processing plant in Cameroon (author's construct)

i) Melting of Scrap

In the smelting process the aluminum is filed in the smelting container before setting the heating chamber operational. As the heating gets on, amount of aluminum in melting container greatly reduces due to melting. Hence there is continues addition of raw material to meet expected volume for given production. When smelting is complete, liquid aluminum settles at the base of container while all other impurities as dirt and soil particles remain afloat. These are taken out skillfully with a long metal spoon to leave silver-colored liquid aluminum. Smelting generally runs for over four hours. The heating may get to temperatures of 600⁰ C and more which is the minimum to melt aluminum.

ii) Pouring of melted tenor into molds

When melting is complete, the melted aluminum is then poured into the molds through

the small opening at the top. This is done as fast as possible to avoid cooling since cooling will result in hardening. If for any reason the process has to be halted the melting dish is placed back in the heating chamber. After pouring, the molds are left for about 5-10 minutes.

iii) Pulling out molds to have pots

After a short length of time upon pouring of liquid aluminum into molds as indicated above, the soil is then shattered and the pots (or new products whatever the case) are then removed and dipped into water to cool them and ensure they are hardened. The soil is then discarded as residue since it cannot be reuse because it has lost its cohesive properties. The empty wooden boxes can then be reused. In terms of scrap material requirement, table 5.1 presents some insights into the relationship between

Table 12 Relationship between quantity of aluminum scrap used to pot size produced (values are based on interview for three production units)

Production Unit 1		Production Unit 2		Production Unit 3	
Quantity of scrap (in kg)	Pot size (numerical or other name)	Quantity of scrap (in kg)	Pot size (numerical or other name)	Quantity of scrap (in kg)	Pot size (numerical or other name)
2 – 2.5	1	2.5	1	1	1/2
4.5	2	4.5	2	1.5	1
5-5.5	3	5	3	2.5	2
6	4	6.5	4	3.5	3
7	5	7.5	5	4	4
8.5	6	8	6	5.5	5
9	7	15	12	6.5	6
		35 - 40	Mt Cameroon*	9	8**
				15	12
				25	20

Source: author's fieldwork 2007/2009.

* Highly subjective and non-standard nomenclature with likely limited area of usage.

** Producer contests the use of a size 7 nomenclature. Hence to him size 7 is non-existent.

quantity of materials and pot size produced for three different production units at

different localities. Basically, because pot sizes increase with increasing numerical size names, then more material is required to produce bigger sizes accordingly. From the table it is observed that pot sizes named or classified based on a numerical size nomenclature, which seems standard for different production units for sizes up to size 6 with discrepancy occurring for bigger size names. For example, according to production unit 3, size 7 is non-existent while production Unit 2 employs non – numerical size names like size Mt Cameroon (a likely size analogy to the highest mountain in Cameroon represent biggest size). Comparing the values for material used to pot size produced for the three production units shows some significant similarities especially for production units 1 and 2. The quantity of material used is also depended on the nature and quality of scrap. Thus less material is needed for production in a case where scrap is pure aluminum and more material needed in case where scrap has lots of impurities. The use of either more pure scrap or more scrap with impurities that account for the differences in values for unit 3 compared to units 1 and 2. More so, this may have to do with the source of the scrap. A producer may be acquiring scrap from a source rich in only pure scrap such as companies dealing with aluminum services (like fixing of door and window frame). A common source of impure scrap is when a producer obtains scrap from MWS arisings in which case there may be a mixture of material types.

5.6 Marketing for Aluminum recycling in Cameroon

The market for recycled aluminum products (in this case household cooking pots) is mostly that between the manufacturers (or producers) and nearby communities. Manufacturers supply their products through one of the following ways:

- Direct supply to individuals by a prior arrangement, direct contact and personal negotiation especially at production unit.
- Supply to retailers in local communities and markets.
- Sales in shops that may be owned by manufacturers.

There is a high demand for aluminum recycled products. Most households used wooden fire-places or saw-dust cookers for cooking (see Tangang, 2008 for details) and the recycled aluminum pots are quite suited for such use. Supply may be in response to a particular demand. For example, pot sizes greater than size 12 are only demanded by services such as kitchen services in student colleges. Despite the fact that there may be stocking of products, there is a less likelihood of producers suffering any loss from

business.

5.6.1 Socio - Economic Analysis of production of cooking pots

For recycling of aluminum in Cameroon by small private schemes to be economically meaningful, the sales of recycled based products should outweigh production costs for each production unit. Different costs are incurred by buyers of scrap and these costs include:

- Costs in direct purchase of scrap from generator or persons involved in pick-ups.
- Costs of hiring an individual assistant in the field to reduced purchased scrap with a hammer and subsequent conveyance to a central location for onward transportation to processing unit.
- Transportation costs.

The main costs incurred by the producer of the recycled based products (pots in this case) include:

- Cost of setting up processing unit (which is a basic initial cost). Once set up, this cost is covered over a period of production.
- Energy costs. Energy in this case may be charcoal, wood, and electrical energy.
- Maintenance cost.
- Transport costs in transporting finished goods to market.

In assessing the profitability of this small scale industry, one is bound to make some assumptions in estimating values for costs. This is because the prices for the production devices as well as products are not fixed. In this thesis, we present (as seen below) a hypothetical economic analysis of the recycling venture.

Production cost

Setting up production plant	\$140.00
Purchase of scrap (100kg) and transportation	\$100.00
Transportation of products to market	\$ 10.00
Labor cost to workers (not greater than 2)	\$ 15.00
Fuel (wood / charcoal) or Energy (electricity)	\$ 10.00
Total	\$275.00

In the above description gives averages of cost since costs vary depending on certain factors. The cost of setting up a production plant depends on the availability of devices that are used to drive the operations and whether such devices are obtained as new or used products. More so, costs in obtaining some devices may be waived given they can be easily gotten from small vehicle or other engine repair stores. Also in the purchase of scrap the price paid depends on the pureness or quality of it based on intended use. Trimmings from industries that make use of aluminum sheets or so but which do not re-melt aluminum are considered pure and of high quality with mean price of \$1.35 / kg. Other scraps like parts of those from automotive sector are equally priced higher than those from pick-ups by children (which are bought at an average price of \$0.80 / kg). The cost of transportation of scrap to production plant depends on the distance and the nature of road network. For example for a distance of about 20km, with good road conditions, to transport 50kg of scrap would cost about \$1.90. Labor cost does vary given that assisting workers may not comprise permanent staff. They may be contracted on days that there is a task to do. And most often for a plant that produces about 10 pots a day, there may be only one assistant to the owner of the plant. The energy required to re-melt the scrap may be supplied by burning of wood or charcoal or with the use of electric current. Using wood or charcoal is far less cheap than electricity. On the other hand using the former is far more time consuming than the latter.

Sales

In the above hypothetical case, we make use of 100kg of aluminum, which can be used to produce 40 Size 2 pots (based on values from Table 5.2). Thus the sales for these pots based on Table 5.2 will be **\$193.37**. The sales of “macocot” pots may vary depending on particular market to which they are sold. The price variations are, however, not large compared to those at which scrap is purchased. More so, if producers sell directly to the market or to households, the prices may be a little lower. In cases where the sale is done to retailers, then the prices are reduced by about \$0.70. Using the hypothetical analysis above to make an analysis of the sustenance of the recycling venture, it becomes obvious that the business can be quite profitable and self-supporting. If there is a steady production, say from 100kg scrap every month, then one expects a yearly generated income of about \$3,000.00. Given production unit is fixed capital, then the venture is quite profitable.

5.7 Factors that Impact on Aluminum Recycling in Cameroon

Several factors impact on the recycling of aluminum for manufacture of especially cooking pots in Cameroon. These factors may either be socio-economic or having to do with the working environment of the recyclers. The socio-economic factors have to do with the market, public perception and participation in the recycling process. The first and major problem with very a direct impact on the recycling aluminum in Cameroon is the availability of aluminum scrap. The industry can only produce the recycled-based products only if the scrap is available in required or economic quantities. In the past 2 decades, there has been a growing market for aluminum scrap in Ghana and China. Thus significant quantities of scrap are being sold to buyers from these countries or to agents who have markets in these countries.

Table 13 Average market prices for different pots sizes produced from scrap aluminum in Cameroon.

Size	Price (CFA Franc)	Price (US Dollar)*
1	2,000	3.90
2	2,500	4.83
3	3,000	5.80
4	4,000	7.73
5	4,500	8.70
6	5,500	10.64
7	6,000	11.60

*Exchange rate considered at 1\$ = 517, 15 CFA Franc and rounded off to 2 decimal places. Source: author's fieldwork 2007/09

Energy is another concern to worry about in the recycling of aluminum scrap in Cameroon. Recyclers who depend on wood or charcoal face serious problems of shortages during the rainy season. During the rainy season, the demand for these two commodities – wood and charcoal – is generally high especially by households who make use of them. The electricity supply in Cameroon in the last decade has been characterized by numerous unpredictable interruptions. Such interruptions in electricity supply have severe negative impacts for processing plants whose air generation system is driven by electric current. Some systems are constructed in a way that they can be

run mechanically as well as by electric current. From a technical perspective, molding can be a complicated process that requires a lot of caution. When poorly done, the pot form is distorted in shape upon hardening. Hence it has to be re-melted and a new mold has to be built again. This can be time consuming and thus affects the process. In the course of pouring liquid aluminum into molds, maximum caution is also required. At such high temperatures as is required to melt aluminum, contact with the liquid and the human body can result in severe burns. Given that the recycling unit is usually owned by an individual with one to three assistants, ill health can affect production especially when this has to do with the main technical person.

The business has a very good market, as there is the constant and, and recently, growing need for pots and other utensils by the growing population who cannot afford to go to shops for those items. The general public view is that the macocot pots are preferable for use on wooden fire cookers than the usually imported lighter aluminum pots. Because of the thickness and hardness of the posts, they resist scratch effects from the use of metal sponge unlike the lighter ones. Thus the some properties of the products alongside the growing market give extra motivation for both producer and buyer. Transport facilities have a significant impact on recycling of aluminum by this small sector. Generally, most of aluminum is bought from villages in the outskirts of towns and cities. In some cases, road networks and conditions are poor especially in the rainy season. Some road networks have limited number of vehicles plying them. Hence transporting scrap from areas where they are bought to production unit may experience some delay in time.

The waste generated in the process may be a problem that is not different from the basic waste problem in the country. However, not much waste is generated from the process. Waste include: soil that was used to build mould; ash from the burning of wood and charcoal; impurities that settle on the surface of the melted liquid aluminum and broken wooden boxes. The waste in this case is not generally harmful. The soil is usually scattered around the surrounding or used to fill some depressions from where they were initially gotten; the wood thrown into the fire, and the impurities discard with other household wastes. In the re-melting process, there may be a likelihood of gaseous emission given the aluminum is generally gotten from varied sources and have adherent substances to it. This, however, is an under looked aspects given the lack of evidence

for the case.

Safety aspects are most often neglected in the recycling process. Not much in terms of safety measures is integrated in the construction of the production units. Given that these units are generally small extensions or attachments to household kitchens, the working environment is usually not quite spacious. The heating chamber is in the open and the re-melting container is equally left open. These pose some danger with respect to body contact. The workers rarely put on safety boots and clothes. In pouring liquid aluminum into the molds, there could be the danger of spill-over which can be fatal to the skin. Since in most cases these workshops are open air structures or partly covered structures, it is common to find children as well as enthusiastic adults hanging around them. The poor safety measures place these individuals at some risk.

5.8 Strategy for Enhancing Aluminum Recycling in Cameroon

The recycling of aluminum especially for the production of “macocot” pots has been quite a successful venture in Cameroon for over two decades. Despite this relative success, the endeavor still faces some problems as highlighted in the earlier sections of this study. Any attempt to design strategies to improve on the performance of this venture would have to draw from the following:

- Municipal and household solid waste management practices
- Public perceptions and willingness to participate in the recycling venture
- Market factors
- Absence of legal and other administrative guidelines
- Continuous education

MSW in Cameroon is generally bound for landfill where they may be burnt or buried. With just general collection containers for commingled wastes, and the lack of MRF, scrap recovery may not be effective in urban areas with such collection facilities. On the other, in smaller communities, individual households manage their wastes. And because volume generated can be relatively small, picking out aluminum scrap can be fairly easy. This is one of the reasons why recyclers go more to these communities to purchase scrap. Thus these areas should be important targets for raw materials.

Public perceptions and participation can be very instrumental in designing of better

strategies for the success of scrap aluminum recycling. In small communities, mainly children pick up the scraps and sold to the recyclers or their agents. Sales are usually done in a day or a few hours in a day. The children are motivated by the small income they derive from it. Not all parents encourage and welcome the idea of children doing this. In urban areas, picking up scraps from dumps can be seen as degrading. If people could be sensitized on the benefits of recycling, their perceptions may be influenced and participation may be high.

Some market and other institutional factors do impact on the production of “macocots” from recycled aluminum. The sales of the “macocots” is generally encouraging, hence the market in itself is a motivation for recycling. There are however, no legal guidelines covering such production. Thus while at the benefit of the recyclers, the absence of such institutional factors may be detrimental to government as well as the public. As a business, such a venture would have to be taxable, which is not the case. On the hand, if they were to be registered, they may benefit from some form of government assistance. Vehicle repair garages can comprise a major supply source of scrap. Good business communication between owners of such units and recyclers can be beneficial in maximizing recovery. Appropriate knowledge on which scrap to collect is quite necessary. A common practice in this case is apprentice smuggling these scraps to sell for personal benefits. And when owners of repair garages discover this, they may take rash decision like not wanting to sell them to recyclers considering they encourage the apprentice to steal. But is coordinated well, both garage owner and recycler stand in a position to benefit. For any comprehensive socio-economic venture of this nature, institutional factors have to be in existence and be applicable.

With continuous public education on the need to recycle common items of the waste stream like aluminum and plastics, more community participation may be rallied. More so, more of aluminum could be recovered for urban households which would have normally been destined for disposal. Continuous public education is highly needed in Cameroon in the area of enhancing recovery, reuse and recycling of items in waste stream. Figure 5.6 presents a schematic picture of the strategies that can be used to enhance recycling of aluminum by the small scale private schemes. The contributions of each the four basic groups involved are also presented. From figure 5.6 it can be seen that the government, public and recyclers of scrap aluminum stand to benefit from their

various contribution to the recycling process. The government on its part needs to formulate adaptive policies and guideline along interesting incentives that would not only encourage this sector but also stimulate public involvement and participation. The public in response has to participate in the recycling process through separation / recovery of scrap and onward sales of these to recyclers or producers of recycled-based products. The public again constitutes an important link in this model because they in turn buy the recycled based products.

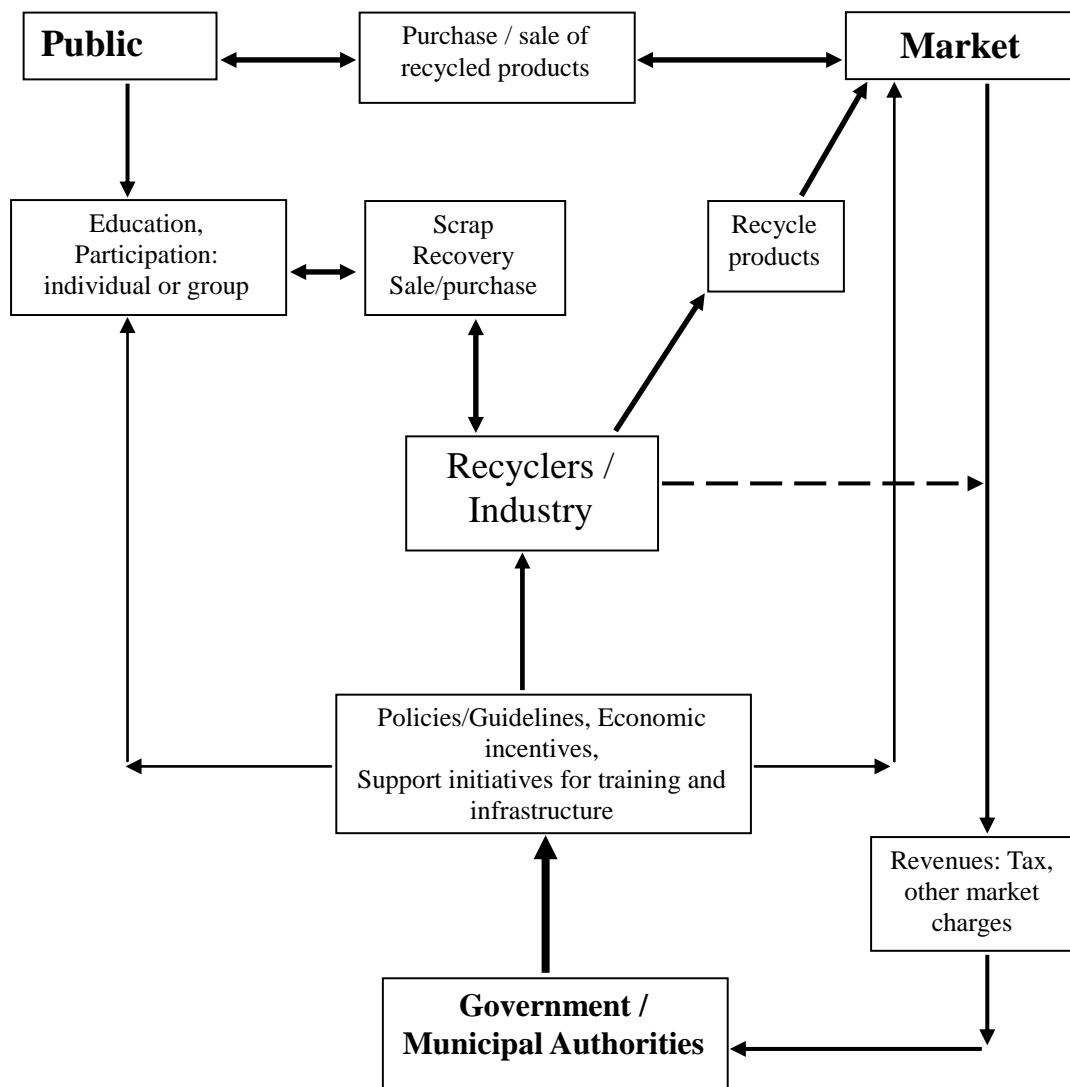


Figure 20 Schematic representation of strategies to enhance recycling of aluminum by small-scale private schemes in Cameroon (source: author's analysis)

The recyclers or producers have the responsibility to adhere to government policies and guidelines. They also have the right to benefit from government incentives and other

forms of support. However, consequent to their business they are expected to pay some form of tax to the government. The producers furnish the markets with finished products which the market then sells to the public. Producers are thus expected to ensure quality and constancy of supply at reasonable prices. The market too would have to operate within the economic frame work of the government and as it maximizes profit, it would be expected to generate income for the government through taxed and other market charges.

5.9 Discussion

Recycling, being a very appropriate and economic approach to MSWM may only be justifiable when some pros and cons are balanced out. Experiences in recycling programs for different communities or regions (whatever the scale) show some similarities but in reality may differ greatly in practice due to conditions of operation and public response to the programs. Recycling programs are generally characterized by a combination of different factors, which boils down to design, cost and implementation.

Considering recycling is not only an environmentally friendly approach of MSWM, but is also an economic undertaking, effort must be geared at keeping productivity and cost-effectiveness in the positive. According to Moore (1993), this can be done by evaluating the entire program to determine whether the material to be recycled by a community will have a market and if they can be collected and processed in a cost effective way. Program design and operational factors are quite essential. Recycling of aluminum, although presenting enormous opportunities for economic and ecological benefits is plagued by several challenges. Getting communities or the general public involved in recycling can be a problem for recycling. Thus in a recycling program focus should not only be on individual materials to be collected but also on community participation strengthened through continuous education. Through continuous education, communities are drilled on parameters for separation of recyclables. This enhances material quality and is a cost effective measure to the recycling program.

In most of the develop countries, recycling continues to be a highly socio-economically and ecologically motivated endeavor due to the growing institutional arrangements that go along with it. Several framework regulations and guidelines are being formulated by

countries at both regional and national levels which do not only impose specifications as to collection, processing and marketing of recyclables, but also provide economic motivations or incentives for recycling. In comparison to the long and well established recycling programs in developed countries, the case for developing countries like Cameroon, with a gleam of hope, at least for some recyclables, stands at the crossroads to answering the trumpet call to action. The big problem to be faced by any attempts to implementing recycling for any materials at end-use point is compounded by the significant absence of MSWM programs. Given that most often people are left to manage their waste in their own way, the notion of coordinated management is lacking and would of course require time to inculcate this into people.

The present experience on aluminum recycling by small scale privately owned industries in Cameroon, shows it has been so far economically rewarding to recycle aluminum scrap especially for production of household consumer products. Everything being equal the cost of producing “macocot” pots from recycled aluminum scraps is significantly lower than the sales from them. From the hypothetical case earlier cited, production cost for 100kg of scrap (minus cost of building production unit) could be about \$135.00 and the sales of pots (say Size 2 pots) made from this lot could be about \$190.00 thus making a positive balance of \$55.00. It is worth noting that production is not on a daily basis. It may range from 2 – 6 times a month. Thus profits of margins higher than this are not uncommon. It is common to find producers involved in some other extra income activity such as farming. And for a country like Cameroon where a good number of workers in some private businesses earn less than \$90.00 a month, then income from recycling should be motivating to sustain the business. In cases where pots are sold to retailers, then the drop in price affects producer’s income. Hence one would imagine that an average drop in price of \$0.67 per pot in the above example would bring down profit in the above case to \$27.00. This profit drop, however, is offset by the fact that the producer does not pay transportation costs to market. Hence profit may rise up to \$37.00.

There is no doubt that given the socio-cultural interactions in Cameroon, rallying the public behind the move to recycle can be a not too difficult task. But the degree to which this can be effectively done or sustained needs to be investigated. The lack of established and guiding institutional structures and regulations in this business has

been shown here to have advantages and disadvantages to both producers and government. Because producers think if such structures are introduced the sector would collapse, any attempt by government to introduce such structures should take strive to protect the interest of the producers as much as possible

5.10. Conclusion and Recommendations

5.10.1 Conclusion

In Cameroon, small-scale private schemes for the recycling of aluminum scrap for the production of especially household cooking utensils represent a small yet significant industry with enormous socio-economic and ecological benefits. Their activities do not only generate income to those involved but also serve as a means to sustainable MSWM. Although this sector does not employ many people, lots of people may benefit from it through their sale of scrap to producers. Despite its success, the sector suffers from: market competition with brokers who export scrap to other countries as Ghana and China; energy supplies during the rainy season in cases where heating for melting is by the use of wood and charcoal; transport problems during remote communities especially during rainy season; and market competition with similar products from neighboring Nigeria. Getting the public involved in recycling through the media and community social groups; government involvement in the activities of this sector through institutional arrangements (which protects the interest of recyclers); and the upgrading of facilities in production plants constitute approaches to enhance sustenance of the sector.

5.10.2 Recommendations

This study cannot be described as being exhaustive on the issue under consideration therein. While it has addressed some crucial aspects of the main thesis, several areas are still open for research to fully understand the problem of MSWM and strategies to recover and recycle materials from waste as well as the relation between this and poverty alleviation. With direct relevance and to complement this present study, further work is required to:

- Determine the actual activity of small scale private schemes for recycling of

aluminum in which case daily inputs (material and financial) and daily outputs (material and financial) have to be determined. This can be achieved through monitoring the activities of this sector over time since no records are kept by producers.

- Make an in-depth socioeconomic analysis of this sector using appropriate methods such as willingness to Pay (participate) in such programs. Hence the effect of the presence or absence of legislative and other institutional structures need to be assessed.
- Carry out a detailed assessment of the technological aspects involved in the recycling of aluminum scrap so as to enhance effectiveness and efficiency in production under safe working conditions.

Research on the following issues below may be of significant importance, in line with the present study, in understanding and designing solution and approaches to MSWM in Cameroon:

- Detail studies on characterization of MSW in Cameroon as this will form a sound basis for informed decision making on endeavors to manage waste.
- Investigation on the effectiveness of existing administrative and legal structures in MSWM in Cameroon as well as their significance in any attempt to conceive a program for MSWM.

Another important recommendation of this study in relation to the problem discussed therein is the need for academic institutions to play significant roles as leaders in research on such problems. The University of Buea runs a Department of Geology and Environmental Science and this department should play an active role in generating data as well as investigating into such areas as MSWM. This may be difficult given their tight budget. But they can still go that little mile in which case students take on such issues of direct importance to community.

Chapter Six

Collective collaboration and/or adaptive innovation? An empirical study of institutional efforts and constraints of recycling and material recovery of MSW in Cameroon

Chapter Abstract

In this chapter, an assessment of efforts and constraints to implementing comprehensive recycling and recovery schemes in Cameroon. Literature review, field surveys, interviews and questionnaires were used to assess the strengths and weaknesses of applying collective collaboration or adaptive innovation for establishing comprehensive recycling and recovery schemes in Cameroon as aspects of broader MSWM. Results show that there are existing practices on which comprehensive recycling and recovery can be built upon that would be beneficial to both councils and engaged schemes – mostly SMEs. An inventory of plastic types for common items in shops with plastic packaging show that most fall within the plastic type class 1 and 2 which are easily recyclable. The challenges to be faced and the way forward to implementing any broad scale recovery and recycling are presented. Should councils decide to maintain their existing MSWM schemes, then collective collaboration in which all stakeholders are involved and actively participating would be beneficial. On the other hand, if they wish to expand schemes or create new schemes, and then adaptive innovation would be highly recommended. In the absence of specific policies and legislation on recycling and recovery, SMEs still stand a better chance of regulating activities within their sectors as such activities stand to alleviate poverty and also present ecological benefits.

Keywords: Recycling, recovery, collective collaboration, adaptive innovation, SMEs, Cameroon.

6.1 Introduction

Developing countries continue to face several environmental challenges which at the moment seem quite difficult to handle given the prevailing atmosphere in which such challenges prevail. One of such environmental challenges is that of MSWM, which for many municipalities may be ranked as a major concern yet is still to receive due consideration. A common reason for lack of such due concern has to do with the fact that greater emphasis is put on other major concerns as health and agriculture. The growing piles of wastes due to increasing economic activities and population growth present huge problems whose management municipalities are falling short of. Unlike in some cases where it is the urban poor who are mostly deprived of collection facilities, in

most municipalities in Cameroon where a MSWM scheme is being operated, deprivation of collection facilities may be due to poor accessibility of residential areas, insufficient collection devices, and financial constraints. There are of course a smaller group of persons or households in residential areas of some big cities like Yaounde who pay for household waste collection by some specialized organization. Given the problems that may be brought about by poor collection or lack of collection, effective collection tends to have a greater impact on urban physical environment as well as delivering economic benefits (Coad, 2003).

While most municipalities are faced with challenges in coping with waste management or delivering sustainable services, the involvement of Medium/Micro and Small scale enterprises could be very beneficial. Such a partnership is however not very common in Cameroon although some exist in bigger cities like Yaounde. Some of the significance of integrating SMEs in MSWM in developing countries is stated in the Cairo declaration of principles for SMEs involvement in MSWM service delivery (based on the UMP/SDC collaborative program on MSWM in low-income countries in 1996). Integrating SMEs into existing MSWM schemes would not only strengthen and enhance operations but may also result into the expansion of such schemes so that aspects like recovery and recycling can become incorporated. Any such integration, however, has got to be sustainable. The fact that SMEs may render more efficient services may attract greater investments there ensuring some form of economic sustainability.

6.2 Objectives and method

The general objective of this chapter is to present a critical analysis of existing MSWM schemes in Cameroon with respect to sustainability and the integration of recycling and recovery as aspect of such schemes. Specifically, an attempt is made to in this chapter to elucidate on the following questions:

- How effective have the present schemes been in meeting their desired goals as well as meeting some sustainability criteria
- What are the opportunities that exist to allow the introduction or expansion of recycling and material recovery programs in existing MSWM schemes in Cameroon?

In order to attain the objectives of this chapter, one approach was by making deductive inferences based on the findings of the previous chapters have been made. In addition, both telephone and direct verbal interviews were conducted with personnel of MSWM schemes in Cameroon as well as sectors such as EEE repairs units and the general public that have some connections with waste. To assess the possibility of recycling for items such as plastic bottles and containers, identification of the different types was done based on the presence or absence of inscriptions on the item in question. Such inscriptions are always seen on the surface of items or inserted on any written material adhered to the items. Such inscriptions may be numbers or signs. And because they provide a pointer to the relative to, say, recycle an item, an inventory of them is quite vital in assessing the plausibility of introducing recycling within an existing MSWM scheme. Relevant literature that highlights on similar studies in different localities were consulted so as to draw comparisons to this study and to add profundity to the discussion.

6.3 Performance and effectiveness of present schemes

6.3.1 Case of the Public

In assessing the performance and effectiveness of existing MSWM schemes in Cameroon, the following have been considered: practices by both public and administration, approval ratings of schemes by public, perceptions of and attitudes toward waste management issues, and stakeholder involvement. The basic practices indulged in by public with respect to MSWM in Cameroon have to do with generation, storage and disposal. Transportation may not be significant in cases where households have yard disposal facilities or dispose of their waste in some nearby facility. The type and volume of waste generated per household depends on factors such as socio-economic status, household size and location but similarities in generation patterns can be observed over wider areas – with a general high amount of organics. Household waste storage devices vary too and depend on the availability of such device. A survey of some households in both the Limbe and Buea (fig 6.1 and 6.2) municipalities show that most residents in store waste in tin containers and old plastic buckets (case of Limbe). In a more detailed survey of the various waste storage devices in Buea municipality in which three different groups (students, households and businesses) are

considered, the following trends are observed: for households, 61.9% of respondents make use of either basket/carton or plastic bucket/tin container to store their waste. For students, 70% of respondents make use of a plastic bag to store waste. For businesses, there is the entire use of either basket/carton or plastic bucket/tin container.

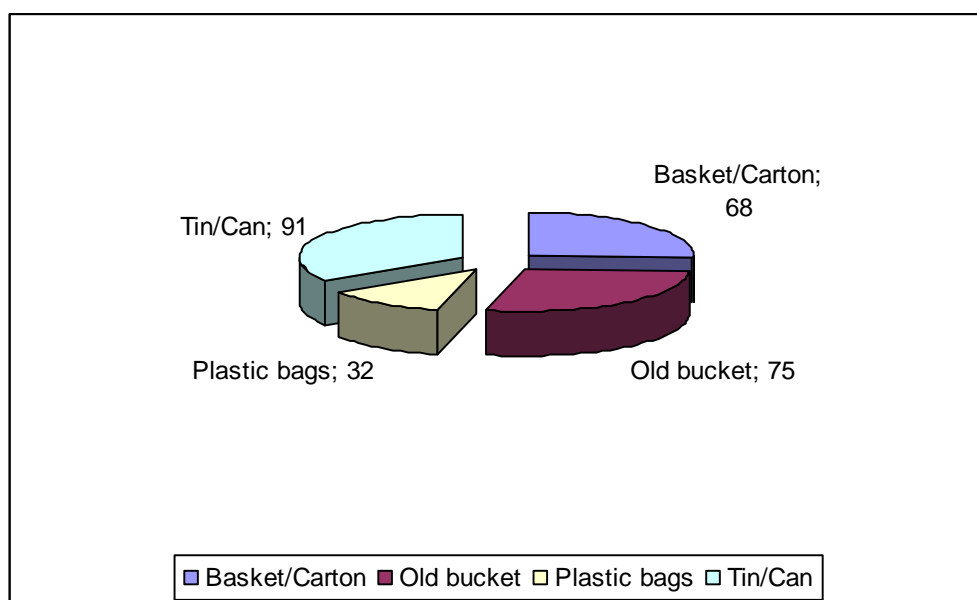


Figure 21 Common household waste storage devices in Limbe municipality (source: author and Nkemnkeng, 2007)

The high use of tin containers and old buckets have to do mainly with the fact that they can last over time and can accommodate a greater amount of waste as well as sustaining the weight.. Hence users are not regularly faced with the problem of getting new storage devices. Among the student community however, the use of plastic bags is due to convenience. Because most students placed their waste storage devices along the balcony, a closed plastic bag is more presentable than an old plastic bucket or metal container. More so, given the relatively smaller quantities of waste generated, short storage time and likely presence of some disposal facility in the vicinity of most student residences, disposal is very regular hence plastic bags serve a better role in this case. Since most businesses use cartons regularly, the cartons once emptied of its contents are usually used to store waste before disposal. Although cartons are not durable in such cases, the fact that they are readily available means that regularity of use is ensured. Some businesses also generate waste with greater weights implying the use of plastic buckets / tin containers is also valuable for this sector. For a waste

management scheme to be sustainable, businesses (which generate greater waste compared to households) are supposed to be served with bigger containers or skips. Thus there is supposed to be special arrangements between them and the council.

The storage time of waste within households differ for both municipalities as well as for the different groups. In Limbe, storage time for those living along secondary collection routes or served with collection facilities is generally lower than those without such facilities. In the later case it may be more than three days. In Buea, storage times are longer for businesses (five days and more) and households (three days and more) than student residents (two days and less). The distance covered to reach secondary collection facilities within municipalities can be quite great especially for areas not well served with such facilities. This distance is, however, relatively shorter for Limbe than Buea where residents may need to cover up to 300m and even more. The implication of such storage time and distance to collection facilities are: 1. amount waste generation outweighs the carrying capacity of storage devices; 2. due to the reason in 1, there is the eventual likelihood to dispose of waste in a way to cope with generation and storage hence any possible means of disposal is employed; 3. the long distances to collection facilities discourage primary transportation of waste to such facilities.

A survey to ascertain public awareness on MSWM practices by the council on issues such as frequency of collection shows that the public lacks informed knowledge on such issues. For example, with a defined collection program, it implies public has to be aware of such days within the week or month. Given responses on frequency of collection vary across respondents, it implies they rather guess than know the actual frequency of collection by council or its contracted agents. The public recognize the fact that the municipal councils are giving some attention to the MSW problem especially from the mere fact that they distribute public collection facilities and transport and dispose of MSW. Yet in Buea, unlike Limbe which has long had a system in operation, over 80% of respondents are the least satisfied with the council operations.

6.3.2 Case of Council and Contracted Agents

Waste management in Cameroon at the municipal level is the responsibility of the municipal council. The council may solely engage in this activity or contract other

agents. Other administrative units like the Divisional and Sub-divisional office may from time to time engage in activities relating to waste management. A typical example of such activities is the “keep the community clean” campaign, which is a day set aside within the month during which all businesses are closed till mid-day and the entire public engages in community cleaning. Such activities are intended to clear litter out of sight. Litter along streets, parks and other public places are collected and most often burned in the open, blocked stream and other smaller water ways that run through communities are cleared-up. This hygiene and sanitation event somehow reduces the burden of the municipal council in managing waste although it has its own setbacks. For example, one set back of such an activity is that little health and safety considerations especially for school and college students during such activities.

MSWM in Limbe, which was initially the sole responsibility of the council but was later contracted to HYSACAM. Thus the latter is thus expected to operate in the terms of the contract it has with the former. HYSACAM has been doing a great job in handling MSW within the Limbe municipality – that is the collection and final disposal of MSW. With increasing generation rates over the last few years, the company has been faced with the difficulty of meeting set targets with minimum infrastructure. Both HYSACAM and the Limbe City council have been working hard to meet their desired objective as stated in the waste management plan for the city – i.e. to provide a clean and less polluted environment for its community. In the last two decades the council has been meeting to this challenge as evidence by the fact that prior to 2000 that city was always among the top 5 cleanest towns in Cameroon. The second aspect of the objective of providing a less polluted environment for the city presents greater challenges.

The MSWM scheme operated by the in Buea municipal council is quite on a far smaller scale with respect to operations and logistics to that of Limbe but with similar objectives. The characteristics of the MSWM systems for the two municipalities are presented in Table 6.1. The MWSM system of Limbe is relatively advanced and broader than that of Buea. Common to the two just like for other systems is the fact that he council is responsible for managing the MSW within the confines of its municipality.

Table 14 Characteristics of MSWM systems for Limbe and Buea Municipalities

Attribute	Limbe Municipality	Buea Municipality
Service provider	-Initially urban council now by contracted agent HYSACAM.	Sole responsibility of municipal council.l
Primary waste storage	- Households use mainly plastic / metal buckets or containers. - Where disposal facility is available there is no storage.	- Households use mainly plastic / metal buckets or containers. - Student residents use mainly plastic bags. - Where disposal facility is available there is no storage.
Primary transport	-Mainly by children to secondary storage (collection) facility or some disposal site. - Drop-in to collection trucks passing around residential areas.	Mainly by children to secondary storage (collection) facility or some disposal site.
Secondary waste Collection / storage	Public skips and containers provided by HYSACAM. - Commingled collection.	A few skips at locations with high commercial activities. - Commingled collection.
Secondary transport	Specialized vehicles for transporting skips and emptying of containers for onward final disposal.	Specialized vehicle for transporting skips to be emptied at final disposal site.
Disposal	- Three abandoned sites. - One functional site on an undercut slope, with no control for leachates. - Waste compacted approximately once in two months.	- Pit disposal at open site not distant from residential areas. - No compaction, but burning of waste to reduce volume.
Stakeholder involvement	- MSWM plan prepared in consultation with quarter heads, councilors, contracted agents and government.	MSWM plan mainly prepared by council with some form of government intervention
Desired goals	Keep municipality clean and reduce pollution by waste.	Keep municipality clean and reduce pollution by waste.
Operations	Free collection and disposal of MSW.	Free collection and disposal MSW.

(Source: Author's analysis)

6.4 Recycling and Recovery

6.4.1 Requirements for recycling and recovery

There are several requirements to be met to enable either a recycling or recovery program start-off or be maintained. One of such requirements is the development of indicators. Indicators tend to reduce complexities of systems to a smaller set of observations which serve to inform our decision and direct our actions (Bossel, 1999). There is no clear scientific agreement which indicators serve best to evaluate say a recycling system. Eik, 2001 identifies three indicators for use in evaluating recycling systems and they include: generally applicable indicators, system specific indicators and company specific indicators. While the concept of indicators remains quite scientific in its application, there are other requirements for recycling or recovery of MSWM, which once fulfilled in whole or part, may enhance a system as well as initiate the kick-off of a new program. Such requirements include:

- availability of recyclables: because some materials may entail great cost to recycle in which case cost to recycle may outweigh profit from sales of recycled-based products, identification of materials that can be recycled at profit margins is very crucial in a recycling program.
- Identification of a market(s) for recycled-based products: there are cases where competition between recycled-based products and products from virgin materials is stiff. Such competition may be that of price, quality etc. Thus for recycling to be profitable, identification for suitable markets for recycle-based products is very important.
- Identification of different business or production links: a recycling venture may be carried out in a single locality as well as may involve a chain of different companies or businesses in different localities and countries. Identification of such connections is necessary to for any recycling scheme.
- Possession of technological know-how to recycle or the existence of a clear plan on how to acquire such technology
- The willingness of the public at large to greatly participate in the recycling venture or to pay for services as the case may be.
- The existence of policy, economic and other regulatory framework arrangements with regards to recycling
- Development of a recycling program that takes into consideration the above

mentioned requirements. Such a program of course needs to be revised with time.

In cases with developed framework for recycling and recovery, several other specifications may apply as to either the proportion of materials to be either recycled or recover as well as the composition of resultant recycled materials. Thus in the EU WEEE Directive (2003a) for example, targets are set for recovery (70 – 80% average weight of appliance) and reuse/recycling (for component, material and substances 50 – 75%) depending on the class of WEEE. Such targets of course may be difficult to achieve for some material components (such as plastics from WEEE) with state-of-the-art technology. According to Riess et al., (2000) a greater proportion of plastics in WEEE contains brominated flame retardants (BFR) and hence recycling for plastics from such sources is limited to manually sorted polymers free of BFR (Hornberger, 2002).

6.4.2 Assessment of recycling and recovery in Cameroon

Although still at a very low level of operation, recycling of some components of MSW has been going on in Cameroon. Recovery on the other hand is an inevitable aspect of MSWM practice as people would always find some item of use in waste that may not be of use to others. However, the scale of the recovery may vary from individuals recovering items from waste, to scavenging at waste disposal facilities and to large scale operations at material recovery facilities. One of the most comprehensive recycling schemes in Cameroon is that of CIPRE (Centre Internationale de Promotion de la Récupération) that recycles plastics in Yaounde. CIPRE was created in 1996 as an NGO under law N° 090/053 of the 19th December 1990 under Liberty of Associations. The organization operates on a broad scale mainly in the cities of Yaounde and Douala. The main objectives of the organization as stated in their website include:

- Promote an integrated, participative, and economic management of urban wastes in general, and plastic wastes in particular through recycling so as to effectively contribute toward the fight against urban environmental pollution and poverty reduction.
- Encourage and facilitate the development of urban agriculture for the production of qualitative and quantitative foodstuff, in the perspective of better contributing

toward the reduction of the quantity of household garbage and, urban food security. This type of agriculture respects urban environment while being economically profitable

- Assure effective communication in view of permitting the exchange of information and experience, notably the management of urban wastes for a durable development.

CIPRE has the following areas of intervention: protection of the environment through recovery and recycling of MSW; enhancement of environmental education and gender issues through education and social promotion activities; promoting MSW research through student training and placements (collaboration with universities and other research institutions); economic development through for example, the recycling of MSW and marketing of recycled-based products; promoting environmental communication through seminars and publication of periodicals. The organization has the following partners: 10 technical partners; five financial partners including the Dutch organization CORDAID (Catholic Organization for Relief and Development Aid), German Development Service DED, The Forum II project of the EU-Cameroon Cooperation, The French Cooperation in Cameroon and The US Embassy in Cameroon; seven institutional partners including the Yaounde VI council and sub-divisional councils of Douala V; and is partner to a bigger Network group of organizations in Cameroon.

According to Tchunte et al., (2000), CIPRE had a set goal to collect 380 tones of plastic waste monthly in Yaounde, recycle 80%, repair 2% and redirect 18% as waste to MSW stream. This set target is, however, about 1% of the monthly generated MSW for the city. Thus strategies and approaches to enhance collection and set higher targets are highly needed. The low target quantity for repair is likely based on the fact that at end of use stage most plastics devices may be damaged beyond repair and hence reprocessing becomes a better option. CIPRE reports in 2002 show around the end of 2001,

There also exist other practices that fall within the realm of recycling and recovery but not quite comprehensive in scale when compared to conventional recycling schemes. A typical example is the recycling of aluminum waste for the production of household cooking pots. This is a typical locally adaptable industrial set-up with commendable

outcome. This set-up comprises small units that buy waste aluminum as raw material for the industry from different sources as stated in Chapter 5. Their operations are barely known to administration but the result of their activities is quite significant to communities. A major recovery operation going on in Cameroon is that of EEE repair units. While repairs serve to extend the lifespan of such equipments through repairs, they also reduce the amount of material going for disposal through the recovery of vital components from equipments. A very coordinated form of such activities in Cameroon is that of BETA (Bamenda Electronic Technician Association), which is also a member of the umbrella association NOWECA (North-West Craft Association) which is subsidized by two German organizations viz: Bread for the World (BfdW) and German Development Service (DED). BETA has been providing services for members including computer training course on downloading and use of manuals for repair works on cell phones and other EEE. Such opportunities are now making members more efficient in services being rendered to the wider public. Because these EEE repair units represent a major link in the product cycle for these equipments in Cameroon, they may also serve a vital role in recycling and recovery efforts directed towards WEEE

In this research an attempt has been made to identify plastic types for some common products in use in Cameroon and the result is presented in Table 6.2 below. Different plastic materials have different potentials for recycling. An identification of plastic type and the number assigned to such a type serves in some way as pointers to recognition of: fact that material or item can be recycled (where facilities exist); type of material product is made of; and compliance with a recognized compliance system. The most common recycling symbol for plastic is the Mobius loop that comprises three chasing arrows forming a triangle with each arrow representing an aspect of a successful recycling program: collection, re-manufacturing/reprocessing into new product and purchase by consumer. There are several other recycling marks found on products with some such as the Green Dot (in Germany) representing compliance to a system. From table 6.2, it is observed that over 62% of the products identified fall with the PETE and HDPE classes which are easily recycled plastics. Just a few of class 5, 6 and 7 plastics constitute these 35 products identified. Interestingly to note is the general scarcity of

Table 15 Plastic type identification for some common products in use in Cameroon

Product	Recycling symbol*	Plastic type	Country of manufacture
Tangui	T	PET – 1	Cameroon
Volcanic water	T	PET – 1	Cameroon
Supermont	-	-	Cameroon
Seme water	T	PET -1	Cameroon
Tom Milk	T	PS – 6	
Nutri Milk	-	-	-
Camlait		MFP – 7	Cameroon
Bridel Milk	T	Model-depose	Cameroon
Dulait yoghourt	T	PP -5	Cameroon
Mayor vegetable oil	T	PET – 1	Cameroon
Soya oil	non-recyclable	PET	Italy
Mayonnaise	T	HDPE	
Magarine	T	PP – 5	Holland
Rosa Elan	T	PP – 5	Holland
Judida	T	PP – 5	Tunisia
Tartina chocolate	-	-	-
Mayor (5L)	T	HDPE – 2	Cameroon
Aloe vera hair oil	T	PP – 5	Nigeria
Limonade	T	PET – 1	France
Cola Light	T	PET	France
Vinaigrette	T	PET – 1	France
Soupline	T	HDPE – 2	Europe
UB Hair product	T	PET	Nigeria
Kiara	T	PET	Cameroon
Ozone Hair product	T	HDPE – 2	Nigeria
Multisheen ebony	T	HDPE – 2	Nigeria
Joy Product	T	HDPE – 2	Nigeria
G&G	T	HDPE – 2	Cameroon

Body milk (babaria)	T	PET – 1	Spain
Vanilla	T	HDPE – 2	England
Mixa	C	PP	France
Vaseline	T	HDPE	South Africa
Nivea	T	HDPE – 2	EU
Vasylis	T	HDPE – 2	Senegal
Body white	T	PP – 5	Cameroon

*T = Mobius loop; C = Green Dot.

Source: author's fieldwork, 2009

class 3 and 4 plastic types (figure 6.2). Given most of the very commonly used plastic items in Cameroon fall in the first three classes, it is logical that with well defined programs for collection and established schemes for recycling, recycling may not pose severe problems with respect to material types.

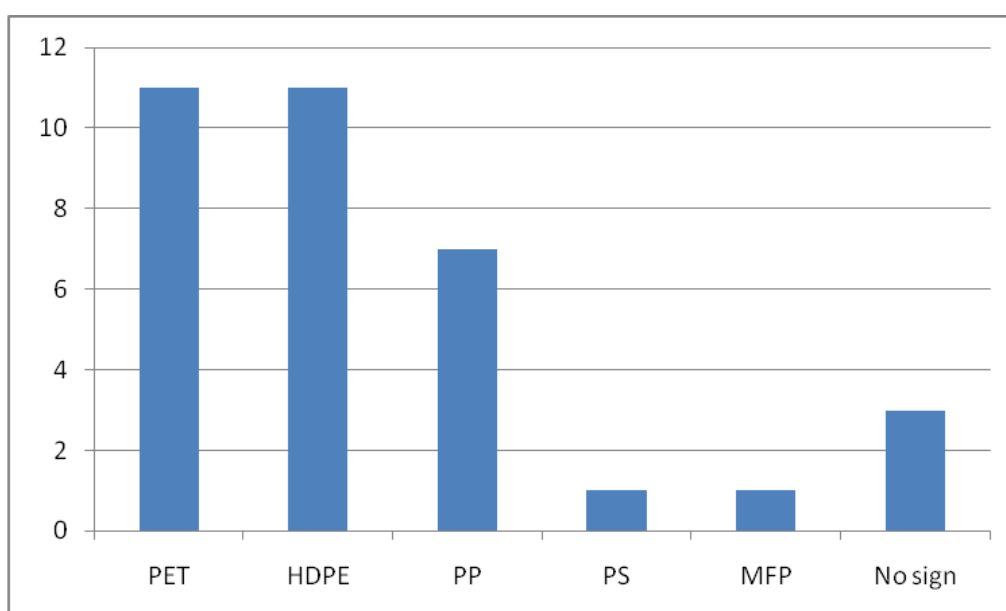


Figure 22 Plastic type identified for 35 products in common use in Cameroon
(Source: author's analysis)

In another survey to assess public willingness to participate in any recycling program if created shows that in both cases (Limbe and Buea) the public is very willing to participate (figure 6.3 for Limbe). However, they think they can participate only if they

receive a payment to handing recyclables to recyclers. Over 90% of respondents in Buea indicate willingness to participate in recycling if they are paid for handing recyclables to recyclers. But the financial arrangements involved in recycling between

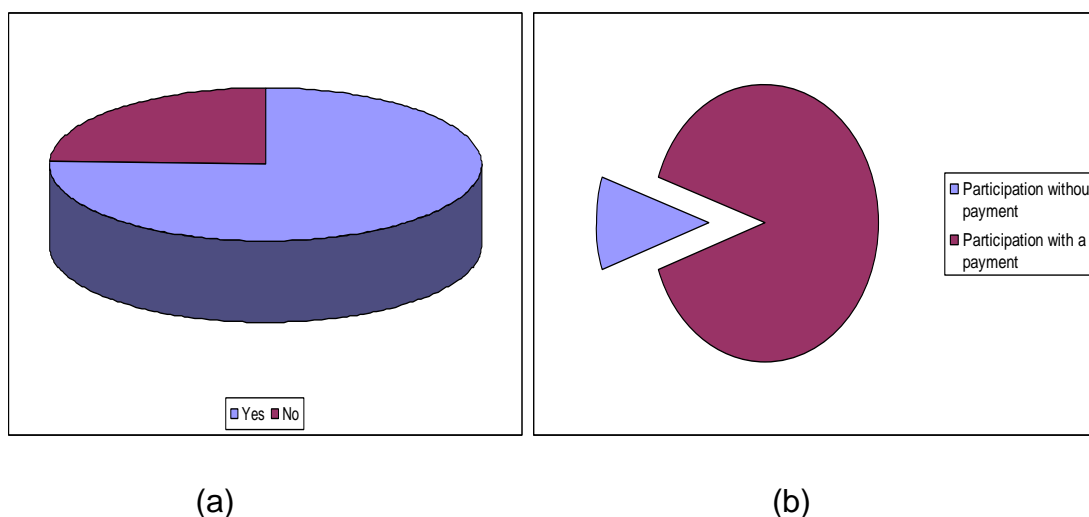


Figure 23 Household willingness to participate in recycling in Limbe: (a) willingness to participate and (b) participation with and without payment.

public and recyclers depend on some other fiscal factors at the level of municipalities and on the contractual agreements with recyclers. If recycling is not subsidized and if collections cost tends to be high, then it is obvious the public may have to pay for recycling services. The notion that participating in a recycling program entails the public receiving some token for such participation stems from the fact that there exist agents who buy plastic materials/bottles as well as glass body lotion bottles. Hence people think for them to engage in returning some components of waste to a recycler it should be accompanied by a token. It is often important to take into consideration the socioeconomic determinants that may be vital to establishing such connection between waste generators and collectors or recyclers. Recovery of items from waste stream is generally done at the level of household and yard disposal facilities. Commonly recovered items from household wastes include body lotion bottles, aluminum and other metals. The generally held view on any form of scavenging at waste sites is that it presents no stigma neither does it bring any shame to scavengers.

6.5 The way forward

6.5.1 Challenges

Although the councils and the contracted agents are trying at their best to ensure proper MSWM, there is also the contention that the present schemes are not operating at optimum and are not sustainable. For example, field interviews reveal that the set target for weekly collections is not met implying failure to operate at optimum. The public thinks that although council is aware of the need to effectively manage MSWM yet they still do not allocate appropriate resources in operations. The several constrains to effectively implement recycling and recovery programs in existing MSWM schemes in Cameroon stems from the operational set-up of such schemes. As long as some key issues are not addressed in the conception of schemes, the impact of failure to address or include such key issues constrains any effort to embark on greater recycling and recovery. Based on the structure and operation of existing MSWM schemes, the following areas are the likely to constrain any efforts to recycle or recover useful components from MSW in Cameroon:

i. Stakeholder involvement

Depending on the nature of the scheme, there can be three to four stakeholders i.e. waste generators – service provider – local government and waste generators – service provider – local government – support agency. As long as all stakeholders are not actively involved, chances are high that the role of a given stakeholder within the scheme becomes missing. Stakeholder involvement and participation also create avenue for greater private sector groups to exploit opportunities especially as service providers. There are many environmental organizations in Cameroon yet many are still to take on MSWM as part of the agenda, at least in practice.

ii. Types of arrangements between stakeholders

In an interview with a staff of HYSACAM, it was found out that the sole choice of collection and disposal were the ultimate choices for the company given that is the basic provision of their contract with the council. Thus it becomes out of concern for the company to worry over any concerns as recycling. It is apparent the council is yet to envisage engagement with other groups or organizations to get them involved in MSWM. Due to the fact that finance may be a limiting factor, it is obvious that the

concern of HYSACAM would be limited only to commercially active areas or services not available to poor remote areas. Therefore the creation of avenues to get other groups involved may lead to wider coverage of schemes. The creation of channels or avenues which may lead to access to support for service providers (through international agencies / organizations, NGOs, other contract partners and local elites / influential citizens) is essential in delivering sustainable schemes. The fact that the local council is responsible for managing waste generated within the confines of the municipality may constrain effort to recycle and recover. In Cameroon, the local councils are expected to manage their waste based on their budget (generated mainly through taxes) and other support from government or international organizations like the French Cooperation. In this set up, councils are not allowed to directly charge the public for waste services rendered. And with the absence of other groups that can foster separate collection of particular items or components from waste, then recycling and recovery becomes a difficult undertaking.

iii. Training, monitoring and enforcement

Technical expertise is a major problem in MSWM in Cameroon. As long as councils and other governmental or private partners involved fail to make provision for regular training to both staff of management schemes or those of other groups interesting in embarking on MSWM the problem of technical expertise looms. Government or council must have the capacity to regulate and control the activities of all groups involved in delivering MSW services specifically in the areas of environmental protection, service standards and enforcing agreements. Thus structures ought to be put in place that cater for issues like illegal dumping or burning of waste, the delivery of standard services which comply with terms of agreements while avoiding fraud, and the avoidance of corruption in transactions.

iv. Developing awareness and information sharing

In a field survey of the public in Buea, Limbe and Kumba municipalities on whether they have media from where they get information on issues like recycling, recovery and sustainable MSWM, almost all respondents (over 98%) stated there are no such media. Without such awareness and the fact that there are channels through which such awareness is reinforced in the public, getting public participation in any move to recycling and recover in a comprehensive manner can be difficult. The radio still

remains a widely used medium of communication hence it stands to play a big role in developing awareness. Also TV is fast becoming popular and thus has a significant audience and can therefore be a good medium for creating awareness. Municipal councils vis-a-vis research / academic institutions need to create some avenues (such as workshops, seminars, exchange of formal correspondences) for which they can share vital information with benefits to recycling and recovery.

v. Economic and financial security

Most SMEs and other private sectors in Cameroon generally face economic and financial problems. Such problems obviously get to constrain their operations as well as ability to expand operations. Due to factors such as lack of information, these groups may not be in any position to exploit possible economic and financial benefits like subsidies, credits and donations from the government and other organizations and/or agencies.

vi. Infrastructure

The constraint placed by poor infrastructure on efforts to recycle may be compounded by both the kind of arrangements that exist between stakeholders and the economic and/or financial security. For example, one of the reasons why specialized collection does not seem important is the fact that there are limited financial resources to acquire bins for such purpose.

vii. Lack of policies and regulations for recycling and recovery

By 2003, Cameroon had no comprehensive policies or regulatory framework to enhance recycling and recovery (Achankeng, 2004) and such is still the case today.

6.5.2 Proposals for way forward

From the foregoing reporting or analyses in this present chapter, it is clear that MSWM in Cameroon has two major approaches for which those involved may want to apply for sustainable MSWM. These two approaches may either be applied separately or together depending on the given context of operation. The approaches are: 1. Collective collaboration and 2. Adaptive innovation.

The first approach, collective collaboration is very vital if councils have to keep up with existing MSWM schemes which are directed towards cleaner environments through the collection and disposal of MSW. Should the basic argument that wanton disposal of MSW and lack of poor collection, transportation and disposal facilities make waste an environmental/health problem then efforts to get rid of waste should be likewise encouraged. In such a case, greater stakeholder participation is very crucial. Getting communities, Community-based Organizations (CBOs), NGOs as well as private partners involved alongside the council and government becomes important. And because in such a situation the main motive is not income or profit generation, altruism becomes the main stimulator for participation. Such altruism may also come alongside several regular education and communication media. CBOs, NGOs and other sectors may go into partnership with council or government towards enhancing improved collection and other decision-making aspects of the MSWM schemes. A big advantage of collective collaboration approach is that collection rates will be improved as a far greater proportion of the public and other groups become highly engaged.

The second approach, adaptive innovation is necessary if existing schemes desire to expand on some aspects of their operations or if new schemes are to be launched. Such expansion may be technological as well as economic. Why innovation in this case has to be adaptive draws from the basic observation that translating waste management strategies of one country to another may not work as expected. Of prime importance then is the fact that socioeconomic parameters and other characteristics of society have to be incorporated in designing any sustainable MSWM program for a given country or municipality. Due to the usual financial constraints faced by developing countries, efforts to expand existing MSWM schemes through innovation has to take into consideration already existing practices that have beneficial impact on MSWM. Such practices include for example, the recycling of aluminum to produce household utensils and the recovery of components from WEEE.

6.5 Discussion

MSWM in Cameroon is mainly the responsibility of municipal councils. Such responsibilities may be shifted to some contracted agents of the council or other registered organizations for a similar cause. The fact that most of the environmental

groups in the country have not incorporated MSWM as part of their agenda has a negative effect on the delivery of sustainable services. Such groups have a greater advantage in engaging and involving the public as they do operate for the most part at grassroots level. The lack of people with expertise learning and training in waste management may be a factor while such groups are not generally involved in MSWM and other aspects of it like recycling. The lack of knowledge too on the options for transformation of waste into resource may also account for the above negligence.

As long as municipal council stick to the of “collect and dispose” paradigm for MSW, any local initiative to recover and recycle waste can be quite beneficial especially to urban poor since such initiative either stand to cut on expenditure or generate income. Such initiatives (for example scavenging at collection points) may slow down collection and result to wanton scattering of litter around collection points. Recognition and greater expansion of existing practices that have positive benefits on MSWM ought to be encouraged. Government, through the Ministry for Small and Medium-size enterprises and local councils may stimulate and support the activities of local groups by creating a fair economic and fiscal environment for operation. Although the bulk composition of MSW in Cameroon, like many developing countries, shows a greater proportion of organics, there is also the presence of a significant proportion of recyclable like plastics and aluminum. Given these proportional of recyclables may be small for larger scale reprocessing, SMEs then stand in a better position to recycle such components. Recycling represents a complete loop or cycle whose components may as well as may not be found within the same country or locality. Thus SMEs serve a better link between local community and distant partners. The role of SMEs in recycling can be quite rewarding based on the fact that the activities of most of them are basically tailored to the needs of their immediate society.

Ngoasong (2007) reports that while economic profit is a priority for most entrepreneurs, SMEs in Cameroon exists mainly to alleviate poverty through income generating activities and contribute to economic development by providing employment for job seekers and household income for especially urban and rural poor. He also states that these SMEs prefer to adapt, imitate and modify existing innovations rather than pursuing Schumpeterian innovation. Because MSWM as well as recovery and recycling present opportunities for poverty alleviation, SMEs then stand to benefit from any efforts

toward involving them in these activities. For this to be sustainable, however, appropriate policies and frameworks should be in place regarding the involvement of this sector into such activities. Such a task is the responsibility of the government. Unfortunately, most of these SMEs are either not registered or not exposed to any information on possible benefits they could derive from government and other support agencies. SMEs need to organize themselves around some priority areas such as upgrading skills, specialization and information sharing. Yet they play a significant role in economic (Baumol, 1993b) and ecological development. Given the significance of the roles they play, the government ought to provide the necessary infrastructure and support to meet the challenges they face.

The public at large recognize the detrimental environmental and health impacts of waste and the poor management of it and is willing to participate in any organized efforts to recycle. The willingness alone does not guarantee the success of a program. The creation of awareness programs can also make participation effective. The councils and contracted agents have got to realize the need for a paradigm shift in waste management. Given they struggle to handle just a proportion of waste generated, any efforts (beneficial) to reduce what goes to final disposal has to be encouraged.

6.6 Conclusion

An analysis of the present MSWM schemes in Cameroon shows that they are strongly built on the “collect and dispose” paradigm for MSW. There has been likewise little concern over local efforts and practices that serve to recover or recycle components of MSW. Such efforts present both economic and ecological benefits. Lessons from established schemes like CIPRE that recycles plastics can be transferred to and implemented by other groups or organization with resultant beneficial effects. One of the greatest limitations to efforts towards recycling and recovery is the fact that there is lack of information in the area of delivering sustainable waste services that benefit a greater proportion of communities and of a shift in thinking from “waste as bound solely for disposal” and “waste as material that can be converted into resource”.

Chapter 7

Summary of Conclusions and Recommendations

7.1 Summary of conclusions

This dissertation sets to address the broader problem of MSWM in developing countries using Cameroon as a case study. The existing management practices and systems involved are discussed and proposals to better the system. Of central attention is the building of an argument that recycling and material recovery are two very beneficial aspects that should be expanded or introduced into MSWM schemes in Cameroon. Thus existing recycling and recovery practices have been discussed and strategies to expand and integrate them presented. To attain the objectives of this dissertation, MSWM in Cameroon was analyzed in order to develop a clearer basis for the main thesis of this research – expanding on and integrating recycling and material recovery (especially through adaptive) in MSWM in Cameroon.

The results show that public involvement in MSWM has been largely based on household preferred options. Existing management schemes are somehow jaundiced of sustainable practices. And because emphasis has always be on the basis of “keep communities clean” focus then has always been placed on collection and disposal. The constraints and challenges that confronts management and which limits management from becoming sustainable includes: infrastructure and logistics; poor urban planning and geomorphological factors; poor landfilling practices, inadequate funding; political and other institutional aspects; influence of long held perceptions; and lack of research and development. Changing consumer life-styles, increasing economic activities and rapid urbanization are impacting greatly on MSW generation thus requiring greater concern for more sustainable management. Hence there is need for innovations and improvements in MSWM schemes that take into consideration all stakeholders. Such innovations will include the introduction of broader but adaptive recovery/recycling programs.

The quantity of WEEE in Cameroon is on an increase due to the increasing demand for used or second-hand equipments whose conditions are not very certain to the

consumer. The desire to live to the taste of technology (though with meager resources) in the recent past has also boosted the acquisition of EEE implying at end-of- life the problem of managing waste from this equipments will be even greater. The WEEE differs in types with location based on the major activities in the area and the educational institutions. However TVs and related acoustics form the greater bulk of WEEE in the localities studied. Although there is a general lack of material recovery facilities in Cameroon, traditional approaches of management such as recovery and reuse of functional components of WEEE are quite plausible. Based on public willingness to participate in management programs, recovery schemes could be implemented, which would be quite adaptable in context though drawing from the experiences of developed systems. Thus we content that such schemes would greatly reduce the impacts of WEEE both to humans and the environment while adjusting to some degree the disequilibrium in the material cycle (where natural materials are exploited when existing products could be recycled and reused).

In Cameroon, small-scale private schemes for the recycling of aluminum scrap for the production of especially household cooking utensils represent a small yet significant industry with enormous socio-economic and ecological benefits. Their activities do not only generate income to those involved but also serve as a means to sustainable MSWM. Although this sector does not employ many people, lots of people may benefit from it through their sale of scrap to producers. Despite its success, the sector suffers from: market competition with brokers who export scrap to other countries as Ghana and China; energy supplies during the rainy season in cases where heating for melting is by the use of wood and charcoal; transport problems during remote communities especially during rainy season; and market competition with similar products from neighboring Nigeria. Getting the public involved in recycling through the media (radio, TV and newspapers) and community social groups; government involvement in the activities of this sector through institutional arrangements (which protects the interest of recyclers); and the upgrading of facilities in production plants constitute approaches to enhance sustenance of the sector.

An analysis of the present MSWM schemes in Cameroon shows that they are strongly build on the “collect and dispose” paradigm for MSW. There has been likewise little concern over local efforts and practices that serve to recover or recycle components of

MSW. Such efforts present both economic and ecological benefits. Lessons from established schemes like CIPRE that recycles plastics can be transferred to and implemented by other groups or organization with resultant beneficial effects. One of the greatest limitations to efforts towards recycling and recovery is the fact that there is lack of information in the area of delivering sustainable waste services that benefit a greater proportion of communities and of a shift in thinking from “waste as bound solely for disposal” and “waste as material that can be converted into resource”.

7.2 Summary of Recommendations

From the above conclusions it can be noticed that for the different issues presented, there similar as well as different problems and challenges faced by MSWM as well as practices in recycling and recovery. Thus the recommendations made in this dissertation may find applicability either directly or indirectly to several areas of MSWM in Cameroon. The recommendations require either action by management in key areas or research into vital areas so as to improve on management.

The following recommendations need to be enacted for MSWM schemes (with recycling and recovery as essential components) in Cameroon to become more efficient in delivering desired services as well as meeting sustainable goals:

Continuous efforts in Research and Development (R & D) alongside information sharing

A very big and detrimental problem in MSWM in Cameroon is that of R and D. Such a problem becomes more compounded when available research efforts do not find opportunities for application. Such efforts would seek to better analyze the existing problems faced by management, assess effectiveness of management approaches, create avenues for innovations within management systems, pave way for collaborative inclusion of stakeholders and creates opportunities for informed decision-making due to reliance on derived and reliable data. More so research and development of local initiatives would be very rewarding to enhance both collective collaboration and adaptive innovation. For such a recommendation to be achieved there must be a medium through which information sharing can be attained especially between academic/research institutions and other stakeholders like municipal councils.

Strengthening the need for and approaches to policy and other regulatory framework formulation

While commitment to implementation of existing legislation (even if not comprehensive enough) has to be increased on the part of government and other institutions related to MSWM, there is need for developing more comprehensive policies, legislation and regulatory frameworks with particular relevance to recycling and recovery and which would cover a greater number of concerns in MSWM such as WEEE. Because comprehensive frameworks are lacking or poorly developed, is obvious ministerial departments, councils and other organizations may be duplication functions as well as staying in doubts over issues. Any comprehensive framework will exclude issues like friction administrative roles for different actors as well avoid duplication of roles and would

Opening up financial constraints

MSWM authorities (mainly councils, private agents and NGOs / CBOs) are limited in their operations due to financial constraints. The nature of financial of councils does not allow them to impose taxes or fees for MSWM activities (for example a collection fee). Thus the fiscal system in relation to councils needs to be readjusted to enable councils garner more financial resources.

Strengthening stakeholder partnerships

Partnerships between different stakeholders especially public-private partnerships are highly desirable in delivering sustainable MSWM. Such partnerships need to be fostered in Cameroon. More so, the creation of CBO may be quite useful in rallying residential support and participation in any waste management scheme. But at the heart of all these is awareness and information. The use of the media to increase awareness of the public and hence their involvement in MSWM is of huge importance.

Strengthening public environmental education and information

The role public education and information play in a MSWM system is very crucial. Unfortunately, this aspect is lacking in Cameroon. Thus it would pay-off much if available media is utilized to continuously educate and provide information on MSWM in general and recycling/recovery on the other hand. Specifically speaking, for recycling

and recovery to be implemented on a broader scale in Cameroon by especially SMEs, the following recommendations may be helpful:

- The actual activity of small scale private schemes for recycling of aluminum has to be assessed in which case daily inputs (material and financial) and daily outputs (material and financial) have to be determined. This can be achieved through monitoring the activities of this sector over time since no records are kept by producers. In the case of handlers of EEE and EoL forms of them, it will be very interesting too, to assess their activities as well. Such assessments can greatly facilitate efforts to justifying the expansion of such sectors.
- An in-depth socioeconomic analysis of this SMEs involved in recycling and recovery using appropriate methods such as, for example, willingness to Pay (participate) in such programs need to be done on a broader scale. Hence the effect of the presence or absence of policy, legislative and other institutional structures need to be assessed as these are necessary for economic development.
- A detailed assessment of the technological aspects involved in the recycling of aluminum scrap and the recycling and recovery of WEEE need to be carried out so as to enhance effectiveness and efficiency in production as well as creating room for adaptive innovation to become more plausible.

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