SUSTAINABILITY IN MUNICIPAL SOLID WASTE MANAGEMENT IN BAMENDA AND YAOUNDÉ, CAMEROON

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ABSTRACT

In Cameroon, and most other developing countries, the problem of inefficient municipal solid waste management (MSWM) is endemic. This is easily identified by persistent heaps of uncollected waste found on street sides or ubiquitous illegal dumps. This thesis examines the sustainability of MSWM in Cameroon using two contrasting city cases of Yaoundé (1.5m people) and Bamenda (300 000 people). As major contributions the thesis generates the much-needed basic original data, critically examines and compares the sustainability of MSWM in both cities' systems, evaluates the environmental impacts and uses these findings to suggest valuable research, policy and strategic-planning recommendations needed to make both systems, and others in similar situations, sustainable.

To achieve these goals multiple triangulated methods were used. In Bamenda, where reliable basic data are non-existent, solid waste from sampled households was collected and analysed for generation rates, quantities and characteristics. In both cities questionnaire were administered to sampled household units selected from four stratified quarters. The survey questions addressed waste management issues and sustainability indicators that were needed to study, compare and evaluate the systems within the wider concept of the waste management hierarchy. The statistical programme for social sciences (SPSS) computer software was used to analyse the survey results. Field observations, interviews and a review of secondary sources complemented the data.

New findings show that Bamenda city generates 120-160 tonnes of municipal solid waste daily (0.40-0.54 kg per capita), 76% of which is biodegradable and 24% non-biodegradable. About 90% of all solid waste comes from households. Bamenda Urban Council (BUC) regularly covers only 1/20th of the city area and collects and transports 20-30 tonnes of waste from its skips, accounting for only 17-25% of the total daily waste generation. The waste is disposed of at an uncontrolled dump on the Mezam River flood plain. The citizens illegally dump the rest. Skips are crucial to the system but their total capacity and access are grossly inadequate (37m^3 over 28 sites), with a further 465m^3 needed. Citizens move an average of 105 m to waste disposal sites.

This suggests a sustainable inter-skip distance of 210 m for Bamenda city, far from the present 700 m.

Yaoundé's daily per capita MSW generation rate is estimated at 0.79 kgs or 1200 tonnes for the entire city, three-quarters of which is biodegradable. Only one-third of the city area is regularly served with about 40-50% (~540 tonnes) of the waste collected and disposed of at the sanitary landfill on the Nfoulou River valley. Total available skip capacity is 1440m^3 with 3048m^3 lacking. The primary waste disposal average distance is 87 m.

Yaoundé and Bamenda cities are unique in physical conditions and status but neither is able to deal adequately with the increasing waste generation rates, quantities and varieties that are driven by rapid urban population growth, spatial expansion and improved affluence and consumption among selected groups. Yaoundé's management has an edge over Bamenda's in terms of performance rates but leaves behind five times more uncollected and illegally dumped waste than Bamenda. Though Yaoundé's system is private and Bamenda's is public, both systems apply the same conventional approach that concentrates on imported technologies while neglecting waste prevention, recycling, safe disposal, involvement and integration of citizens and other stakeholders. This limited and monopolistic approach makes the system unworkable and equally creates huge environmental and health-related problems present at all the stages of the waste management cycle. Government devolves the waste function to urban councils but centralises funds and power. Its waste policies are limited, fragmented and confusing. The garbage tax law yields only 5% in Bamenda and 7% in Yaoundé, making both cities rely heavily on extra financial support from Cameroon and abroad. In all, neither city in the study demonstrates sustainability in any aspects of its MSWM system.

The existing systems are not sustainable. A new system based on an integrated sustainable model operated within the context of good urban governance is proposed. This model accommodates the uniqueness of cities and is recommended for other cities in the country, Africa and the developing world.

DECLARATION

This work contains no material that has been accepted for the award of any other degree or diploma in any other university or tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference is made.

I give consent to this copy of my thesis being available for photocopying and loan.

Signed______________________________________ Date___________________

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SHORTENED FORMS:
ABBREVIATIONS, CONTRACTIONS, ACRONYMS, INITIALISMS AND SYMBOLS

ADF	Advanced Deposit Refund
3Rs	Reduce, Reuse, Recycle
ADS	Advanced Deposit System
BUC	Bamenda Urban Council
CBO	Community-based Organisation
CFA	Central African Franc
CIG/GIC	Common Initiative Group/Groupe d'Initiative Commune
CIPRE	Centre International de Promotion de la Recuperation /International Centre for the Promotion of Waste Recovery,
CPDM	Cameroon Democratic Movement Party
CUY	Communauté Urbaine de Yaoundé/YCC: Yaoundé City Council
CWG	Collaborative Working Group
DO	Divisional Officer
DRS	Deposit Refund System
DSCN	Direction de la Statistique et de la Comptabilité Nationale/National Statistics and Accounts Department
DSS	Decision Support System
DSW	Domiciliary Solid Waste
EEA	European Environment Agency
ENCAPAFRICA	Environmental Assessment Capacity Building Programme for Africa
ENDA	Netherlands Directorate for Development Assistance
ENS	Ecole Normale Superieure/Advanced School of Education
ENSP	Ecole National Superieure Polythenique/National Advanced School of Engineering
EPA	Environmental Protection Agency
EPR	Extended Producers Responsibility
ERA	Environnement Action Recherche au Cameroun
ESA	External Support Agency
EU	European Union

FOCARFE	Fondation Camerounaise pour une Action Rationalisée des Femmes sur l'Environnement
FOURMI	Fonds aux Organisations Urbaines et aux Micro Initiatives/Urban Organisations and Micro Initiatives Funds
FSD	Fonds Sociale de developpement / Social Development Funds,
GOC	Government of Cameroon
GOSA	Government of South Australia
GRET	Groupe de Recherche et d'Echange Technologique/ Research and Technological Exchange Group.
HABITAT	United Nations Centre for Human Settlement
HDI	Human Development Index
HYSACAM	Hygiène et Salubrité du Cameroun/Cameroon Hygiene and Sanitation Company.
IBRD	The International Bank for Reconstruction and Development
IMSWM	Integrated Municipal Solid Waste Management
ISMSWM	Integrated Sustainable Municipal Solid Waste Management
LEMP	Landfill Environmental Management Plan
LULU	Locally Unaccepted Land Use
LWMA	Lagos Waste Management Authority
MAETUR	Mission d'Aménagement et d'Equipement des Terrains Urbains et Ruraux/ Urban and Rural lands Development Authority
MSW	Municipal Solid Waste,
MSWM	Municipal Solid Waste Management
MTC	Marginal Trash Collection Charge
NGO	Non-Governmental Organisation
NIMBY	Not In My Backyard
NIMTO	Not In My Term Of Office
OECD:	Organisation of Economic Co-operation and Development
PDM	Programme de Developpement Municipal/City Development Programme
PR0	Producers' Responsibility Organisation
QA	Association de Quartier/Quarter Association
RDF	Refuse Derived Fuel
RECEUP	Programme d'Economie Environnementale Urbaine et Populaire
RSW	Residential Solid Waste

SAP	Structural Adjustment Programmes
SDF	Social Democratic Front
SIC	Société Immoblière du Cameroun/Cameroon Real Estate Corporation
SKAT	Swiss Centre for Development Cooperation in Technology and Management
SME	Small and Medium-size Enterprise
UBS	Unit–Based-pricing System
UMP	Urban Management Programmes
UNCHS	United Nations Centre for Human Settlements (HABITAT)
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
USW	Urban Solid Waste
UWEP	Urban Waste Expertise Program
WASTE	A waste management consultancy group funded of the Netherlands Development Assistance for the Dutch Ministry of Foreign Affaires.
WCED	World Commission on Environment and Development
WHO	World Health Organisation
WRI	World Resources Institute
YA	Youths' Association

PART ONE CHAPTER 1

Introduction and Background

1.1 Introduction

> Solid waste has become a major consequence of development and modernization, yet some of the greatest challenges to its management are felt mostly in the developing countries. This is part of the larger paradox of development –factors, which create the most intransigent problems currently facing the developing countries, are invariably those that derive from development itself. This irony is based on the gap between the patterns of growth and modernization in the developing world on the one hand, and the capacity to pay for, plan for and effectively manage solid waste as part of an integrated national system, on the other (Thomas-Hope 1998, p. 1).

Municipal solid waste management (MSWM) is one of the critical environmental challenges of rapid urban development facing the developing countries including Cameroon. Solid waste arising from human domestic, social and industrial activities is increasing in quantity and variety as a result of growing population, rising standards of living and development of technology (Suess 1985; UNEP,1991; Dickerson 1999). A decade ago, Beede and Bloom (1994) estimated the global MSW generation rate at 1.3 billion tonnes per day; translated to an average of two-thirds of a kilogram per capita per day or ten times per capita body weight per year. A recent report from Research Markets in Dublin, Ireland estimates a global total amount of municipal solid waste generation at 1.84 billion tonnes, an increase of 7% over the 2003 figure <http://www.jxj.com/msw/index.html>. The report further estimates that between 2004 and 2008, global generation of municipal waste will rise by 31.1%.

The need to manage this increasing waste in an environmentally effective, technologically feasible, economically affordable and socially acceptable manner is a problem faced by all nations of the world today. It is hard to reconcile the trade-offs between the four dimensions presented above, partly because some of them actually conflict and the problem is also linked to the paradox of the sustainability concept itself. Waste management is also not glamorous; yet without it, every city would cease to exist (Zurbrügg 2002). Hence all cities, the world over, have developed some way of dealing with the problem.

The degree of success with which the developed and the developing countries, including Cameroon, are coping with the problem is, however, very different. While the developed world has sought effective solutions through greater efforts to move up what is called the "solid waste hierarchy", the developing world countries are simply overwhelmed with the waste problem or can now barely grapple with the elementary stages of it. The solid waste hierarchy is an internationally accepted and recommended ranked priorities of waste handling using the following ascending order of preference: open burning, dump, landfill, incinerate, recycle, reuse, prevent (Beukering *et al.* 1999; Adams *et al.* 2000; Wright 2000; Hansen *et al.* 2002). The first two (open burning, and dump) are least preferred and actually not recommended even though the methods are highly used by many developing countries. The concept is discussed further in Chapter 2.

1.1.1 Global Significance of Municipal Solid Waste Management

As mentioned above, the problem of municipal solid waste management varies in magnitude in different regions, nations and cities of the world. Table 1.1 summarises the world and regional dimensions of solid waste. The table suggests a gruesome future of solid waste management, especially in the developing regions of the world.

TABLE 1.1

Global Dimension of Solid Waste Problem

Factors	**Observation**
Population	By 2050 the global population is projected to be 50% larger that today) i.e. 9 billion people), and 95% of that growth is expected to occur in the developing countries (Swell and Morrison 1999)
Consumption	Consumers in certain rapidly expanding non-OECD economies are emulating the ecologically challenging consumption pattern of consumers in the OECD countries.
Affluence	Some of the highest GNP growth rates in the world are taking place in countries outside the developed world, such as China, India, Brazil and Indonesia (OECD 1997b)
Technology	The World Bank reports that "massive levels" of industrial investment will occur in developing countries (Hanrahan 1995). In principle, "leap-frogging" the dirty technologies of past may be possible since many developing countries have fewer sunken costs in older "eco-unfriendly" technologies (Andrews and Socolow 1999)
Impact	A five-fold increase in global waste generation is possible by 2025 (CSD 1997)

Source: OECD 2000 in United Nations Economic and Social Commission for Asia and the Pacific {UNESCAP} 2000, P. 4

As in Table 1.1, the major driving forces behind waste generation are population, consumption, affluence and technology. In the developed world, the factors of consumption and affluence fuelled by technology are stronger in determining the prolific waste generation. These developed societies are increasingly prolific generators of municipal solid waste, for example, they represent only 16% of the world's population but consume 75% of global paper production (The International Bank for Reconstruction and Development {IBRD} *et al.* 1999). They are usually described as 'throw away' societies because they produce huge quantities of packaging, regularly utilise disposables and have an insatiable desire for acquiring the latest models of goods and by so doing, discard the old as waste. The OECD statistics show that between 1990 and 2000 MSW increased by 14%, that is, from 530 –605 million tonnes, 509-540 kg per capita per year (1.4-1.5 kg per capita per day)[1] (Organisation for Economic Co-operation and Development {OECD} 2004) However, city and national variations exist, for example the US average generation rate in 1999 was as great as 2.1 kg per capita per day (Mihekcic *et al.* 1999; US EPA 2003).

Increased waste generation does not, however, determine the degree of efficiency in the management of waste. The developed world is not only a greater waste generator but also a better waste manager compared to the developing countries. The developed countries have rigorously applied the waste management hierarchy principles within the wider framework of integrated solid waste management systems, and through using policies and strategies that emphasise waste prevention, minimisation, and safe disposal. Generally MSW management has improved drastically with collection attaining almost 100% everywhere (UNEP-IETC 1996). According to De Tilly (2004), in the OECD member countries between 1995-2000, rates of waste incineration with energy recovery, recycling and composting increased; and even though landfill waste quantities continued to increase, landfilling rates dropped and those of incineration stagnated (De Tilly 2004).

In the developing countries, the stronger driving force for waste increases is the high rate of urban population growth (Figure 1.1). Figure 1.1 shows that while the rates are slowing down in the developed world and Latin America, Africa and Asia are experiencing very high growth rates, higher than the rates of the entire developing world. Other sources also confirm that by 2015, half the world's population will be living in cities, growing at an average rate of 2.4% per year consistent in doubling with 29 years with the greatest increase being in Asia followed by Africa. The same source notes that apart from New York and Los Angeles in the developed world, the remaining 19 out of the 21 largest cities ($\geq$10 m people), will be located in the developing parts of the world (United Nations Population Division 2002)

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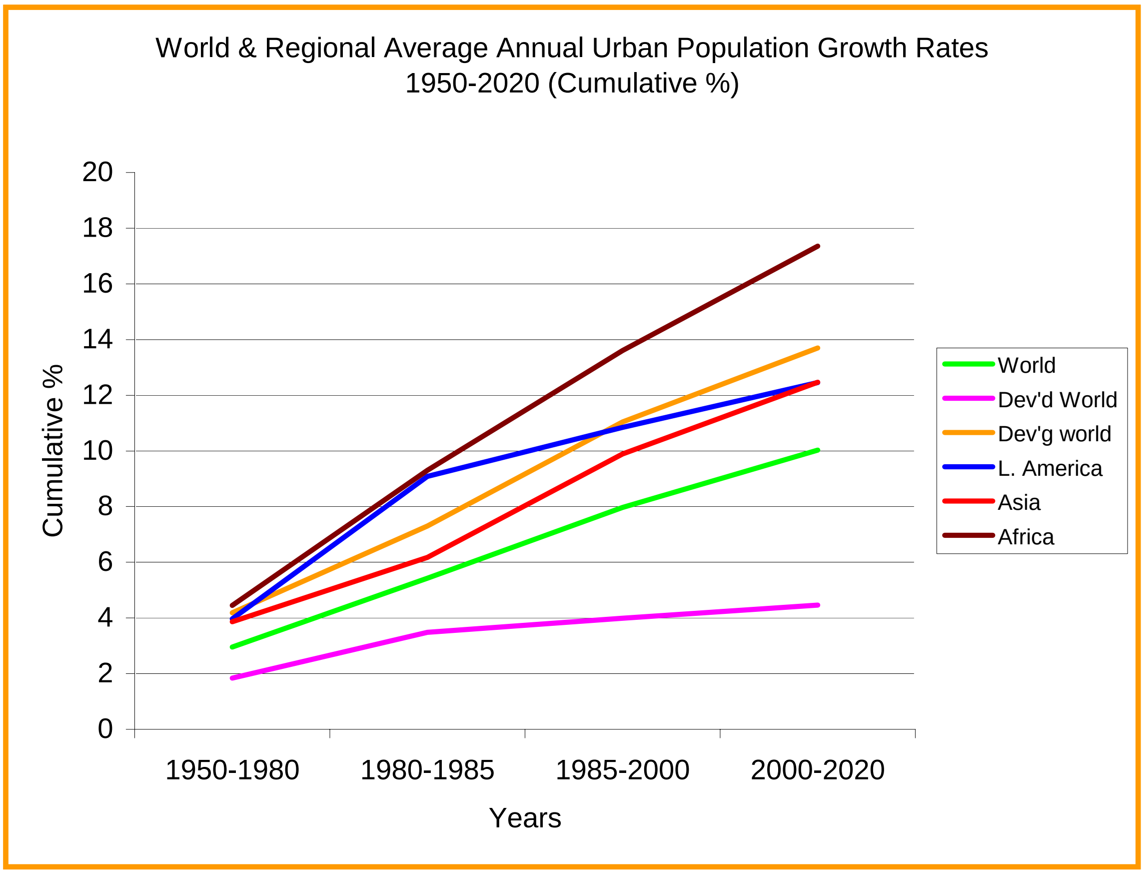
[1] 1 pound = 0.4536 kg,



Dev'd World=Developed World
Dev'g World=Developing World

FIGURE 1.1: World & Regional Average Annual Urban Population Growth Rate 1950-2020 (Cumulative %)

SOURCE: Compiled from Statistics in Hardoy *et al.* 2001, WIR 1998, and United Nations Population Division 2002

Urbanisation in itself need not necessarily be a problem. In fact, in the developing world, urbanisation has been the engine of economic and social development in these cities. Habitat (1996) notes that urbanisation has helped such cities attain stronger and more stable economies in the past few decades. There is an inextricable link between urban population growth, development and environmental problems. Whereas urbanisation has helped improve the economic and social situation of developing countries, one major challenge has been the emergence of environmental problems, municipal solid waste management being one. This relationship is not straightforward, especially as increased waste generation does not itself suggest poor management. According to Satterthwaite (1997, p. 216), ‘many environmental problems lessen as cities get larger’. While this may be true many authors still observe a positive correlation between urban growth, development and specific environmental problems (Traver 1994; HABITAT 1996; WRI *et* *al.* 1996, Overton *et al.* 1999). These negative impacts associated with rapid urbanisation are summarised as follows:

- Pollution from urban waste: typically, this includes municipal and industrial wastewater, storm water drainage, municipal solid waste, hazardous wastes and ambient as well as indoor air pollution.

- Urban transport externalities: increased motorisation, poorly operated public transportation, inadequate road maintenance, insufficient bicycle paths and walkways, poor traffic management, and lack of enforcement and education are all factors contributing to congestion, road accidents and vehicular air pollution.

- Resource management issues: unsustainable patterns of resource consumption, including depletion and degradation of water supplies, inappropriate land development, inefficient urban fuel consumption and loss of natural and cultural heritage.

- Environmental hazards: urban areas are subjected to natural hazards (severe storms, floods, earth quakes, volcanic eruptions, wildfires, etc) and anthropogenic ones, including prolonged exposure to pollutants, chemical contamination and industrial accidents (Leitmann *et al.* 1992, p.123).

Hardoy *et al.* (2001, p. 4) argue that '[these] environmental problems become particularly serious where there is a rapid expansion in urban population and production with little or no consideration either for the environmental implications or for the political and institutional framework that is needed to ensure such environmental problems are addressed' This is true for most cities of developing countries. Specific to waste, Schubeler (1996, p. 11) suggests that 'solid waste generation and demand for waste collection service generally increase with economic development'.

Municipal solid waste management is a propriety area for many reasons. As Figure 1.2 also demonstrates, solid waste [and carbon dioxide] is the only environmental problems, which tend to increase with per capita income and standards of living levels (The World Bank 1992; WRI 1996). 't Hart *et al.* (1995) carried out a survey on environmental problems in Bamenda city and the results ranked municipal waste management and drainage as the most pressing problems. In the same vein the WHO Regional Office for Africa carried out a survey of environmental health concerns in which 27 African countries responded and the results indicated MSWM prioritised second after water quality (Senkoro 2003). These references suggest the problem of MSWM is endemic, real and needs urgent attention.

Despite the magnitude of the MSWM problem, it was neglected along other urban problems due to conflicting agendas. It was the resurfacing of major disasters in cities such as the plague in Surat, India and epidemics in Latin American cities in the late 1980s and

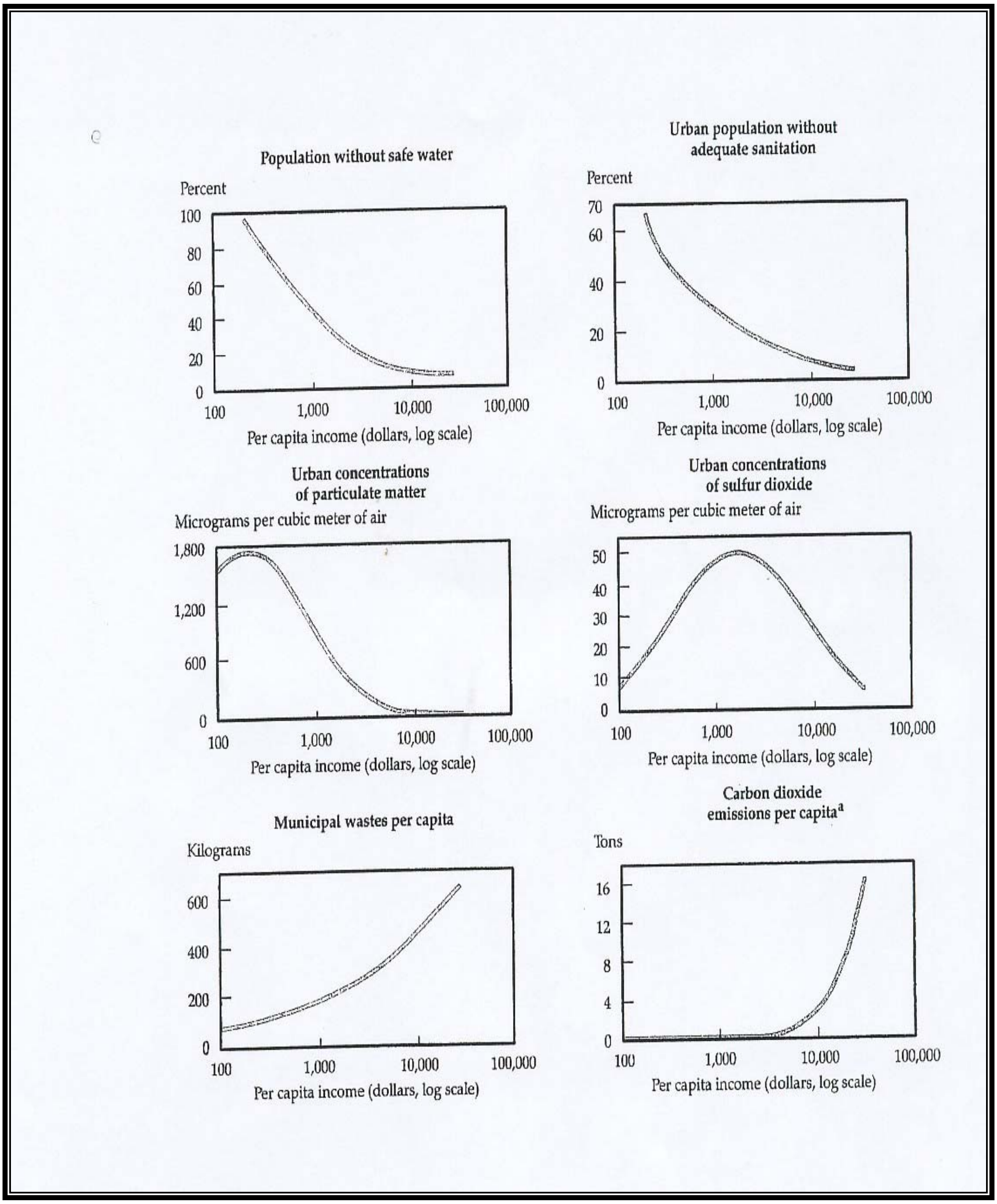


FIGURE 1.2: Environmental Indicators at Different Country Income Levels

Source: The World Bank: World Development Report 1992. Figure 4, p. 11

early 1990s that spurred nations and international concerns towards action on city sanitation (Hardoy 1989; Stren 1995; HABITAT 1996; Drakakis-Smith 2000). The municipal solid waste management sector remained neglected. The UN-Habitat (2001), on launching its ‘Sustainable Waste Management for African Countries project (00/01K),’ admitted this neglect, saying:

> In both the developed and developing countries, too little attention has been paid to the management of municipal solid wastes. Since 1995, UNECA, UNEP, UNCHS (Habitat) have been developing a common position towards forging a sustainable waste management policy and strategy in Africa (Ray 2001, p. 1).

The World Bank loans for urban development for the period 1981-1998, confirm the gross neglect of solid waste management. Within the period in question, loans for water supply, sanitation, and drainage together ranged between 12.8 to 27.9 %; meanwhile solid waste management had one negligible funding of 0.1% in the 1993-95 subperiod (Hardoy *et al*. 2000, pp. 323-4). According to Johansson and Boyer (1999, p. 9), ‘Of all the regions, Africa has the lowest level of investment in World Bank funds in the solid waste sector.’

1.1.2 Some Key Issues in Municipal Solid Waste Management in Developing Countries

Solid waste management in the developing countries demonstrates daunting problems partly due to this negligence in international circles, but more as a result of the inability of the national and local responsible sectors to cope with the problem. The per capita waste generation rates are generally less than those in the developed nations but are equally increasing in amount and variety. There is great city, national and regional variation. The daily average per capita rate for Africa is 0.50-0.87 kg (UNEP 2000a; ENCAPAFRICA 2004). In Asia it varies widely between less industrialised and industrialised regions, for example, from an average of 0.1-0.6 kg in India [less industrialised] to 5.5 kg in Hong Kong [more industrialised] (Bureking *et al*. 1999). Latin America and the Caribbean have averages of 0.3-1.0 kg per capita per day (UNEP 2000d.) The composition is mostly organic biodegradable waste 70-90% (Yhedego 1995, UNEPA2000a; UNEP-IETC 1996).

Management faces many problems as waste management authorities have, in a majority of cases, experimented with almost every strategy and with high and modern waste management technology acquired from the developed countries, with very little success. This failure has been linked to the acquisition and use of incorrect and ill-adapted technologies with heavy costs of maintenance, lack of expertise and inadequate funding and staff. Some authors believe that even more pertinent are corruption and the autocratic 'command-and-control' approach to waste management issues (Kironde *et al*.1997). Non-inclusive management that excludes other stakeholders has also been a crucial issue. Management is concentrated on collection and transportation of which only 20-80% is collected using 20-50% of the city's operational budgets; yet servicing less than 50% of the city population or areas (HABITAT 1996; Hardoy *et al.* 2001)**.** According to Johansson (1999) landfilling remains the most prominent technique with open dumps being the common practice. There are also many illegal dumps created in empty spaces, lakes and ponds, drains, canals, street corners, riversides, estuaries and coasts. Littering is a common phenomenon. These uncollected solid wastes deface the aesthetics of the city and bring about serious environmental and health hazards. According to Kironde (1994 in Halla 1999) this phenomenon caused some African cities in the mid 1980s to be dubbed 'Garbage Cities' and 'Cities of Mess' (Halla 1999, p. 352).

The urban council, which is the statutory authority to manage wastes in the city, is duty bound to play a leading role in addressing these critical issues including the organization, coordination and cooperation with the other actors. These other waste stakeholders include the national government authorities, external support agencies (ESAs), non-governmental organizations (NGOs), common initiative groups (CIGs), community based organizations (CBOs), formal and informal private sectors, scavenger and scavengers' cooperatives, households and individuals. These groups and individuals are usually termed informal until they are recognized and have been registered (Ali *et al.* 1999). These groups are involved in waste collection and removal, recycling, composting and waste recovery for reuse. They are also involved in street sweeping, clearing drains and repairing, transforming and reusing discarded articles supplying waste collection equipment. All these groups and individuals do play an important role in municipal solid waste management. However, it is only relatively recently that some urban authorities in the developing countries have recognized, and eventually integrated them into their solid waste management systems. Elsewhere each group operates parallel to the others. In cities where they have been recognized and integrated, the waste management situation has greatly improved as in the cases of the many scavengers' cooperatives in Latin America and Asia (Furedy 1992;

Pacheco 1992; Medina 2000; Hardoy *et al.* 2001). Nevertheless the situation of solid waste management in many towns and cities of the developing countries remains inadequate and inefficient. Schubeler (1996) describes the situation as highly unsatisfactory. This suggests that the conventional management system and the unorganised informal sector in place are not based on sustainable strategies and methods. This is why I agree with Omuta (1987) who reiterated that:

> Unless the structure and causes of this failure are discerned and pointedly addressed our cities may become veritable agents of danger and overall human degradation, through epidemics, and visual as well as ecological devastation (Omuta 1987, p.78).

Another important issue, which comes into question, is the limited applicability of the theoretical recommendations so far put forward to address this predicament.

1.1.3 Municipal Solid Waste Management in Cameroon

Cameroon towns and cities share the waste management experience of many developing countries even though details for many cities are not known. Despite the threat this predicament poses to the environment, the problem remains inadequately addressed by both the academics (theory) and society (waste managers and stakeholders). In Cameroon very scanty research has been carried out on the subject and waste management authorities are trying out all sorts of modern technologies. UNEP (2002, p.1) is sceptical about this state of affairs and argues that ‘without research and development of new environmental methods and styles, there is a great danger that in pursuing and using new technology the same problem of environmental degradation and ecological impoverishment will continue’. Municipal solid waste management in Cameroon, as with other nations, is complex. The subject is understudied and as such reliable data and information are non-existent in many cases. The system is inefficient and its failure is easily identified by persistent heaps of uncollected waste found on street sides or ubiquitous illegal dumps that pose a threat to the environment. If one has to intervene to improve the situation it makes sense to explore the many related activities taking place in order to understand the processes and systems in operation. In MSWM an important starting point is the knowledge of basic waste management data such as the generation rates, characteristics, formal and informal operations in place including producers’ behaviour. Such information is vital for policy, planning, setting targets and evaluating such set targets in some quantifiable units. At the national level there is no legislation in place which details waste policies, let alone that which creates a uniform reporting mechanism that could enable annual, nation-wide, and publicly available summaries of MSWM in the country. This is the reason why this research focuses on the theory as well as a critical study of the municipal solid waste management process in Cameroon, using two contrasting examples of Bamenda and Yaoundé cities. The workability of the systems is studied by using qualitative and quantitative sustainability indicators to evaluate performance at each stage of the waste management cycle.

1.1.4 Research Aims and Objectives

The research has as its major aim the critical examination of the sustainability of the municipal solid waste management cycle in the cities of Bamenda and Yaoundé, Cameroon, from the measurement of solid waste generation in sampled households through collection and transportation to its treatment and disposal. The first objective is to collect data and information for specific kinds of urban areas, which would be used to study, evaluate, and make recommendations on the systems' sustainability based on the environmental, institutional, economic, socio-cultural and technical dimensions peculiar to the cities. So far the conventional methods have failed to adequately address the MSWM issues. Secondly, it is hypothesised that current theories have limited application to solid waste management in these cities. This will also be assessed. The specific objectives are as follows:

1. To generate major original data and collect information especially on MSWM in Bamenda and supplementary data for Yaoundé
2. To critically examine the sustainability of the policy, strategies and practices of Municipal Solid Waste Management (MSWM) systems adopted in Bamenda and Yaoundé cities from generation to disposal.
3. To compare MSWM in Bamenda and Yaoundé.
4. To observe, investigate and evaluate the environmental impacts of the MSWM systems.
5. To assess the role of the waste management hierarchy in MSWM using the two cases studied.

6. To use the findings obtained to make specific recommendations for policy, strategy and practice and further research necessary for improving sustainability of MSWM in the cities studied including other cities with similar conditions.

In order to meet these objectives this study will seek answers to the following research questions:

- How is solid waste managed in Bamenda and Yaoundé cities, Cameroon?
- How sustainable are the municipal solid waste management systems in both cities?
- What factors influence the solid waste management of both cities?
- What are the environmental problems associated with the MSWM in these cities?
- What differences or similarities exist in the waste management systems?
- How may MSW in these cities be managed sustainably so as to improve the urban development?
- What lessons for theory and practice can be drawn from the study to improve MSWM in the two cities, other cities in Cameroon and other countries?

1.1.5 Rationale/Justification

The preceding discussions show that municipal solid waste management in Cameroon is a crucial problem needing urgent attention from academics as well as practitioners because of its ramifications on the environment, health, aesthetics and the toll it takes on the state and cities' resources**.** This rationale justifies its study.

1.2 Background: Limiting the Scope: Waste Terminologies and Research Area

For reasons of clarity, interpretation, comparison and legislation, terms centred on waste matters are often defined. However this has always been a controversial issue because of the different ways in which waste is classified. The final definition and classification is often a function of the specific issue being addressed. For the same reasons mentioned and as a way of limiting the scope of the study the terms 'municipal solid waste management' and the research area and location, are now defined.

1.2.1 Waste Terminologies

1.2.1.1 Waste

The term ‘Waste’ has undergone changes in definition, concept and classification. According to Brown (1991, p.28), “waste is superfluous refuse, no longer serving a purpose, left over after use;” “.. or, useless by-product of manufacturing or physiological process”. Some other authors define waste as “ any moveable material that is perceived to be of no further use and is permanently discarded” (Eleanor *et al.*, 1998, pp. 445). It includes solid, liquid and gaseous wastes and the physical state can change with conveyance or treatment (Michaels 1966). For example, dewatered sludge from treatment becomes solid waste. It is becoming increasingly clear that there is no such thing as ‘absolute waste’. ‘Waste can be considered, as those materials no longer required by an individual, institution or industry’ (UNESCAP 2000, p. 1). The European Union legislation (Directive 75/442/EEC) defines waste as ‘any substance or object in the categories set out in Annex 1 which the holder discards or intends or is required to discard’ (UNESCAP 2000, p. 1).

1.2.1.2 Solid Waste

Solid waste is defined by the United States Environment Protection Agency (USEPA) (cited in Adedibu 1986 and in Omuta 1987) as ‘any useless, unwanted, or discarded material with insufficient liquid content to be free flowing’; or waste which is ‘spadable’ (Brown 1991, p. 7). Eleanor *et al.* (1998, p. 387) distinguish solid waste as ‘non-gaseous and non-liquid waste resulting from a wide range of community, industrial, commercial and agricultural activities’. According to Michaels (1966), solid waste is also called refuse. The sub classifications of solid waste (refuse), their descriptions and sources are shown in Appendix 1. Another definition, which includes the sources and the fact that the term ‘waste’ is relative, is that of Anschutz (1996). According to this author, ‘Solid waste is discarded non-liquid materials from households, individual and commercial establishments, institutions and streets, that do not have value any more in the eyes of the first generator or user’ (Anschutz 1996, p. 12).

The other definitions of ‘waste’ omit reference to the fact that one individual’s ‘waste’ may be someone else’s potential raw material or resource. Brown (1991) uses the word ‘superfluous’ to describe waste. This definition suggests that something can be termed waste not because it is useless but because the current owner has more than can be used.

Thus, this surplus that the current owner cannot use becomes waste. The concept of 'waste' is changing from seeing 'waste' as something, which should be discarded to recognising it as a resource to be reused, recycled, repaired and recovered. This changing philosophy is at the base of the transformation of solid waste management strategy all over the world today. It is discussed in detail in Chapter 2.

1.2.1.3 Municipal Solid Waste, Management, other Urban Solid Waste Terms

The following phrases and their abbreviations are common in the solid waste (SW) literature: municipal solid waste (MSW), urban solid waste (USW), domiciliary solid waste (DSW), and residential or domestic solid waste (RSW). The last two are self-explanatory and synonymous. They describe waste generated from domestic households or living quarters. According to Buenrostro *et al.* (2001), indistinctive use of the terminologies gives rise to confusion and may contribute to inconsistent interpretation of results because the source being analysed is not clear. The argument emanating from here is whether MSW, as a term, derives its meaning from the waste source or because the municipality is responsible for its collection and management. If it is because of the source, then the SW generated by the peri-urban fringes is not included. But waste generated from there is often merged into the USW stream because movement of waste in such areas will normally be fuzzy. Meanwhile on using the type of source for definition, Bowen *et al.* (1995 cited in Buenrostro *et al.* 2001), rightly argue that

> Legislation in a large majority of developing countries establishes that the federal administration is responsible for the management of hazardous or potentially hazardous waste while the municipality is responsible for the remaining SW generated within their jurisdiction (Buenrostro *et al.* 2001, p. 31).

Sometimes some industries and institutions manage their solid waste without due regard to either the federal government or the municipal authorities. Cailas *et al*. (1996 cited in Buenrostro *et al.* 2001) classify MSW as the residues coming from households, commerce, institutions, and in general, all activities of the community. In the same article, Bruner and Ernst (1986) define MSW as materials collected by the municipality, or by authorized organisations. Urban solid waste (USW) may be understood as all the solid waste generated within the urban area. For the purpose of this thesis only solid waste managed or supposed to be managed by the municipality (about 80% USW) will be considered. This decision will help limit the scope and enable accessibility to secondary data. Solid Waste Management (SWM) encompasses the full range of activities from the generation of the used materials to their disposal' (Beede and Bloom 1996; Beukering *et al.* 1999). Schubeler (1996) expands these activities in his definition as follows:

> Management is a cyclical process of setting objectives, establishing long-term plans, programming, budgeting, implementing, operation and maintenance, monitoring and evaluation, cost control, revision of objectives and plans, and so forth (Schubeler 1996, p.18).

The same author says that 'Municipal solid waste management (MSWM) encompasses the functions of collecting, transfer, treatment, recycling, resource recovery, and disposal of municipal solid waste' (Ibid p 9). This definition excludes generation, which is crucial to the entire system. According to another author MSWM '..deals with the whole cycle of generation of wastes, their storage, collection and transportation, and their eventual treatment and disposal' (UNESCAP 2000, p. 2). This study adopts this latter definition, which also encompasses the scope.

1.2.2 Introduction to the Country of Research-Cameroon

1.2.2.1 A Brief History

The research has been carried out in the Republic of Cameroon. The country called Cameroon today has a complex history, which has affected all facets of its activities. The Portuguese discovered the territory in 1472 and named it *"Rio dos Camaroes*", which means "River of Prawns" after the many prawns they saw at the mouth of one of its rivers. The Spanish later came and called the territory *Camerones.* The Germans colonized the area in 1884 and named it *Kamerun.* With the defeat of the Germans in World War 1 the area passed into the hands of the British and the French who defeated the Germans in Cameroon. Britain had two small patches on the west, one to the south called British Southern Cameroon, and the other to the north called British Northern Cameroon. Both accounted only for about one-sixth of the whole territory. France had the eastern part called French *Cameroun*. These territories were mandated to Britain and France in 1916 as the League of Nation's territories. However, they were simply ruled as colonial territories. The British ruled theirs as part of Nigeria. After World War 11 the territories were transformed into the UN's trusteeship under the same administrating countries, Britain and France.

In 1960 French *Cameroun* was granted independence. The two British Cameroon territories were subjected to a plebiscite in 1961, which asked them to decide whether they preferred to be independent by joining the Republic of Nigeria (where they were currently being administered) or the French Cameroon (with whom they were during the German rule), which had just gained independence, to become *la République du Cameroun*. The British Southern Cameroon opted to join *la République du Cameroun* to form 'The Federal Republic of Cameroon' (*La République Fédérale du Cameroun)*, which later became the 'The United Republic of Cameroon' (*La République Unie de Cameroun*) in 1972 and it is today simply back to 'The Republic of Cameroon' (*La République du Cameroun*). Cameroon has ten provinces. The Northwest and South West provinces came from former British Southern Cameroon. The country uses its French and English names and documentation, depending on who is using it. The changing names have not changed the people's thinking. This partly explains why some documentation in this thesis is in the French language.

This history has produced a country with two major but disproportionate groups of people who have developed under two different colonial systems. That separate development is reflected in every aspect of life in Cameroon. The two groups are actually different and this is reflected in the language and their general perception of, and approach to things. Even the way they perceive waste management is different given that the colonial laws, ordinances and legislations (many of which are still being applied today) have influenced them differently. However, the goal of the government's policy is unity in diversity and the promotion of bilingualism (French and English) in Government business is of paramount importance.

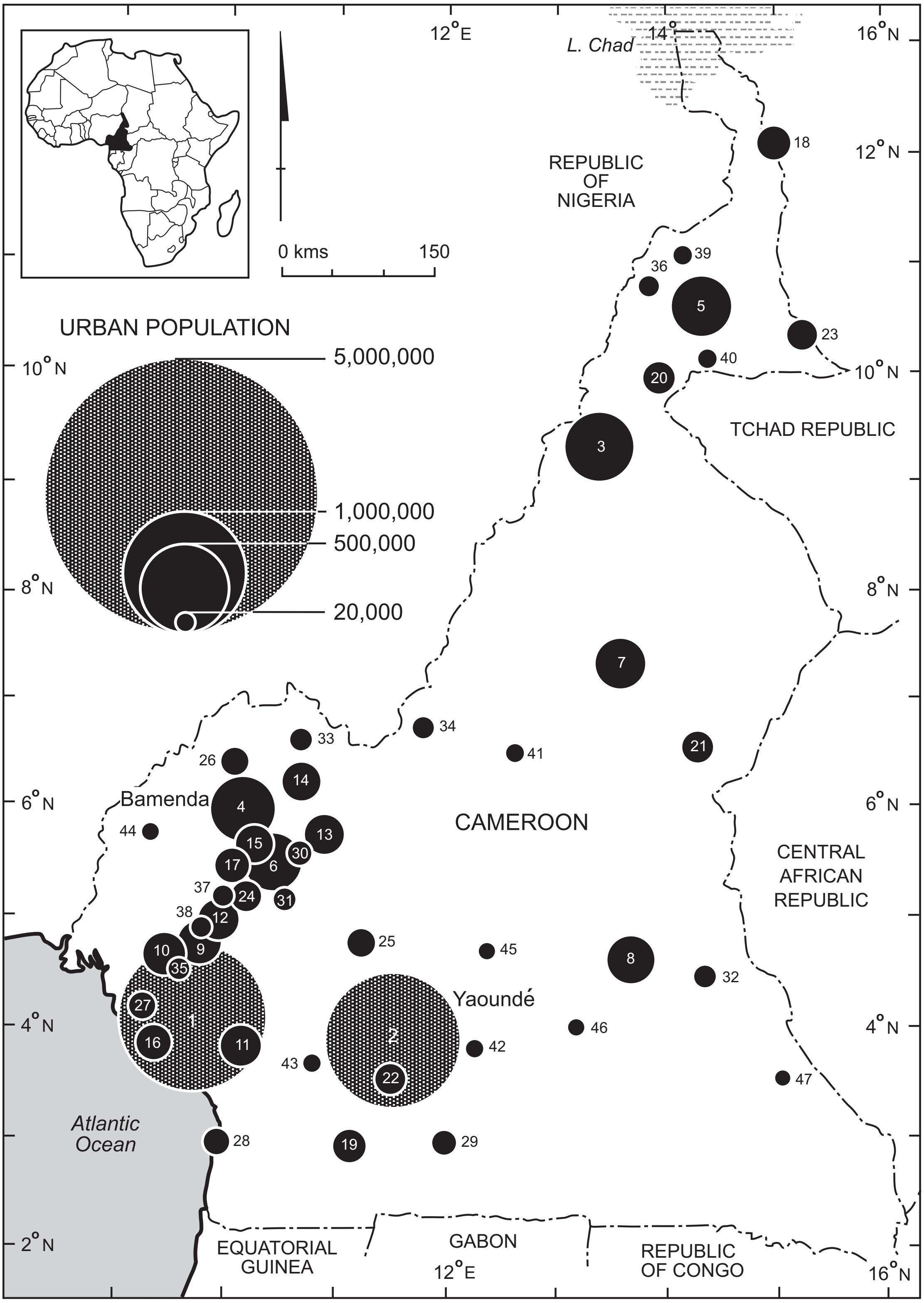


FIGURE 1.3: Map of Cameroon, Bamenda and Yaoundé in its Urban System
Sources: Complied from urban population data (DSCN, 2000) and Cameroon Atlas 1985

1.2.2.2 The Geography, People and the Economy

Two cities: Bamenda (29 4873) and Yaoundé (1 438 087) (DSCD 2002) have been chosen for the comparative study. Bamenda (4 in Figure 1.3) is the biggest city of the predominantly English-speaking part of the country. It has experienced very rapid population growth since it became the provincial headquarters of the North West Province in 1972. Yaoundé (2 in Figure 1.3) is the National capital of Cameroon. It is situated in the predominantly French-speaking part of the country. It has a rapid population growth and is almost catching up with the largest city of the country, Douala (1 in Figure 1.3) located on the coast. Cameroon is situated on the eastern end of the golf of Guinea, West Africa. It is shaped like a triangle making a wedge between West and Central Africa. It is bounded in the west by the Republic of Nigeria, north by The Republics of Niger and Tchad, east by the Central African Republic and south by the Congo, Gabon and Equatorial Guinea Republics (Figure 1.3). It lies between longitudes 8 and 16 degrees east of the Greenwich Meridian and latitudes 2 and 13 degrees north of the Equator (Figure1. 3). The population is 14 859 000 people spread over an area of 475 640 km^2 (DSCN, 2000). The urban population is 7 307 000 people, accounting for 49.2% of the total. The urban population grew at the rate of 3% between 1976 and 1987 and 2.8% between 1987 and 2000 (DSCN). Urban centres in Cameroon have been defined as agglomerations of 5000 and more, having a developed daily market, developed health centre, complete primary school, water and electricity supply. All administrative headquarters are automatically urban centres. These administrative headquarters range from District, Sub-Division, Division, and Province to National. There are two large cities: Douala, the economic headquarters (1.5 million) and Yaoundé, the national capital with (1.4 million) people. There are 11 other second-degree cities with population between 100 000 and 300 000 people. A third group is made up of smaller cities with populations ranging between 20 000 and less than 100 000. This group includes 33 towns. The rest are between 5 000 and 20 000.These last two groups are classified as small towns.

The long south-north extent of the country (respectively Atlantic Ocean to Lake Chad) and the volcanic formations, which traverse the country in a SW-NE direction, endow the country with diversified landforms, drainage, climate, vegetation, animal life and ecological zones. The climate is varied but mainly tropical with two seasons: wet and dry. The south has 7-8 months of dry season and the north only 3-4 months of light rain. The country has more than 280 ethnic groupings. The north of the country is dominantly

Moslem and the south, Christian. The system of government is parliamentary democracy, the administration centralized and the economy is capitalistic.

The country is number 125 on the Human Development Index (HDI) ranking with an average life expectancy of 50 years at birth and a Gross Domestic Product (GDP) per capita purchasing power parity (PPP) US$ 1573 (1999) (HDI 2001). These rates were higher in the past decades but declined because the country suffered an economic crisis as did most developing countries. Rydin (1992, p. 21) explained the phenomenon thus:

> Global economic dislocation in the 1970s, as a result of oil crises, and the slow recovery and poor economic growth of developed countries, coupled with the very much weakened commodity markets have led to severe economic consequences for developing countries during the 1980s.

In Cameroon this was followed by the introduction of the World Bank's Structural Adjustment Programmes exemplified by devaluation of the national currency (the Franc CFA), privatisation of state-owned enterprises, downsizing of the public sector and deregulation of the private sector. Solid waste management saw the dark days of its history during this period. However, Cameroon has a relatively rich, diversified and fast-growing economy and remains one of the healthiest economies in its region, Sub-Sahara Africa. The country is politically stable and usually described as 'Africa in miniature' because it summarises African characteristics in many areas. There is small scale recycling of waste in Cameroon cities at household and craft levels. However, waste picking especially on garbage heaps is taboo and consequently not common.

The bi-cultural nature of the country, the free flow of a variety of goods (including foodstuffs from different geo-ecological zones), the free movement of heterogeneous groups of people from all over the country and beyond into the cities, and the other varied characteristics discussed above undoubtedly have profound implications on solid waste management in towns and cities of the country including Yaoundé and Bamenda, the cities under study.

1.2.3 Introduction to Bamenda and Yaoundé Cities

1.2.3.1 The Yaoundé City Council (*Communaute´ Urbaine de Yaoundé*, CUY).

Yaoundé ("City with Seven Hills" in the local language) is the administrative and political capital of Cameroon. It also has an important city council, which with Douala were

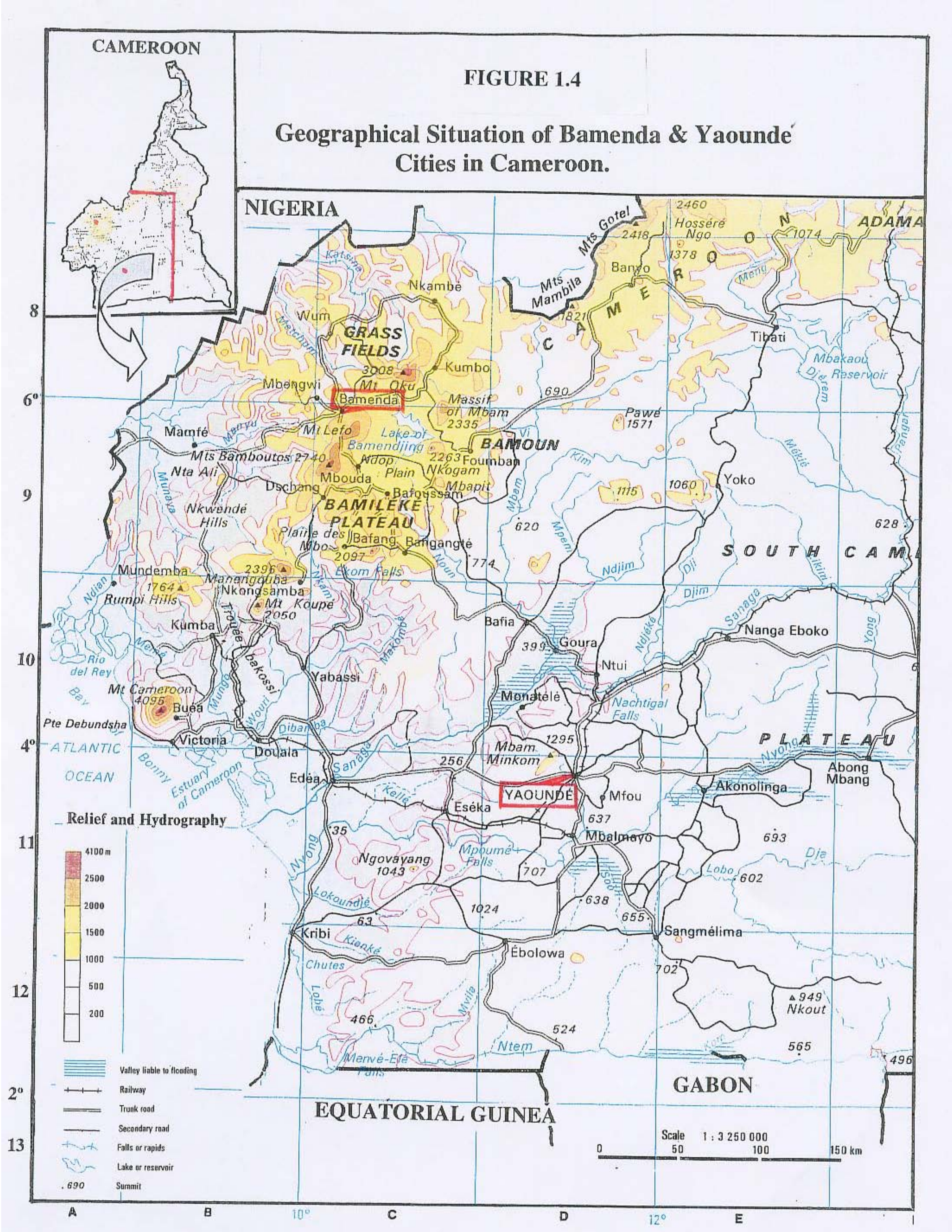


FIGURE 1.4

Geographical Situation of Bamenda & Yaoundé Cities in Cameroon.

Sources: Adapted from Atlas of the United Republic of Cameroon. *Les Atlas Afrique* by *Jeune Afrique*, George Laclavere, Groupe J. A. 1980, pp. 6 & 7 accorded the highest urban council status in the country known as *Communauté Urbaine*. The city area is divided into six Sub-Divisions. Yaoundé has one of the highest annual urban population growth rates (6.8 %) in the continent (Tanawa 2002). The population was estimated at 1. 4 million people in 2002 (DSCN 2002).

The city is located around latitude 03° 51´ N. and longitude 11° 29´ 48° E. It is situated 200 km east of the Atlantic Ocean on the Southern Cameroon Plateau. This plateau is dominated by rolling topography 600-1100 m. above sea level. The highest hills are mounts: Fėbe 1073 m, Mbankolo 1056 m, Eloumden, Ding-Dang and Messa. The River Mfoundi and its tributaries drain the city and then flows into the Nyong and on into the Atlantic Ocean. There are many small lakes situated in the valleys that separate the numerous ridges and concave hills that make up the city's scenery. According to Yaoundé City Guide (2002), the altitude and continental location of the city have endowed it with a sub-Guinean Equatorial temperate climate with four seasons; two dry and two rainy. The average annual rainfall is 1600 mm, and temperature 23.5°C. The natural vegetation is equatorial rain forest even though much of it is now degraded (Yaoundé City Council 2000).

The major functions of Yaoundé were originally administrative and political. Nevertheless economic, social and other functions have arisen. Yaoundé has become a centre of commercial and processing industries. It is also a big centre for education and research, referral hospitals, entertainment, sports infrastructure, and international and diplomatic services. The city lies at the heart of the greatest cocoa-producing zone of the country. Yaoundé is also a transport hub with roads, rail and air transport systems radiating from there and serving its immediate environment, the country and beyond (Figure 1.4).

These favourable characteristics of the city highlighted above, and the general peaceful situation of Cameroon in a sub-region with histories of many civil wars, have made Yaoundé an attractive place for both nationals and foreigners including refugees. As a consequence it is not only the city's population, which has been growing at an alarming rate but also the spatial occupation of the land area. According to Tanawa *et al.* (2002), the area of Yaoundé expanded from 12 000 hectares in 1961 through 18 000 hectares in 1995 to an estimated 28 000 hectares in 2005 (Tanawa *et al.* 2002). YCC sources give 25 600 hectares in 2001. This spatial occupation ranges from the high residential areas with adequate housing and good infrastructure to the other extreme where the majority of the citizens live in unplanned spontaneous and ill-equipped quarters. These characteristics have far-reaching implications for solid waste management in the city of Yaoundé.

1.2.3.2 The Bamenda Urban Council (BUC).

Bamenda is the administrative headquarters of the Northwest Province of Cameroon. It is also the seat of the largest opposition party in the country, the Social Democratic Movement (SDF). It is not only the largest city in the predominantly English-speaking part of Cameroon but also one with a very fast urban population growth rate.

Bamenda is located 250 km north of the Atlantic Ocean on the Western Highlands, which constitute part of the northeast-southwest range of volcanic formations called the Cameroon Dorsal that transverse the country (Figure 1.4 above). The location is around latitude 05° 58'N and longitude 10° 08'E, with an altitudinal range between 1230 m and 1470 m. The local relief is made up of hills, plains, plateaux, deep valleys and fault scarps. One of these fault scarps (200 m high) divides Bamenda City into two parts. Many streams, all constituting the tributaries of the River Mezam, drain the city.

The vegetation is predominantly grassland and a few trees. This explains why the region is called 'Grassfields' (Figure 1.4). The climate is moderated by altitude and this has given rise to the Equatorial Cameroonian type characterised by two seasons, wet and dry. The wet or rainy season extends from mid March to November, and the dry seasons from November to March. Rainfall ranges between 2000 and 3000 mm per year, while annual average temperatures are 27° C and 13.7° C for the hottest and coldest months respectively.

Bamenda was founded by the German colonial administration in 1902 on a vantage point on top of the fault scarp overlooking the indigenous settlements below. By 1953 the population had reached 9 765 (Achankeng 1984). From then the town gradually grew but had an upsurge after 1972 when it was made the headquarters of the northwest province of the United Republic of Cameroon. In the 1976 official census Bamenda had 48 111 people. Its population today is estimated at 294 873 (DSCN 2002). It is a regional primate city and ranks fourth among the cities of Cameroon. The rate of population growth is equally very high. Bamenda is a great centre of attraction for people of the region and neighbouring countries, especially Nigeria. Nature and administration have divided the city into two parts, the predominantly administrative and well-planned area above the fault scarp called 'Up Station' and the mostly unplanned spontaneous quarters on the low plateau at the foot of the scarp face occupied by the Mankon and Nkwen parts of the city.

1.3 Organisation of the Thesis

The thesis chapters are structured into two sections. Each section is made up of chapters with major sub areas. Section one, is divided into four chapters and it sets out the foundation and direction of the research. Chapter 1 has situated the significance of MSWM in the world, regional national and city perspectives including Cameroon. The major research aims, objectives, methods and significance including limitations of the study have been also outlined. A background to the municipal solid waste-related terms and area of study are presented and help define the scope of the study. Chapters 2 and 3, which are separated for convenience, review related literature on the subject. Chapter 2 reviews the conceptual frameworks including theories, principles and models used in MSWM. Chapter 3 reviews how these principles have been transformed the world over into policies, strategies and practices including their outcomes. Lessons are drawn from the study but caution is sounded for wholesale transfer without studying city-specific conditions. Chapter 4 details the research methodologies and types of data collected including the methods and tools used to analyse the data. The rationale for choosing methods, case studies, and samples and analytical tools is explained. Research methods applied for each chapter are discussed.

Section two examines the core subject, namely, sustainability of MSWM in Bamenda and Yaoundé in six chapters followed by a concluding chapter for the entire work. Chapter 5 studies the major waste management issues that cut across both cities and those that are determined by the central authorities. These issues include public participation, policy, legislation, financing and governance. From here the study splits into two with an examination of waste management in each city. Chapters 6 and 7 handle MSWM in Bamenda. Chapter 6 focuses on waste generation, storage, collection and transportation. It is here that much new solid waste data for the city are generated from the waste experiment analysis, questionnaire surveys results and other methods. The next chapter, Seven, completes data generation and analysis on MSWM in Bamenda as it examines waste treatment, disposal and waste management-related environmental problems. The next two chapters, Eight and Nine, use the same headings as Chapters 6 and 7, respectively, to study Yaounde. The experiment was not conducted in Yaoundé because some basic data exist already. In Chapter 10 the findings for Bamenda and Yaoundé are summarised, compared and discussed. The last chapter, Eleven, concludes by presenting and discussing the major objectives met and making recommendations for further research, policy, strategy and practice. Lists of references and appendixes are included after the last chapter.

CHAPTER 2

Major Concepts in Municipal Solid Waste Management

2.1 General Introduction

The global goals of municipal solid waste management (MSWM) are to protect environmental health, promote the quality of the urban environment, support the efficiency and productivity of the economy and generate employment (Schubeler 1996). Despite increasing policies and strategies put in place to achieve these goals, the success remains elusive, as net municipal solid waste generation continues to increase in volume and variety. Thus, waste reduction with an emphasis on prevention is increasingly becoming a major policy focus in all countries. The ways by which MSWM is conceived, planned and executed including the principles and policies that govern such frameworks is a complex issue and vary in space, contexts and time; yet it is possible to speak of common models and general management principles. This chapter examines the major concepts; principles and strategies applied in MSWM in major regions of the world but their outcomes are overviewed in the next chapter.

2.2 Concepts, Principles and Philosophies of Solid Waste Management.

2.2.1 The Concept of Sustainable Development

Waste management is now seen as part of the broad global concern for sustainability and it clearly overflows national boundaries in terms of problems and possible solutions (Fagan *et al.* 2001)**.** The recent concepts, principles, and thinking on the need for good waste management emanate from the global concept of sustainable development propounded by the Brandt Commission of 1987. It came to be known as the World Commission on Environment and Development (WCED) 1987. The commission report noted that: 'Humanity has the ability to make development sustainable-to ensure that it meets the needs of the present without compromising the ability of the future generations to meet their own needs' (WCED 1987 p.43). This was a new direction away from the corrective and isolated approaches of the previous decades, to a global, long-term, integrated and preventive one, with advocacy for shared responsibility as a substitute for the command–and-control approaches in place (Gervais 2002). From this point onward, many spheres of human endeavour and in all parts of the world embraced the doctrine. It was expanded and endorsed at the 1992 Rio de Janeiro Earth Summit as 'Agenda 21'-the document of hope that spells out the principal global plan to confront and overcome the economic and ecological problems of the late twentieth century (Sitarz 1993). In keeping with the Rio Agenda 21 recommendations and other international agreements, Cameroon adopted the principles and a strategic framework for sustainable development. A national environmental management plan was enshrined in Chapter 1 Article 13 of the 1996 Law on the Environment (LOE). Chapter IV Articles 42-53 addressed general issues of sustainable waste management (Government of Cameroon {GOC} 1996).

However, the relationship between sustainable development (provision of human needs) and ecological sustainability (environmental health) appears to conflict. For example, in the urban areas, Freire and Stren (2001) note that:

> While many cities "score" well on the development of the new economic sectors, few succeed in building a good quality of life and in creating a city which is clean, safe, and beautiful, without major environmental hazards or desperate transport congestion (Freire and Stren 2001, p. 49).

2.2.2 Concept of Sustainable Urban Development

What constitute agendas for sustainable urban development have always been a matter of controversy between the developed and the developing worlds, which respectively adopt the 'green' or 'brown' agendas. The green agenda emphasises ecosystem health, the impacts of cities on rural resources and surrounding regions and the future threat posed by urban consumption, for example, the emission of urban-generated chemicals into the atmosphere causing global warming, ozone depletion and cancer. The brown agenda, accusing the developed world of bias, focuses on the environmental hazards and social justice, and are more concerned with immediate problems faced by the urban poor such as the provision of safe water supply to households and disposal of faecal matter, liquid and solid wastes and disease-vectors (Hardoy 1989; Stren 1995; HABITAT 1996; Drakakis-Smith 2000; Baud and Post 2002). Baud and Post (2002) attempted a reconciliation of both the ecological (green) and the immediate needs (brown) sustainability by combining them and making explicit the trade-offs between them. These authors proposed the integration of ecological, social, economic and environmental health in an urban sustainable development plan for solid waste management.

2.2.3 Sustainable Municipal Solid Waste Management (SMSWM)

The concept of sustainability developed through sustainable urban development to its subset, sustainable solid waste management. The major strategy is using an approach, which integrates the four dimensions of management options, stakeholders, related systems and driving forces (Figures 2.1 & 2.2). The overriding principle here is to integrate and involve all these concerned sectors in solid waste management so as to achieve sustainable goals.

Figure 2.1 demonstrates how the scope, the stakeholders (actors) and strategic aspects need be integrated within city-specific contexts. A special innovation is greater involvement of the local population to an extent where it is recommended, that they conceive, decide, initiate, and execute their own projects with the council's collaboration rather than the other way round. This is sometimes described as a bottom up approach as opposed to top-down. Goodey (1973 cited in Omuta 1987) justifies this approach by arguing that based on studies in environmental psychology, ego involvement through public participation reduces friction, resentment, resistance, rejection, and confrontation.

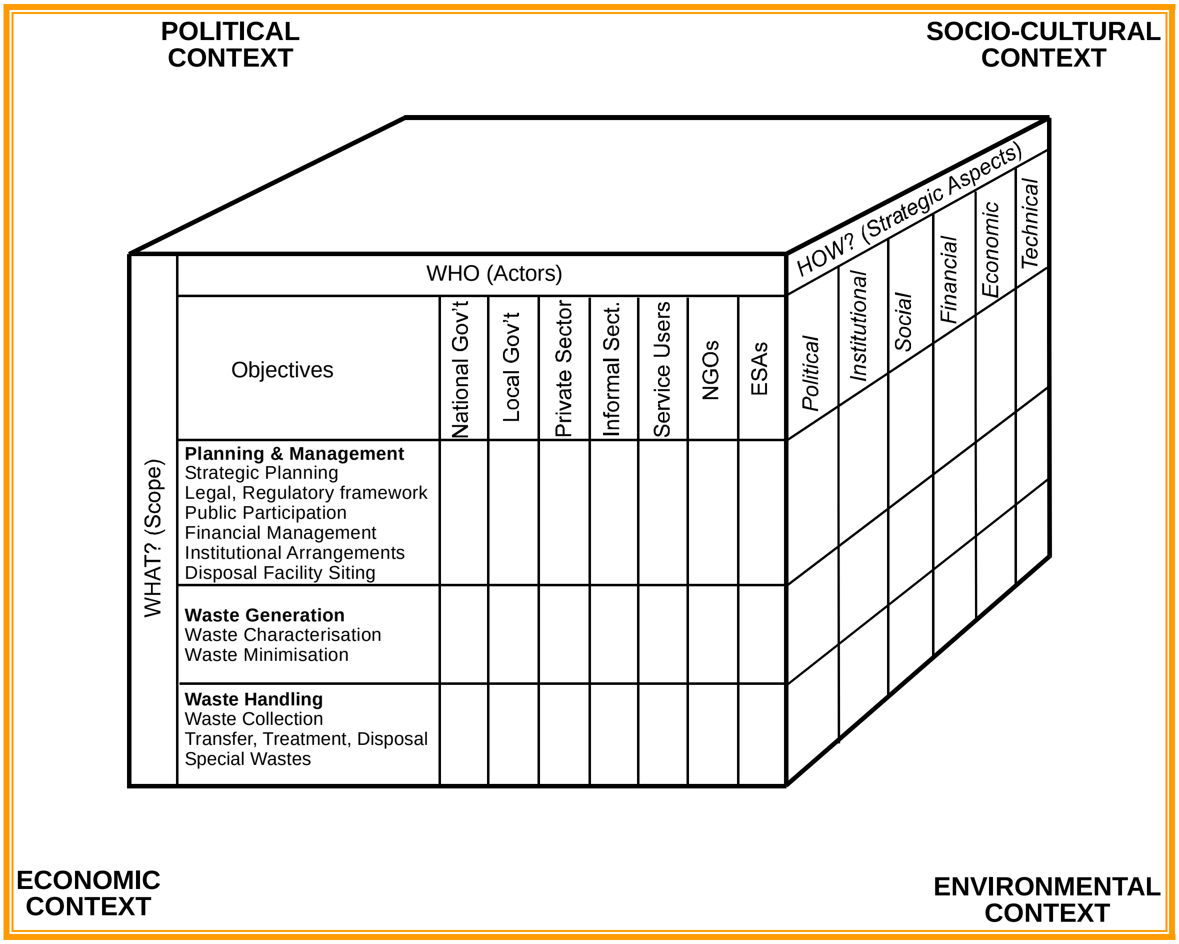


FIGURE 2.1: Structure of the Conceptual Framework for MSWM
Source: Schübeler 1999, p. 17.

The issue of waste is central in several chapters of Agenda 21 as a cause of environmental problems or a result/output of human activities. However, Chapter 21 deals directly with sound management of solid waste and sewage-related issues. Solid waste is also discussed in other chapters that are inextricably related to waste. For example, changing consumption patterns (chapter 4), population dynamics (chapter 5) protection and promotion of human health conditions (Chapter 6), promoting sustainable human settlements (chapter 7), and protection of fresh water (chapter 18) (United Nations Division for Sustainable Development 2003). Agenda 21 recommends a framework for required action founded on a hierarchy of objectives and focused on the following areas: waste minimisation, maximisation of waste reuse and recycling, promoting environmentally sound waste disposal and treatment and extending waste service coverage (United Nations Division for Sustainable Development

2003). The agenda further notes that these four areas are interrelated and mutually supportive, suggesting that they must be integrated in order to provide a comprehensive and environmentally responsive framework for managing municipal solid wastes.

2.2.4 Integrated and Sustainable Municipal Solid Waste Management

An integrated municipal solid waste management (IMSWM) is defined as 'the selection and application of appropriate techniques and management programmes to achieve specific waste management objectives and goals' (Tchobanoglous *et al.* 1993 quoted in Tanskanen 2000 p.1; The International Bank for Reconstruction and Development {IBRD} and The World Bank 1999 p. 18). The concept of integrated sustainable waste management (ISWM) was developed by WASTE and first presented at the **"**Ittingen Workshop on Municipal Solid Waste Management" held in Switzerland, April 1995 (Zurbrügg 1996; van de Klundert 2000). ISWM seeks to integrate stakeholders, system elements and aspects (Figure 2.2), so as to meet objectives or to arrive at sustainable results (SKAT 2000). The guiding principle would be to embrace the philosophy of MSWM which recognises that 'there is no single practice that is always preferred over others rather to consider the full range of waste streams to be managed as a menu from which waste managers can select the preferred options based on site specific environmental, economic and social considerations' (EPIC and CSR 2000 p.1), or that ISWM is 'not a package solution'(Zurbürgg 2002, p. 11).

From WASTE experience gained under the Urban Waste Expertise Program (UWEP) in the developing parts of the world, Bulle (1999) suggests that the overall conditions for sustainability and integrated municipal solid waste management in such regions would select options as follows:

- bring together the private, public, and community-based sectors and give them well-defined responsibilities in the various fields, from preliminary collection to recycling waste,
- integrate especially adapted technologies into the sector (from source separation to primary collection, recycling and composting), thus generating income and jobs

- take into account the poorest neighbourhoods, that are now untouched by urban management and lack basic services (Bulle 1999, p.11).

Van de Klundert and Anschutz (1999) further explain the terms “sustainable” and “integrated” as used in municipal solid waste management concepts to emphasise the need for its localisation and self-maintenance through time without compromising the present and future resources. They expanded the concepts thus:

Sustainable: a system that is:

- appropriate to the local conditions in which it operates from a technical, social, economic, financial, institutional, and environmental perspective, and;
- capable of maintaining itself over a long time without reducing the resources it needs.

Integrated: a system that:

- uses a range of inter-related collection and treatment options, at different habitat scales (household, neighbourhood, city).
- involves all stakeholders, be they governmental or non-governmental, formal or informal, profit- or non-profit orientated
- takes into account interactions between the waste management system and other urban systems (van de Klundert and Anschutz 1999, p. 5).

The Urban Expertise Programme {UWEP} (1996) observed the stages of MSWM communities tend to go through as follows:

- In the first step, driven by some concerns for public health and sanitation, some type of collection is designed to meet such goals.
- Next, communities may be motivated by the need for better quality of life. Such is achieved by enhancing cleanliness of streets and community appearance.
- Environmental quality and cost reduction, that is, increased attention to recycling and composting, increase in separate collection and number of system components emerges and;
- Finally, the first-order goal of a sustainable waste system is put in place.

The author notes that a city does not need to follow all the stages, because the final stage could be developed from the onset (UWEP 1996).

These twin concepts of sustainable and integrated MSWM are crucial; as they provide parameters for studying, assessing, evaluating, and a guide for proposing a waste management plan for a municipality (Figure 2.2). Figures 2.2 & 2.3 demonstrate the complex relationships between the sustainability aspects that have to be examined within the MSWM system elements as operated by various stakeholders. In short, integrated refers to an approach or method of planning whereas sustainable refers to an objective or result (SKAT 2000).

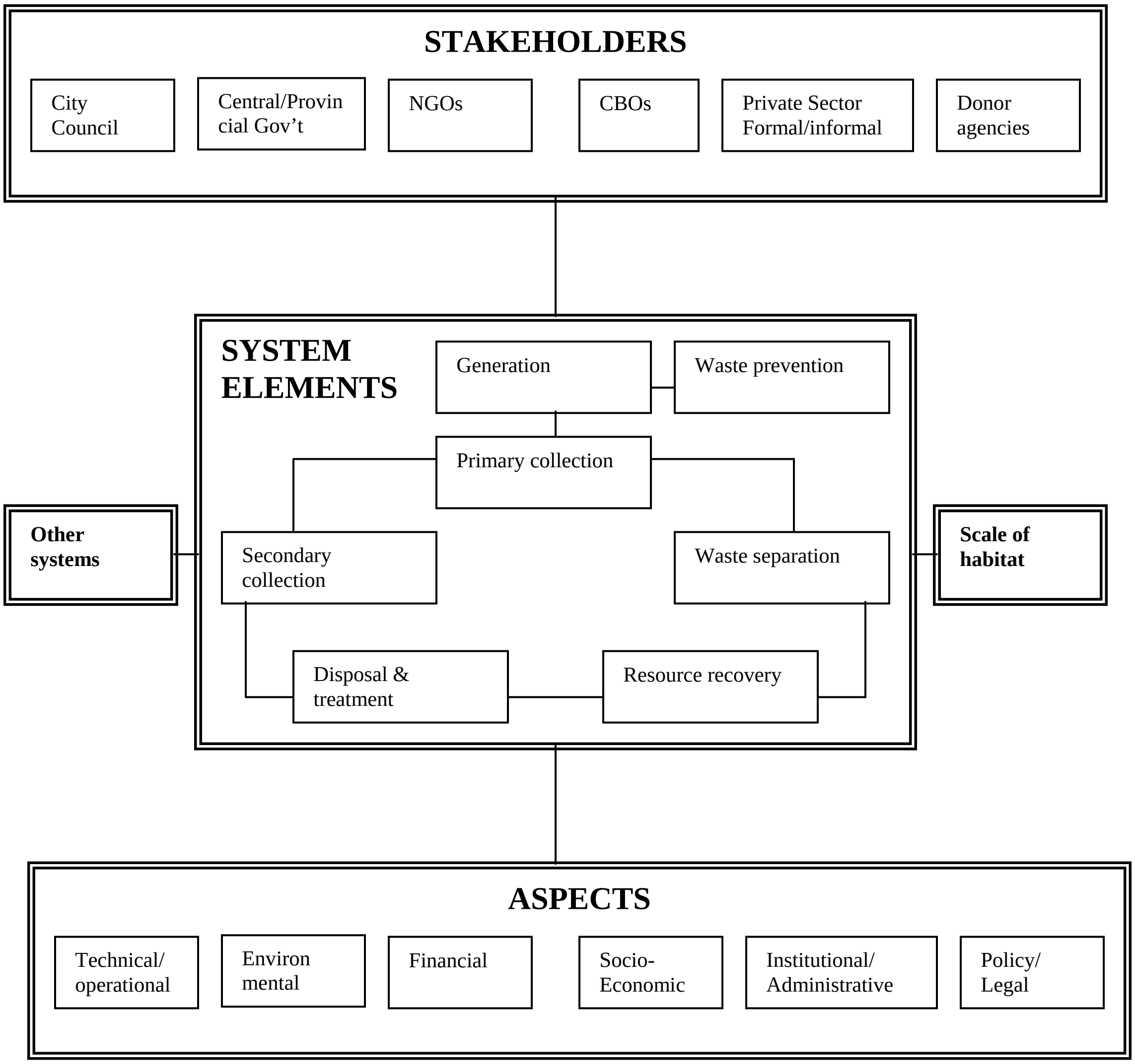


FIGURE 2.2: Dimensions of Integrated Sustainable Waste Management
Source: van de Klundert and Anschutz 1999, p. 6

2.2.5 Policy Concepts Supporting Waste Strategic Options

Waste policies are made at individual, institutional, industrial, city, national, regional and global levels**.** Such policies vary widely and what drives them is a huge range of reasons, from aesthetic and prestige to economic and environmental imperatives and fears of health risks such as common illnesses and outbreak of plagues. The consequences of inadequate waste management know no national boundaries. This is why the problem of waste is increasingly seen as global, and so too are the solutions sought. This explains partly why global institutions, international bodies, regional grouping and organisations are increasingly working together to produce common agendas, agreements, directives, that guide international companies, national governments, cities and other participants involved in waste management. Some of these international and regional bodies include the related organs of the UN, such as the Division for Sustainable Development, the World Health Organisation (WHO), the UN Environment programmes (UNEP), UN Development Programme (UNEP) and UN Centre for Human Settlements (UNCHS-HABITAT); the World Bank; the European Union (EU), the Organisation for Economic Cooperation and Development (OECD), ENDA Third World, Collaborative Working Group (CWG) and the City Development Programme (PDM) for West, Central and Southern Africa. These notwithstanding, the availability or non-availability of finance, technical and human know-how, accessibility, technology, scavengers, and good governance remain key determining factors to policy options.

2.2.5.1 The Concept of Waste Recognition

Despite successful waste reduction practices, net waste generation continuous to increase as a result of increasing population and affluent lifestyles supported by technology. At the same time waste disposal facilities are becoming limited, thus the overriding philosophy is to minimise waste with greater emphasis on waste generation prevention (Hohnholt and Meyers 2002). The new philosophy stipulates that if waste cannot be prevented, it must be seen as a resource from which useful things can be recovered. Waste recovery should be perceived not only from an economic perspective (as it was in the past) but also as safeguarding the environment for the present and future generations. This concept is known as ‘Resource recognition' (Furedy 1992). Gray-Donald and Wastenet in the same vein reiterate that 'waste' should be seen as ' an under-utilised resource'(Gray-Donald 2000, p. 17) or 'capital and nutrients' (Wastenet 2003, p. 1). The central options for achieving these objectives are from strategies that develop from a concept called the waste management hierarchy.

2.2.5.2 The Concept of the Waste Management Hierarchy

This is a concept that accords priority action options to solid waste management based on sustainability. As Figure 2.4 demonstrates, the priority options comprise from top to bottom (most to least preferred respectively), prevention, reuse, recovery (recycle, compost, and energy), incineration, landfill, dump, and open burning (HABITAT 1996; Thomas-Hope 1998; Beukering *et al.* 1999; Adams *et al.* 2000; Wright 2000; Hansen *et al.* 2002). There are various permutations to this model and ongoing debates on the appropriate order. However, its direction is clear and stipulates thus: First try to prevent waste, then seek to minimise (mainly through increases in efficiency and careful design), and to recover (a term that includes recycling, composting) material and only then move to 'energy recovery', through various means. Finally, we can consider disposal which must be done safely (Fagan *et al.* 2001). Another source acclaims the waste management hierarchy that: 'It is established to identify key elements in integrated solid waste management (ISWM)' (The IBRD and The World Bank 1999, p. 18).

More recent policies have expanded the horizons of waste management strategies. Such policies want strategies to go beyond safe storage and disposal practices and consider comprehensively, not only the volume and character of waste arising but also what steps must be taken to reduce waste altogether. Waste reduction or minimisation in the new strategic approach to Waste Management Action 3, emphasises strict avoidance. Prevention is seen as the key to reducing both quantity and toxicity. This approach would lead to virtual elimination of hazardous substances, materials and energy intensity.

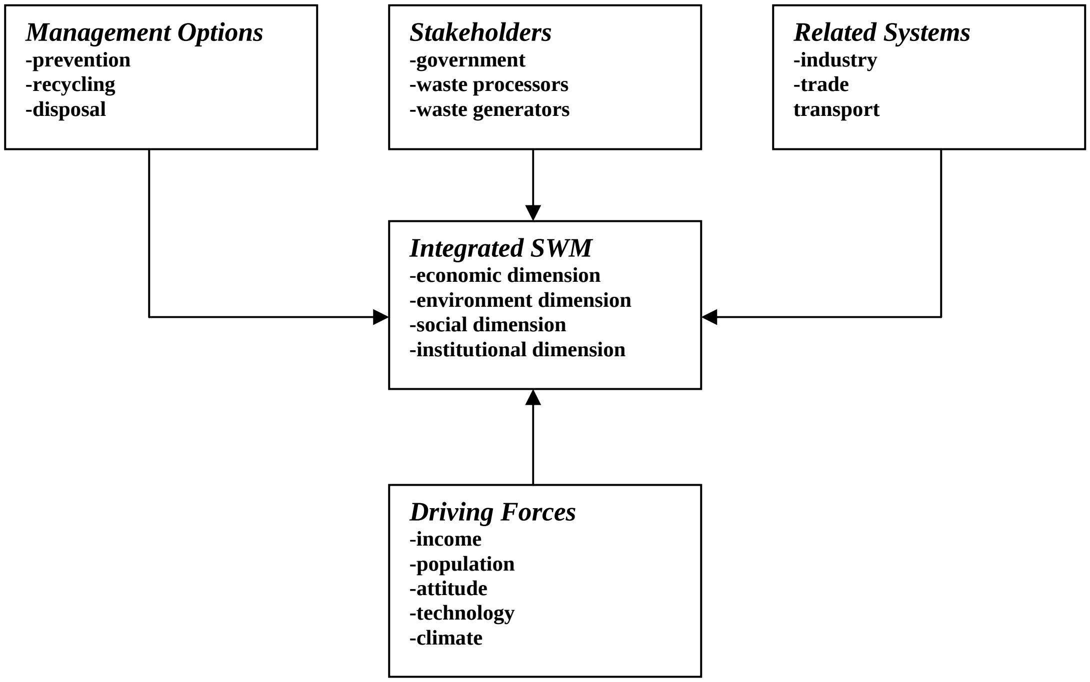


FIGURE 2.3: Framework for Analysing the Concept of Integrated MSWM
Source: Beukering *et al* 1999, p. 4

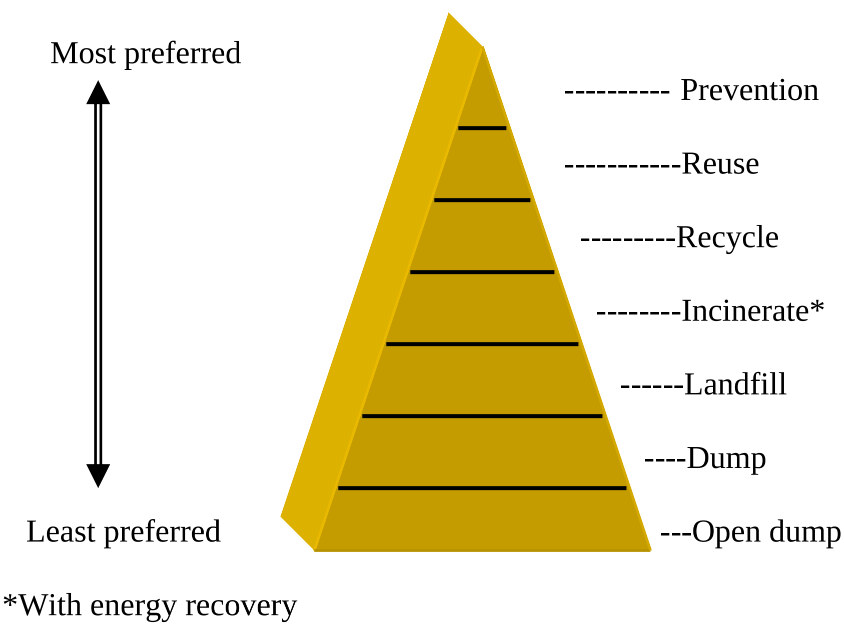


FIGURE 2.4: The Waste Management Hierarchy
Sources: Compiled from various sources reviewed

generated in production and distribution. Quantity reduction entails the use of smaller amounts of resources to produce the same products such as reducing thickness, introducing refill or re-use systems. Re-use means using a product more than once in its original form or for an alternative without reconditioning.

However, the waste management hierarchy model has come under fierce attack. There is overwhelming evidence that points to its pitfalls. The ranking of priorities is seriously questioned (Beukering *et al.* 1999; Adams *et al.* 2000). These authors argue that the model is based solely on environmental effects, while other aspects have been ignored. They suggest that the options should not be ranked rather 'used as a guide not a prescriptive set of rules' (Adams *et al.* 2000) or 'considered as a 'menu of alternatives' (Beukering *et al.* 1999). Schall (1995) notes that: 'Each option is equally appropriate under the right set of conditions addressing the right set of waste stream components' (Schall, 1995 in Beukering *et al.* 1999, p. 6). Pearce (1997 cited in EPA 2002) accuses governments of following the environmentalists blindly, arguing that the hierarchy is not based on any analysis and that it is merely an article of faith (EPA 2002). A definition of integrated solid waste management (ISWM) by EPIC and CSR (2000) suggests that the hierarchy is too uniform to take care of spatial realities. This model also appears to put emphasis only on the waste treatment section of waste management. Waste collection, which is a great problem in the cities of the developing countries, is not addressed in this model. One key emphasis of the hierarchy is prevention by minimising quantity and toxicity at the production level. However; many developing country economies are simply consumers of these already-produced goods and as such, prevention through reduction at source of production means little to them, nor does recycling to produce raw materials for industries. Recycling may not be useful unless there are export market possibilities for the recycled materials.

The main disagreement on the principle is concentrated on the bases for ranking priorities across space. It is useful, however, because it provides us with a spectrum of options from which we can make choices to manage waste in an environmentally sustainable way. The waste hierarchy content is being used as the basis of solid waste management with a lot of progress in focusing on prevention parameters.

2.2.6 The Strategic Plan and Cultural Approaches

Having determined the quantities, composition, variations, recycling potentials, the transportation and disposal, waste management strategies and considering the environmental, economic, financial, socio- cultural aspects, technical know-how, infrastructure available and the physical conditions of the areas, a strategic policy concept for supporting the path to be followed is considered. Thereafter, the method of approach and participant roles are determined. The MSW planning strategic management framework or plan, as the name suggests, is key to a successful waste management system. A failure to have such a plan is planning to fail. Wilson *et al* (1998) proposed that a seven-step plan for MSWM would be to mobilise the planning process, define the baseline, establish the strategic planning framework, identify and evaluate options, develop strategies and implement the strategic Plan (Appendix 8) The fourth, identifying and evaluating options, was identified by these authors as the core in the strategic plan and includes:

1. Institutional framework
2. Waste collection and Recycling
3. Waste treatment and Disposal
4. Financial Sustainability.
5. Public Awareness and Participation (Wilson *et al.* 1998).

Addressing questions of who does what, and when, and how consensus is arrived at including conflicts' resolution, are intriguing and challenging issues, given the multitude of participants involved (Figure 2.1). This will depend on the preferred method through which things are usually made to happen, especially in changing old deep-rooted behaviours and practices such in the MSWM context. Bertolini (1996 in UNESCAP 2000) identified four options of such methods or cultures from which a country or community is likely to choose. The cultural systems are linked to the political system in place and both have a profound effect on the success or failure of the strategic waste management opted. Bertolini's socio-cultural systems are listed below:

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- A culture of ‘government by consensus’, which is characterised by good Government-Industry relations, and in which advice, consultation, and persuasion are the preferred instruments.
- A ‘non-intervention’/‘liberal’ culture, also characterised by good Government-Industry relations, which favours consultation and voluntary agreements as well as the use of economic instruments.
- An ‘adversarial culture’ in which openly declared conflicting interests and positions have to be settled by a process of political arbitration, which will tend to result in legal and regulatory instruments. However, this does not exclude basically liberal elements and hence the use of economic instruments.
- A culture of ‘planning and programming’ (after due consideration of all points of view and the balance of power, even in a ‘corporatist’ culture context), which will opt for legal and regulatory approaches (UNESCAP 2000, p. 27).

These scenarios of cultures suggest that in order to achieve an integrated management programme, objectives and goals, consensus, non-intervention, adversary and planning and programming approaches, using one or a combination of instruments such as good relations, advice, consultation, persuasion, economic, legal and regulatory, must be sought. As concerns waste management options, the approach chosen will depend on the case in question and no option may be best for every situation. However, adversarial cultures such as ‘command-and-control’ and ‘stick-and-carrot’ approaches are less likely to yield good results.

2.2.7 Decision-making

Figure 2.2 presents a multitude of SWM parameters all of which should have a fair chance of being integrated into the system. It is hard identifying the methods of choosing the preferred parameters, as well as analysing all available options. Direct administrative decisions, public meetings, councillors and other forms of representation may be used to select options for IMSWM. However, computer assisted decision support systems (DSS) such as life cycle assessment using multi-criteria (also called multi-attribute or multi-objective analysis) are increasingly being used by academics to suggest to waste authorities the preferred options based on specific conditions (Finnveden 1999; van de Klundert and Anschutz 1999;

McDougall 2000). Other methods used for proposing and analysing sustainable waste management systems include the cost-benefit and institutional approaches.

2.2.8 Concept of Waste Management Mode: Public Versus Private

Having developed a strategy and made a plan, another key issue is making provisions for sustainable implementation, evaluation and feedback processes for the solid waste management system. The local government remains the statutory authority for waste management in its area of jurisdiction. In practice, three management systems are observed from the literature reviewed: government through the city council, privatisation or joint city and private sector ventures. Management here is directed to one or several post-primary waste activities such as collection, transportation, treatment and disposal. Increasing literature suggests that in the cities of the developed countries and big cities of the developing world, privatisation is taking root (Clark 1998; United Nations Centre for Human Settlements (Habitat) 1998; Halla and Majani 1999; Obirih-Opereh and Post 2002). Privatisation is the gradual process of disassociating state-owned enterprises or state-provided services from government control and subsidies, and replacing them with market-driven entities. For MSWM it will mean reduction of local government activity but with participation of the private sector or reducing government ownership (ENCAPAFRICA 2004). Participants in the private sector include companies, small-scale enterprises, community-based organisations (CBOs) and scavenger cooperatives. The privatisation process is generally believed to increase service efficiency, improve coverage and environmental protection. ENCAPAFRICA (2004) outlined five modes of privatisation, namely, concessions, management contracts, commercialisation, franchises and private enterprise/entrepreneurship. The same source summarised the advantages usually advanced for privatisation by many authors suggesting privatisation can:

- Leave municipal resources available for urban infrastructure and equipment
- Reduce costs of public service to consumers
- Reduce financial and administrative burden on government
- Improve productivity and competition

- Stimulate the adoption of innovation and new technology
- Improve the maintenance of equipment
- Create greater responsibility to cost control measures (ENCAPAFRICA 2004, p. 9).

However, worldwide results have demonstrated mixed outcomes. While it has been successful in some cities, opponents of privatisation caution that urban governments must assess if it will be cost-effective, or, if they would be able to define the outputs and have the capability of monitoring and evaluating service performance, capability, facilities and equipment. They also warn that monopoly by a company at the expense of small and medium-size enterprises needs to be guarded against, while at the same time considering the gains of economies of scale. Increasing literature also suggests that privatisation may not mean a reduction of work or costs for municipal authorities. As noted by one author:

> Municipal councils that opt to privatise or commercialise their services …need to upgrade all their staff in accounting, auditing, information management, policy development and management to gain the required expertise for efficient and effective performance (United Nations Centre for Human Settlements {Habitat} 1998, p. 10).

Habitat (1998) also argued that waste coverage in cities of developing countries may not be increased because of the tendency for both private ventures and councils to serve with a bias for middle- and high-income sectors. This discriminatory practice is not due to an inaccessibility problem but economic reasons. The same source also notes that it is important to understand and address the concerns of private sectors. These concerns include non-payment for contracts, inflation, currency devaluation, taxation, political changes and the regulatory framework. It is also worth noting that many companies would not want to risk their money in long term and large-scale investments that rely on government payments such as urban solid waste management.

Another approach is a joint public-private venture, usually called “parastatal”. Olokesusi (1994) notes that management under the parastatals is even worse because such corporations usually place too much emphasis on personnel expenditure. He illustrated this point with the case of the Lagos Waste Management Authority (LWMA), which used 96% of the gross waste management funds for personnel wages (Olokesusi 1994).

In conclusion, privatisation will not reduce the responsibilities of the urban council that remains the monitoring and enforcement of waste management standards, with regards to reliability, efficiency, customer relations and environmental protection. Whichever management choice the urban council decide to make, competition, performance and accountability must be the ultimate guiding rule to a sustainable integrated MSWM system (Habitat 1998; Cointreau-Levine and Coad 2000; ENCAPAFRICA 2004).

2.3 Conclusion

The concept of waste minimisation based on the solid waste management hierarchy established within the framework of an integrated sustainable system has been promoted to address the problem of increasing waste generation, shortage of waste disposal facilities and the desire to safeguard the environment. Fast growing urban populations, affluence and technology are blamed for causing the problem. However, conditions and the application of these concepts and policies differ between the developed and the developing regions of the world, including Latin America, Asia, Africa and more particularly Cameroon, the country chosen for this study. These regional case studies test the concepts and their applications together with lessons learned from their experiences and that constitutes the subject of the next section.

CHAPTER 3.

A Review of Municipal Solid Waste Management: Developed world. Developing Countries and Cameroon

3.1 A General Introduction

In Chapter 2, I examined some of the major general concepts, management principles, frameworks, policies, and strategic plans that underpin MSWM and argued that some of them cannot adequately address the situation in the cases being examined. The argument continues in this chapter where I review the literature on the major broad trends in the current applications and outcomes of these theoretical concepts and strategies in different regional contexts of the world. The point I aim to demonstrate is that, while an exchange of lessons learned from such knowledge might be useful in improving solid waste management elsewhere, caution must be exercised in wholesale transfer of such policies, strategies, technologies and practices without considering the specific conditions in the receiving region, country or city. Solid waste management in the developing countries, including Cameroon, has continuously suffered from such 'off-the-shelf' transferred solutions.

3.2 Municipal Solid Waste Management in the Developed World

3.2.1 Introduction

The developed world is a group of 35 highly-industrialised countries located in North America, Europe and Asia-Pacific areas (UN Population Division 1998). It is hard to find agglomerated waste management data covering the entire area, however, the membership of the Organisation of Economic Co-operation and Development (OECD), which roughly corresponds to the developed world, has some useful data from which generalisations for the regions can be drawn. The OECD came into effect in September 1961 with 20 members and the number has since expanded to 30 members today[1] with an estimated population of 1.2 Millard in 2002 (OECD 2004). The European Union (EU) is within, and collaborates with, the OECD. In general terms, this is the most industrialised and technologically developed part of the world, characterised by high incomes, affluent life style, high consumption and stable democratic governments.

These societies are increasingly prolific generators of municipal solid waste, for example, they represent only 16% of the world's population but consume 75% of global paper production (The IBRD and The World Bank 1999). They are usually described as 'throw away' societies because they produce huge quantities of packaging, regularly utilise disposables and have an insatiable desire for acquiring the latest models of goods and by so doing, discard the old as waste. Although sub-regional, national and state variations exist, increasing literature in the last decade suggests that municipal solid waste generation continues to increase tremendously, raising heightened concerns on the problem at all levels, from local through national to regional groupings and world organisations. Commensurate efforts are being made through the successful use of conventional methods employing intensive capital, high-level technology, elaborate policies and instruments, legislation and strategic guides such as the solid waste hierarchy, in an attempt to cope with the ever-increasing municipal solid waste management problem.

3.2.2 Municipal Solid Waste Characterisation

Comparing regional or national municipal solid waste management (MSWM) statistics is difficult because of varying definitions, methods, units and times of data collection. However, broad trends can be traced. Municipal solid waste (MSW) generation in the developed parts of the world is constantly increasing. According to De Tilly (2004), broad trends in municipal waste generation in the OECD member countries continue to rise in absolute and per capita terms. He notes that the OECD statistics show that between 1990 and 2000 MSW increased by

[1]The original members were: Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, the United States and Turkey. Later entrants are Japan, Finland, Australia, New Zealand, Mexico, the Czech Republic, Hungary, Poland, Korea, and the Slovak Re public. It works with the Commission of the European Community (CEC). By the UN Human Development Index 2003, 27 out of 33 countries classed as developed are OECD members. Only Turkey and Mexico OECD members are excluded.

14%, that is, from 530 –605 million tonnes, 509-540 kg per capita per year (1.4-1.5 kg per capita per day)[2] while population increased by 8%. However, national variations are great, for example the US generation rate in 1999 was 2.1 kg per capita per day, up from 1.2 kg in 1960 (Mihekcic and Hutzler 1999; US EPA 2003).

Whereas increases in population and the level of incomes continue to account for such increases in municipal solid waste generation, EEA (2001 cited by Braathen 2004) underlines new emerging factors. These factors are linked to consumption patterns, family structures and lifestyle. The author suggests that single households produce more waste per capita than families. Ready-made food produces more packaging than individually family-prepared food but traditional preparation results in more organic kitchen waste. The author also notes that increase in incomes results in the use of long-lived goods and services, which later produce other types of waste such as bulky waste and waste from construction and demolition (Braathen 2004).

The composition of MSW in countries of the developed world may differ but the tendency is for non-biodegradable waste to dominate over biodegradable. For example, the average for the US cities shows the following composition: ‘paper (38%), yard trimmings (12.1%), food waste (10.9%), plastic (10.5%), metal (7.8%), glass (5.5%), wood (5.3%) and others (5.3%)’ (USEPA 2003, p. 3). Sakai *et al.* (1996) compiled MSW composition for some other developed countries (Canada, Germany, the Netherlands, Sweden and Japan) in Table 1 which demonstrate similar trends (Sakai *et al.* 1996).

3.2.3 Trends in Waste Management Strategies and Outcomes

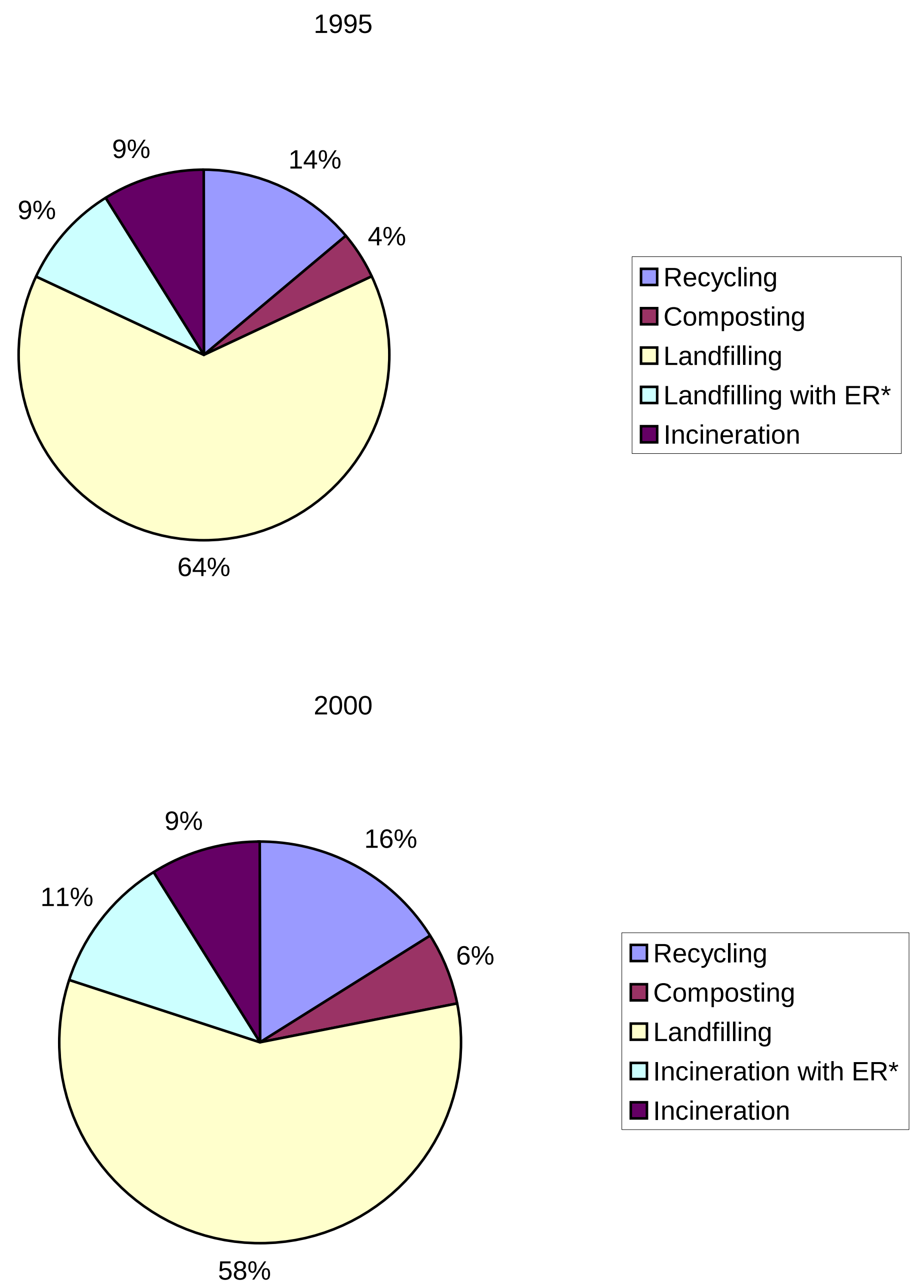
3.2.3.1 General Trend

The overarching idea of sustainability governs the general direction for waste management and forms the basis for the hierarchy of waste management enshrined in the EU policies as well as in other developed countries (Hansen *et al.* 2002). The EU, in addition, uses the principles of precaution, proximity and polluter-pays to direct waste legislation through directives to its member states. The European Environment Agency {EEA} (1999) report

[2] 1 pound = 0.4536 kg,

remarked that: ‘There is urgent need for integration of waste management into strategies for sustainable development, where waste prevention, reduction of resource depletion and minimisation of emissions at the source are given high priority’ (European Environment Agency {EEA} 1999:206 cited in Fagan *et al.* 2001 p 2). This policy is adopted by the EU and binding on all member states. It is guided by the overall principle of the community waste management strategy of 1996, which aims to establish an integrated waste management policy and respects the principles of the waste hierarchy. These principles are incorporated in the EU waste framework directive 75/422/EEC and subsequent directives: hazardous waste 91/689/EC, landfilling of waste 99/31/EC, shipping of waste 259/93, packaging 94/62/EC, end-of-life vehicle 2000/53/EC and the proposed electric and electronic equipment waste (Gervais 2002; Hansen *et al.* 2002).

Figure 3.1 demonstrates the outcomes of new waste management strategies in the OECD member countries between 1995 and 2000. In general, waste recovery performance is increasing. Central to this success is the efficient sorting, kerbside streaming by waste generators and mechanical collection techniques applied to waste management. Incineration with energy recovery, recycling, composting and incineration with energy each increased by 2%. Most of the waste still goes to the landfills even though rates dropped by 6% (form 64% to 58%) while incineration stagnated at 9% between 1995 and 2000. De Tilly (2004) notes that recycling rates seem to have reached their optimum, as they are flattening out and even falling in most countries in this region. This suggests the need for a re-examination of policies. This may partly explain why Braathen (2004) doubts the European Commission 2003’s current directives that ‘foresee that all Member States should achieve the same recycling targets’ and questions ‘whether uniformity in targets is most effective from both an environmental and economic point of view’ (Braathen 2004, p.11).

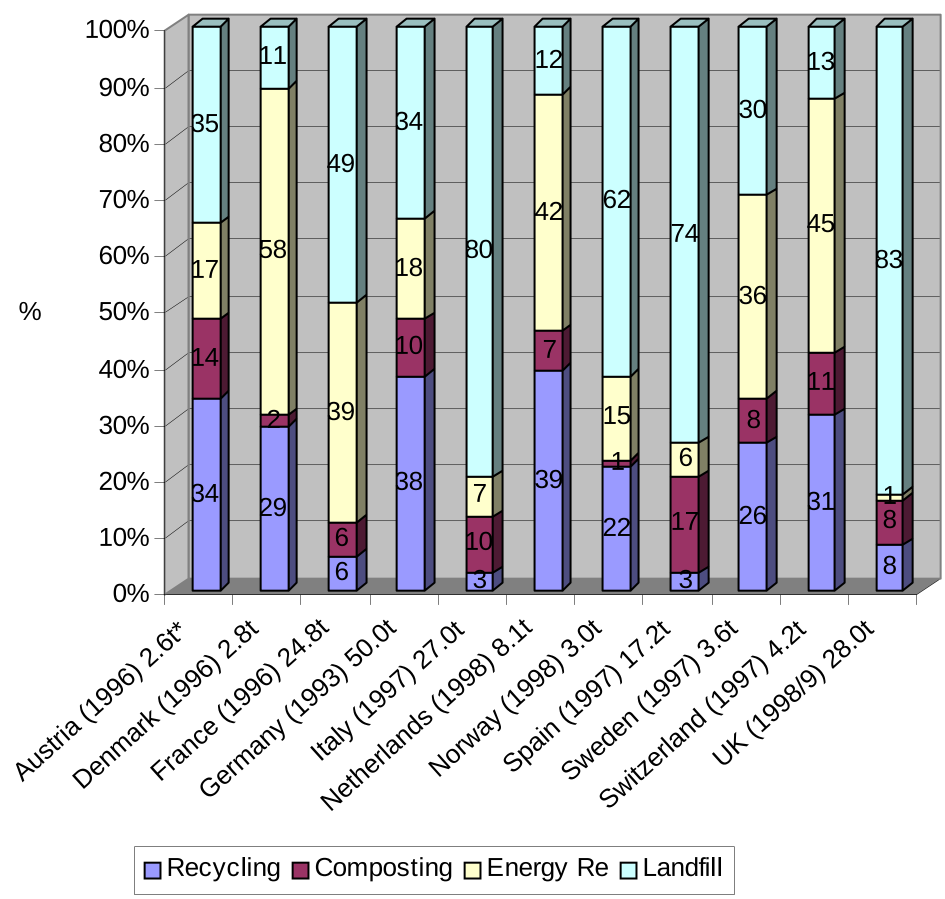


* Energy Recovery

FIGURE 3.1: Municipal Solid Waste Management in OECD Member Countries 1995 & 2000
Source: De Tilly (2004)

3.2.3.2 Trends within the European Union (EU)

There are national variations in recovery rates and disposal methods (Figure 3.2). The UK and Italy not only produce huge quantities of solid waste but also dispose respectively of 83% and 80 % of such waste at landfills. Other countries with high landfilling rates include Spain (74%), Norway (62%) and France (49%). Meanwhile Denmark, the Netherlands and Switzerland landfill only 11%, 12%, and 13% respectively of their waste and by the same token they are the best in waste recovery. Sweden, Germany and Austria closely followed them. Other OECD non-European members show similarities and differences in policy and options.



*** 10^6 t/year**

FIGURE 3.2: Waste Management in Europe 1993-99

Source: Malcom (2000)

3.2.3.3 Non-European OECD Member Countries

3.2.3.3 (i) The US: The US EPA (2003) indicates that in 1999, the US generated 230 million tonnes of MSW, 57% of which was landfilled, 15% burnt and 28% recycled. Separation and recycling improved, yielding 9300 tonnes at the kerbside and 900 tonnes at the drop-off centres. In all, 300 material recovery facilities developed in the country (US EPA 2003). Records from the preceding years show that the volume of waste generated continues to grow but with improved management. For example, according to Themelis (2002), the Council for Environmental Quality Report suggested that in 1996, 22% was recycled, 5.4% composted, 17.2% combusted, and 55.4% landfilled (Themelis 2002)**.** Strict regulations on landfill operations directed towards the safeguard of public health and the environment are reducing their number even though they continue to receive increasing quantities of solid waste (United Nations Environment Programme {UNEP} 2000). Fewer but larger, more environmentally friendly regional landfills called 'megafills' are now preferred (United Nations Environment Programme (UNEP) 2000).

3.2.3.3 (ii) Canada: Environics International and EcoLog Information Resources Group (2002) estimate that, in 1998, Canada generated 29 million tonnes of solid waste, 21 of which were either disposed of in landfills (90-95%) or incinerated. Nine million tonnes, mostly industrial, commercial and institutional, were diverted through recycling, composting or reused. The same source notes that beverage containers, used oil, scrap tyres are recycled by industries under stewardship programmes while the municipalities recycle paper and plastics. Of special note is the huge volume of Information Technology (IT) waste such as PCs, monitors, laptops and peripheries including printers, disk drivers, and scanners that are disposed of in landfills. In 1999 close to 35 000 tonnes were disposed of, 15 593 tonnes recycled, 24 507 tonnes sent for reuse and 6 128 put into storage (Environics International and EcoLog Information Resources Group 2002)**.**

3.2.3.3 (iii) Australia: The National Packaging Covenant is the leading instrument for managing packaging in Australia (Government of South Australia {GOSA} 2001). It was signed on 27 August 1999 by Australia and New Zealand council of ministers, local governments, and a broad range of industries in the packaging supply chain-based on the principle of shared responsibility through product stewardship. It is applied through the packaging chain, from raw material suppliers to retailers and to disposal of waste packaging. It gives no prescription, only minimises environmental impacts of waste packaging every 5 years (Government of South Australia {GOSA} 2001).

According to Newton and CSIRO (2001), between 1996-97, Australian landfills nationwide received an estimated 21.2 million tonnes of solid waste. Australia has 20 million people. This translated to 1.1 tonnes per capita/year, placing Australia among the top ten solid waste generators within the OECD and second only to the US. State and Territory per capita generation figures varied from approximately 800 kg/year in the ACT to 1400 kg in Western Australia. The main method of waste disposal in Australia is landfilling, which accounts for over 95% of solid waste disposal in some States and Territories. Australia identified a further problem of vehicle tyres and litter of cigarettes butts, bottles, cans, paper, packaging that cost most states problems and cost. For example, in Queensland 50% of the councils spend $25 000 each annually on litter collection (EPA Queensland 1999 in Newton and CSIRO 2001).

3.2 3.3 (iv) Japan: Japan opts for incineration as its main waste disposal practice. According to many sources including Wright (2000), it generates 51 million tonnes of domestic waste per year and 400 million tonnes of industrial solid waste, 30 % of which is recycled. Generally, 70% is incinerated, 10% landfilled and 10% composted. Japan emphasises the waste hierarchy's 3Rs (reduce, reuse, recycle) through its law on waste sorted collection and recycling of containers and packaging in 1995. Prevention through 'Zero-waste' and 'industrial re-utilisation of processed waste materials' policies are succeeding. Kiri Breweries in Nagoya, attained a 'Zero Waste' target in 1998, and obtained ISO 14001 certification to International standards of environmental management at its breweries. There is early streaming of bottles for waste minimisation and recycling. Everything is used and attention to the final waste disposal of the few per cent age of the difficult waste. Nippon Steel uses blast furnace slag to and oxygen for production of sand substitute in cement production and for fill materials in the construction industry, respectively (The IBRD and The World Bank 1999; Wright 2000). Other waste minimisation strategies such as garage sales, second hand shops and auctions exist here as with other parts of the developed world. In addition, neighbourhoods encourage exchanges and gifts of unwanted articles such as clothes and daily-used items (UNEP-IETC 1996).

3.2.3.4 Waste Management Techniques

3.2.3.3.(i) Collection and Storage: On-site solid waste streaming, collection, and storage by households, establishments and industries follow prescribed legislation. The containers are standardised, designed with environmental safety, ease of recycling and collection technology in view. For example, at the household level in Adelaide, South Australia, 240-litre galvanised iron or polyethylene receptacles are used. They are impervious with close fitting lids to protect content from pests. For effective waste streamlining, each household has three distinctive[3] receptacles, one for green waste, two or one partitioned into two parts, for recyclables and rubbish. In Germany colour coding is used to identify various types of bins for recyclables and a further colour coding for different waste bottle igloos[4].

Waste collection is at the kerbside, alley or backyard. The waste is removed mechanically by one person (the driver) manipulating a gooseneck-designed arm attached to the vehicle for lifting and emptying containers into the compactor hopper. The process follows well-planned routes and is very fast, and named the "rapid rail" system. In industries and institutions where waste generation is much, skips are used. Roll on-roll off (R.o-R.o) waste vans use winch and hydraulic systems to haul up these skips. The skip waste is transported to the processing centre, transfer stations or disposal facilities and emptied by tipping. Compactor trucks that load waste from bins mechanically or manually from the sides, rear or front, are also used. For long-distance transportation, truck trailers, rail cars or barges are used from transfer stations. Bulky and household hazardous wastes have special programmes for collection and disposal. There is a flow of information between waste generators, waste company and the city council on collaborative issues such as collection timetable, sorting and recycling procedures, using public meetings, flyers, newspaper, radio and television media, telephones and websites.

3.2.3.4 (ii) Treatment: Waste treatment includes a series of activities meant to facilitate recycling, resource recovery, transportation and disposal. These include bailing, shredding and grinding to reduce volume, and magnetic and manual separation, sorting, air classification, screening, composting, energy recovery and incineration.

3.2.3.4 (iii) Disposal: Treatment always ends up with rejects and residual waste that must be disposed of, and landfills remain the ultimate answer. Their importance varies from one country to another (Figure 3.2). However, landfills are a potential source of environmental and health hazards emanating form the gases and leachate they produce and are increasingly

[3] Colours, labels and illustrations are used to identify each bin.
[4] Igloos are large bottle-like public waste containers for collection used bottles for recycling.

coming under opposition from citizens. That is why in the developed countries, stringent regulations on landfill design, construction and operations are in place in order to make them function in an environmentally friendly manner. These majors include leachate management, which entails putting adequate liners to contain and direct leachate to treatment plants before discharging it to the environment. Landfill gases are vented, flared or collected for generation of electricity. Provisions are also made for closure and post closure monitoring and restoration of the areas. Both landfills and incinerators are increasingly facing these stringent measures and many are closing down or seeking far away locations.

Variations exist among countries in costs allocated for waste collection, transportation and disposal. Collection has attained 100 % in most countries even though collection costs are declining with automatic techniques. For example, in Japan collection accounts for 4%, treatment 45% and disposal 6%; whereas in developing nations such as Malaysia collection alone accounts for 70% (The IBRD and The World Bank 1999). NIMBYism[5], LULU[6], NIMTO [7], and scarcity of land for waste treatment and disposal facilities in or around cities lead to long-distance siting of waste disposal facilities in neighbouring districts, states or countries (Beukering *et al.* 1999; Fagan *et al.* 2001).

This phenomenon increases transportation costs and tipping fees. According to Themelis (2002), New York's 6 out of 13 transfer stations, and many of its landfills, are located out of the state. The author notes that the 10 ton vehicles travel 64 000 km a day while 20 ton vehicles, 216 00 km transporting waste out of the state. Each round trip takes 480 km and, 40 million litres of fuel are used in a year (Thermelis 2000). This practice is contrary to the UK's EU-influenced policy of proximity, that emphasis waste management as near the place of generation as possible (Malcom 2001).

Synthesis of literature in the last two decades suggest that there is a tendency for countries with high population densities such as Japan, the Netherlands, the UK and Switzerland to adopt incineration as the major solid waste management method, while low-density nations,

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[5] Not in my backyard
[6] Locally Unacceptable Land Use
[7] Not In My Term of Office

for example, Australia, Canada and the US exhibit high rates of waste landfilling (Sakai *et al.* 1996; OECD 2004).

3.2.3.5 Municipal Solid Waste Management Modes

Solid waste management in the developed world is increasingly becoming a joint venture between nations, states, local government and communities, and the private sector. The role each plays varies with countries**.** In the US, the government develops legislation and policy guidelines and allows many participants in a free market situation to find cost-effective solutions for fulfilling policy directives. This is different from Europe's integrated solid waste management approach. In Canada, the private sector is increasingly taking a bigger part, for example, in collection and transportation where they undertake more than 50% of expenditures. In other situations government and the private sector co-manage tertiary facilities such as transfer stations and landfill.

3.2.3.6 Technological Innovations and Applications

Along with polices and strategies, are developments of new waste management technologies, and improvement of the old, to enhance recovery and safe waste disposal. Some of these technologies are summarised by Wright (2000) as follows:

There are mechanical technologies that sort and separate waste. Biological technologies include controlled use of naturally living organisms to break down organic waste into useful products such as mulch and humus. These include land application, open windrow composting, vermin composting, enclosed composting, anaerobic digestion and fermentation. Thermal technologies include incineration with Refuse Derived Fuels (RDFs) such as electricity and/or steam. Pyrolysis or gasification technologies produce solid char or liquid (oil) char and syngas. Another thermal technology is waste melting. Waste incineration is not a preferred option by the waste hierarchy, but where inevitable it is only accepted with energy recovery and designed to operate with minimal environmental externalities such as fly ash, chrome, manganese and dioxin emissions. Landfills are of three categories, conventional wet, conventional dry and bioreactor landfills. Landfill engineering and operations are also under stringent regulations aimed to mitigate leachate contamination of soils, ground and surface water including air pollution and other hazards from landfill gases. Open dumps have since been banned and replaced by sanitary landfills in the developed world. Leachate is controlled by the use of liners with synthetic membrane and gases management by venting, flaring and recovery for generating electricity. Daily soil cover over the cells is an indispensable activity at the landfill (Wright 2000). Figure 3.1 shows an inclination of each country in Europe in applying these technologies at varying scales. However, some of these technologies are still under experimentation.

3.2.3.7 Policy Tools Applied in Waste Management Practices

3.2.3.7 (i) General Aims and Principles: In the developed countries, waste management has drastically improved with collection in most cities attaining 100%, while transportation is efficient and disposal facilities improved to mitigate environmental and health-related hazards (UNEP-IETC 1996). Policy and practice have moved from barely efficient collection, transportation and disposal towards emphasis on prevention or avoidance, recycling and reuse, using the principles of the waste management hierarchy as the menu for selecting nation-specific solid waste management options within the wider framework of integrated solid waste management planning (Timilsina 2001; Hansen *et al.* 2002). According to Hansen *et al*. 'what is not produced does not have to be disposed of' (Hansen *et al.* 2002 p. 3) and as with all matter, solid waste cannot be destroyed or treated without environmental impacts. Thus, minimisation and prevention are accorded the greatest attention given those end-of-pipe solutions seldom sustainable.

In this direction, drivers of waste generation types and amounts are being identified and addressed in policy instruments and practice. Waste is the unwanted end product of goods designed by manufacturers upstream and distributed by middlemen to consumers downstream. All these participants in the waste chain must share responsibility in waste policy and practice. While still it is important to emphasise reuse and recycling, the policy must go upstream to urge producers' stewardship towards the re-design of their products with a view to reducing quantity, weight, volume, toxicity and increase it 'recyclability' or take responsibility for products and their packages at the end of use.

Innovation or product change is a risk because consumers' behaviour in accepting such new products may not be ascertained. Therefore consumers downstream must be made/encouraged to accept and consume these new products. Different policy instruments based on economic regulations, directives, taxes, unit charges, mandates, incentives, standards, covenants and voluntary agreements have been designed to push these policies ahead. An OECD (2004) report suggests that more emphasis should be laid on 'economics of waste' to limit waste generation (OECD 2004). Directives descend from the OECD and the EU through to direct policies in individual member states and municipalities.

The 'Polluter Pays' principle is applied in this region and the costs of waste that must be covered are in two major categories, private and external. Private costs, also called internal costs, go to pay for waste equipment, wages and the opportunity costs of land needed for collection, recycling and disposal, while the externalities cost is a tax for various environmental damages such as noise, odours, leachate, dust, gases and litter caused by the waste produced. Both costs constitute what is termed the social costs of waste management (Davies and Doble 2004). Porter (2004) stresses that 'there is no easy formula for deciding what mix of taxes and subsidies is appropriate for waste handling'(Porter 2004, p. 151). However, policies are directed towards changing producers', distributors' and consumer behaviour using some of these incentives and/or taxes or deposits. The key approaches are fiscal, voluntary, covenants and enforced shared responsibilities and product stewardship. Different countries use different policy and strategy names to achieve these same goals, for example, the German 'Law on Prevention and Disposal of Waste' (1989) followed by the Close Loop Economy Law 1994; the US Pollution Prevention Act in 1990; Japan's Container, Packaging and Recycling Law; Denmark's Government Action Plan on Waste and Recycling 1993 and Australia's National Packaging Covenant 1999 (Sakai *et al.* 1996; GOSA 2001). Specific targeted policies follow.

3.2.3.7 (ii) Manufacturer and Distributor-targeted Policies: One common tool directed towards influencing manufacturers is the advanced deposit fee (ADF) or advanced deposit system (ADS). According to Porter (2004), this is a tax levied on manufacturers or distributors for the package and/or product at the time it is put to the market representing costs of collection, recycling and disposal externalities (Porter 2004). The ADFs vary from one country to another. They are higher in Germany than in France and in both cases vary with the type of recyclable in question, e.g. glass, steel, aluminium, paper and carton, and plastic. As policy continues to shift up-stream, the Extended Producers Responsibility (EPR) policy instrument is increasingly applied, with success, to influence manufacturers to re-design or change products with a view of reducing packaging, volume, toxicity and increased recyclability. EPR is

> ...a voluntary measure, which places the onus upon the manufacturer to reduce the environmental impact of their product at each stage of the product's life cycle-that is from the time the raw materials are extracted, produced and distributed through the end use and final disposal phases (The IBRD and The World Bank 1999, p. 14).

When industries apply this principle to their end products, the responsibility over the life of their products, such as recycling, is made less expensive. In practice, industries find it hard to follow up the life cycle of their products once the products leave the industry. Producers' Responsibility Organisations (PR0s) intervene at this level to organise activities leading to the industries' products stewardship or responsibility. They organise collection and recycling of such end products on behalf of the manufacturers as required by the law or voluntary agreements. PROs charge the manufacturers for the service and in principle such charges are a function of the characteristics of the industry's end products (Glauchant 2004).

A mandate is a direct policy used to reduce waste and encourage recycling. The EU directives through mandate, banned or set reduced quotas for certain wastes from landfills such as biodegradable materials, automobile tyres, batteries, motor oils between 1995-2016 (GOSA 1999; Fullerton and Raub 2004). In the same vein, some countries impose a tax on manufacturers for the use of virgin materials and/or a minimum recycled content standards policy that stipulates a proportion of recycled materials to be included in the manufacturing of certain goods (GOSA 1999; Fullerton and Raub 2004).

Businesses and industries also divert waste from disposal to a beneficial use by swapping waste as raw materials in a programme called 'Waste Exchange'. According to the IBRD and The World Bank (1999) more than 50 such programmes are in North America: New York, Chicago, and Toronto. They operate through published waste lists over the Internet. The same source notes that the Canadian Waste Material Exchange has a 20 % chance of waste becoming diverted for useful purposes (The IBRD and The World Bank 1999)**.**

Environmental labelling is also becoming an important policy tool. To raise environmental awareness and momentum throughout the OECD, businesses are required to label their products so as to inform consumers of the more friendly nature of such products to the environment. This helps achieve the following goals: improves sales or image of the labelled goods, raise consumers' environmental awareness, provides accurate, complete information regarding product ingredients and makes manufacturers more accountable for the environmental impacts of their products (e.g. Germany, Canada, Japan, Norway, Finland, Austria, Portugal, and France) (The IBRD and The World Bank 1999).

3.2.3.7 (iii) Consumer-targeted Policies: End consumers such as households and institutions are also targeted in policy instruments that attempt to enforce the waste hierarchy principles of waste minimisation. The marginal trash collection (MTC) charge is a levy on households for the collection and disposal of packages or remnants of their products. Consumers could also have been made to deposit a charge on the goods' containers at the time of purchase. Such a deposit is refunded when the end-user returns the used product, for example, beverage packaging, pet bottles and cans to appropriate centres. The system is called, the deposit refund system (DRS), and it is well developed in the US, Germany, Denmark the Netherlands and Australia (De Tilly 2004). In some situations recycling and collection charge (or refund) is levied on households that set aside materials for recycling.

A stringent policy instrument that is being introduced to reduce waste generation is the unit–based-pricing system (UBS). This is a system whereby the costs for waste collection are charged per weight or volume at the kerbside or at the disposal-tipping site. According to Fullerton and Raub (2004) only 6 000 municipalities in the US, 4% of Danish and a limited number in Korea are experimenting with the USB method. Early results indicate that the USB promotes dumping, suggesting that the flat rates remain a better strategy for household waste charge (Fullerton and Raub 2004).

3.2.3.8 Environmental Impacts of MSW in the Developed World

Environmental impacts of waste in the OECD member countries have diminished, but not disappeared, over the last ten years. This improvement is due to the institution and enforcement of extensive regulations especially on landfill and incinerator standards, which have witnessed the development of highly efficient technologies such as incinerators that reduce significantly the emissions of gas particulates, nitrogen oxide, sulphur dioxide, carbon monoxide, metal, acid gases and dioxin emissions (UNEP 2000c). However, the long-term contamination of surface and ground water, and the soil arising from former poorly managed landfills remains a big problem. The current waste disposal facilities are also insufficient because net waste generation continues to increase, as waste reduction efforts are offset by such increases; and some operators prefer closure to meeting up with the stringent waste facility standard. NIMBYism results in waste export to facilities in neighbouring states or countries, thus pushing such facilities further and further away from the sites of generation and thereby increasing transport costs as exemplified by the case of New York (UNEP 2000c; Themelis 2002). The waste management challenges demonstrated by many writers such as Hansen (2002), suggest that the search for lasting MSWM solutions is an on-going process even in the developed societies.

3.3 An Overview of Municipal Solid Waste Management in the Developing World

3.3.1 Introduction

The developing world constitutes nations that have not achieved a significant level of industrialisation and also have a low standard of living. It includes most of Africa, Asia (excluding Japan). Latin America and the Caribbean and Oceania (excluding Australia and New Zealand). The region's per capita waste generation is about half that of the developed world but very different in character. Municipal solid waste management remains a crucial problem, as the cities are simply overwhelmed with it. A survey of waste shows that it is increasing in both quantities and variety, yet collection ranges between 20-80%. Waste management takes 20-50% of operational budgets, even though more than 50% of the city dwellers do not have access to the MSW facilities (UNEP-IETC 1996). The municipalities have experimented with many strategies and technologies, both local and imported-conventional, to collect, transport, treat and dispose of MSW, a majority of which have failed. A panacea lay in using non-conventional methods such as human and animal muscles including locally adapted technology.

3.3.2 MSW Characterisation and Service Delivery

3.3.2.1 MSW Generation

Municipal solid waste generation rates vary among the regions and cities of the developing world. The rates are available only for some cities. Africa's mid-range generation rate is from 0.50 to 0.87 kg per capita per day and everywhere generation exceeds collection (Kironde and Yhdego 1997; Agunwamba *et al.* 1998; UNEP 2000a; ENCAPAFRICA 2004). Asian cities experience both extremely low and high rates of MSW generation, dictated by the level of industrialisation and consumption patterns. According to the IBRD and The World Bank (1999), Asian cities generate 760 000 tonnes of MSW a day estimated to reach 1.8 million tonnes in 2025, with a per capita per day generation rates varying from an average of 0.64 kg among low-income groups through 0.75 kg in middle-income to 1.1 kg in the high (the IBRD and The World Bank 1999). Extreme rates include India 0.1-0.6 kg and Hong Kong 5.0 kg (Beukering *et al.* 1999). In Latin America and the Caribbean, per capita per day generation rate ranges between 0.3-1 kg (UNEP 2000d).

3.3.2.2 Composition, Density and Humidity

All over the region the biodegradable fraction constitute a very high rate in the municipal solid waste stream. In Africa it is estimated at 70-90% (Yhdego 1995; Fehr 2000; Tanawa *et al.* 2002; ENCAPAFRICA 2004), and, in Asia and South America 30-75% (Medina 1998; Beukering *et al.* 1999). In a descending order, the general composition rates are ranged as follows: organic, ash (mostly Asia) paper, plastics, glass, metal, textile leather, bones, and feathers. The organic fraction declines in favour of the other types as incomes and western lifestyle increase. Solid waste densities range from 250-500 kg/m^3 and relative humidity of about 50-60% (Beukering *et al.* 1999; Tanawa *et al.* 2002).

3.3.2.3 Collection and Transportation

Collection is a key link in the MWM system. Generation exceeds collection and is well above the ability of the municipal governments to handle. Collection is usually undertaken by the municipality or contracted out to private companies. In either situation waste collection coverage is inadequate as it ranges from 20-80% with a mid range of 40-50% (UNEP-IETC 1996; Thuy 1998). Collection accounts for a very high fraction of the total waste management budgets with Asia having as much as 80% (The IBRC and the World Bank 1999; Ngoma 2000). With the inability of the official waste delivery teams to serve the whole city efficiently, waste generators further arrange with informal and informal private groups to collect their waste for a negotiated fee. For most of the areas house-to-house collection is rare. The official waste collectors are responsible for collecting waste disposed of in public moveable containers placed at strategic spots of the city.

Various types of transportation equipment are applied to carry waste. These range from locally adapted equipment such as human or animal drawn carts (wheel barrows, tricycles, push carts) to conventional open-back trucks, side and rear compactors and trailers. These conventional trucks are often acquired from foreign friendly cities, governments and international non-governmental organisations (NGOs). In West Africa vehicular transportation of waste accounts for 70% (UNEP-IETC 1996). This equipment is often poorly adapted to the high-density bio-waste, the terrain, the moist climate, narrow and unpaved streets with mechanical breakdowns being commonplace (Casanova 1999; Medina 2000).

3.3.2.4 Disposal

Modern technologies applied in waste disposal in the developed world can be spotted out in cities of developing countries alongside the most backward ones, for example, from state-of-the-art sanitary landfills of Jubaid in Saudi Arabia, Belo Horizonte, Mexico City, Buenos Aires to illegal ocean, river-banks, open-air dumping; burning and burying of waste that is common to most cities in the region (UNEP-IETC 1996; Thomas-Hope 1998; ENCAPAFRICA 2004)**.** However, the most common and convenient method of waste disposal remains landfilling. In a recent study of 50 landfills across Africa, Asia and Latin America, Johannessen and Boyer (1999) concluded that the open dumps approach remains the predominant waste disposal method in the region. The authors also identified three major cross-regional findings in waste disposal as follows:

> … the extensive use of daily soil on newly deposited or compacted waste, little management of landfill gas, and problematic and often no serious leachate management measures (Johannessen and Boyer 1999, p. 1).

The report noted that some of the countries were upgrading their landfills to the sanitary types, usually identified by the daily application of soil cover and compaction over waste deposited including leachate and landfill gas management. The improvement in this sector has been due to the assistance from the World Bank, even though Africa has the least share of such aid compared to other regions of the developing world. Inadequate waste disposal practices pose significant threats to the environmental as well as human health (El-Fadel *et al.* 1997).

3.3.3 MSW Minimisation Strategies

3.3.3.1 Introduction

Waste recovery by individuals and groups is a longstanding tradition in cities of the developing world. It is motivated by personal economic and cultural reasons and takes place throughout the waste management chain. It is difficult to estimate, in concrete terms, the amount of waste recovery that occurs, especially as it varies among regions and cities. In the past, municipal authorities encountered many difficulties handling these recovery activities that were dominated by informal groups, operating parallel to the mainstream conventional waste management system. However, since the 1990s the incorporation of professional scavengers and other community-based groups (CBGs) involved in municipal solid waste management has increased. This move has been seen as a panacea to the new strategy of waste management based on searching for non-conventional approaches to waste minimisation in the developing world. Furedy (1992) strongly advocates moving waste management away from the conventional engineering system that emphasises

> ..collection, transporting and disposal and privatisation as solutions to environmental problems of uncollected and unsafely dumped waste, towards 'non-conventional approaches' that must have some general social and ecological goals and potential to change the simple collect-transport-dispose organization of waste service…linking 'resource recognition' to social betterment and attitude change at the local level (p. 43).

Furedy was thinking of structures that organise and incorporate the rich waste economy (itinerant waste buyers, waste pickers, small waste shops, second-hand markets, dealers, transporters and a range of recycling industries) in Asian and other cities of the developing countries for waste collection, reduction, separation for compostables and recyclables. She also envisaged the incorporation of projects that would improve scavengers' social status, economic situation and health standards.

Many levels of source recovery exist in cities of the developing world. It takes place when households, institutions and businesses that generate waste do separation of material at source and itinerant buyers, in turn, purchase these source-separated recyclables. The collection crew sort recyclables while on their collection routes, meanwhile informal collectors retrieve recyclables prior to the disposal of refuse they pick up. Scavengers also retrieve materials from communal storage sites, street or public places, vacant lots or illegal dumps where garbage is dumped, composting plants, municipal open dumps and landfills, canals and rivers that cross urban areas (Medina 2000; Zerbock 2003).

3.3.3.2 Composting

Owing to the large biodegradable organic fraction in the MSW stream in cities of the developing world (3.3.2.2), composting has been understandably promoted as a desirable method for converting such waste into a reusable product such as compost (Mbuligwe *et al*.2002). But most of the large mechanical plants introduced in Africa, Asia, Latin America and the Caribbean in the 1970s and 1980s failed, and those that survived operate below optimum capacity (UNEP-IETC 1996; Furedy 2002). Examples of failed mechanical composting plants were in Bangkok Hanoi, Shanghai, Tokyo and Delhi. Reasons for the failure included high operational costs, under utilisation, maintenance costs, high cost of the manure, high labour costs, contamination by plastics, glass, metal and toxic substances. These failures suggested poor feasibility studies (Nkotto *et al.* 1995; Hoornweg *et al.* 1999).

In Kathmandu the windrow composting was installed but it soon broke down. Bangalore is experimenting with windrow composting. Since the 1990s small neighbourhood-based aerobic composting and vermiculture (worm composting) have been experimented with assistance from international organizations (UNEP-IETC 1996). In all, the experience suggests that composting is very limited and still fraught with many problems. Furedy (2002) concludes that 'Compost-making promoted as a waste reduction strategy, has little impact on the quantity of organic waste at dumpsites in developing countries' (Furedy 2002, p. 1).

3.3.3.3 Incineration

Incineration, as with large-scale composting, has been introduced in many cities of the developing world, for example, Mexico City, Sao Paulo, Buenos Aires, Africa, Lagos and Manila. The costs have been prohibitive. In addition, it is not practicable because the organic waste fraction is too high. Medina (1998) reveals that in Lagos three incinerators with Western European grants (US $30 million) in 1979 were never used, two were dismantled and one turned into a civic centre. Medical waste is usually incinerated in small-scale incinerators. However, incineration of municipal solid waste is common with the more industrialised and high-density parts of Asia such as Korea, Taiwan, Hong Kong, Indonesia and Singapore that incinerates 90% of it waste (UNEP 2000b).

3.3.3.4 Solid Waste Recovery in Latin America and the Caribbean

According to recent studies in Latin America by Arroyo (1999 cited in Hardoy *et al.* 2001), there exist many micro-enterprises or small enterprises and cooperatives of scavengers involved in waste recovery activities. He identified and studied 89 of them in seven countries. They use well-adapted local vehicles for waste collection and transportation (Appendix 9). Arroyo (1999) also reveals that the scavenger activities extend to recovery of recyclables (paper and cardboard, glass, metal, plastics), street sweeping, cleansing of canals and storm water drains, and maintenance of parks, and other public places including the management of deposit sites. This was feasible because there are formal large-scale recycling programmes in major cities in the areas and cooperatives of scavengers and small-scale waste enterprises are also well developed. The informal sector (scavengers) is very active in Latin America and Asia. For example, in Bogotá 12 000 families with an estimated population of 30-40 000, and 15 000 families in Mexico are involved in waste recovery (Medina 2000). But until the 1990s the informal and the formal sectors existed parallel to one another with the informal often facing harassment from city authorities including kidnap, round ups and killings (Medina 2000).

Despite the brutal treatment given scavengers they tend to persist because their activities are economically motivated. International NGOs, religious groups and local SW authorities have developed waste scavenger cooperatives with environmental underpinnings, such as with the cases of Belo Horizonte and Porto Alegre, Brazil and Mexico City. In Mexico City 3 200 tonnes of waste are recycled per year in a plant with proceeds going to the separators of the waste. Cooperatives provide training, financial and health support to their members leading to an increase in their financial and social standing. They are able to acquire bank loans.

3.3.3.4.(i) The Importance of Scavenger Cooperatives in Latin America: Some National Cases

Medina (2000) analysed the individual scavenger cooperatives in some countries of Latin America: Colombia, Brazil, and Mexico. He demonstrated that Colombia has the most dynamic scavenger cooperative movements in the world. He notes that one of them called 'Fundacion Social' was created in 1986. It soon launched a national recycling program, which today has 100 scavenger cooperatives spread all over the country. Bogotá has seven of them. The foundation awards grants, makes loans for specific projects, provides members with legal, administrative and business assistance. It also aims at educating Colombians on social, economic and environmental benefits of recycling and improving working conditions of scavengers. Colombia's scavengers are said to recover 5000 tonnes of recyclables every year (Ibid). This is why Pacheco (1992), writing on scavengers and recycling in Bogotá, argued that those who make a living out of the collection and recycling of waste should be viewed positively and assisted with equipment to use.

Another important scavenger cooperative is based in Medellin. Created in 1983, it now operates with 1000 scavengers, 60% of them women. It does not only recover 5000 tonnes of recyclables a month but also has a contract with Guaine city to collect, transport, and dispose of waste. In the transaction they earned US $30000 while the city gains a cost reduction of US $5000 (Ibid). Therefore, both the city and the scavenger cooperative gain from the operation.

In Brazil, Medina (2000) observed that many scavenger cooperatives have also been formed in Rio de Janeiro, Horizonte, Recife, Niterioi and Salvador. In Rio alone there are 17 cooperatives with 2500 members. In Porto Algre, scavengers are incorporated into the city's kerbside recycling program, reducing overall costs, and serving 75% of the city's 1.5 million people. Educational kits, monthly newsletters, data banks, hot lines and scrap brokers exist for scavengers. These facilities were created by CEMPRE[8] and supported by NGOs, big companies such as Coca Cola, Mercedes Benz, Nestle, and Pepsi Cola. Medina argues that the cooperatives are doing a good job as illustrated by the Coopamare cooperative in Rio, where each member earns an equivalent of US $300 a month compared to the average of US $150 earned by half the nation's labour force (The IBRD and The World Bank 1999; Medina 2000).

Mexico is no different. Medina (2000), further examines the special case of a scavenger cooperative operating in Juarez on the US-Mexico border called Sociedal de seleccionadores de materiales (SOCOSEMA). This success case illustrates how the elimination of middlemen can help improve the scavengers' earnings. The cooperative recovers 150 tonnes of paper, cardboard, glass, rubber, plastic, animal bones, organic materials and metal a day. It was created in 1975 and gradually fought and drove out the middlemen who not only paid lowered prices for their recyclables but at some moment decided they could only buy paper. Since then the waste workers' earnings have increased tenfold. They are now said to enjoy higher incomes, participate in training courses, have formal education programs, access to health care and legal protection. They have equally developed good relations with the industries. Meanwhile, over the last decade, scavenger cooperatives have grown in numbers in the other Latin American countries for example: Venezuela, Peru Ecuador, Guatemala and Costa Rica.

3.3.3.5 Waste Recovery in Asia

Asia shares many management attributes of Latin America and the Caribbean. But this is one region in the developing world that faces a greater need to break the strong link between waste generation and affluence. For example, the per capita solid waste generation rate ranges from an average of 0.33 kg per day in India to 5.0 kg in Hong Kong, and it is not matched with management, especially recovery (Beukering *et al.* 1999; WASTE-UWEP 2003). This is why

[8] Brazilian Business Commitment for Recycling

Furedy (1992), who has long studied the waste economy in Asian cities, advocates the non-conventional methods of waste management in Asia and the developing world (2.2.51).

There are sub-regional, national and city variations in Asia. International NGOs and missionary bodies have organised some of Asia's scavengers exemplified by Karachi (55 000), Calcutta (40 000) Manila (32 000) and Chennai (Beukering *et al.* 1999; Medina 2000; Hardoy *et al.* 2001). Medina (2000) notes that India's waste pickers recover 7-15% of solid waste. The 'Waste Wise' project was launched in Bangalore, India in 1900, with the aim of exploring non-conventional methods of managing solid waste in the city (Furedy 1992). In the Philippines the 'Cash in trash' Metro Manila and 'Women's Balikatan Movement' in Manila, used 1500 trained scavengers called 'Eco aide' organised into 17 cooperatives with 897 middle people available to purchase and collect 4000 tonnes of recyclables per month sourced from households and schools of the whole Metro Manila city (Gaite and Eggerth 2000; Medina 2000). Still in Manila, the Vincentian Missionaries organised the 10 000 scavenger families of Papayas in Quezou city, who have lived off the dumpsites at Smoky Mountain, into micro enterprises (UNEP-IETC 1996; Vincentian Missionaries Social Development Foundation Inc. (VMSDFI) 1998). The waste enterprises organised waste collection, recycling and sales and expanded their activities to improvement of housing, health and social welfare (VMSDFI 1998).

Exnora International NGO in Chennai aimed to organise local people into voluntary self-help groups called Civic Exona for managing local civic amenities and sanitation. They encouraged the creation of local neighbourhood associations that made collections and transfers of household solid waste to public skips and transfer stations. Collectors were trained to use tricycles carts to collect waste. Each household pays a fee of US$ 0.30 a year to support the community-based organisation (Medina 2000; Anaud 1999). By 1996, 1500 Civic Exonas provided services for 45 000 people (Anaud 1999). In the Indian City of Prune approximately 6000 'rag pickers' formed a cooperative, which in 1995 recycled 25% of the city's 1 million residents (Medina 2000). Throughout the South East Asia area, food waste is sold from households and restaurants to poultry and pig farmers. In China pigs are released on garbage dumps (UNEP-IECT 1996).

3.3.3.6 Waste Minimisation in Africa

Many sources recognise the Zabbeleen in Cairo, Egypt as the world's oldest and best-known scavenger organisation (Furedy 1992; UNEP-IETC 1996; Korfmacher 1997; Hardoy *et al.* 2001). According to Medina (2000) there are 30 000 Zabbeleen refuse collectors many of whom use donkey drawn carts to collect and recycle waste. He notes that a pair of Zabbeleens serves 350 households in a day from which they sort and recycle into animal feed, manure, scrap metal, paper and plastics for middle people who then sell to crafts people or industries (Medina 2000). Limited numbers of scavengers exist in many African cities but the organisation and number is insignificant compared to the experience in Asia and America (Kironde and Yhdego 1997; Korfmacher 1997; Adeyemi *et al.* 2001). In many African cities waste is also diverted to feed animals.

3.3.4 General Management Issues

General management issues such as the mode, financing and problems of conventional strategies are examined here. Municipal solid waste management (MSWM) everywhere in the region is the responsibility of the local municipal governments who are simply overwhelmed with the problem. Many studies lament the failure of public servicing including MSWM and suggest private contractors, who are believed to be politically independent, economically rational, efficient, dynamic and innovative, as a way of circumventing this problem (Habitat 1998; Obirih-Opereh and Post 2002). Such privatisation attributes the government's main role to control and is believed to save costs, reduce political interference and red tape. However, increasing experience suggests that the whole process is not a relieve for local councils who have to upgrade their staff capacities to be able to effectively plan, control, monitor and supervise contracts, meanwhile private concerns have been noticed to cut corners while executing contracts (UNEP-IETC 1996; Clark 1998; UNCHS 1998; Obirih-Opereh and Post 2002). I think either or a combined approach requires serious work from both the municipal authorities and the contractors concerned.

There is tendency for local municipal governments to manage waste in smaller cities while in the large cities it is privatised. For example, in Latin America and the Caribbean region the local government in bigger cities remain supervisors, organising concession contracts with the private sector or managing directly. In some cases such as Sao Paulo supervision is further contracted out leaving the local authorities with overall supervision only (UNEP-IETC 1996).

Financing MSWM operations, including investment, are in most cases covered by the general assembly revenues of the central government grants or donor funding. User fees for the direct use of waste facilities would be a wrong strategy, as this would increase illegal dumping. Waste services are charged along with other urban services and collection by the central government through the taxing system. In contrast to the ‘polluter-pays’ principle in the developed countries, WASTE developed the ‘all beneficiaries pay’ principle incorporated with ‘the ability to pay’ as useful to cities of developing countries, given that cost-base tariffs are not affordable to low-income populations (van de Klundert and Anschutz 1999).

Collection and transportation remain a key activity of MSWM in the developing countries and there is increasing use of conventional approaches, one being the compactors trucks**.** Compactors are not suited for the organic dense waste, narrow, unpaved and hilly paths. Other problems associated with compactors include the lack of spare parts and the expertise of local repairers. These problems cause waste trucks to lie idle as a result of breakdowns and by so doing increase accumulations of uncollected waste. According to Medina (1998), out of 300 compactors donated to Manila in 1990 by Japan, only 120 were in good working conditions by 1992 (Medina 1998). In the same vein, ENCAPAFRICA (2004) reports that in West Africa, 70% of the waste trucks were always out of use at any one time in 1999 and that in Harare only 7 out of 90 such trucks were in good order and as a consequence daily waste collection in the city was paralysed. The same author concludes that poor management, financial fiscal irresponsibility, malfeasance, equipment failure and inadequate waste management budgets are at the root of waste problems in the regions (ENCAPAFRICA 2004).

3.3.5 Discussion and Conclusions to MSWM in the Developing World

There is hardly any approach used in the developed countries that has not been experimented with in the developing world. Thus, the developing world demonstrates a mix of conventional and non-conventional approaches with the latter (non-conventional), having a stronger hold especially as the former (conventional approach) has failed in almost all attempts. A new focus has seen the incorporation of scavenger cooperatives and other local initiative groups, which were informally involved in collection, recycling and transportation, into the mainstream management system. An organisational style and technologies adapted to the realities of the environment have been adopted. Policies and strategies in this region focus more on collection, transportation and disposal with collection and transportation accounting for more than 70% of the waste management operations. Recycling at artisanal and domestic levels has always been there. It is insignificant and not a priority, putting the application of the waste management hierarchy in these areas under scrutiny.

Central to sustainable MSWM in the developing countries is the involvement of large dynamic scavenger cooperatives and other local initiative groups. The numbers and achievement of such groups in waste management, social and economic enhancement, especially in Asia and Latin America and the Caribbean, demonstrate this. African countries are still grappling with the concept of integrated and sustainable MSWM, let alone its practice. It was at the October Cairo, 1996 UMP-SDC-CWG organised workshop that participants from Africa and other parts of the developing world met and made the Cairo Declaration on the principles for Micro and Small Enterprises Involvement in MSWM Service Delivery meant to endorse the need for expanding the participation of Micro and Small Enterprises in MSWM (SKAT 1996). And it was only during the first Regional Waste Management Workshop held on February 2003 in Nairobi that 15 mayors of the East African region made other declarations. They pledged firstly, to achieve sustainable municipal solid waste management in the region by following a new paradigm shift based on sound policy framework, appropriate intervention, more stakeholder involvement and free flow of information; and secondly, to place more emphasis on the need to collect, sort, and reuse refuse to fight poverty as well as protect the environment (Wastenet 2003). In the same vein, PDM, operating in Cotonou for West and Central Africa, and Zimbabwe, for Southern Africa, through its structures such as the African Wastenet, creates forums for permanent brainstorming on waste-related issues such as sustainability (Adegnika 2002).

The only organised formal waste group in Africa are the Zabbeleen scavengers in Cairo, Egypt. Elsewhere in the African region small numbers of scavenging and other groups exist but they are not organised or integrated. In Cameroon scavenging is not only insignificant but also picking things from waste facilities is taboo. Hence the problem of sustainable MSWM in Cameroon has to be viewed with these special conditions in mind.

3.4 Review of Municipal Solid Waste Management Literature on Cameroon

3.4.1 Introduction

Research on urban development and environmental management in Cameroon is rare, let alone municipal solid waste management. Urban waste management is understudied especially in small cities and towns. Mostly urban waste projects that attract sponsorship or contract awards usually enjoy sponsored research. Waste management, especially in small cities and towns, would hardly attract private contractors and sponsored research. The municipalities do not understand they can do research to understand the situation of their waste. Most of these cities, such as Bamenda, are also ‘working in the dark’. There are no current and reliable data on the characteristics of the waste they are managing or intend to manage or are supposed to manage because detailed research has not been conducted to determine such data. Coherent studies that measure MSWM’s sustainability with the view of illuminating the merits and weakness of such a system, and by extension inform waste generators, management and policy, have not been accomplished. As such, waste research in small urban settlements is either absent, exists but is elementary or is limited in scope and thin in depth. In almost all cases they are end of course papers by a very limited number of undergraduates and graduates who produce such works under many constraints that are reflected in the results. Many publications are overviews of the whole MSWM. Topical studies on specific aspects are understandably not much studied except composting which emerged in the early 1990s and soon disappeared with its failure almost everywhere. I have reviewed the literature of some major sources chronologically and reserved more reviews as each topic is studied following the waste management flow chain in substantive sections.

3.4.2 Review of Related Literature on MSWM in Bamenda

One key problem of solid waste management in Bamenda is that it lacks consistent and reliable data that can provide measures for conditions and trends for rethinking integrated and sustainable strategies. The problem of waste management has confronted not only academics but also administrators in Bamenda. One very early attempt to give a scientific appraisal to solid waste management in Bamenda was made by Chuba (1978). He made a comprehensive report on MSWM to the Governor of North West province in which he not only described but also made the first attempt to calculate waste generation by the Bamenda population estimated at 42 720 with 9493 households in 1978. He used the city and household levels. For generation at the city level, he used a formula derived by Llyedyn and Co that:

$$\text{Total daily waste generation in tonnes} = \frac{\text{Thousand of Population} \times 3}{4}$$

$$= \frac{42 \times 3}{4} = \frac{126}{4}$$

$$31.5 \text{ tonnes per day}$$

He developed another hypothesis that each family generates 3 kg of waste a day and given that there were 9493 families, total waste generated was 28.479 tonnes per day.

In the third scenario he used average load weight carried by the waste tipper van, which he estimated, carried 3½ tonnes and making an average of four trips a day, totalling 14 tonnes. But he argued that this accounted only for one-third of the town's waste. So he tripled this rate to acquire 42 tonnes. He said the figure appeared frightening but argued against himself that given the huge quantities of illegal dumps it was real. However, he chose the mid way attributing the town's generation rate 30-42 tonnes a day (Chuba 1978). This administrator' s descriptive report was based on careful observation and ingenious calculations. But I notice that by applying the international formulae from Llyedyn and Co. Chuba ignored local realities. There can be no universal formulae for determining waste generation quantities, which is why results from such imported formulae would most likely not be reliable. Applying that formulae to Bamenda today would give a daily total generation rate of 225 tonnes or 0.9 kg per capita. The estimates of 3 kg per family per day waste generation and one-third waste removed remain speculations needing verification.

Nsoh (1994) studied solid waste evacuation in Bamenda with a focus on causes and consequences of inadequate evacuation and treatment of MSW in the city. In a four-week field study she collected samples from two quarters, Old Town and Station, using questionnaires. This author also weighed solid waste found at different sources during the course of administrating the questionnaires and also spread some of the waste out on the ground to analyse it for composition. She derived a per capita day generation rate of 1.2 kg and a total daily generation rate of 129.15 tonnes from the city population of 107628. These were key aims and objectives of the research but the methodologies and analysis performed raised many doubts about the results obtained. This was one of the earliest attempts to research some important causes of inadequate MSW management in Bamenda such as population growth, the lack of public skips and insufficient equipment and personnel. She also identified and mapped dumpsites from where the council collected waste, including illegal dumps found all over the city.

't Hart and Langeveld (1995) from a one-day workshop on the environmental situation in Bamenda, Cameroon evaluated the range of environmental problems as seen by the Bamenda population and verified the necessity for an environmental strategic plan for Bamenda. The workshop identified the following as the environmental problems facing the city: waste (municipal solid and liquid), drainage, housing and urban planning, roads and traffic, erosion, agriculture, pollution, environmental awareness of the people and population pressure. It was a general brainstorming seminar in which participants raised the problems outlined above survey and waste management was indicated as most pressing.

Anschutz *et al.* (1995) from a five-month interdisciplinary field survey, studied solid waste management through testing the suitability of the ‘ecopolis’ concept used for developed countries in Bamenda. They aimed to gain an insight into MSWM in Bamenda by exploring and describing it, including its environmental effects through the application of the ecopolis concept. Ecopolis’ central strategies are: responsible city (hierarchy of actors and responsibilities), living city (environmental and health concerns) and participating city (involvement in the problem). This study made important contributions to MSWM in Bamenda and such findings are well acknowledged in subsequent places in this thesis (6.4, 6.5). Three hundred and forty litres of waste were collected from two dumpsites, sorted and analysed for characteristics as follows: metals/tins 1.5, 2.7%; glass 1.8, 0.7%; organic 86.6, 83.3%; paper/cardboard 2, 3.6% and plastics/rubber/textile 8.2, 16.9%. The density was 350 kg/m^3. Based on the waste van capacity, they estimated a monthly waste collection by the council at 120 tonnes or 4 tonnes a day.

However, these measures did not address the critical problem of basic waste data, such as, quantities and generation rates, as aimed for in one part of this thesis. The council collected waste from destined ground dumpsites but that did not constitute the city's total waste, as illegal dumps have always existed. From these measurements neither the sources, quantities nor the rates of waste generated can be determined. They observed, conducted interviews and administered questionnaires to study waste collection and disposal including environmental problems. They also tested samples of soils (for suitability of dumpsites) and water (for waste contamination). The dynamic of MSWM in Bamenda has changed because it is a decade since these studies were conducted. This has rendered the data, many conclusions and practices observed, obsolete. For example, the system has since changed with the introduction of waste compactor trucks and 1000 L public skips. Waste is no longer collected by scooping from ground dumpsites, as noted by the report, but through organised circuit collection from skips using automatic rear-loading compactors. A few NGOs are also beginning to emerge in MSWM. The population and economic activities have changed drastically.

3.4.3. Review of Related Literature on MSWM in Yaounde

3.4.3.1 Early Research in Yaounde

More research has been realised on municipal solid waste management (MSWM) in Yaounde than in Bamenda. These studies have been advanced thanks to the student and teachers of the department of urban development of the National Advanced School of Engineering, (ENSP) in the University of Yaounde I, including donors who have been prepared to sponsor such major projects. There is a variety of publications directed for different purposes and they exist as reports, journal articles, conference papers, parts of a book and students' end of course essays, memoirs and a thesis. The key sources are reviewed here (others within related topics in the relevant chapters), with the purpose of demonstrating how the present research foci differ from such previous works as well as the complementary role the previous researches play in realising this project.

The late 1980s and early 1990s saw the emergence of the first researches on MSWM in Yaounde. They were students' end of course papers and include Kengang's (1987) solid and liquid waste in Yaounde; Kalsingbe's (1988) methods of solid waste collection in Yaounde and Mbalmayo; Tanawa's (1988) municipal waste treatment and poor hygiene in Yaounde; and Ngnikam's (1992) two propositions for municipal waste management in Yaounde (Nsoh 1994; Ngnikam *et al.* 1997).These publications made useful contributions to specific aspects of MSWM studied. This was during the first phase of HYSACAM's contract to manage solid waste in the city, which soon ended (8.2.4) and waste management dynamics also changed rendering most of these findings obsolete.

The 1990s was characterised by economic crises that precipitated the exit of the official waste contractors-HYSACAM and the entrance of NGOs and private formal and informal groups into the MSW management. International bodies and national corporations became more interested and sponsored waste management including research (9.2.1.2). The focus of activities was composting of municipal household waste as a means of reducing quantities of waste that must be disposed of, so too was the orientation of the research papers presented at seminars or published in journals at the period. Ngnikam *et al.* (1993), studied the treatment by composting of household waste in a spontaneous quarter in Yaounde. Ngnikam *et al* (1993) proposed a guide to making an artisan composting plant in Cameroon. Nkotto *et al.* (1995) examined the viability of composting municipal household waste as a triple solution to unemployment, providing a substitute for expensive imported fertilizers and improving urban sanitation in an era plagued with economic crisis. Wethe (1994) in a seminar paper examined aspects of community composting in Messa Quarter, Yaounde. Vermande and Ngnikam (1994), at the request of the National Hydrocarbon Company (SNH), made a pre-feasibility study for engaging a waste management and treatment enterprises in Yaounde. Tanawa and Wethe (1995) reviewed the contributions of the National Advanced School of Engineering (ENSP) in municipal waste management in Cameroon. FOCARFE, the NGO that championed the waste composting venture in Yaounde, had many publications in 1994 and 1995, on waste composting in the city (FOCARFE 1995). These studies suggest that the approach was topical and not holistic with a view of developing an integrated sustainable system as aimed by his research.

Vermande et al (1994) conducted the first detailed study of solid waste management, requested by Yaounde III and sponsored by FIECOM[9]. This research generated basic data and research methodological foundations for MSWM in Yaounde. Thereafter, most researches have updated parts of the information for use in various purposes. The study examined MSW management from generation to treatment in the short, medium and long term. It described the city's background including those factors that drive solid waste management. This report produced much-needed data and analysis that demonstrated 'the situation as it was', for the attention of decision-makers who were facing the crucial problem of waste collection in the city. The study did not suggest any system such as Ngnikam's thesis (2000) did using the multi-criteria analysis**.** This study did not also develop the environmental impacts of MSWM in the city. Moreover, the information in this work has been made obsolete by time and events.

3.4.3.2 Review of Recent Literature on the State of MSWM in Yaounde

HYSACAM signed again a three-year renewable contract to manage the city's solid waste in August 1998, after its services were interrupted in 1991 as a consequence of the economic crises (8.2.4). In terms with the contract provisions, three years later an evaluation of HYSACAM's activities was made with the financial assistance of AGRO-PME and the French Cooperation Services together with the collaboration of the Yaounde City Council. The final report by Monkam *et al.* (2000) analysed the company's performance based on the contract specifications 'Cahier des Charges' by examining and evaluating the general cleanliness of the city, waste quantities collected and public sensitisation campaigns. Findings suggested that MSWM had relatively improved but strongly observed that each one of the parameters measured fell short of required standard, hence needing drastic improvement. It signalled that the public skip capacity available could only permit the removal of 25% of the solid waste generated in the city. The report also gave recommendations for improvement (Monkam *et al.* 2000). This report has very valuable data and information, however, it focuses on HYSACAM activities that constitute only a part of the waste management scenario.

[9] FEICOM=Local Council Bank

Ngnikam's (2000) claim that MSW research in Africa focused mainly on management and left out economic and environmental aspects, led him to study MSW in Yaounde using a decision support system (DSS)-the Life Cycle Analysis to select the best system of four proposed waste management systems using multiple (six) environmental criteria. The systems he proposed were:

1. Conventional collections and landfilling
2. Conventional collections and landfilling with gas recovery
3. Conventional collection, separation for composting and landfilling
3. Conventional collection, gas recovery, composting and landfilling of residues

The environmental criteria were:
1. Depletion of natural resources (consumption of petrol)
2. Greenhouse effects
3. Acidification
4. Eutrophication
5. Toxic and eco-toxic impacts
6. Volume occupied by waste at the landfill

He performed a multicriteria analysis by aggregating and weighted the six environmental impacts or criteria listed above with each system proposed. From the evaluation, ranking and section results he retained the second (2) option, conventional collections and landfilling with gas recovery, as the best sustainable solid waste system for Yaoundé. The presentation is simple but the detailed process entailed generating vital data for the systems and subsystems and the finding could be very useful to the decision makers. Although the multicriteria analysis is seen as a good method because it facilitates the comparison of MSW options against a wide range of conflicting factors simultaneously in a quantifiable and auditable way, the method still has a general problem of defining the level of sustainability of each option (Gaines and Stodolsky 1997; Aravossis *et al.* 1998). Moreover, if different stakeholders give different weightings the results will also be different making it hard to determine which is actually sustainable (Hokkanen and Salminen 1997; Sarkis 2000). Overriding constraints such as finance may cause decision-makers not to use the support tool. Increasing literature demonstrates that waste landfilling with gas extraction has failed in most places in the developing countries.

Two recent papers deal with specific aspects of MSWM in Yaoundé. Ngoma (2000) focused on financing MSWM as concerns HYSACAM, the main waste management company of the city. He estimated the total annual cost was three Milliard CFA, with exploitation (collection, street sweeping and transportation) taking 78.59% of the total costs, leaving the remainder of costs spread over headquarters and local administrations, landfilling (treatment) and equipment maintenance costs. Djeutcheu (2001) conducted an environmental edict of the Nkolfoulou landfill Yaounde, ten years after its existence. He noted that an environmental impact assessment (EIA) was never carried out prior to the establishment of the facility, as such; only makeshift safety measures have been put in place to mitigate landfill environmental problems. Ngoma’s and Djeutcheu’s papers both respectively made proposals for improving the situation of financing as well as landfill management.

In a recent contribution to a publication on *Enjeux de la Proprieté Urbaine*, Tanawa *et al.* (2002) examined solid waste management in Yaounde as a case from the Central African region. After making an outline of the city’s background including the history of waste crises, they went ahead to review the whole SWM situation of the city including financing, institutional arrangements and technical aspects, all of which were identified as problematic. They conclude that the last three decades of municipal waste management, during which a plethora of methods were applied, demonstrated that no sustainable solution has been found to the city’s hygiene problems. The solution, they suggested, lies in decentralisation that makes urban councils strong enough to bring together the diverse stakeholders and define role and responsibilities (Tanawa *et al.* 2002).

These papers further demonstrate that the search for a sustainable approach to MSWM in the city is ongoing because no lasting solution has been found despite many experiments. I hold this view to be true and that is why this thesis aims to contribute towards such a goal.

3.5 General Conclusion

Countries of the developed world have used the principle of the waste management hierarchy to develop a sustained MSW system that operates on well-defined strategies and goals. They apply conventional methods using strict regulations, high technology, heavy capital, research findings and consumer participation in an environment with developed infrastructure. The application of conventional approaches in the developing countries has generally met with failure. The central issue to sustainable MSWM strategy in these countries is the use of the private sector including local initiative groups, especially the large dynamic scavenger cooperatives in Asia and Latin America and the Caribbean. In Africa, the Zabbeleen of Cairo, Egypt is the only classic example of organised scavengers. Elsewhere in the region scavenging exists to a limited extent and is not well organised. Informal waste groups exist but have also not been incorporated in many countries. In Cameroon, scavenging is not only insignificant but also picking things from waste facilities is taboo. A few isolated local-initiative groups have recently timidly emerged in the big cities, alongside the ailing conventional system in place. In small cities such as Bamenda, waste is understudied and its management remains the sole business of the urban council. Hence, the problem of sustainable MSWM in Cameroon has to be viewed against these special concerns.

CHAPTER 4.

Research Methodology and Sources

4.1 Introduction

Research methodology is the investigative technique employed to acquire answers to issues put forward for research. The type of methods used will depend on the scope, type, purpose, and focus of the research topic together with the specific context in which such research is undertaken. The researcher's beliefs about the world (ontology) and ways of knowing the world (epistemology) are also linked to the type of method employed (Winchester 2000).

The scope of municipal solid waste management (MSWM) includes issues such as the institutional framework (strategic planning, legal and regulatory framework, public and private sector awareness and participation, financial management), waste generation (characteristics, minimization and separation) and waste handling (collection, storage, transportation, treatment and disposal) including environmental impacts of such management (Schubeler 1996). Each level of management has different types of activities that also involve different groups or individual participants. For example, the basic waste activities at the primary level are generation, separation and storage, while the participants include the households, institutions, commercial places and industries. Such scenarios necessitate the application of multiple methods and techniques of research.

4.2 General Methodological Underpinnings: Research Scope, Type and Context

In this thesis I examine the theories and practices relating to municipal solid waste in Bamenda and Yaoundé with a focus on management, policy and the environmental impacts posed by such management. The study follows that order. As with most cities of developing countries, secondary data on MSWM are mostly non-existent, outdated, inadequate or fragmented. This is why new data were generated not only to update existing data but also to fill some significant gaps. This approach enabled a recast of the old and new data on solid waste management into a coherent form. Such a synthesis makes possible a comparative study of the two cities.

Research can be classified by purpose or method (Ofo 1999), or purposes and goals, which could be exploratory or descriptive (Hart 2001). These differences are most often not very distinct. In terms of its purpose, the thesis includes basic, applied and illuminative evaluation types of research. Palm and Brazel (1992 in Pacione 1999), in the following statements, not only demonstrate the purpose and goals of basic and applied research but also their differences thus:

> Applied research in any discipline is best understood in contrast with basic or pure research. In Geography basic research aims to develop new theory and method that help to explain the processes through which spatial organisations of physical or human environment evolves. In contrast, applied research uses existing geographical theories or techniques to understand and solve empirical problems (Pacione 1999 p. 4).

Not withstanding, I think in the course of applying geographical theories or techniques to solve real-world problems, new methods and theories can be developed and further tested and applied. That is why Frazier (1982) argues that there is little merit in perusing the false dichotomy between pure and applied research. Both, he notes, are two sides of one coin and none is perceived as superior to the other. Frazier (1982 cited in Pacione 1999) points out that

> …applied geography uses principle and theories of pure geography but is different in that it analyses and evaluates real-world actions and planning and seeks to implement and manipulate environmental and spatial realities (Pacione 1999, p. 5.

Pacione (1999) points out that most applied geographers have a commitment to use geographical knowledge and skills to resolve the real world social, economic and environmental problems, a move challenged by Marxists as patching up the present and hindering the achievement of the greater goal of social revolution that would address final social change. Secondly, applied research has a greater interest than the pure research in taking the investigation beyond analysis into the real of application of results and monitoring the effects of proposed strategies. Hence applied research guides decision-making as well as developing method and theory. This research is mainly applied because it aims to test and apply theories as well as evaluating the usefulness of such theories in solving SWM problems. Another purpose of applied research is to produce recommendations to some problem(s) faced by people in a situation (Hart 2001), in this case, municipal solid waste management and environmental problems.

According to Hart (2001) basic research is that which contributes to theory or knowledge by formulating and testing hypotheses, applying a theory or method to a new area and evaluating the generalisability of propositions across time and space. Considering the last part of Hart's definition, a part of this research is basic because it aims is to apply the waste management hierarchy theory to a new area, Cameroon, and to question the generalisability of its principles across space and time. This principle is very much promoted by international and regional organisations and greatly applied in the developed parts of the world.

By expansion applied research demonstrates attributes of an illuminative evaluation research type because it exposes the existing and threatening environmental problems posed by inadequate MSWM and also makes a key behaviour or attitude in a given context visible for contemplation. Evaluative research attempts to collect and analyse data that will guide decision-making (Ofo 1999; Hart 2001). Therefore illuminative evaluation research generally aims to enlighten policy makers or participants to the dynamics of their behaviours, so that such behaviours can be understood and attended to in a more appropriate way.

According Ofo (1999) the common classifications of research by method are: descriptive, ex-post facto, correlative and historical. Descriptive research is concerned with:

> … conditions that exist; practices that prevail; beliefs, point of view, or attitudes that are developing. At times, descriptive research is concerned with how and what is or what exists, is related to some preceding event that has influenced or affected a present condition (Ofo 1999 p 8).

This research examines conditions of MSWM, its practices, peoples' views, beliefs and attitudes towards various aspects of it, so it is descriptive. According to the same author, most descriptive researchers use survey methods through questionnaires and interviews as with this study.

Ex-post facto is also known as causal-comparative because it attempts to determine the cause-and-effect relationships by examining conditions and tracing back the information and available data for probable causal factors (Ofo 1999). Such is the methodological approach applied to study and explain some of the existing problems in MSWM, which have their roots in the past event, and, by extension indulging in the historical method. The historical method entails evaluating and synthesizing humans' past acts and thoughts in order to establish facts. In causal-comparative methods we may also tend to measure certain relationships, consequently entering the area of correlative method. From the foregoing illustrations it becomes clear that methods would always dovetail during a research process. This phenomenon is strong in this research. The research is mainly applied with a plurality of other methods dominating at some points rather than a specific method for the entire research. The key issue was to identify the best ways of collecting, assembling and analysing relevant data that would address problems of the research, purpose and types.

Answers that satisfy the purpose and research types come from 'why'? 'What'? 'How'? 'When'? 'Where'? and 'By how much'? questions. Hence they ask for quality, as well as quantities, because processes and relationships are dealt with over space and time. These scenarios demonstrate the reasons why I chose to use different research methodological approaches that would lead to achieving specific goals. However, the main methods for data collection and analysis applied in this thesis are the qualitative and quantitative.

4.3 The Case for Mixed Methods

The question of whether qualitative and quantitative methods can be used for data collection and analysis in the same piece of research remains a debate. Some researchers see the two approaches as different, with the qualitative viewing the world through a wider lens and the quantitative viewing it from a narrow lens (Brannen 1992a cited in Winchester 2000). Brannen (1992a) argues further that data generated from different methods cannot simply be aggregated, as they can only be understood in relation to the purpose for which they were created. But arguments for studying the same phenomenon by combining quantitative and qualitative methods, called triangulation, are much stronger. Winchester (2000) affirms it thus:

> Classically, qualitative and quantitative methods …are seen as providing both individual and the general perspective on an issue. This triangulation of methods and use of multi methods are sometimes deemed to offer cross-checking of results by approaching a problem from different angles and using different techniques (Winchester 2000, p. 14).

Denzin (1970 cited in Balnaves 2001) expanded the principle to include triangulation of data (with different types of interactions by groups over time and space), investigator (with more than one person) and theory (with alternative theories) used to examine the same phenomenon. According to Balnaves (2001), Lazarfeld *et al*., (1944) were the earliest strong advocates of the triangulation principle, which they called hybridity. They not only recommended it but also suggested its application thus:

- Any phenomenon should be measured with objective observation as well as with introspective reports;
- Case studies should be combined with statistical information;
- Data gathering should be combined with information about history of what is being studied;
- Data from unobtrusive studies (e.g. observation) should be combined with questionnaires and other self-reporting data (Balnaves and Caputi 2001).

I applied the triangulation principle to investigate some aspects of solid waste management in this thesis. Multiple data sources were also consulted. These combined techniques improved research results through internal and external validation, especially as data sources in Cameroon are highly inconsistent.

4.4 Selection of City Cases and Sampling Procedures

4.4.1 City Cases: Purposeful

Cameroon has 42 towns and cities spread over the national territory. Apart from Douala, the economic capital, and Yaoundé, the administrative and political capital, which respectively have populations of 1.6 and 1.4 million, the rest have populations below 400 000. The top 13 have populations greater than 100 000 people and are loosely termed cities and placed under the Ministry of Urban Affairs. According to sampling theory, one would expect that a study aiming to generalize for the country would include a minimum number of these towns and cities selected from different hierarchies and geo-political and ecological zones. Given the limited time and resources this was not possible. I decided to choose two cities.

The historical foundations of the country make it imperative for a case to be selected from both sectors of the country. Cameroon emerged from the English and French colonial system only 40 years ago. Today the country is bi-cultural, one part predominantly English-speaking and the other French-speaking. I wondered if their different cultures had anything to do with the way waste is perceived and managed or if they are more symbolic than substantial or significant. My aim was also to choose a big capital city and a relatively smaller provincial city in different geographic zones with different systems of waste management; one contracted to a private company, the other council self-managed. I envisaged that such a selection would represent the typical situation in most cities of Cameroon. I selected Bamenda which has 300 000 people, fourth on the national ranking and headquarters of the grasslands North West Province. It is the biggest city in the predominantly English-speaking sector and the urban council directly manages its solid waste.

In the other sector it was a choice between the bi-primate cities of the country: Douala and Yaoundé. Solid waste management in both cities is contracted to the same private company-HYSACAM and the same top administrators co-manage waste in both cities. So a choice of any of the two did not make a difference. I chose Yaoundé. Choosing only the big cities of the same magnitude for a comparison did not appeal to me. Such a comparison of the two biggest cities could only have gone to reinforce the arguments for bias among academics in favouring large cities at the expense of small ones (United Nations Population Division 2002). This is what is already happening in Yaoundé and Douala in terms of waste research. In Yaoundé and Douala cities, substantial sponsored research focused on varied aspects of SWM has already been accomplished. A two-contrasting city comparison was envisaged to lead to an understanding of critical institutional and organizational issues, which were common or contrasting, that would be lost in a single case study. It is also hoped the results would increase the general applicability of the findings to other cities of the country and beyond, by drawing out lessons by identifying where the waste management systems have failed or succeeded.

4.4.2 Sampling Procedure: Random

After purposefully selecting the cities, the samples within them were chosen using the principle of random sampling. “Random sampling is a method of selecting units from a population in such a way as to enable us to estimate the values of the population and make valid inferences about it” (Folarin 1999, p. 24). The use of the random selection is emphasized so as to guarantee representativeness of the population sampled, known as external validation (Balnaves and Caputi 2001). It is probabilistic sampling and gives every member of the population an equal chance of being selected, hence increasing objectivity and eliminating bias. This technique was used to select household waste management survey samples for Yaoundé and Bamenda. In Bamenda it was also used for selecting sampled households, hotels, restaurants, hospitals, schools and factories that were investigated for solid waste generation.

In Bamenda, a multi-staged classified cluster random sampling was conducted to select household units for the solid waste generation experiment and general waste management survey. Official operational frames and definitions were used. The city quarters were classified into socio-economic strata as is known in official census frames and town planning records. These classes are: high-income residential, moderate, low-income residential and peripheral quarters. All the quarters in each class were ordered alphabetically and numbered serially. This constituted the frame from which quarter (cluster) samples were randomly selected using a random number table. The selections that resulted were as follows: the Government Residential Area (GRA) Up-Station (high-income residential), Ndamukong (moderate), Old Town (low-income residential) and Nchuobu (peripheral) (Figure 6.1).

To select the household sample frame, all the houses in each selected cluster (quarter) type were serially numbered on the base map (Bamenda 1: 5 000, 1985). A random selection was made using a table of random numbers. The number of samples allocated to each class was proportional to their population in the city. This resulted in the following household sample allocations: GRA Station 16, Ndamukong 20, Old Town 50 and Nchoubu 18, making a total of 104. The result was then verified in the field as some of the houses had either disappeared, ceased to serve as private residences or new ones had been built on formerly open spaces, especially as this map is very old. It was a difficult exercise identifying sites because few streets have names, and the houses are not numbered. A household is the final sample site or unit within which one person, an adult, was chosen for the survey. The definition of household was drawn from the official census. Two types of households are identified: private households and collective households. A collective household consists of a group of persons living in camps, institutions or boarding schools and it is considered later. Official sources define private households thus:

> A private household comprises either one person who provides his own essential needs or a group of related or unrelated persons who join together to provide their essential needs. Such a group therefore recognises the authority of one person: the head of the household (Ministry of the Plan and Regional Development {MPRD} 1987, p. 20).

Meanwhile, 'a quarter is a small sub division of a town headed by a 3rd class chief and has a recognised name" (MPRD 1987, p.13), and 'a village is a traditional unit headed by a 3rd class chief. It is made up of one or more localities' (MPRD 1987, p. 14).

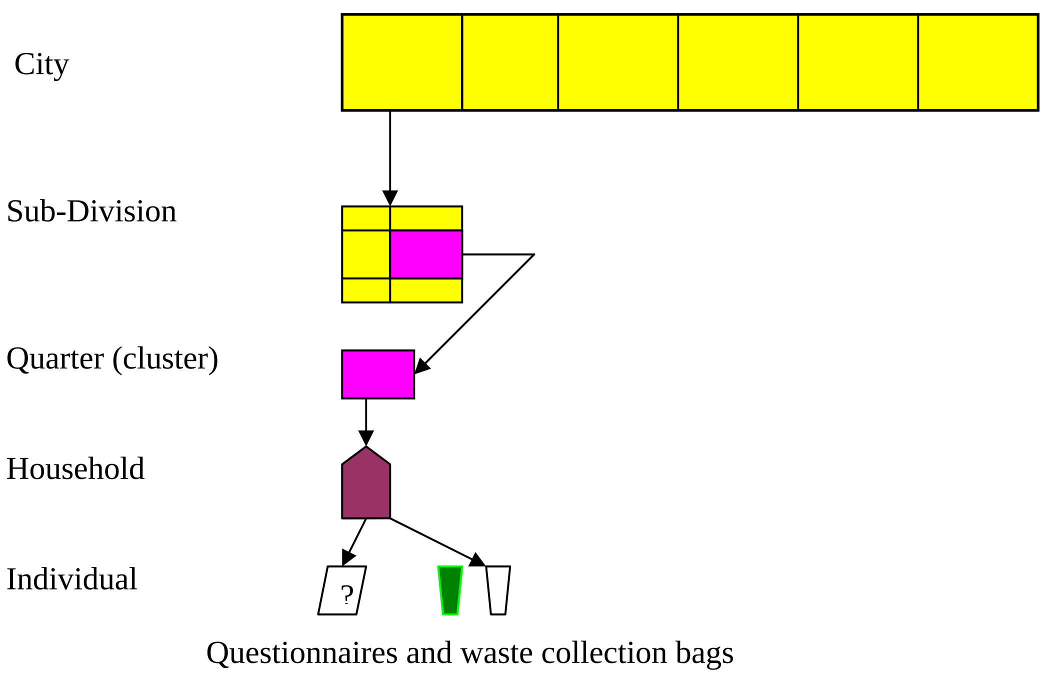

FIGURE 4.1: General Plan for Multi-Staged Cluster Sampling for Yaoundé and Bamenda

Unlike Bamenda, which constitutes only one subdivision, Yaoundé has six. In Yaoundé the same multi-staged cluster random sampling procedure, from city through subdivisions, quarters, households to individuals, was followed to select samples for the general municipal solid waste management household survey. The socio-economic strata or classification of the city is well established including the proportions of such classes in relation to their area sizes and populations (Vermande *et al.* 1994; Ngnikam 2001; Pettang 2002). The following quarters and household unit quotas were randomly selected for sampling in each residential class: Bastos 33 (high standards), Cité Verte 32 (moderate income), Nvog Ada 75 (low-income) and Efoulan 32 (peripheral) (Table 4.1). The problem of most streets not having names and unnumbered houses was encountered in this city. Only Cite Verte quarter, built by the Cameroon Real Estate Company (SIC) had well-numbered blocks and house units occupied by households. Details of the procedure are discussed in Section 4.8.3.

4.5 Sample Unit and Sample Size

The sample unit or site is the household. Households are the main source of municipal solid waste generation in most of the non-industrialised world accounting for more than 70% of their city solid waste (Thomas-Hope 1998; Asomani-Boateng and Haight 1999; Tanawa *et al.* 2002). Household waste is a microcosm of the city's waste. This suggests that if household waste generation is accurately assessed, then the city's waste situation can be fairly understood and the remaining waste can even be estimated with reasonable accuracy.

The determination of sample size is a thorny problem in research including the even more important selection of representative samples. Increase in sample size obviously improves accuracy in results but case studies reviewed for some cities suggest that sample sizes adopted by MSW researchers have been more discretional, dictated by economy and limited resources, rather than the conventional 700 samples for 95% confidence interval with 5% sampling error (Van der Broek and and Kirov 1992 in Abu Qdais *et al.* 1997) or 1/200 of the sample frame (Ngnikam 2000). For example, in Abu Dhabi, 40 household units with 840 people were selected (Abu Qdais *et al.* 1997), in Nairobi 662 households were selected for questionnaires (Mwanthi *et al.* 1997), in Klippan, Winterveld in South Africa waste was collected from 19 households including interviews in 117 others (Korfmacher 1997), 300 households in Ilorin city were selected for questionnaire survey (Olorunfemi and Odita 1998) and in Bangalore 200 households were selected for waste collection and analysis (Beukering *et al.* 1999).

Balnaves and Caputi (2001) argue that: ‘There are few occasions in behavioural research where samples smaller than 30 and larger than 500 in size can be justified’ (Balnaves and Caputi 2001 p. 94). Recent estimates from government sources show 60 101 households for Bamenda and 277 981 for Yaoundé (DSCN 2002). Putting these arguments together including the contextual constraints, I chose a sample of 104 households (537 people) for Bamenda and 180 households (910 people) for Yaoundé.

4.6. Methods of Assessing MSW Quantities and Composition

Knowing the quantities and composition of municipal solid waste is important for management and planning (Fobil *et al.* 2002). Such knowledge helps direct waste policy options and planning strategies, for example, in waste separation, recovery, recycling, transportation, composting and disposal. However, acquiring accurate data remains a daunting problem. This is because waste generation varies among individuals, cities and parts of the same city, seasons, and days of the week; changing with incomes, technology and population. It is dynamic and complex. Accurate quantification must deal with these factors and it is impossible to accommodate all these factors efficiently. Abandoning the exercise because of its complexities and fears of inaccuracies is even worse, so academics are comfortable with good estimates.

4.6.1 Quantities

Many methods have been used for assessing total quantities of MSW. The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP 2000) identifies the input method whereby waste generation is estimated from industrial output statistics with the assumption that production is equal to consumption and there is no recycling. This method appears to look at only one source of waste and assumes a closed economy.

The same author, together with others, examined another method employing secondary information such as income and assessing the purchasing attitudes of individuals. Through such analysis the likely rate of waste generation is established (Boyd and Hawkins 1971 in Adedibu 1986).

One other output method uses weights derived from volume of vehicle loads or containers collected per day. The volume is converted to weight by multiplying it by the average density obtained by sampling (Filani & Abumere 1982 in Adedibu 1986; UNESCAP 2000). I used this method to estimate sustainable capacities of public waste skips in Yaoundé and Bamenda. An average of sample loads of every load that passes through the weighbridge could also be used to calculate the generation rates for cities (UNESCAP 2000). This is a good method but presupposes there are no illegal dumping activities and no recovery at the disposal sites, which is not true. The best method of estimating waste generation should emerge from per capita per unit time generation through per city ward to city. None of these methods above can adequately address these issues. Photogrammetry is another technique whereby a portion of waste is photographed and the photo used for analysing the composition (UNESCAP 2000). Such a method is limited as only the top view may be seen; in addition other elements such as weight and density cannot be assessed. Each of these methods has both merits and problems, however, each is useful in its own right.

4.6.2 Composition

Assessing composition of solid waste is even more complicated whereas information about it is pertinent for policy orientation. A common method is setting aside a waste truckload for analysis. The load is quartered and one of the quarters is further quartered. One of the quartered quarters, typically 100-200 kg, is taken and sorted for analysis of its characteristics (Agunwamba 1998; UNESCAP 2000; Ngnikam 2000). The problem with this method is that once waste is mixed, physical and chemical reactions take place and this could alter the composition. The second problem arises from the fact that the specific source of the waste cannot be determined.

4.6.3 Mixed Quantity and Composition Assessment Methods

Other methods have been tried to estimate both quantities and characteristics. Through questionnaires households have been requested to estimate quantities based on the volume of their waste containers and using follow-up questions, asked to assess the composition of the waste they generated (Korfmacher 1997; Mwanthi *et al.* 1997; Olorunfemi and Odita 1998). Waste bins in most households in cities of developing countries are not standardized. Household waste estimates based on such containers could be very imprecise. Even if containers were standardised, the filled level attained by each container is still a problem and where the volumes are known, weights must be calculated based on the density.

Another method is collecting waste at source of generation. Separate bags are administered to stratified households who are requested to stuff the bags with specified types of waste due to be collected after one or more days for analysis (Abu Qdais *et al.* 1997; Monkam *et al.* 2000). This method is more reliable and I have adopted it for this study. It avoids the problem of the preceding methods. However, you have to face households many of whom might receive you with mixed reactions. In the Cameroonian society where scavengers are almost non-existent and waste picking is taboo, it could be hard acquiring waste research assistants.

4.7 Data Collection and Assembly Techniques

Qualitative and quantitative data were collected from primary and secondary sources. Primary or original sources included interviews, questionnaires, letters, field experiments and observations including recordings of field phenomena. Secondary data were sourced from existing data compiled by individuals, agencies, government and non-governmental organizations (NGOs). Where access to such documents is easy, time and expense could be saved, giving the method an advantage. But the problem of content verification remains. Government official texts were heavily used to examine policy. They are hard copies and in Cameroon it took a long time, patience and money to have access to them. The fieldwork in Cameroon lasted from 20 July 2002 to 10 April 2003.

4.7.1 Secondary Sources

Related literature was extensively reviewed in order to acquire an understanding of the topic and what has already been done on it including how it was researched. It also directed my attention to the key issues of MSWM including concepts, principles and strategies and how they have been employed in addressing such issues in various parts of the world. Such a review also highlighted major criticisms of theory as well as successes and failures emerging from practices over space and time. Available literature on MSWM including the relevant government texts in Yaoundé and Bamenda was examined. Information about each document consulted is stored and sourced from my personal computer (PC) under a library catalogue system using the EndNote (6.0) software.

4.7.1.1 The Library

In Australia, Barr Smith Library in the University of Adelaide, Flinders University and University of South Australia were consulted for books, journals and electronic sources. In Cameroon some university departmental libraries were consulted for graduate dissertations and the academic publications on the subject. These included the Departments of Geography, Geology and Environment at the University of Buea, the Departments of Geography in the University of Yaoundé I, the Advanced Schools of Education (ENS) Yaoundé and Bambili[1], University of Yaoundé I. The Yaoundé City Council library was also consulted. The library has very useful general and specific publications on the city's development. Significant MSW research on Yaoundé started in the early 1900s led by the lecturers and students of the department of urban development[2] in the National Advanced School of Engineering (Polytechnique), University of Yaoundé I. Their work was an invaluable source of secondary data for this thesis.

4.7.1.2 Administrative Sources

In Cameroon the Department of National Statistics (DSCN) publishes government statistics, census, and surveys. Many such documents were consulted including the most recent Cameroon Statistical Yearbook 2000 and 2001. Government texts, for example, decrees, laws, orders and circulars were acquired from the National Archives in Yaoundé and the Bamenda Urban Council Archives. These were important sources of official data, published in the Official Gazette of the Republic of Cameroon or the Government News Paper, *the Cameroon Tribune*. They have important information such as policy and laws that govern the city and

[1] There are two campuses of the Advanced School of Education (ENS) both belonging to the University of Yaoundé I. One is located in Yaoundé and an annex in Bambili on the outskirts of Bamenda City, North West Province.
[2] Laboratoire d'Aménagement Urbain (LAU).

waste management issues, population figures, administrative and functional structure, operational definitions, sampling frames and history. Some examples are Decrees: No. 74-23 of 5 December 1974, 77-220 of 1 July 1977, 80-17 of 15 January 1980, 87-015 of 15 July 1987, 87-136 of September 1987, 90-53 of December 1990, all related to organization and reorganization of the council areas, structures, functions including sources of waste management revenue and expenditure. One key government document extensively consulted is Law No. 96-12 of August 1996 related to national environmental management.

4.7.1.3 Map Sources

Yaoundé and Bamenda City general maps were acquired from the National Institute of Cartography (NIC) Yaoundé, for example, Plan of Yaoundé (1: 15 000, 2000) and Bamenda (1:10 000, 1991). More topic-specific maps of Yaoundé (1:80 000, 2001) came from its Department of Technical Service, Urban Observatory Service. They included maps of the city's organization (into subdivisions and quarters), waste, pollution, residential classifications by socio-economic status, roads and streets, illegal dumps and physical landscape. The Provincial Service of Town Planning in Bamenda furnished us with the 1985 City Master Plan (1:5000 Sheets 1 & 2). It was from this map that quarters (clusters) selected for sampling were carved out and enlarged for used on the field survey. In Yaoundé the field survey map Yaoundé (1:5000) came from a city plan by a private company, CISM. Other maps and documents came from private companies including some NGOs namely: Bamenda (1:10 000 June 1994) by SOACEG International and Bamenda Town and Quarters (1:17 000, 1999) by IDF/CRET. Solid waste deliverers such as HYSACAM in Yaoundé and the Garbage Department in the Bamenda Urban Council also had documents that were consulted.

It is worth mentioning that apart from documents published in the French and English languages in the government gazettes, 95% of other government texts and secondary source on Yaoundé are published in French. Most sources in Bamenda are in English. The translations from French to English in this thesis are mine. Translating and synthesizing such information posed considerable problems given the technical nature of the subject.

4.7.2 Primary Sources

4.7.2.1 Interviews

I conducted several scheduled in-depth interviews, using prepared semi-structured but flexible question guides, with key practitioners in solid waste management as well as waste generators. These people included the Government Delegate to the Bamenda Urban Council (BUC), the head of the Garbage Department BUC, and the provincial delegate of Urban Affairs, Bamenda. The NGOs interviewed in Bamenda were 'Paradise on Earth' and Community Initiative for Sustainable Development (COMINSUD). Interviews in Yaoundé were conducted with the director in charge of exploitation HYSACAM for Yaoundé and Douala, service head of the Nkolfolou landfill, the head of the Hygiene and Sanitation Service in the Yaoundé City Council (YCC). The administrative directors of the following NGOs that are involved in MSW collection and recycling were also interviewed and these included, FOCARFE[3], International centre for the promotion of recovery (CIPRE[4]) and Tam Tam Mobile.

Informal interviews were conducted with workers in these workplaces during participatory field trips. Information obtained from interviews was important to me because such cannot be sourced through questionnaires and it was also an opportunity to cross check information not yet documented. Policy issues were better explained at interviews. The problem with this method is that only a few participants are involved constituting only a small sample. Moreover, subjectivity, time consumption and low coverage are also limitations to the method. It takes time to arrange and have interviews with these high-level personnel who appeared to be always very busy and hardly available.

4.7.2.2 Pilot Studies

Ten households were selected for each city to pre-test the questionnaires and the experimental procedures (in the case of Bamenda). This enabled the weaknesses and strengths of the procedures to be appreciated. As a result, some questions were modified and methods of giving instruction on waste classification for each waste bag were re-examined. The process reduces bias and errors, which is the key to enhancing internal validity. It also gave indications of expected results and problems. Such preliminary findings of waste generation quantities

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[3] FOCARFE= Fondation Camerounaise pour une Action Rationalisée des Femmes sur l'Environnement
[4]CIPRE= Centre International de Promotion de la REcupération

made it possible to prepare pick-up schedules and transportation of the samples to the field laboratory.

4.7.2.3 The Survey

Folarin (1999) describes surveys as: ‘important means of gathering data in most disciplines and investigations, which are not amenable to experimentation’ (p.1). A survey through questionnaires was a key method used to study the current situation of MSWM in both cities. Questionnaires had the advantage of covering a large area easily and quickly. They were anonymous and self-administered so as to increase return rate and solve problems related to supplementary information. This method was also combined with field observations. For example, answers to some questions such as street conditions, relief, dwelling, sex and type of container used for waste collection did not necessarily need to be asked but observed and recoded.

There were 46 closed-ended and semi-close ended questions with 120 variables designed for analysis using the SPSS for Windows computer software. Questions were divided into five sections aimed at acquiring general information about the respondents’ physical and socio-economic environment, solid waste generation, collection and disposal, issues of participation, minimization and environmental concerns (Appendix 2). The last question was open-ended and called for respondents’ opinion on waste management and proposed improvement in their cities. This last question served as a pressure release valve for the respondents who had pertinent pending concerns. It was an opportunity for them to criticise the waste management system. Their observations were very useful.

TABLE 4.1
Survey Activities Program in Yaoundé and Bamenda

<table>
<tr><td rowspan="2">Date</td><td rowspan="2">City</td><td rowspan="2">Quarter</td><td colspan="2">Household Unit Questionnaires</td><td rowspan="2">% Returned</td><td rowspan="2">Questionnaire Administrators</td></tr>
<tr><td>Administered</td><td>Returned</td></tr>
<tr><td rowspan="4">7th to 10th March 2003</td><td rowspan="4">Yaoundé</td><td>Bastos</td><td>33</td><td>33</td><td>100</td><td>2</td></tr>
<tr><td>Efoulan</td><td>32</td><td>32</td><td>100</td><td>2</td></tr>
<tr><td>Nvog Ada</td><td>75</td><td>75</td><td>100</td><td>3</td></tr>
<tr><td>Cite Verte</td><td>33</td><td>32</td><td>97.0</td><td>2</td></tr>
<tr><td rowspan="4">28th and 29th March 2003</td><td rowspan="4">Bamenda</td><td>GRA Station</td><td>16</td><td>16</td><td>100</td><td>4</td></tr>
<tr><td>Nchoubu</td><td>18</td><td>18</td><td>100</td><td>4</td></tr>
<tr><td>Old Town</td><td>50</td><td>50</td><td>100</td><td>4</td></tr>
<tr><td>Nda-mukong</td><td>20</td><td>20</td><td>100</td><td>4</td></tr>
<tr><td>Total</td><td>2</td><td>8</td><td>277</td><td>276</td><td>99.6</td><td>25</td></tr>
</table>

Table 4.1 summarises the main activities of the survey including the dates, quarters and the cities, questionnaires administered and return rates. Postgraduates from the Department of Geography University of the Yaoundé I assisted in the administration of the questionnaires in Yaoundé City. In Bamenda, undergraduates from ENS Bambili did it. Many pre-meetings were held for briefings on the administration of the questions using experience from pre-test questionnaires. Pre-visits to the sample quarters were also made to appreciate field problems and pre-seek solutions, such as non-numbering of houses. The questions were in English but the administrators were multi-lingual and used English, French, Pidgin English (lingual Franca) or the local languages, whichever the respondents preferred. This was very successful. I used the mobile phone to locate, shuttle and work with each group during the questionnaire administration. Interviewers also made reports on their observations regarding the administration of the questionnaires including the state of MSWM on the field.

The questionnaires were designed to identify variables and reflected levels of measurement that could be coded and transformed into figures, tables and graphs for easy appreciation. For example close-ended nominal level measures, such as, Yes (1) No (2), Male (1) Female (2) were analysed for frequencies. Interval-level (range) was used for sensitive questions including income levels and ages. Ordinal or rank-level variables required people to answer in ranks. In the Likert type, choices have different levels or degrees of intensity (e.g., too much, much, quite, not much). The degrees of intensity could be converted to a summated ratings scale (e.g., from strongest to weakest: 1, 2, 3, 4, 5) or combined levels of intensity with summated scales called the Thurstone type (Balnaves and Caputi 2001).

This last technique was used to design many questions, for example, Questions 9 and 10. As an illustration, question 10 set out to test the types and magnitude (degree) of solid waste generated from each household. The degrees of generation were suggested for respondents to choose as applied. The analysis was made, first, by assigning higher values (codes) to higher degree and vice versa as follows 'Too much (1)'=4, 'Much (2)'=3. 'Quite (3)'=2, 'Not Much (4)'=1. The total responses for each degree were multiplied by the corresponding assigned value.

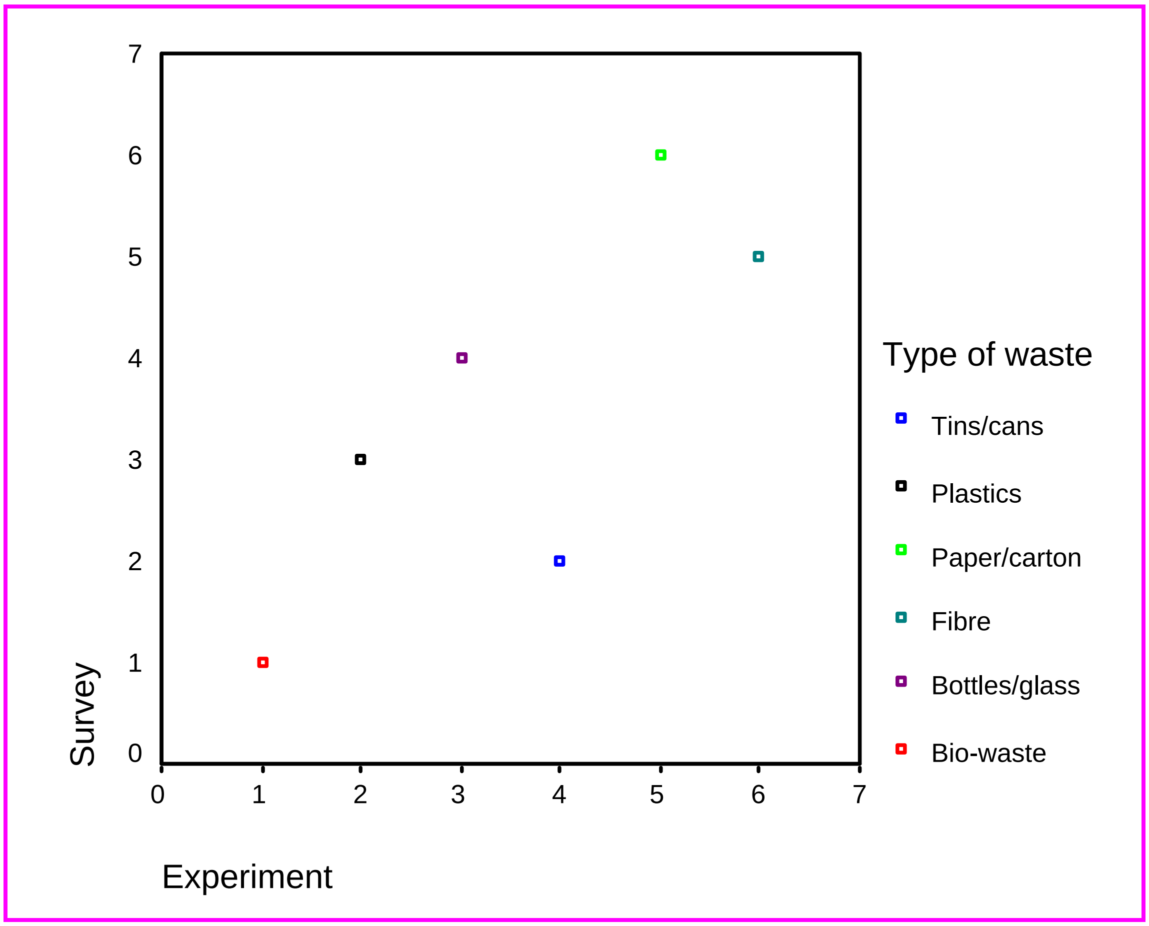

FIGURE 4.2: Rank Correlation Between MSW Categories by Survey and Experiment Results in Bamenda

The results are graphically presented in Figure 6.7 and when rank-correlated with the results from the experiment it is a positive 0.8, suggesting the closeness of results from the survey questionnaire technique and the experiment (Figure 4.2). It also builds confidence in results from surveys where experiments cannot be conducted. However, such ranked measures have limited applications.

4.7.2.4 The Survey Analytical tool: SPSS for Windows

Statistical programme for social sciences (SPSS) for Windows is a powerful statistical analysis and data management system in a graphical environment using descriptive menus and simple dialogue boxes to perform operations (Norusis 1993). The software has the capability of managing large amounts of data and giving output in summary forms, tables, cross-tabulations, averages, and percentages. It can also transform these results into graphic presentation such as bar, line, pie, area and scattered graphs. The software can also perform statistical operations to test relationships such as central tendencies, deviations, correlations and regressions. A total of 276 questionnaires with 120 variables each were edited, coded, and put into the program to study various aspects of MSWM in Bamenda and Yaoundé. This tedious but necessary task took more than one month. Version 11.0 was used. The Microsoft Excel 2000 Chart Wizard programmed was also used to perform some illustrations. The high positive rank correlation obtained from results using the experiment and surveys questionnaires suggests that careful surveys can also provide reliable results (Figure 4.2).

4.7.2.5 Household Solid Waste Collection Experiment

An experiment was conducted alongside the questionnaire administration in Bamenda, to collect an analysis of household solid waste, using the same household units and interviewers. It was absolutely necessary to generate original data for the city's solid waste generation rates, quantities and characteristics that has never been attempted. Collection was made for three days; the maximum time households could tolerate keeping waste that they usually remove daily. After three days the bags were collected for analysis. Three pairs were never returned. Some households did not separate their waste. They gave back one bag with mixed waste and owned the other. Farmers use these plastic bags for sheltering themselves from rain during the farming season, and one had just begun. Some households would not give their 'waste', others asked for compensation for taking away their animal feed or manure, which we did not give. We explained our aims and allowed them to decide what they had to put in the bags as 'waste' given that the definition is relative. For example, the European Union legislation (Directive 75/442/EEC) defines waste as ‘any substance or object,.. which the holder discards or intends or is required to discard’(European Union (EU) 2001, p. 1).

Observations from waste collected suggest that some households became too conscious of the fact that their waste was to be used for an experiment. They either over stuffed the bags with old waste such as cans, tins and bottles gathered from around, or under stuffed them by keeping away some of their waste. The latter could be an explanation for having only a few fruit peels collected from some households in three days. The return rate for the survey was 94%. The detailed procedure is presented in (4.8.5) and results in Chapter 6.

4.7.2.6 Observation

Field observation played a very important role throughout the study. This process entailed informal observation of waste management phenomena as well as ‘participant-as-observer’ activities (Kearns 2000). The latter involved accompanying the waste management teams to the field in their trucks or following them in a separate vehicle to observe their activities. In Bamenda I also worked with the waste management team during monthly clean-up days. The field observation method was intensively used to learn the environmental problem associated with solid waste management. For example the physical examination of the quality of the environment: polluted water bodies, flooding, littering, dumps and landfill externalities. The findings are documented textually, numerical and in photographic format, many of which are used to illustrate phenomena in several chapters.

4.7.2.7 Personal Communication

Vital information was sourced from the research field through electronic mails (E-Mails) contacts with informants. These included updates or vital information that could not be sourced while in the field.

4.8 Method Application in Chapters

4.8.1 Chapters One, Two, Three and Four

Many methodologies were applied in this research. Literature review was used throughout the chapters of the thesis. However, each chapter had a dominance of specific methods over the others. Chapters one, two, three and four are mainly a systematic analysis of secondary data and information from which the author strived to establish a theoretical frameworks, focus, limitations, justification, objectives and methods for achieving such objectives. In Chapter Four, appropriate methods and analytical tools are selected. A new method for determining primary waste disposal distances was invented and the application of methods triangulation yielded new insights into waste research.

4.8.2 Chapter Five

This chapter addresses issues of participation in MSWM. This is linked to urban organization, governance and citizens' participation in decision-making and waste financing. The first part discusses theories of public participation and governance including case studies in participation on municipal solid waste management. This section used a literature review from library sources. The next section, the administrative structure, institutional arrangements, participation of councils and citizens, made used of secondary data from council laws and administrative texts sourced from the BUC and the National Achieves. The urban councils' annual budgets are reviewed to demonstrate the weak financial contributions of citizens to waste management services in several tables such as 5.2, 5.3 and 5.6. The maps earlier mentioned were used. Citizens' participation and collaboration in MSWM was evaluated through survey questions that requested them to indicate 'who decided the location of public waste skip,' 'how often they had sensitisation, public meetings, educational advice on waste management and with whom' and 'how much money they were willing and able to pay for the management of their waste'**.** The results are, summarized in cross tabulations in Tables 5.1, 5.4 and 5.5 and textual forms in Sections 5.6.3.2 and 5.6.3.3.

4.8.3 Chapter Six

This chapter examines municipal solid waste management in Bamenda including generation, storage and transportation. The factors that drive waste are introduced such as organization, functions, population and waste management history of the city. The following maps were used for the organization:

- SOACEG International Bamenda June 1994, 1:10 000 (NGO)
- Bamenda Town Quarter 1:17 000 by IDF/CRET 1999 Integrated Development Foundation (NGO) 1999
- Bamenda 1:10 000 (NIC) 1991
- Texts from archives

The population data came from DSCN sources and the history was compiled from the BUC Archival and administrative files. Interviews were also conducted.

4.8.3.1 Waste Characteristics

One key aim of this thesis was to generate primary data for MSW in Bamenda. This has never been attempted before whereas such data are crucial to MSW planning and management. An experiment was conducted alongside a survey using questionnaires to complement and verify some aspects. The sampling technique was described in Section 4.4. The experiment was conducted in the four stratified quarters of Bamenda City between March 28 and 29, 2003. Map extracts of each quarter were used to identify the sample sites. Each house unit in the sample was given two fifty-litre plastic waste bags, one marked green for collection of biodegradable waste and the other white for all non-biodegradable waste. Each set of bags was identified with the sample number and quarter as found in the sample frame registered. The households were schooled on the techniques of collection, storage and separation of the solid waste. A team of undergraduates from ENS Bambili, University of Yaoundé 1, was selected and trained to assist in the administration of the experiment and survey on the general MSWM. Four students (subdivided into two) worked in each of the four quarters. Working in groups not only safeguarded interviewers but also instilled confidence in them.

A survey on the general solid waste management in Bamenda, using questionnaires, was self-administered alongside the waste collection bags. This was to guarantee the return rate. However, some respondents insisted on filling out the questionnaires, but not all of them were returned. On the advice of the Delegate to the BUC, one waste worker from the BUC was co-opt to each group to disperse suspicion because the city is characterized by animosity among members of political parties. Three days later, the filled waste bags were collected in the same order as they were administered. The bags were assembled on the main street in each quarter from where they were transported by a pickup van to a field laboratory (an NGO's experimental plot) for analysis (Plate 4.1).

4.8.3.2 Analysis

Approximately, 0.6 ton of municipal solid waste was collected from 93 households (sample sites/units) consisting of a population sample of 537. The samples were registered and analyzed according to sources (households and quarters), for quantities, types, compositions and separation ability (Form[5] A). A 10 kg spring scale balance was used for weighing. The bags with biodegradable waste were further individually sorted and analysed for subtypes (Form C) while the non-biodegradable were sorted and further weighed for the types (paper/carton, plastics, bottle/glass, tin/can, fibre and others) (Form B). Not all the bags were analysed for detailed characterization because some of them contained unsorted waste. Such bags were simply weighed for their totals. One other test involved the evaluation of the ability of households to separate waste, after only one instruction exercise by interviewers. The results are presented in the chapter according to quarters. Complementary information such as family size, source and incomes needed to perform specific calculations were transferred from the questionnaires. The results of analysis from various aspects are summaried in textual, tabular and graphic forms in Chapter 6.

[5] Forms are prepared data-recording sheets

PLATE 4.1: Field Laboratory Household MSW Sample Analysis Scene, Bamenda 31/03/03

Data on other management practices such as waste storage, frequency of removal, remover and destinations of the waste removed were realised from survey and analysed using the SPSS program into cross tabulations (summaries of selected variables in tabulated forms), frequencies, summaries and correlations. The notion of distance is very important in solid waste management. The decision to dispose of waste in an official facility or an illegal dump is closely linked to the distance between such facilities and the source of waste generation. One aspect of the survey was to investigate distances travelled to waste disposal sites. Respondents were requested to estimate the distance from their house to where they disposed of their solid waste. An ingenious technique of estimation was introduced. Respondents were requested to give the number of electricity poles they passed to dispose of their waste. Electricity poles are regularly spaced at 50 m intervals. The data were summarised in interval data with ranges (<50 m, 50 m-99 m, 100 m-200 m and >200 m) and the average distance calculated using the mid-point of such intervals in the ranges. The results are presented in tables and charts. Such distances are crucial in deciding the optimum inter-public skip locations that would discourage illegal dumping. The average distance people are willing to travel to dispose of their waste is used to calculate the area served by official waste management service, and by extension the total area served.

4.8.4 Chapter Seven

This chapter studies MSW treatment, disposal and the environment in Bamenda. Treatment of waste involves separation, recycling, repairs, reuse and composting. These phenomena were studied using observation, interviews and surveyed through different sets of questionnaires (Appendix 2). Data on transportation and waste collection circuits were studied from observation, field recordings and moving with the waste collection teams. I also used a Global Positioning System (GPS) to mark locations of skips and a car to calculate inter-skip and landfill distances. The results are presented in tables and maps in the chapter.

Environmental problems were investigated through survey and field observations. Urban stream-contamination by solid waste disposal was observed for colour, smells, turbidity and floating waste matter. Observation and survey questionnaires were used to study illegal dumping, conditions at dumps and public skips such as the presence of humans, leachate, domestic animals, odours, fires, rats, insects and mosquitoes and consequences including prevalence of diseases and preventive measures. Survey results were analysed using the SPSS program. Observation results expose the hazards posed by poor waste management practices and are described and supported with photographs in the chapter. Massive literature was reviewed to demonstrate the potential environmental and health impacts of inadequate waste practices in the city, drawing from experiences elsewhere.

4.8.5 Chapter Eight

Chapter Eight examines MSW generation, storage, collection and transportation including the factors that drive waste management in Yaoundé city such as the organization, functions, population characteristics, development and solid waste management history. As earlier mentioned, substantial research on solid waste management in the city has been carried out for various purposes. So secondary data is available but fragmented. In this study I synthesized some of these data for use in addition to generating new data from the questionnaire survey. This was intended to be a supplement and update the existing one, given that the waste management industry is very dynamic.

Literature review, survey, interview, field visits and observations including accompanying the waste management teams during work, were the techniques used. The survey questions were the same as for Bamenda and addressed issues such as collection and storage, separation, removal, disposal sites, distances to disposal sites, participation in waste management and willingness to pay for waste. The survey data was analysed using the SPSS program as with Bamenda and the results are presented in the chapter.

There are many participants in MSWM in Yaoundé including private formal and informal groups, NGOs who play a complementary role to the official private waste contractors for the city, HYSACAM. I visited some of the groups and interviewed their coordinators. Many months were spent with HYSACAM consulting their records, studying their activities by making field visits with the waste teams. Access to important documents of the company such as, "Cahier des Charges" (Contract Specifications Book for HYSACAM and the Government of Cameroon), current field data and recent population estimates for the city, enhanced the study. For example, data from the former on the waste public skips and statistics of city sub-divisional populations from the latter enabled me to perform important operations related to sustainability of public waste skips for the present and the future of each urban sub division. These findings on waste management in Yaoundé are summarised in Figure 8.8. The synthesis of these sources is an attempt to reconstruct the record of solid waste management activities in Yaoundé from generation to transportation and demonstrating that despite efforts being made these sectors of MSW in Yaoundé continue to face serious problems.

4.8.6 Chapter Nine

This chapter completes the SWM cycle started in Chapter 8 and addresses issues of treatment, disposal and the environment. A survey, using questionnaires, was also used to study these sectors. Surveys were used to investigate phenomena such as separation of waste, informal and formal disposal techniques, informal recycling, environmental problems associated with waste facilities and prevalence of diseases and prevention measures. Several formal interviews, visits and field recordings and analysis of documents from recycling facilities such as CIPRE, which recycles plastic and rubber waste, were made. There was field observation of the quality of the environment, e.g., waste dumps, polluted water bodies and flooding. In the landfill, leachate, odour, dusts, noise and scavengers' activities were observed and documented. Laboratory chemical or biological analysis were beyound the scope of the work and were not conducted. Maps such as 'Illegal Waste Dumps in Yaoundé' (Yaoundé City

Council 2000), were used to complement other information. The results are presented in the chapter and substantiated with photographs.

4.8.7 Chapters Ten and Eleven

In Chapter Nine I compare major aspects of MSWM using summaries of data that emerged from the research findings in the two cities. I draw out the contrasts and similarities and draw out lessons for discussions towards improvement of the systems in both cities and beyond. Discussions on major differences and similarities are made.

In Chapter Eleven general conclusions and recommendations are presented using the main results acquired in the research.

4.9 General Issues

Information obtained from respondents during the field research is treated confidentially. Questionnaires were anonymous and respondents were free to answer questions as they wished. Quarters were visited after consulting with the administrative authorities. All photographs were taken with the approval of the waste management bodies as well as the individuals concerned. Access to all documentation in institutional libraries, archives, and services was officially applied for and only used with due approval. The university departments concerned officially sanctioned the use of their students for the survey.

4.10 General Problems

In addition to the specific problems already raised in the chapter, the key problem faced was the lack of crucial data such as a recent population census. The last official population and housing census was conducted in 1987. Since then, population data have remained estimates projected from the 1987 census. Solid waste generation is a function of population size and the lack of such current data causes inaccuracies in calculations of waste characteristics. Maps for Bamenda are equally old and outdated. Yaoundé city has recently endeavoured to make good maps covering various aspects. The absence of street names, house numbers and population data at the level of quarters makes it hard to derive a sample frame for research. Generally there is not only a lack of basic documentation on MSWM in Cameroon but also a problem having access to the little that exists. Bamenda, in particular, lacked basic data on MSWM. Shuttling between two cities, 400 km apart, organizing visits, interviews, surveys, experiments, field observation and consulting secondary sources, was a difficult task.

4.11 Conclusion

Municipal solid waste management (MSWM) is complex, so too are the methods used for studying it. A multiplicity of MSW research methodological traditions was explored. In this thesis many of such methods are used for various aspects and rationales for these choices is explained. The concept of triangulation yielded good results and suggests a close relationship between results obtained form different methods such as the survey and experiment methods used to study waste characterization in Bamenda. A new method of measuring average distances to waste disposal sites (illegal or official) is discovered. The measure gives a new insight to calculating various distance-related issues such as sustainable skip distances and area served by official waste skip. The search for better methodological techniques in MSWM is an ongoing process because current methods have many imperfections.

PART TWO CHAPTER 5

Public Participation, Institutional Organisation And Governance in Solid Waste Management in Bamenda and Yaoundé

> The collection of waste generated by the rapidly expanding cities in developing countries is increasingly beyond the capacity and financial means of the municipal administrations. A promising approach to improve collection coverage is the introduction of community-based management schemes, involving the local communities in proper waste storage, collection, sorting, and recycling activities. Research has shown how such schemes can be implemented under different conditions (Pfammatter and Schertenleib 1996 cited in Zurbrugg and Ahmed 1999, p. 2).

5.1 Introduction

Since political independence many governments in African countries, including Cameroon, thought that centralising powers at the top and providing for urban services such as garbage collection, water, electricity, was the better way forward. At the most users were asked to subsidise the service at token tax rates. This practice has not been sustainable, especially in the area of municipal solid waste management (MSWM) where poor management has been persistent, causing serious environmental problems as well as taking a toll on the government's finances. Sustainable strategic waste management planning places great importance on the institutional framework; issues of financing and participation (2.2.4), and all these can only operate successfully under good urban governance. The opening quotation taken from Zurbrugg and Ahmed is apt. This chapter addresses these issues, which are interrelated, cut across both cities and are determined from the central government. It places emphasis on participation; examining how and why having citizens' meaningful involvement can help improve MSWM. An overview follows the rationale for participation with related theories and case studies elsewhere, including Cameroon's cities of Yaoundé and Bamenda.

5.2 The Case for Pubic Participation in Sustainable Environmental Management and Policy: Conceptual Underpinnings.

5.2.1 A General Perspective

There is a growing body of literature on the rationale for public participation in environmental management. According to Srinivas (1997, p. 5) ‘Agenda 21, the Green Paper on Urban Environment, and most other recent international declarations on environmental issues recognize the need and value of participation in defining problems and finding solutions to them’. Srinivas argues that participation is facilitated by decentralizing decision-making to the local level to the greatest extent possible, and includes all parties involved: all residents, politicians, and those responsible for managing the implementation of programs. The purpose served by participation is said to include the principle of democracy, that people with immediate experience in the causes and effects of pollution have information that is invaluable in designing an effective program. Participation not only builds knowledge and competence on the part of those participating but also develops a practical constituency for the program. This is the reason why participation and a bottom-up approach are major principles in strategic planning. Prescription, on the other hand, is used to convey the idea that standards and procedures are technically determined and specified as required features of programs. Srinivas (1997) also notes ‘Not uncommonly, prescription appears to be less a function of better information based on scientific analysis than a function of conserving and enhancing the power of those doing the prescribing’ (Srinivas 1997, p. 5).

According to Richardson (2002), there is increasing awareness of the environmental role of indigenous people as part of a wider movement for local approaches to environmental management. For this author and others, ‘calls for genuine community and “grass roots” participation in environmental management decisions is (are) now commonplace in discussions and research in both developing and developed countries’ (Richardson 2002, p. 2). This author also argues that theories of public participation in decision-making, the value of local empirically sourced environmental expertise, and the institutional possibilities for local collective actions are some of the conceptual foundations for locally-based approaches for environmental management. All of these are further linked to the wider concept of environmentally sustainable development, in whatever venture we may be pursuing, and for what purpose, on the surface of the earth.

5.2.2 Urban Environmental Management View and Governance

A special issue of World Resources (1996-97) that devoted attention to the urban environment, pointed out that policies needed to improve urban environments require more effective urban governance, entailing the strengthening of such governments and the involvement of many actors such as the poor and the private sector. The report also noted that 'Community-based approaches are essential if urban services are to reach those who need them and if there is to be broad-based support for needed changes in strategies and practices' (WRI *et al.* 1996, p. xi). According to Wekwete (1997), in African cities and towns the traditional view associates urban management primarily with municipal and central government. This is purely a supply-driven model, in which the state and its agencies have the statutory responsibilities for management. The author notes that the provision of services and their maintenance are therefore viewed as a right that citizens expect, partly as a result of the taxes they pay and partly because of the political legitimacy that they give both the state and local authorities. This approach meets strong disagreement from Mabogunje (1990 quoted in Wekwete 1997, p. 2), when he says that: 'A more recent approach articulates a broader governance that brings to the fore the role that civil society plays and expands the range of stakeholders to include private sector agencies, non-governmental organisations (NGOs), community-based organisations (CBOs) and a variety of interest groups'. The author suggests that urban management within a broader governance perspective must be more participatory, broader in outlook, more transparent and less bureaucratic. However he notes that other forces are also at work, especially globalisation of the world economy.

The waste management issue and the broader issues of sustainable development ultimately, concern governance in contemporary societies. According to one author: 'Governance is taken to refer to the sum of interactions between civil society and government. Good governance is currently taken to include transparency, effectiveness, openness, responsiveness and accountability' (Fagan *et al.* 2001, p. 4). Explaining how the governed value governments Fagan *et al.*, believe that a government can be legitimately judged by its day to day dealings with the civil society (individuals, community groups, environmental groups), and its concerns such as NIMBYism and its new 'spin' called LULU[1] (Fagan *et al.* 2001). Sometimes in place of listening to the citizens on such issues, experts and authorities tend to despise them.

The essence of governance focuses on mechanisms to govern societies, which rest on the use of authority and of sanctions by those in power. Governance also: 'recognises the blurring of boundaries and responsibilities for tackling social and economic issues' (Stoker, 1998 in Fagan *et al.* 2001, p. 4). The latter also comment that both in terms of strategic decision-making and service delivery there is a widespread turn away from the 'Westminster model' to a more complex model of governance more in tune with the more complex society we live in. They also argue that 'In terms of waste management strategy, government by central decrees would need to be replaced by a more consensual model based on multi-agency partnership, the blurring of responsibility between the public and non-public sectors, and the emergence of self-governing networks concerning waste management as a central issue in sustainable development' (Fagan *et al.* 2001, p. 4).

The preceding paragraph raises the question of partnership which Werner (2000 in Fagan *et al.* 2001) emphasises that the type of environmental empowerment necessary for good waste management practices is that which communities have control over their community events rather than that which authorities make decisions for them. However, other authors, including Srinivas, argue that national governments have the major responsibility for designing environmental quality improvement policies and programs, setting standards, and controlling implementation; the reason why national governments direct local governments to carry out programs and to employ methods set at the higher levels to ensure that all members of the society enjoy a healthy and desirable environment (Srinivas 1997).

[1] Locally Unaccepted Land Use

5.2.3 From Government to Governance with Participation

Different approaches with similar goals drawn from political theories of democracy have been used to identify fundamental principles for public participation in works such as those of Nelson Rosenbaum (1978), Fiorino (1990) and Frank Laird Daniel (1993). The last two evolved generic techniques of participation from democracy theories (Webler 1998). According to Webler (1998) since the 1980s there has been a major change of direction in governing in Western countries. The focus is no longer on hierarchy and formal organisation. The central concept of government is giving way to a new concept of "governance"- a term which is yet to find a contextual definition in politics. This new concept is characterised by decentralisation with a reduction in the role of the state, styled "the hollowing out of the state" concept; the transfer of state functions to specialised institutions and other actors within the state; transfer of decision making and implementation capacity to the lower levels, i.e., municipal and state authorities. It limits the scope and form of public intervention, civil servants' prescription and makes a distinction between politics and administration. It ends up with a more fragmented public sector. Storey (2001) also agrees it is a recent trend towards what he calls 'rolling back' the state, together with an increase in community-based responses to social and economic concerns. According to Rhodes (1996 in Bjork and Johansson 2000), this governance can be understood by examining several categories: the minimal state, corporate governance, new public management, good governance, the socio-cyber system and the self-organising network. All these are different names for describing the new governance in different contexts. For example, "Good governance" was coined by the World Bank to describe specific conditions of good administration prescribed for developing countries soliciting international financial assistance. The government of Cameroon responded to this by creating the National Programme on Good Governance (NPGG) and the National Plan for the Fight Against Corruption. The government also instituted a National Electoral Observatory (NEO) to oversee elections in the country. But opposition parties in the country see these moves as cosmetic because the government appoints its supporters to such organisations. Nevertheless, these actions helped Cameroon benefit from international loans and debt relief such as the Heavily Indebted and Poor Countries (HIPC) initiative programme.

Storey (2001) developed a concept of community-based territorialization, (an expansion of his wider theories of territoriality in human society) arguing that: "the sense of local community and attachment to place has been instrumental in the evolution of another dimension to new forms of governance at the local level” (Storey 2001, p. 139). This author explains this concept as the application of community-based responses to particular social and economic problems such as crime and service provision. He argues for the espousal of a more bottom-up, people-centred attempt to develop local responses to particular problems, a move away from a top-down traditional planning model. This approach is not new, but he points out that it has assumed greater importance in current years than ever before and most probably in response to wider social movements associated with such issues as the environment. This emerging horizon places new challenges on states and demands new theory to address the way in which society is organised and governed.

5.3 Concepts and Theories

Theory gives meaning to what might be perceived as unrelated phenomena. According to many authors including, Webler (1998) theory in the field of public participation is not only scattered but also benefits and intertwines with theoretical works from other fields, notably democracy. Early theories sought to elaborate on Marx’s views concerning public participation**.** The concept of citizen participation in environmental management remains an unresolved issue to date in all societies of the world. The role civil society ought to play in environmental public policy remains ambiguous and depends on the type of government in place. According to Vanderwal (1999), traditionally liberal democracies see society as the ultimate source of political legitimacy primarily through the institution of voting for legislative representation. However, deep suspicion looms over civil society, as they are constantly characterised as irrational or an impediment to political decision-making. This suspicion helps limit the level to which participation or empowerment is accorded to the lay public.

One of the most widely appraised models from public participation literature is that of Sherry Arnstein (1969) cited in Webler (1998) and Vanderwal (1999). It is called Arnstein’s ladder of citizen participation (Figure 5.1).

8	Citizen Control	Degree of citizen power
7	Delegated power	
6	Partnership	
5	Placation	Degree of tokenism
4	Consultation	
3	Informing	
2	Therapy	Non-participation
1	Manipulation	

FIGURE 5.1 Conceptual Hierarchy of Public Participation in Governance.
Sources: Adapted from Arnstein's Ladder of citizen participation (1969 in Vanderwal 1999, p. 2).

According to Arnstein's model, levels of participation range from the lowest (1) manipulation, to the highest (8), which is citizen control. The three major degrees of empowerment are summarised along the ladder (Figure 5.1). Wilcox (2001) organised Arnstein's eight-level ladder of citizen participation into a five-rung type namely:

- Information: where people are merely told what is planned;
- Consultation: offering to the people some options, listening to feedback, but not allowing new ideas;
- Deciding together: encouraging additional options and ideas, and providing opportunities for joint decision making;
- Acting together: not only do different interests decide together on what is best, they form a partnership to carry it out; and
- Supporting independent community interests: local groups or organisations are offered funds, advice, or other support to develop their own agendas within guidelines.

Many governmental organisations exist and tolerate citizens' levels of empowerment and participation processes differently. Vanderwal (1999) identifies two extreme spectra of government organisations as concerns allowing entrance into decision-making positions. One spectrum is the arcane, authoritarian bureaucracy with a strong adherence to rules, roles, and hierarchy; the other is an open bureaucracy, responsive to public values in its decisions and open bargaining with those outside the government. Those wanting to get involved include:

- An activist: a special interest group trying to influence political decision through civil disobedience, legal action and the media

- A source of knowledge.
- Stakeholders- a person or organisation with various forms of local knowledge to bring to the negotiation table or a representative of a broader sector of the broader public.
- Facilitators-concerned citizens who draw attention to inconsistencies and incongruities of government policies and regulations and play the role of bargaining and drawing the parties together.
- Self-governance. In some cases participation may extend to the level of self governance

According to Webler (1998), many typologies have been developed based on the principle of empowerment distinguishing such goals as "informing the public" and "developing a consensus" (Creighton 1995); "obtain data about public's values", "solicit advice from the public" and "let the public make the final decision" (English *et al*. 1993); while another suggested "informing the public," "listening to the public' and "involving the public in decision making" (Environmental Management Resource Manual 1995) all cited in (Webler 1998, p. 9). However, these typologies, the same author notes, are not universally accepted. Some people disagree about the appropriateness of empowering a group of citizens who are not legally empowered to make public choices. Others argue that the concept of power is not adequately worked out to develop a detailed theory of power that would allow a precise characterization of participatory techniques. Meanwhile the last group questions how the empowerment ability of different participants can be readily estimated (Webler 1998).

Lessons have been learned from theory and practical shortcomings of participation. Wilcox (2001) has re-examined some aspects and presented key ideas on a guide to effective participation. The available literature suggests that there is undeniably an overwhelming general consensus among authors on the principle of getting the community involved in municipal solid waste management (MSWM). However, it is the debate on the level and nature of participation and empowerment that is at the crossroad especially as it has also to do with relinquishing power. Understanding the nature of participation is made worse by the vague representation in the literature on some deep-seated issues related to who should participate, where, when and how. Wilcox (2003) in his new guide to effective participation, has clarified some of these misconceptions and proposed a guide which he thinks could help move participation from theory to practice. The guide called "ten key ideas about participation" is summarised below.

According to Wilcox's guide, clarity on the initial stance on what is to be done and the degree of participation, even if it is small, of each party is very important. For this author, one level of participation is not necessarily better than the other but simply a matter of ‘horses and courses’. Moreover, participation does not just happen. It develops through a process starting from initiation, through preparation, participation to continuation. In the process the initiator has a strong position to decide how much or how little control to give to others.

According to Wilcox (2001) understanding participation involves understanding the ability of different institutions to achieve what they want. People are empowered when they have the ability to achieve what they want and money, knowledge, skills, and confidence; traditional and religious standing also play a significant role in deciding who gets the power. This author notes that there appears to be some confusion between community and stakeholder. The term community puts everyone together but clouds other interests with different priorities and who among the group may like to be closely involved in an initiation and who would prefer less involvement. A stakeholder is anyone who has a risk in what happens and it does not follow that everyone affected has an equal say. Moreover, partnership, like community, is a much-abused term. It is used to mean the situation where a number of different interest groups willingly come together formerly or informally to achieve a common purpose. The parties do not need to be equal in skills, funds and even confidence but there must be trust and a shared commitment. These take time.

5.3.1 Philosophical and Psychological Underpinnings in Participation

Commenting on apathy, Wilcox notes that: ‘People are committed when they want to achieve something, apathetic when they don’t’(Wilcox 2001, p. 2). Two big philosophical propositions are made here to illustrate commitment to participation:

> People care about what they are interested in, and become committed when they feel they can achieve it. If people are apathetic about proposals, it may simply be that they don’t share the interests or concerns of those putting forward the plan. People are most likely to carry something through if they have a stake in the idea. One of the biggest barriers to action is “not invented here”. The antidote is to allow people to say, “we thought of that” (Wilcox 2001, p. 2).

To put ideas and wishes into practice, Wilcox concludes:

> What we need is a public meeting, but the conventional set-up with fixed agenda, platform and row of chairs is stage set for conflicts. Many participation processes involve breaking new grounds- tackling difficult projects and setting up new forms of organisation. It is unrealistic to expect the individuals or small groups suddenly to develop the capability to make complex decisions and become involved in major projects. They need training – or better still the opportunity to learn formerly and informally, to develop confidence and trust in each other (Wilcox 2001, p. 3).

Anschütz (1996) observes motivational factors causing people to participate in MSWM from many cases studied in the developing countries. These observations are summarised in this paragraph. Felt needs to solve problems such as waste storage place or disposal site would spur people to participate. High-density areas experienced these problems more and studies in Indonesia showed that people living in low-density areas, were most prepared for participation. Studies in Kathmandu suggest that education and campaigns can change peoples' felt needs. Meanwhile, in the same direction, consultation with the community's committee level helped change the minds and priorities in Cameroon and Ivory Coast. Incentives such as giving buckets out for trash collection, clean home competition and prizes, annual cleanest city competition with national prizes and TV show of the city in Asian cities, (e.g. Kathmandu, Nepal) and a household points award system as in China, also motivated the population to participate. Cameroon organises a "Cleanest Councils" competition each year also. One other experience was asking food-making women in Mexico to separate food waste for bio-fertilizers. From the fertilized farms, vegetables are produced and sold to the food-making women at a reduced rate. The results from this study of an Integrated System for the Recycling of Organic Waste in Mexico, known in its Spanish acronym as SIRDO demonstrate that economic benefits such as the sales of recyclables or the reduction of vegetable prices to food-making women, more than environmental education, help change people's behaviour towards participation in solid waste management (Anschütz 1996).

5.4 Cases

5.5.1 Early and Mid 1990 Cases

In the early 1990s, countries in Asia appear to have embraced a participatory approach but with a rather superficial involvement of local communities in solving the increasing urban environmental problems. In 1994 the *Asian Journal of Environmental Management* (AJEM) in a special issue, published a series of articles on community-based urban environmental management experiences in Asia. This was in a bid to improve debates on finding solutions to improving institutional capacity for the management of environmental problems. Three areas had been identified as targets for addressing environmental problems: decentralisation, privatisation and increasing capacity of community-based organisations to improve daily habits through cooperative associations. This review concentrates on the last option.

Chan *et al.* (1994) studied two low-residential areas (Shan Tseng and Diamond Hill) in Hong Kong with the objective of examining the levels and dynamics of women's participation in community environmental projects. Their findings suggest that while women with past experiences in communal organisations were more receptive to participation, the ones without such experiences showed apathy. Impediments to participation were identified as: "no time", "lack of knowledge", and "not well". Other considerations to participate or not included whether the inhabitants saw themselves capable of doing it, or if the project would be beneficial to them and for how long (for those with a short stay in the area).

In another study in a poor residential neighbourhood (Kampung) of Cibangkong in Bandung City in Java (Western Indonesia), (Dharmapatni and Parabatmodjo 1994) studied the community response to social and environmental management participation within the structure of the government Kampung Improvement Programme (KIP). Community response to environmental government initiated projects was highly varied. The government structure during Suharto's period (1965-1998) was hierarchical and centralised. Social and environmental projects were handed down to community and neighbourhood leaders who in turn involved the inhabitants because their land, labour, and direct financial contributions were needed. These represented their share of the responsibilities. Religious places such as the mosques were also being used to encourage participation.

Inhabitants' reasons for participation range from increased self-esteem to serve the community to fear of punishment for non-compliance from the leaders of the community. Meanwhile, the study attributes the success of community projects to the presence of good and dynamic leaders. On the contrary, low participation stems from resentment emerging as a result of the high costs incurred in giving out personal land, labour, and direct cash payments for community projects. A lack of consensus on the necessity and means for specific projects by the inhabitants was identified as another problem as well as the fact that the government externally imposed most projects, and at times with imported workers. Nonetheless, community leaders successfully organised 72 per cent of door-to-door collection of household solid waste by negotiating with and paying youth groups, using fees collected from households. Some government-owned projects were abandoned. These examples suggest there are strong inks between sustainability, environmental management, good governance and participation.

In a study of 55 community-based solid waste projects in developing countries, Anschütz (1996), observed the following as constituting the role of communities in MSWM:

- Adapting daily habits to agreed waste management systems (rules, schedules, e.g. to offer the waste at the right time and place to the collection team)
- Bringing garbage to communal collection point for transfer
- Storing garbage in plastic bags or special bin
- Cooperating in clean-up campaigns
- Keeping house and immediate environment clean (drains, streets in front of the house)
- Separating waste into organic and non-organic, wet and dry, keeping plastics, papers etc. Apart
- Composting the organic fraction in own backyard.

Such a system also needs some education and awareness campaigns, as well as cash, kind and labour to support the service. Money is needed to pay collectors, and acquire and maintain equipment. Communities also have to work with these other waste stakeholders: scavengers, micro-enterprises, CBOs, NGOs and the Urban Council. Micro-enterprises are groups of about eight to 20 people sharing responsibility and profit in providing a service such as sweeping a street. They may be residents in that community or not. The community-based organisations (CBOs) on the other hand develop and operate within the community. The NGOs operate at local, regional, national and international levels. They are involved mostly in supervision, financial assistance, control, coordinating, recruitment, management, education, sensitisation, advice, and cooperation with councils and government.

5.5.2 Late 1990s and 2000s

SANDEC[2] has many cases emerging later in the 1990s. One of such cases chosen for illustrative purposes is that of Shah Rasool Colony in Karachi -Pakistan studied by (Zurbrugg and Ahmed 1999). These authors had on the one hand an objective to acquire experience in people's concerns in their attitudes towards waste collection and on the other, field testing an approach to enhance community awareness and initiate genuine involvement of the community in all stages of the waste collection project. As concerns involvement, the research established that self-help and the use of community participation is significantly important in solving solid waste management problems in low-income areas. They identified motivation and education, the importance of competent individuals working as volunteers, and the existence of motivated members to lead the community, as vital ingredients for effective public participation. The significant role played by women and children is also highlighted. However, they note the danger of the withdrawal of any such helpful individuals or groups of the community. They also observed one other setback that: 'Political affiliation also restricts the project development as the majority of the residents joined the opposition party, thereby creating resentment by the ruling class towards any area upgrading efforts' (Zurbrugg and Ahmed 1999, p. 6).

ENDA-WASTE[3] has a plethora of single-objective projects in multiple sub-areas, on community participation in urban solid waste management all over the developing countries. A series of reports published in 1998 and beyond suggest community participation has gained significant success in MSWM. The cases cover various aspects of MSWM ranging from handling single waste items by individuals such as organic, plastic, rubber and hazardous waste, through small-scale community resource recovery by groups, to whole community participation in waste management (WASTE-UWEP 2003).

Many studies have been carried out to learn lessons on public participation from these project reports. One such is an elaborate synthesis of eight project reports (Bulle 1999). From the cases studied, the concept of interest (collective or individual) is identified and expanded upon

[2] SANDEC is the Department of Water and Sanitation in Developing Countries at the Swiss Federal Institute for Environmental Science and Technology (EWANG) in Duebendorf, Switzerland.

[3] WASTE studies are part of the Urban Waste Expertise Programme (UWEP) founded by the Netherlands Development Assistance of the Foreign Affairs Ministry since 1995. The European Commission founded ENDA in 1994 to support local initiatives towards solving urban environmental problems in the South.

as the cornerstone of public participation in MSWM. Participation is almost completely tied to interest. This includes interest in their community itself, interest because of economic and financial benefits such as employment; credits from NGOs and donors; proceeds from recyclable and composting; redistributive effects from solidarity funds and reinvestment benefits. Interest may also arise because the citizens' health is at risk or threatened. For example, the 1994 cholera and plague epidemics respectively in Patan and Surat cities spurred interest not only locally but also worldwide and caused urban authorities to rethink the state and approach to the environmental problems especially solid waste management. The two cities have a successful MSW system in place today, thanks to the epidemics. Community participation, according to Bulle (1999), is all about community motivation, awareness, education and management. Waste collection or clean-up activities are most effective when residents gain control over their content and their social or sanitary scope; when they take an active part in monitoring and/or raising awareness at the neighbourhood level.

One important revelation is the role played by key actors: traditional and informal leaders, women and young people in this new initiative. Traditional leaders such as wise people, nobles, district leaders and religious figures act as mediators, moral supporters, and arbiters in the neighbourhood projects. Social and informal leaders, namely: opinion leaders, teachers and leading politicians are involved at the management level, initiating projects, setting-up committees and clean-up campaigns. This is illustrated with cases from Karachi, Ouagadougou and Cebu. Young people are the motor behind most projects as they provide the labour needed, both paid and voluntary. Women are the first to feel the problem of environmental deterioration and bear the brunt of the daily load of unhealthy situations. Formerly kept out of decision-making because of cultural, traditional and religious reasons, change is gradually taking place, as they get increasingly actively involved as in Bamako.

Dr Madibo Kieta has also been following up these projects with special attention on the Commune IV Bamako. In two recent articles (Kieta, 2001, 2003) he assesses and highlights lessons learned from this successful case study, which has evolved participation to a level of creating a coordinating body called “the municipal platform,” made up of municipal officials, service providers, households etc. At the municipal platform there are opportunities for discussions, sharing options and perspectives and participatory decision-making for communal waste management in the city district. He notes that it is a success story, the basis of this success being the coordinated efforts, shared ideas and concerns. They also have the ability to modify services to suit local needs while at the same time integrating national legal requirements with the local laws. Women's role here has evolved to the high position of ward leadership charged with monitoring waste collection and sanitation issues. This is a great stride ahead for women and MSWM in a Muslim environment such as Mali.

Some current initiatives of the municipal platform are:

- Separate collection and transportation of bio-medical (hazardous health) waste
- Rehabilitation of illegal dump sites, transforming them into green spaces and playing areas for children.
- Setting centres for waste sorting and composting
- Testing an appropriate technology for primary and secondary collection: combining the use of donkey carts, motorised carts and trucks by small enterprises (investigating effectiveness, efficiency and economics) (Keita 2003, pp. 6&7)

Focus on participation, decentralisation and culture are seen as the engine of the process. However, he further attributes achievement, thanks to the introduction of democracy in the country in March 1991 and the trend towards decentralisation that came with it (Keita 2001, 2003).

In the same vein, and using literature reviewed from ENDA-WASTE projects publications and primary sources from Pakistan and India, Ali and Snel (1999) also identified among other lessons learned from community-based solid waste management initiatives, the recurrent central issue that sustainable waste collection schemes need strong linkages established between the community and the municipality and emphasised the fact that these could be achieved via legislation, discussion forums involving all stakeholders and two-way communication between the community and the municipality.

Developing this position from an overly governance interpretation, Kironde and Yhdego (1997) see waste management as an important arena of governance because it involves the success or failure of authority to deal with this waste, and the response of society to this success or failure. According to these authors, the success of authorities in managing waste (as is the case with other publicly provided services) hinges on the availability of resources, and on good governance and also creating legitimacy for the state in the eye of the public. Failure creates hostility, and distances the public from the state, and this has important connotations for resources generation, democracy, transparency and accountability.

Using Dar es Salaam, the capital city of Tanzania as, a case study, Kironde and Yhedgo (1997), examine urban solid waste management in terms of democratic principles of public participation, citizens' rights, transparency, accountability, financial efficiency and sustainability. They concluded that the urban waste management system has been a failure. The failure is seen not in terms of the dearth of resources as is usually promoted by the authorities, but as a result of poor governance described by the authors as corrupt, unaccountable, inefficient, non-collaborative and using a command-and-control approach to partnership. A community-based model for managing urban waste is needed.

Timilsina (2001), also examines public and private sector involvement in municipal solid waste management in Kathmandu Valley. He proposes a model in which participation in MSWM is ranked into three levels: primary, secondary and tertiary representing respectively, household door-to-door collection and recycling, transportation and landfill disposal levels. Households, NGOs, CBOs, private organisations manage the first level, while city councils are to be responsible for the secondary level, which is transportation, while the state takes care of managing the waste at their final disposal sites, being the landfills or incinerator. Surprisingly he recommends command-and-control and polluter-pays principles to be used to supplement his model. The model shares responsibilities but fails to show that much-needed cordial link between the parties concerned which can bring about meaningful collaboration for effective municipal solid waste management in the valley.

5.5.3 Unit, Nature and Levels of Participation in MSWM

Urban space is organised into the following units: households, communities, neighbourhoods and the city. A community is a group of households, which inhabit the same area, have access to, and use the same services. When they further share religious, cultural, political and socio-economic interests the community bond is stronger and makes community participation easier. A neighbourhood is a geographical area or an administrative unit in which a community lives. Community participation is "a sociological process by which residents organise themselves and become involved at the level of a living neighbourhood, to improve conditions of daily

life (waste, water, sanitation, health, education etc.). It comprises various degrees of individual or collective involvement (financial and/or physical contributions, social and/or political commitment) at different stages of the project" (Bulle 1999, p. 9). The city is made up of communities. In the context of Cameroon, the community and neighbourhood levels would respectively correspond to quarters and villages (next chapter). A totality of projects organised at community or neighbourhood levels would mean serving the whole city.
Participation will be principally at the primary waste management stage (see next chapter). Community participation is part of the wider concept of public and private sector participation. The level of MSW community involvement will vary from contribution in cash and kind, labour, changes in behaviour to involvement in administration, management and decision-making to community management, the latter being the final stage in which the community takes responsibility for the project by obtaining authority over it, carrying out control of operations, managing and maintaining the public service, using a management committee (Anschütz 1996). According to this author, all members of the community are not necessarily responsible for all aspects of the service nor should all works be done voluntarily.

5.5 Conclusion

The overall message emerging from the literature on theories and cases examined is the necessity of getting local people to participate fully in urban solid waste management. It is such an arrangement that has been found to be sustainable. The emphasis is on governance that encourages shared responsibilities by the councils, private sector, community-based organisations, common initiative groups and gives residents an opportunity to take control and possession of their city. It moves MSWM from the command-and-control, government by decrees, top-down, prescriptions by bureaucrats, Westminster model to a more consensual multi-agency partnership with more emphasis on bottom-up, community-based and grass roots control over solid waste management initiatives in their neighbourhoods.

5.6 Governance and Participation in Waste Management, Cameroon

5.6.1 Introduction

In Cameroon, the idea of passing down governance and empowerment to the base, so as to improve effective participation in development, appears to have always been there. Page (2003) notes that in the colonial English-speaking parts of Cameroon, community development was well advocated and entrenched. The concept was not only defined and explained in 1950 by a colonial administrator serving in the area, Mr. E. R. Chadwick, as: "The development of communities by their own efforts and industry and not development of communities by government" but also enforced with the objective "to induce in the people a desire for progress and the will to achieve it by their own efforts," and a rationale that "community development was morally superior because it developed a work ethic and because it preserved an historical African tradition of co-operation". (Page 2003, p. 4). Today in Cameroon there is much talk about decentralisation and regional autonomy by the politicians, the administration and the people. The opposition parties are pressing hard for this to happen. Field experience also revealed this. For example, at the last interview with the Government Delegate to the BUC, on how to move MSWM in Bamenda ahead, he was categorical: "Councils should be given financial autonomy!" The central government is quite aware of these historical perspectives as well as the local, national and international trend and desires toward devolution of power. In the last reorganisation of 1998 government ministries, the Ministry of Territorial Administration was accorded one other new function, being that of "Decentralisation".

One wonders then what should be holding back the progress of reversing the conceptual pyramid for meaningful change. Wilcox's hypotheses discussed above might have given us some clues to the conceptual framework. The following paragraphs examine the actual organisation of issues of administration, governance and participation as they affect MSWM in Bamenda and Yaoundé, Cameroon.

5.6.2 The Institutional, Administrative and Political Structure of Cameroon

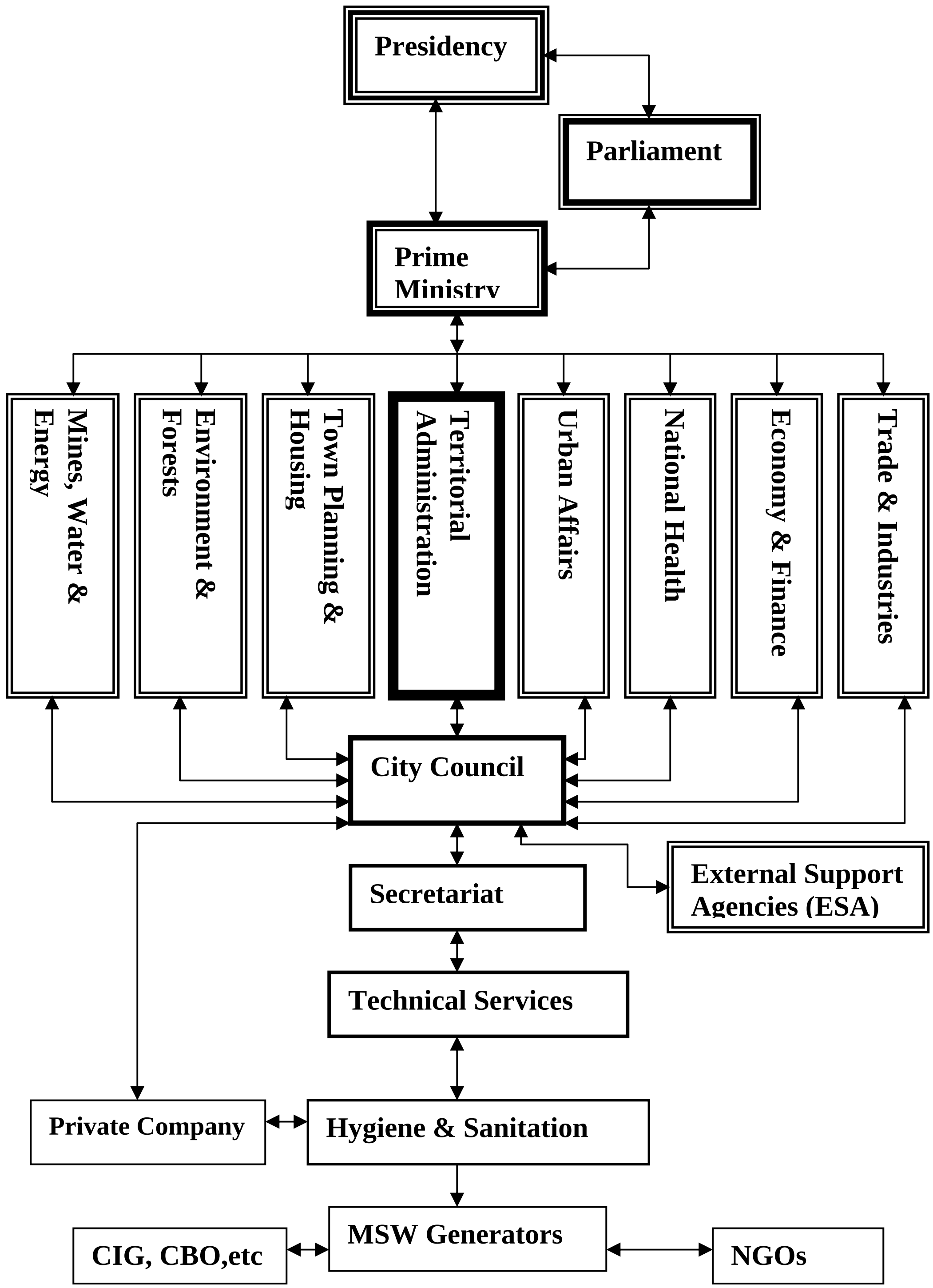

FIGURE 5.2: Institutional Organisation of Waste Management in Cameroon
Sources: Compiled from relevant official texts by the author

Institutional aspects of MSWM concern the institutional structure, arrangements of solid waste management, organisational procedure, role, regulations and responsibilities of various actors and collaborators. It is also tied to the administrative and political system in place. Figure 5.2 is an illustration of the structure. The state defines and fixes laws and regulations governing waste management, sanitation, hygiene and environment throughout the different structures of government and NGOs in the country. Figure 5.2 illustrates the hierarchy of the administrative structure and power. At the top is the highest authority (the president) and in descending order the lowest at the base are the councils. The system is highly centralised at the top; even bills deliberated and passed by parliament must be promulgated into law by the president. In addition the president can make decrees for any issue in the interest of the state. Decrees, laws, orders, decisions, texts and service notices are used to organise and regulate all the functions of government. All levels, from the quarters through the councils to the presidency of the country, make some form of binding regulations of various powers, but orders from higher in the hierarchy take precedence over lower orders in the case of a conflict. However, major decision-making, finances, technical advice and services are concentrated at the top. It is a complicated network. According to the various existing government texts, everyone, as with each ministry, is implicated in waste management matters. Nonetheless, only very important texts and ministries closely related to municipal solid waste management are discussed below.

5.6.2.1 Institutional Responsibilities: Overlapping and Conflicting.

Institutional responsibilities are contained in the texts creating the institution and defining its mission or in subsequent decrees, laws, orders, circulars or decisions. Ministries are responsible for specific functions. They expand on the application of texts and ensure their implementation at the external services spread all over the provinces. The jurisdiction of some services such as solid waste management crosses ministries. Serious coordination is needed to avoid conflicts, negligence and duplication.

Ministries: Administrative Responsibilities and Policies.

i) The Ministry of Territorial Administration and Decentralisation

Councils are one of the functional units in the national administrative hierarchy and as such placed directly under the supervision of this ministry. In addition, since Decree No. 98/147 of

17 July 1998 the ministry is very involved with decentralisation and ensuring good sanitation and waste management among other duties in all the administrative units of the national territory.

ii) The Ministry of Environment and Forests.

The ministry is responsible for laying down national environmental policy plans, coordinating and ensuring their implementation. In the national environmental law N0. 96/12 of 5 August 1996 emanating from this ministry, articles 42 to 53 define the policy and prescribe specifically the accepted solid waste management practices for the country.

iii) Ministry of Urban Affairs. This ministry was created with the mission of the management and restructuring of urban areas with populations greater than 100,000 in Cameroon. Decree N0. 98/153 of 24 July creating the ministry among other duties charged it, in Articles 22-25, with the general cleanliness and drainage, solid waste management, hygiene and salubrity of the cities. Article 24, specifically assigned the ministry with the responsibilities for elaborating plans for evacuation and treatment of solid waste; carrying out research on improving collection and transportation; supervision and coordination of collection and transportation; and sensitising the public on the practice of pre-collection of MSW. It also has the task of maintaining urban roads and streets, coordinating activities of social groups and the informal sectors (Biya 1998).

iv) Ministry of Town Planning and Housing

This ministry is responsible for town planning and housing as it is with the specific management of hygiene and sanitation of the towns. It operates in the same cities as the ministry of Urban Affairs. This is where the zone of operation is not clear. The organization of streets and housing by this ministry also is an important factor influencing the collection of solid waste.

v) Ministry of Public Health.

Waste management is a public health problem. Promoting good public health, sanitation and hygiene have long been the primary responsibility of the Ministry of Public Health. In the councils the sub section for sanitation and hygiene, including waste management is under the technical supervision of the ministry’s preventative medicines services.

vi) Ministry of Industrial and Commercial Development.

It promotes the development of industrial, commercial and artisan activities in the country. These areas generate large quantities and varieties of wastes. The policy on industrial and commercial waste management is indispensable, needing the collaboration with the other concerned ministries. Private waste management companies are within this ministry's jurisdiction. Issues related to importation and exportation of wastes or recycled waste also lie within their domain.

vii) Ministry of Finance and the Budget

Councils are decentralised local and corporate bodies governed by public law. Consequently the Ministry of Finance and Budget is responsible for collection and disbursing funds for the running of councils' operations as is with other government corporate bodies (Section 52 of Law No. 87-105 of 15 July 1987). The minister represents government when councils are engaged in signing big financial contracts.

Other ministries such as Higher Education through its university institutions is doing research in solid waste management; the ministry of Agriculture is interested in organic fertilizers from composting MSW; and so on. These ministries are by law supposed to work together; however, the practice is full of conflicting roles and rules rather than complementary, because the line between their jurisdictions is fuzzy. This is no surprise given that a venture such as waste management involves everyone and all spheres of life and good coordination is not yet in place. Law No. 053 of 19/12/90 on "liberalisation of associations" and the emergence of donors and international bodies such as World Bank and IMF during economic crises together with friendly-country/city governments play a role in the administrative and management hierarchy.

5.6.2.2 Deliverers of MSW Services.

While the ministries take specific administrative roles all over the country, for greater efficiency, the country is further divided into provinces, divisions, sub-divisions, districts and council areas. Councils are not only the smallest unit of administration but also the most basic and most important. Everyone in the country lives either in an urban or a rural council area.

They are the main deliverers of services to the population. The economic, social and cultural development of each council area and its people logically means the overall development of the country. This important role of councils is well understood by the government and is demonstrated in the various comprehensive decrees, laws and texts in place that define the mission, organization and functional mechanisms of these councils. Nonetheless, the practice is far from the ideal. Power and finance still remains at the top and it appears councils are yet to be equipped with the necessary means and empowerment that will help them deliver council services, including waste management, at sustainable limits.

At the level of deliverers (Figure 5.2) are the NGOs, Common Initiative Groups (CIGs), Community-Based Organizations (CBOs), private concessionary companies, and waste generators. The situation is more confused at the base because some groups deal directly with the waste generators while others operate through the councils' Hygiene and Sanitation Technical service. Collaboration is lacking. Another big source of assistance usually comes from External Support Agencies (ESAs) such as the World Bank, IMF, friendly cities and countries overseas. Their support to the council may come directly or through the ministry. Meanwhile it is not uncommon to have a big internal support leapfrogging from the Prime Ministry or Presidency to alleviate a waste management disaster. Both the Yaoundé and Bamenda Cities' solid waste management system are relying on these last two options for survival. The main stakeholders, the households, are not meaningfully involved in the system. This overreliance on external support and complete negligence of local stakeholders is simply unsustainable. The organization at city levels for Yaoundé and Bamenda is discussed in the specific chapters dealing with those cities.

5.6.2.3 Urban Councils and SWM Legislation: Responsibilities and Financing

All texts consulted define a city council as a decentralised local authority and corporate body governed by public law and having a legal personality and financial autonomy Other attributes point to the fact that it must have a name, headquarters and area of jurisdiction. It may also have sub-divisions or not. The main task is to manage local affairs aimed at economic, social and cultural development of its population (law 87-1365 of 24 September 1987, GOC, 1987).

Many administrative texts define the organization of councils. One very important text is law No. 74-23 of 5 December 1975. This long document, comprising 183 sections, laid down the basic law that define the administration of councils in the country. Later laws and decree such as Decrees No. 77-220 of 1 July 1977 and No. 80-17 of 15 January 1980; and Laws No. 87-015 of 15 July 1987, have barely amended parts if it.

In all these texts the urban councils are charged with the responsibility for developing and maintaining streets, public spaces and parks, markets, halls, cemeteries, roads, libraries museums and monuments and policing of private and public lands (Chapter 4 1974 Law). In the same law Councils were empowered (in section 96) to institute direct annual tax collection from the inhabitants of the area on each of the following services: water, street lighting, household waste collection, ambulance and electricity generation. The latter is where the urban council generated its own electricity. Introducing these taxes was however subject to the approval of the supervisory authority. The taxes were barely a proposal, as they did not appear on the council's indirect taxes and fees source which included slaughter tax, sanitation inspection fines, pounding fees, market space tax, building permit fee, temporary occupation of streets or parks fees, motor parks tax, advertising tax, stadium fees, vacant plots tax, communal stamps, highway dilapidation tax, animal transit and custom taxes. Councils could also obtain revenue from exploitation of the public property of the city council; loans; subsidies and advances granted by the state or any other public bodies; private sources; gifts, donations and legacies.

Decree No. 77-220 of 1 July 1977, fixed the maximum collection rates and methods of payments for taxes spelt out in the preceding paragraph. There is no mention of citizen's financial contribution to waste management. So the burden is still placed on other sources of revenue or the central government. Decree No. 80-17 of 15 January 1980 fixed maximum rates of direct taxes proposed in the 1974 law. Councils for the first time were empowered to collect taxes on garbage. Section 1 emphasised that councils may levy, for the purpose of running technical services of public establishments, water tax, street lighting tax, garbage collection tax and ambulance tax. Section 4 stipulated that the Garbage tax shall be an annual flat rate payable in three categories: 50–250 francs CFA for non-workers of public or private sectors; 150-1 000 francs CFA for employees of the government or private sectors and 2 500-30 000 francs CFA for licensed institutions (GOC 1980).

Law No. 87-015 of July 1987 made major changes on the foundation law of 1974. The law did not only create sub-divisional urban councils (Section 2) within the city councils' structure but also highlighted waste management and other urban services especially as jurisdictions were now shared between city and sub-divisional urban councils (Figure 5.3).

City Council (CC) areas covered by their powers are:	Sub-Divisional Urban Councils (SDUC) areas covered by their powers are:
1 town planning and urban development 2 collective facilities and infrastructures; 3 maintenance of major reads and road signs; 4 pubic lighting and supply of drinking water; 5 traffic and transportation; 6 public parking and parking lots; 7 municipal slaughter houses; 8 markets and fairs; 9 municipal museums; 10 recreation parks and gardens; 11 graveyards; 12 implementation of measures related to land tenure, State lands and building permits; 13 naming of streets, squares and public buildings; ✓14 hygiene and sanitation.	1 enforcement of laws and regulations; 2 civil status matters; ✓3 collection and treatment of garbage and waste, and treatment of waste matters; ✓4 sanitation; 5 policing of dangerous, unhealthy or obnoxious establishments; 6 health and social activities; 7 distribution of drinking water; 8 maintenance and cleaning of secondary council roads; 9 council libraries; 10 sports and recreational facilities; 11 local dissemination of information.

FIGURE 5.3:Responsibilities of the City and Sub-Divisional Councils by 1987 Law
SOURCES: Law No. 87-015 of 15 July 1987, Sections: 3 &11.

The city council's powers covered 14 areas with hygiene and sanitation the fourteenth item area (Section 3), meanwhile the sub-divisional urban councils were assigned amongst 11 other duties, the collection and treatment of garbage and waste, together with treatment of waste matters. Sanitation was also included amongst their duties (see Section 11 sub 3 & 4). In the section the function "sanitation" remains vague as applied to both levels of councils and in practice it actually creates confusion. Revenue sources were also shared between the city council and the sub-divisional urban councils. Among other sources the sub-divisional urban councils were to collect garbage tax and sanitation tax (Section 50 sub 12 & 13).

Decree No. 87-1365 of 24 September 1987 set up the Yaoundé City Council (as was with Douala No. 87-1366 same day) with four sub-divisional urban councils: Yaoundé I, II, III and IV. In another reorganisation (1993) two more sub divisional urban councils: Yaoundé V & VI were created out of former Yaoundé I & III (Decree No. 93/321 of 25 November 1993).

5.6.3 Participants in MSWM in Yaoundé and Bamenda, Cameroon

While government has been busy organising urban councils, the urban community seemed forgotten. Their level of participation is so low that some households have nothing to do with the councils' arrangements. This suggests they have never had a forum to discuss waste maters despite the fact that the section 72 of the Cameroon Law on Environment pays lip service to public participation in environmental management. This section guarantees the public free access to environmental information, involvement through consultations for their opinion and ideas and the right to be sensitised, informed and educated on environmental matters. The next section (73) charged educational institutions: primary, secondary and university to include environmental management in their curricula.

To investigate the level of collaboration, participation and involvement of communities in Yaoundé and Bamenda in MSW management I used some survey questions. Respondents were requested to indicate who decided the location of the public skip that they use and whether they had ever had any form(s) of sensitisation on waste management matters. They were further asked who organised it and the media used. Their willingness and ability to participate in waste management through rates payments was also surveyed (Table 5.1).

5.6.3.1 Decision-making

Analysis from Table 5.1 shows that in both cities only one percent of the respondents say all the parties: Urban Council, waste generators (quarter people), and waste management company (HYSACAM in the case of Yaoundé) came together to decide where to place the public bin. In Bamenda it was 95 percent a Council decision. In Yaoundé people believed it is the waste management company, more than the council who decided the location. An average of 17 percent admit that the quarter people contributed to the decision on where to locate public skips. This suggests the people are simply informed over the radio or television network to put their waste into the skips.

TABLE 5.1

Cross Tabulation Results on Who Decided the Location of Public Skip:

City * Public bin located by Urban Council (UC)

		Yes	No	3	Total
City	Yaoundé	28	97	1	126
	Bamenda	85	5		90
Total		113	102	1	216

3=don't know

City * Pubic bin located by HYSACAM

		Yes	No	Total
City	Yaoundé	86	41	127
	Bamenda		84	84
Total		86	125	211

City * Public bin located by quarter & HYSACAM

		Yes	No	Total
City	Yaoundé	3	123	126
	Bamenda		84	84
Total		3	207	210

City * Public bin located by (ALL):1, 2, 3 above

		Yes	No	Total
City	Yaoundé	3	122	125
	Bamenda		84	84
Total		3	206	209

Sources: Field survey March/April 2003

5.6.3.2 Education and Sensitisation

As far as education and sensitisation are concerned, an average of 61.5% of the respondents from both cities said they have had some form of it, 80 % of the Bamenda respondents and 49% of Yaounde's. Summarily 76% came from the Councils, 10% from the waste management company (Yaoundé), nine from NGOs, six per cent from academics, and seven per cent from other sources. The media through which this information was passed on included the radio (52 %), television (40%), school (15 %), posters (15 %) and quarter meetings (15%). The messages carried were: “put your waste in the public bin,” “Keep your areas clean”, “Keep Bamenda Clean is on Thursday” etc. The number of times the respondents heard the sensitisation and education varied from one to many. Many simply said they have never heard or seen any thing.

5.6.3.3 Solid Waste Financing

According to Bulle (1999) a tax is viewed more as a conventional task than as a real participation. In Cameroon the texts were made for users to contribute to the costs of services such as water, street lighting and garbage collection, to assist government. At first these services were free, later councils were at liberty to institute taxes on them and lastly a token tax was instituted by government (1980 law). These rates were not only small but also few contributors existed, mainly salaried workers whose contributions could be cut at the source of the salaries and institutions. These placed councils in permanent need of support.

The following Table 5.2 shows the total income for four successive budgetary years in Yaoundé, income from the community, direct taxes on water, garbage, electricity etc., the part of income accruing from garbage collection, the contribution of the budget of the city council in the financing of the garbage management and lastly the percentage of garbage tax income over expenditure.

TABLE 5.2
Fiscal Revenue and the Part Contributed from Garbage Collection Tax 1987-1991 (in Million FCFA). (Yaoundé City).

Financial Year	**1987-1988**	**1988-1989**	**1998-1990**	**1990-1991*-**
Revenue	5.215	3.848	3.584	3.928
Council direct taxes (water, street lighting garbage etc).	8,6	146,642	153,566	81,626
Revenue from garbage collection tax	2,836	48,392	50,677	26,936
Contribution from the budget of Yaoundé City Council to garbage collection	533,536	533,536	319,115	563,054
% of revenue over expenditure	0,5%	9%	15,9%	4,8%

* Yaoundé City Council shares a third of the total service costs.

Sources: Financial Service of the Yaoundé City Council in (Ngnikam 2001, p. 122)

Over the years the contributions of the community towards waste management is an insignificant average of 7.6% for Yaoundé. The situation now has not changed Bamenda's 1999/2000-budget direct tax revenue including garbage was only 5% (Table 5.3). It is not easy to say, with some certainty, what comes in as revenue but not expenditure especially where the council directly manages waste such as in Bamenda. The garbage tax with other direct taxes (Table 5.3) contributed only 0.5% of the revenue in 1999/2000. This is 8.7 times the desired amount as indicated by the 2001/2002 proposed budgets. Expenditures on garbage management are divided among workers' salaries, garage, drivers, and vehicle repairs, servicing and fuelling. Some of these services are general and many waste workers 'borrow' from other services. Direct salaries for garbage workers was only 1 843 402 CFA[4] for 1999/2001 and 1 039 452 CFA for 2001/2002. There is no expenditure shown for garbage equipment but 2001/2002 budget shows 15 000 000 CFA. In all the contributions in Bamenda as for Yaoundé are too small to offset the costs of solid waste management. This demonstrates why the government comes in almost on a permanent bases to support the council (Table 5.6).

TABLE 5.3

Garbage and other Direct Council Taxes in Bamenda Urban Council Revenue 1999/2000 and 2001/2002.

Nature of revenue	**1999/2000**	**2001/2002**
1. Excess of Revenue over Expenditure	326 318 555 -	-
2. Tax of the rolls (poll, business, liquor, cattle)	125 134 434	190 000 000
3. Additional council taxes	47 884 653	154 000 000
5. Direct council taxes (water, street lighting, garbage, ambulance and. Electricity)	3 425 001	29 500 000
5. Indirect Council taxes (Sanitation, slaughter house etc (see 5.6.2.3)	158 626 599	211 700 000
6. Single articles (renting council property)	6 960 175	20 000 000
7. Rebates and Royalties	-	
8. Single headed (only incidental revenue)	16 378 100	244 400 000
TOTAL	**685 563 508**	**890 000 000**

Source: Bamenda Urban Council Budget 2001/2002, BUC

Survey results from Yaoundé and Bamenda (Tables 5.3 & 5.4) suggest that many citizens are prepared to pay up to 12 times the current yearly tax rates (a flat rate of 50-1 000 frs per

[4] 1 ASD ($)=400.374 francs CFA; 1 USD ($)=539.058 francs CFA; 1 Euro (€) = 655.957 francs CFA

taxpayer). The survey rate is what people are prepared to pay in a month. This is illustrated by data shown below including the fact that many people, especially in Yaoundé, pay private individuals or community groups to remove their waste at higher monthly amounts than the current tax system stipulates. However, not all the respondents were prepared to pay.

TABLE 5.4
City. Proposed Monthly Waste Service Payment Cross-Tabulation

Rate → City	**<500 Frs CFA**	**500-699 frs CFA**	**700-999 frs CFA**	**1000-1500 frs CFA**	**>1500 frs CFA**	**Total**
Yaoundé	56	15	29	18	30	148
Bamenda	37	10	7	10	32	96
Total	93	25	36	28	62	244
%	**38.1**	**10.2**	**15.8**	**11.5**	**25.4**	**100.0**

Source: Field survey March/April 2000

Table 5.5
Quarter * Proposed Monthly Waste Service Payment Cross Tabulation Counts

Rates Quarter	**<500 Frs CFA**	**500-699 frs CFA**	**700-999 frs CFA**	**1000-1500 frs CFA**	**>1500 frs CFA**	**Total**
Bastos	4	4	2	7	15	**32**
Efoulan	11	2	8	2	9	**32**
Nvog Ada	29	6	14	4	1	**54**
Cite-Verte	12	3	5	5	5	**30**
GRA Up Station	7	3	1	1	2	**14**
Nchuabuh	2	1	1		14	**18**
Nta Mbag (Old Town)	24	6	5	5	4	**44**
Ndamukong	4			4	12	**20**
Total	**93**	**25**	**36**	**28**	**62**	**244**

Source: Field Survey March/April 2003

Some families saw removing waste from households as a legitimate contribution by the children to household duties. Some think it is the urban council's duty to take away the waste as with other urban services. The ability to pay and the paid rates have a strong positive correlation with the socio-economic standing of the quarter. High residential quarters e.g. Bastos and Nchuabuh, show higher rates, meanwhile the two low-residential quarters in the two cities, Nvog Ada and Nta Mbag, indicated low rates of payment (Table 5.5).

TABLE 5.6
State, City Council and Urban Sub-Divisional Council Contributions toward Household Waste Collection in Yaoundé, 1998/99-2001/02 Budgetary Years

Financial Year	**The State's Contributions**		**City Council's Contributions. (CUY)**		**The six Urban Sub-Divisional Councils' Contributions. (USDC)**	
	Amount (million frs CFA)	Percentage of the total	Amount (million frs CFA)	Percentage of total	Amount (Million frs.CFA)	Percentage of total
Year 1 1998/1999	1.300	86,6%	100	6,7%	100	6,7%
Year 2 1999/2000	900	60%	500	33,3%	100	6,7%
Year 3 2000/2001	500-600	33.3-40%	800-900	53,3-60%	200	13,3%
Year 4 2001/2002	0	0%	100% payment by the councils "les collectivites public locales".			

(Ngnikam 2001, p. 123)

Table 5.6 illustrates the declining contributions of the state. It registers zero in 2002. This is normal given that support is not meant to be permanent. On the one hand the state expects the council to gradually increase the taxes to increase revenue. On the other, this is not allowed by the texts. However, in 2003 the government renewed the contact with HYSACAM to pay 2.5 milliard francs with councils contributing 0.5 milliard francs for the next three years (Interview with service head in charge of Hygiene and Sanitation CUY, Yaoundé 10/3/03). The relation between the city councils and the sub divisional councils is another area which needs to be carefully worked out in texts and application so as to address conflicts. It is certain that both the texts and the whole philosophy of providing these services have to change, if the situation of waste management is to be sustained.

5.7 Conclusion

The involvement of the citizens in the waste management in Bamenda and Yaoundé has been rather cosmetic. The financial contribution rates are not only too small but also hardly ever collected. Even if the average of 500 francs (less than US $1) per working population per year garbage tax, or 15 000 francs for the licensed establishments, came in, these amounts would not sustain the management of the yearly per capita solid waste generation. Participation is much more than paying money for waste removal. The beautiful laws and decrees on the environment and organisation of the council structures and functions suggest that the central government at the top understands the prominent role councils at the base can play in improving the general economic, environmental, social and cultural life of its populations and especially solid waste management. For now there is no efficient mechanism for enforcing the laws in place. The administrative structure and roles are too interconnected yet effective coordination is not in place. The top has theoretically passed down autonomy to the councils at the base but is still holding firm onto the process of passing down the necessary financial and empowerment that the councils need to function effectively. Schubeler (1996) on decentralisation and distribution of responsibilities observes that: “Problems arise when certain functions are centralised, while responsibilities for operation and maintenance remain at the local government level” (p. 30).

For MSW there is a strong reliance on the central government and external support agencies in both Yaoundé and Bamenda cities whereas the mass of literature reviewed points to the necessity for and the successes of community participation in moving MSW ahead in places with similar conditions, as is Cameroon. There is too much faith on machinery rather than on citizens and local institutions. This is not sustainable, and the persistent poor state of solid waste management in Bamenda and Yaoundé cities as demonstrated in the next chapters confirms. Hence, in conclusion:

> In terms of waste management strategy, government by central decrees would need to be replaced by a more consensual model based on multi-agency partnership, the blurring of responsibility between the public and non-public sectors, and the emergence of self-governing networks concerning waste management as a central issue in sustainable development (Fagan *et al.* 2001, p. 4).

CHAPTER 6

Municipal Solid Waste Management in Bamenda City: Generation, Storage, Collection and Transportation

6.1 General Introduction

Crucial to any successful municipal solid waste management (MSWM) system is the understanding of the waste production rate, types, the characteristics and the history of the system including those factors that drive the entire system. Knowledge gained from such data helps guide policy, planning and management strategy including monitoring of progress in quantifiable terms. This chapter examines solid waste generation, storage, collection and transportation in Bamenda City. Collection and transportation are discussed at two levels, namely primary and secondary. Important data and information are generated from field experiment and survey analyses. I begin by presenting the major driving forces, which have directly, or indirectly affected waste management in Bamenda. These drivers include the organisational structure, growth, and development politics and waste management history of the city. A simplified flow diagram of the MSWM system which defines the path being followed is introduced; however, discussions on the parts of that plan dealing with treatment, disposal and waste-derived products are reserved for the next chapter.

6.2 Bamenda City

The Bamenda Urban Council (BUC) governs Bamenda City. A Delegate to the Urban Council, appointed by a presidential decree, heads it. Two major administrative structures can be identified in Bamenda: the traditional under the control of the chiefs and other, the modern one emanating from the central government. The traditional system has villages subdivided into a number of quarters. The chief or ‘Fon’ heads the village or ‘fondom’ while the Fon-appointed quarter-heads, lead the quarters. Bamenda is made up of three main villages Mankon, Nkwen and Mendankwe (Figure 6.1). There are many quarters with diverse characteristics in each village and not all the quarters of these villages fall within the urban areas.

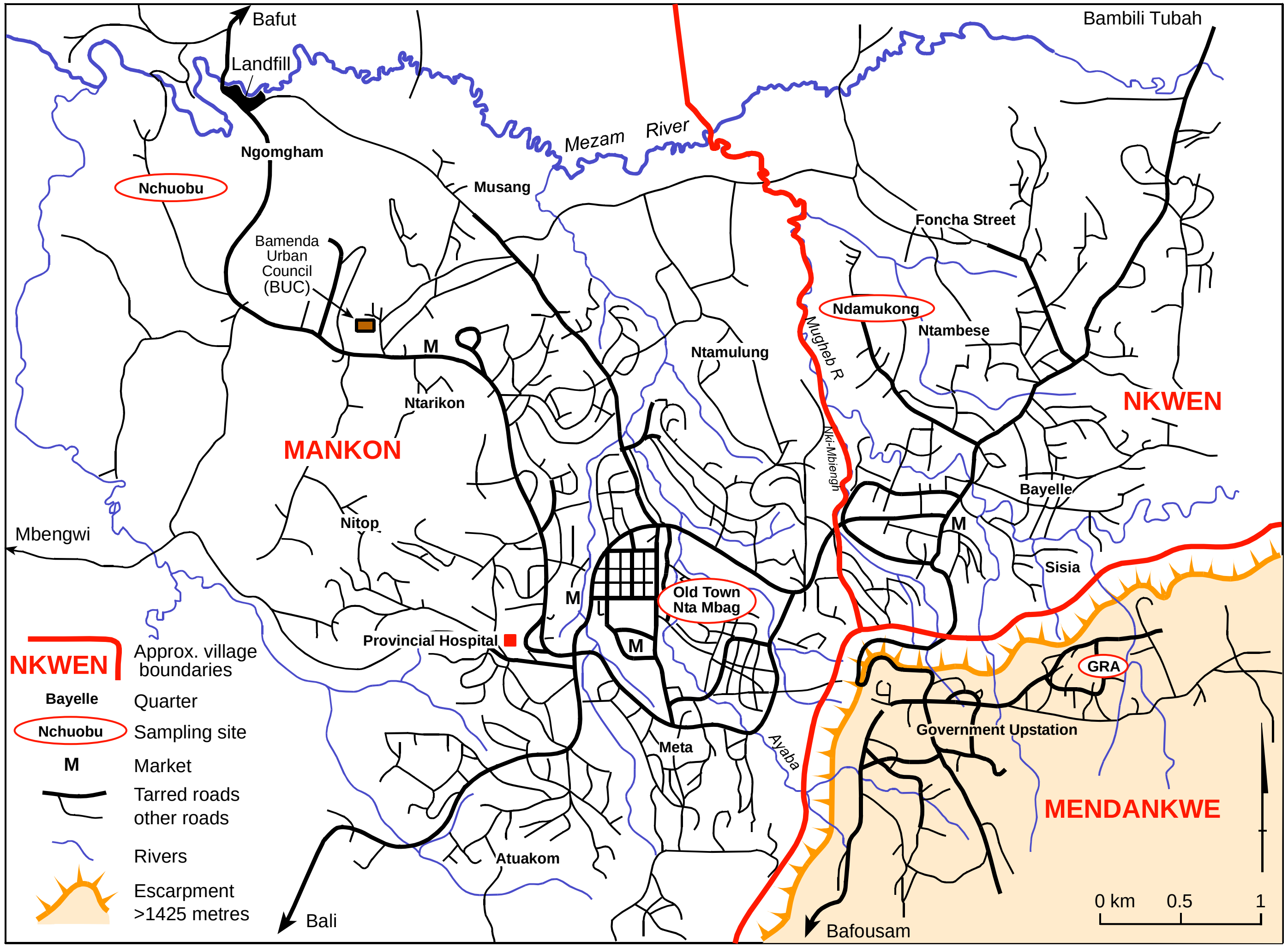

FIGURE 6.1: General Map of Bamenda City

These villages were once well-organised states but lost their hegemony to colonial administration and later to the central government, which now controls every level of administration in the national territory since political independence in 1961.

The central government style of organisational and structure follows the hierarchy of the Ministry of Territorial Administration. The ministry is at the top; followed by the province, division, sub division, the councils and lastly the villages. BUC areas correspond roughly to the last three levels in the hierarchy. The immediate overall supervisory authority is the Divisional Officer (D.O) in charge of the Bamenda Central Sub-Division, which corresponds roughly to the city area. This makes the organisation and functioning of the city more complicated, especially as the city also houses the administrative headquarters for Mezam Division and the North West Province.

This new horizon, in which the traditional and modern systems mix, is problematic. According to Mabogunje (1992 cited in Olokesusi 1994, p.381)

> .. current urban management structures in Sub Saharan Africa are a reflection of the displacement of traditional hierarchical arrangement for mobilising people and ensuring their active participation by the state apparatus, by systems which have little or no coordination between state agencies and community-based organisations.

However, an apparently smooth functional system had been put in place over the years until the late 1980s and early 1990s chaos set in with the emergence of economic crises, Structural Adjustment Programmes (SAP), devaluation of the currency, massive salary cuts, and generally difficult living conditions in Bamenda and Cameroon. The fact that the birth and seat of the main opposition party is in Bamenda has increased political instability. The situation is yet to stabilise for any meaningful collaboration towards a common goal.

6.2.1 Population and Spatial Growth

Bamenda is the biggest city in the predominantly English-speaking part of Cameroon. The rates of population and spatial growth have equally been very high. The drivers for this growth have been the increasing administrative status and functions of the town, trade and commerce, transport, education, health and other socio-economic and political developments. Founded in 1902 as the location of a fortress by the Germans on the edge of the escarpment (Up Station in Mendanke), the African city developed below with the gradual occupation of Abakwa (also called Old Town) by local farmers, traders and crafts men, together with migrants form neighbouring territories. As the city expanded it spread to Mankon, Nkwen and Mendankwe villages, engulfing quarters systematically. Today Bamenda is number four in national urban settlement ranking (DSCN 2002). It is a regional primate city, occupying an area of about 36.07 km^2 with a heterogeneous population of nearly 300 000. In 1934 the population was a modest 1299 (Figure 6.2). Kumbo, the next largest city within the region, had less than 100 000 people by 1999 data sources.

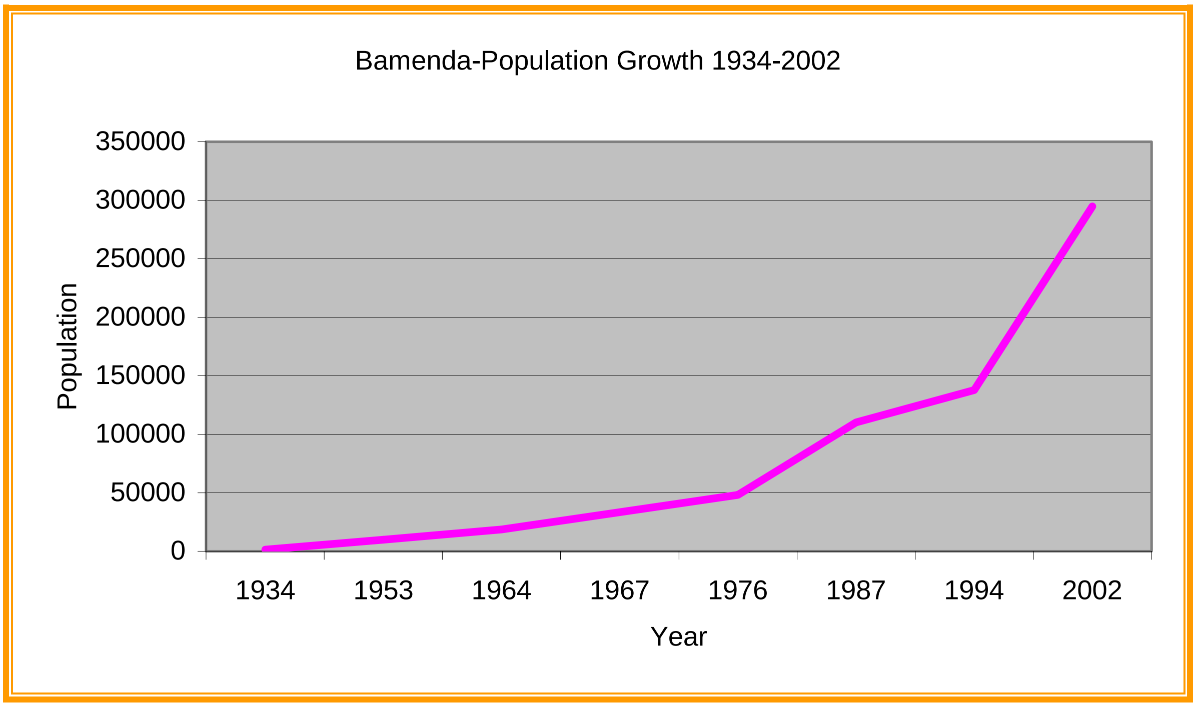

FIGURE 6.2: Urban Population Growth in Bamenda-1934-2002
Sources: 1953-1976 data (Achankeng 1984); 1987 & 1994 data (Anschutz *et al.* 1995); 2002 data (DSCN 2002).

TABLE 6.1
Annual Average Rates of Population Growth (AARPG) in (%) for Bamenda 1934-2002

Year (1)	Year (2)	Population Year (1)	Population Year (2)	AARPG %
1934	1953	1299	9760	11.20
1953	1964	9760	18489	5.98
1964	1967	18489	33498	21.91
1967	1976	33375	48111	4.15
1976	1987	48111	110142	7.82
1987	1994	110142	137571	3.23
1994	2002	137571	294873	10.00

Sources: Compiled and Calculated from 1953-1976 Data (Achankeng 1984); 1987 & 1994 Data (Anschutz *et al.* 1995); 2002 Data (DSCN 2002).

Figure 6.2 and Table 6.1 show that the growth has been very rapid, the last decade showing an accelerated annual average rate of 10 per cent. Calculations are based on the preferred common compound interest method[1] (ABS 1998). Omuta (1987) argues that increase in population will no doubt increase waste generation but that increase in waste *per se* is not equal to the degree of environmental pollution. However, I argue on the contrary that given the conditions demonstrated in this thesis the council has not been able to cope with the waste management challenges posed by the startling urban population growth**.**

6.2.2 Social, Cultural and Political Organisations

The highest decision-making body of a village is the traditional council. Next down the ladder are the quarter councils. Specific ethnic groups in the cities also have their cultural meetings but may not have administrative functions. Youths, women and other social groups also exist in the cities while the Christian and Moslem faiths have multiply sub groups. Clubs of various status from top civil servants' clubs and associations to students' clubs are also present as are financial groups locally called 'Njange". These groups have different objectives but a common objective that cuts across all is to improve human life. These organisations are potential areas that can be exploited for non-conventional waste management strategies. Some NGOs such as CAMINSUD and Paradise on Earth are working in that direction.

The city is a hot spot for party political activities. The first and the main opposition party in the country, the Social Democratic Front (SDF) was born here in 1990. SDF's struggle to get into power, along with other opposition parties, especially after the first multiparty elections of 1992, failed. Associating their failure to win with fraud orchestrated by the government and ruling party, the opposition parties plunged the city and country into years of political instability characterised by civil disobedience, 'ghost towns', strikes, and road blockades. The Cameroon People Democratic Movement (CPDM), transformed from the original one-party system, continues to rule the country. The chairman of SDF and one of the first national presidents of CPDM live in the Mankon part of the city. In some areas such as Bamenda the opposition (SDF) won all the urban council seats but the head of the council is appointed from the CPDM by a presidential decree. One may find it hard to

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[1] AARPG=((P2/P1)^(1/n)-1)*
Where ^ is the power, i.e., the number of years between two years/periods P2 & P1;
and * is the rate unit (percent, i.e., 100) as multiplier by.

believe that such an arrangement would not pose a threat to good governance, which is so pertinent nowadays for sustainable waste management. According to Fagan *et al.* (2001) good governance is supposed to include transparency, effectiveness, openness, responsibility and accountability. In situations such as the one mentioned above, being able to implement these canons of good governance has not been easy. Given the nature of multi-party feelings in this part of the world, wounds have hardly healed. Each party still treats its opponents and their zones of political support with animosity and discrimination. This atmosphere affects service provision as some parts of the city suffer from deprivation because of their political leaning.

6.2.3 The Economy and Infrastructure

Bamenda has a disproportionately large share of the province's urban economic activities and infrastructure. Agriculture is an important activity in and around the city. This can be an available market for city-derived organic manure. Food processing, construction enterprises, arts and crafts, farm machinery and furniture works dominate the secondary sector. The tertiary sector is mostly involved with services industries such as wholesale, hotels and restaurants, retail trade, transport, banks, insurance companies tourism and cooperatives. Public services are offered by the state through ministerial representation at provincial, divisional, sub-divisional and council levels. The local and international NGOs are also located in the city. The informal sector is equally very active in retailing and hawking. According to MINEFI (2001) Bamenda has 14 out of the 37 hotels of the province, six banks, six cooperatives, and 15 international NGOs. They are involved in urban development, health, education and agriculture.

The three main villages that make up the city are distinct in character. Mankon occupies the largest portion, with the core of the city's business. The Central Business District (CBD), all the banks and insurance companies, three of the four central markets, 70 percent of the colleges, the four best hotels of the province, and the provincial hospital are all located in this part of the city. Included in Mankon are also a range of old to new expanding quarters. Nkwen is next to Mankon in size and functions with an expanding commercial and residential area. One of the city's main markets is located here. The Mugheb stream and its tributary the Nki-Mbiengh separate both villages (Figure 6.1). Meanwhile, a cliff face divides them from Mendankwe, where the Station, the seat of government offices, administration and residence for civil and military officers alike, is located.

The availability of a good road and street network is an indispensable factor for effective and efficient waste management system. A look at any Bamenda Map (Figure 6.1) would imply that the city is well served with a good network of roads and streets. However, a closer scrutiny would show that only about one-twentieth of these roads and streets are tarred. The remainder are untarred and either passable in all seasons or not. Motorable streets also do not serve the peri-urban quarters; rather one finds many paths barely used by pedestrians. Another factor, which further exacerbates the accessibility problem, is the uneven terrain and numerous streams. This inadequacy of access is a great impediment to waste evacuation in the city.

6.3 Introduction to Municipal Solid Waste Management in Bamenda

6.3.1 General MSW flow.

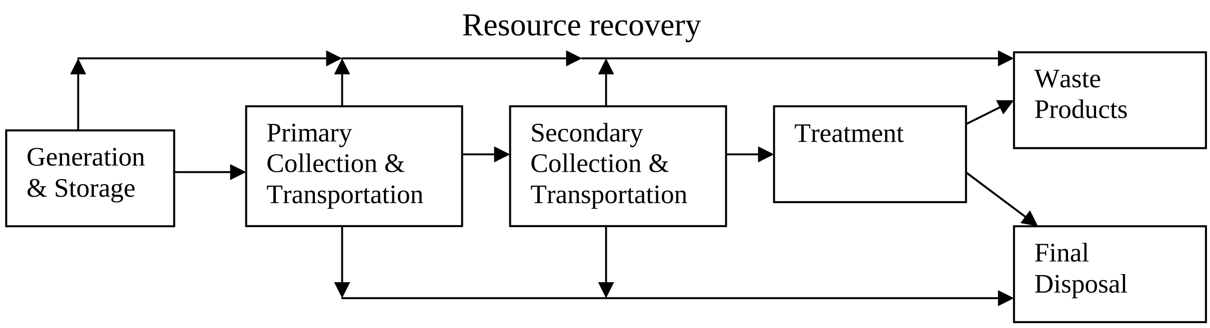
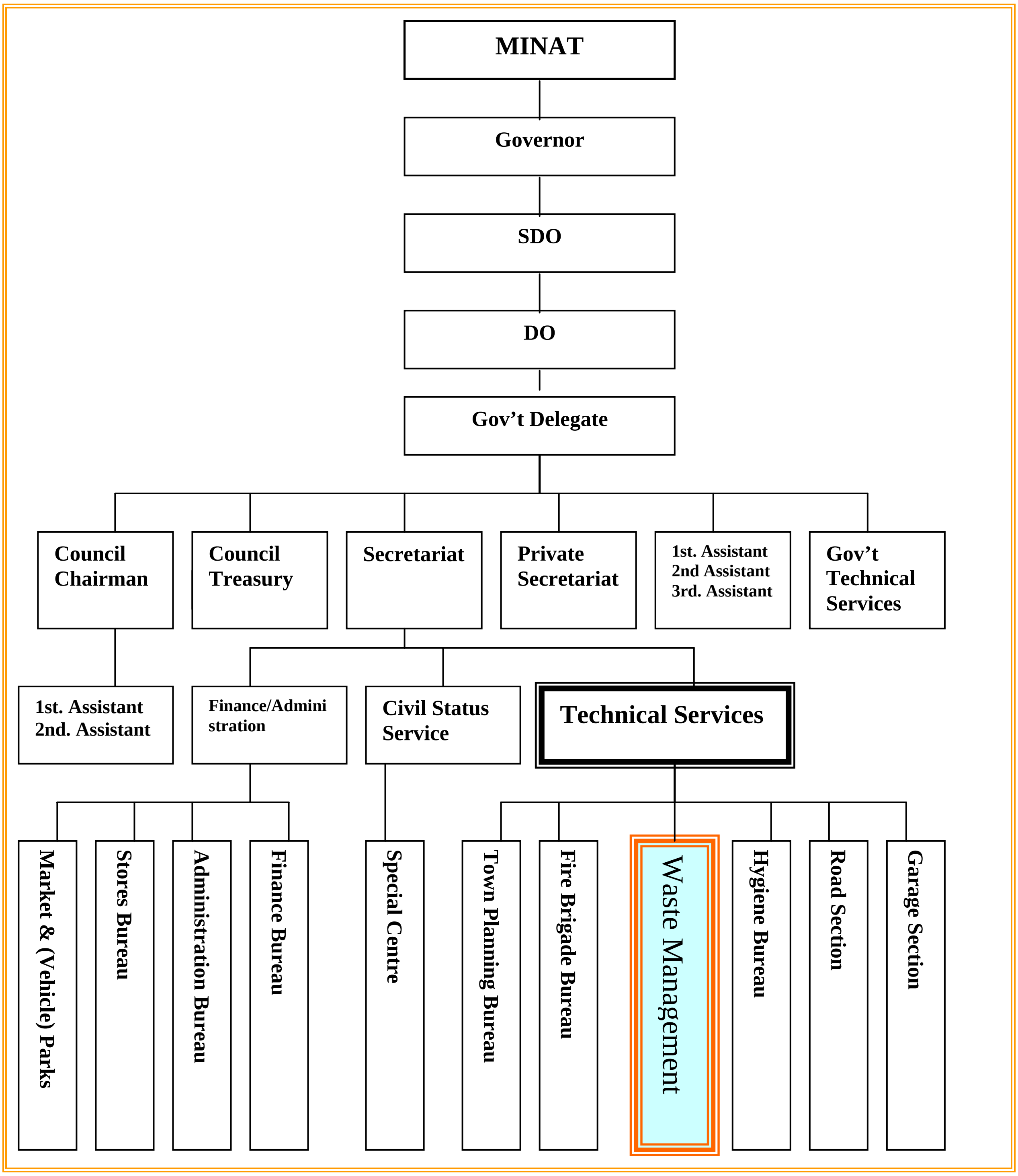


FIGURE 6.3: Schematic MSW Flow Diagram
Source: Adapted from Heeramun 1995; Beukering *et al.* 1999; Ngnikam 2000

Figure 6.3 is a general plan for navigating the waste management system. It charts a clear path through which the research questions are answered. The diagram demonstrates that waste is generated and stored, then transported primarily to where the official waste management pick-up facility is located. The waste is lastly transported to a treatment phase (to recover waste products or resources through composting, recycling). Resource recovery take place at all stages, so the word ‘waste’ is loosely used to describe what the original generator puts aside as no longer wanted. Moreover, not all originally discarded waste undergoes recovery or treatment stages. What cannot be recovered, i.e., the ultimate waste is finally disposed of at landfills or incinerated). The plan represents the lower levels of an incomplete conceptual model of the waste management hierarchy. It lacks the preferred pyramid apex options of waste avoidance and zero waste.

6.3.2 Solid Waste Unit in BUC Administrative Flow Chart

Rural and urban councils are by law responsible for the hygiene and sanitation of their areas of jurisdiction in Cameroon. Councils are the smallest units of administration (after villages). However, the solid waste management sector finds itself in many other ministerial organisational plans such as Urban Affairs, Forest and Environment, Town Planning and Housing, Mines and Energy, Public Works, Finance and the economy and, particularly, Health. These related ministries provide financial and technical assistance. Technically, the Ministry of Health closely supervises the service and in some plans the waste management sector is under the health ministry (Appendix 5). Meanwhile, Figure 6.4 is an administrative plan under the Ministry of Territorial Administration (MINAT). Good coordination and collaboration with all these related services are necessary for a smooth waste management system. Nonetheless, experience from waste management history in the city indicates that complex administrative bottlenecks, conflicts in roles and authority are characteristic of the plan. These hitches slow down the waste management process.



Key to abbreviations: **MINAT**: Ministry of Territorial Administration
SDO: Senior Divisional Officer
DO: Divisional Officer
Gov't Delegate: Head of the Urban Council

FIGURE 6.4: The Waste Management Unit in the Administrative Flow Chart of BUC
Sources: Compiled from File No. 460, BUC

6.3.3 History of MSWM in Bamenda

The waste management system in Bamenda today has evolved from a long history of experimentation with different strategies and techniques in the past. An examination of these past experiences not only helps expose the merits and weakness of the present system but also acts as a basis for making informed suggestions. From archival, oral and field observations, it is clear that the history of municipal solid waste management in Bamenda is as old as the city itself. The problem of poor solid waste management appears to have always been a cause for concern, and increasing with the rapid growth and development of the city. It is a history of problems with no lasting solutions having been found to date, even though administrative regulatory orders and new modern equipment are gradually but increasingly introduced into the management system. The major challenges have been endemic ubiquitous heaps of uncollected waste, illegal dumping by street sides, river and pond sides, open spaces and neighbourhoods. Burning and burying were also practised as methods of eliminating waste. All these easy but dangerous approaches created environmental nuisances and their presence attracted the attention of the administrative authorities, the inhabitants, businessmen and even visitors to the city.

6.3.3.1 Colonial Period (Before 1961)

Since the colonial period, the hygiene and sanitation sub-sector of the council has always been responsible for managing waste in the town. The service has always been placed under the supervision of a department of the health ministry located in the city-generally the central hospital. In many cases this has been the Department of Preventive Medicine headed by the medical doctor. According to archival sources in the BUC, in the colonial days the African town was just what is known today as Old Town or formerly Abakwa but whose traditional name is Nta Mbag. During this period the council provided waste bins and incinerators and employed labourers to operate them. Both facilities were a nuisance to the inhabitants who soon discovered that smoke and fire from incinerators was a source of danger. Even though waste bins were built far away from their houses, the bins were often a source of bad smells, flies and rodents. As the town grew larger, more congested and expanded beyond the nucleus, there was a change of attitude. People did not want these waste facilities located near their houses. So the NIMBY syndrome is an old concept. Meanwhile in the Government Residential Area (GRA) Up-Station, the situation was the same. The government was responsible for allocating land, providing and maintaining structures. The philosophy of the government providing for waste management facilities in the Government Station has never changed since. To date the urban council does not provide regular and official waste collection facilities in this part of the city. Paradoxically, the highest orders over the city's waste management matters, like all other businesses of the province, are issued from here.

6.3.3.2 Early Postcolonial Period (After 1961)

Immediately after independence (1961), things worsened when the colonial administration ended and gave way to a new urban council to deal with the problem. There was a general shortage of money for the services. However, according to information from the BUC File (No. 319 Vol 1/68), on April 9,1970 a refuse collection tipper was purchased from Renault-CEAC Victoria Cameroon at the sum of 2,699 040 CFA by the Mankon Area Council to remove waste in its own part of the city. Arrangements were immediately made calling on all compounds to place their refuse at specific spots directed by the Health Officer. Interested farmers were also asked to apply (at first free but later at a hire charge of 100 CFA per kilometre) to the council to dispose the refuse in their farms as soil conditioners.

The following refuse disposal itinerary was drawn up by the medical doctor in charge of Preventive Medicine and Rural Health Services Bamenda and passed to the council for implementation. It was soon put up as a public notice to be followed thus:

Monday: Community Layout and Small Mankon Areas
Tuesday: Nta Mbag and environs
Wednesday: Hospital and Atuakom Area
Friday: Community Layout and Small Mankon Area
Saturday: Hospital and Atuakom Area

Large quantities of solid waste were still left uncollected for weeks as the D. O. for Bamenda later remarked. In the same vein the council was further accused of diverting the tipper to do private work other than the work for which it was bought (BUC file No.319 Vol. 1 p. 86).

In 1972 during the reorganisation of the territorial and administrative structure of the country after re-unification, Bamenda gained the status of a divisional as well as that of a provincial headquarters for the newly created North West Province. This implied an influx of administrative services and civil servants, and the ancillary functions that normally go to support such a system. The question of rapid increase in population has been addressed above. The direct effect of this population was increase in the volume of waste generated and leading correspondingly to an inability of the city authorities to deal with the situation. The rest of the story is more about a history of interventions in a variety of notices, texts, orders, decrees and laws, high-handed passed from the top down the administrative hierarchy (Chapter 5). One of such early and stern notices is that of the governor of the province to the Mankon Area Council in 1973. It went thus:

> I am writing to draw your attention to the poor sanitary conditions of the Bamenda town, which as you know attract many comments and criticisms form both visitors and its inhabitants. One would have expected that with the new status of provincial headquarters Bamenda town should be the cleanest place in the province. But quite on the contrary one finds that the present situation leaves much to be desired, e.g.:
>
> 1. domestic animals killed by passing vehicles are left to decompose in the streets for days;
> 2. stagnant water and refuse heaps are allowed to breed mosquitoes, rodents, and dangerous reptiles;
> 3. market places are always dirty looking;
> 4. pot-holes on roads are traps to both pedestrians and vehicles;
> 5. lawns and hedges are hardly or never cared for;
> 6. hawkers and traders build haphazardly along the streets etc. etc.
>
> While I appreciate the fact that the general cleanliness for the town is not only dependent on the municipal authorities, I wish to remind you that points 1, 2, 3, and 4 are entirely the responsibilities of the Council and I am requesting that every effort be made to render the town a little more habitable. As from the end of November 1973, I intend to undertake regular inspection tours of Bamenda town to see for myself what efforts are being made to give the provincial headquarters the standards which befits it (The Governor NWP 1973).

The governor addressed similar letters to concerned services in the town, notably the Prison Department, the Highways, Town Planning and the Department of Preventive Medicine. Reports from the BUC Health and Sanitation file show that some of these institutions actually made efforts to come in and help. For example the medical doctor in charge of Preventive Medicine on many occasions wrote to remind the Council of its duties towards sanitation in the city. In 1978 the same department, at the request of the governor, went further to study and report on the waste disposal situation of Bamenda Town. The study attempted an estimation of the number of households in the city (4.500) and the waste generation rate of 30-40 tons per day. Meanwhile, correspondences between the Hygiene and Sanitation Sector of Bamenda Council and the Superintendent of Prisons Bamenda indicated that gangs of prisoners were sometimes used to clean up the city (BUC File No. 460, p. 241). As concerns the Governor’s own activities, it is not known whether the Governor made his promised regular inspection tours but what is certain is that the situation did not improve much as reported later at the end of the decade by the Senior

Health Superintendent. That administrator succinctly reported the solid waste management practices in what he called then "the present situation" as follows:

> I have mentioned already that there are no sanitary labourers. The 7 market labourers who are themselves insufficient to cope with the amount of refuse that piles up daily. How do people treat refuse now?
>
> - Refuse from the market is piled up (its almost a mountain now) in an old incinerator just below the market. One needs to see this mountain of refuse.
> - Some people who have enough space in their compound bury their refuse;
> - Some people just dump on the wayside and along the banks of the streams, very close to bridges.
> - In the dry season, one can see smoke of motor tyres, refuse of every description ascending into the sky from anywhere in town. When we find refuse piled up in a particular place, we often call in Market labourers to gather the refuse together and burn or bury on the spot.
> - Some people empty their refuse, from private dustbins within their compounds, into the lone refuse tipper when it goes around. This refuse is carried to our refuse site near the council forest.
> - From the colonial times several health campaigns have been lunched with a view of clearing away refuse, keeping the town clean etc.
> - In the G.R.A. people just dump refuse behind their house where they cultivate gardens and farms.
> - In institutions and hospitals refuse is either buried or composted or in dry weather, incinerated.
>
> The above practices are inevitable although insanitary in some respects. In the absence of a refuse disposal service some or all will continue to be practised
> (Chuba 1980, p. 3).

With the tipper truck aging and breaking down very often, more items of equipment were acquired. In a presentation to the Council on December 8 1980, the Delegate to the urban council announced that in addition to its refuse disposal van, which was already old, a modern system had been introduced. He described it as consisting of 'a tractor, chassis and container', and remarked that it had proved very successful. He also hoped the use of the 'modern system' would gradually expand and eventually cover the whole area of the Council.

Another important local initiative has been the reinforcement of monthly general clean-up campaigns started in the colonial days. The Government Delegate to the BUC usually makes a request to the Divisional Officer for Bamenda Central who in then decides and issues a decision stipulating the conditions for the clean-up campaign. Such conditions include the day, time (usually 8-12 noon), the excepted services usually hospitals, police and the gendarmes, some of whom help in enforcing the order (Appendixes 6 & 7). On such a day normal work is suspended and the inhabitants do general cleaning of their premises, work places and the streets including the drains.

At the national level, many decrees and law were passed on the issue. What one notes is that the early decrees and laws were silent on the specific question of garbage. Law No. 74-23 of December 1974 organised councils including direct taxes to be collected by councils to ensure exploitation of their technical services but waste tax was not one of them. Decree No. 77-220 of 1st July 1977 fixed maximum rates and methods of collecting these council taxes. Twelve areas were mentioned but again waste tax was absent. On the contrary that decree, Section (1) warned, “A councils may not collect any council taxes other than those provided for by law, instituted by decision of the municipal council and approved by the authority with supervisory powers”. Even if a council had to take initiative to create a tax this would have meant a long process involving the scrutiny of the administrative hierarchy. However, in 1980, Decree No. 80-17 of 15 January laid down the laws outlining the services and corresponding tax rates councils may levy for the purposes of running these technical services or public establishments. This time a garbage tax was instituted along with water, street lighting, and ambulance taxes. Section (4) of the decree elaborated on garbage thus:

> Garbage collection tax shall be an annual flat rate tax payable by the inhabitants of an area wherein collection of garbage is borne, by the council or failing which, is organised by the municipal regulations.

The annual rates for garbage tax ranged from 50 - 250 francs CFA for ordinary citizens through 150 – 10 000 francs CFA for employed public and private sector workers, to 2 500 – 30 000 francs CFA for licensed institutions per year. Water and street lighting had the same quotations while the ambulance tax had a flat rate of 240 francs CFA for each taxpayer per year. Further discussion on financial and administrative arrangements is developed in Chapter 5.

6.3.3.4 Private Sector Involvement

Meanwhile, the private sector was also very concerned with the poor state of waste management in the town. Individuals sought to advise the Council whereas companies wanted to win contracts for the removal of the waste in the town. On November 25, 1984 one visitor to the city on return to his station wrote to the Municipal Council Bamenda complaining and advising thus:

> Sirs,
> when I was in Bamenda the other day I was shocked to see how dirty the town is, refuse lying all over the place. In the interest of the public and in the interest of the reputation of Bamenda as provincial capital, I would like you to take necessary steps to keep the town clean. Surely the council can afford to employ some sweepers or pass some laws to enforce cleanliness. If you think this is not possible, then you should be once in Singapore, a town with 8 million inhabitants, where it is hard to find even a cigarette end or a sweet wrapping on its streets (BUC Archives: File No 460, p. 237).

In the same vein other individuals within the council area wrote complaining about dumping waste on their building plots, near their quarter or location of the public dustbin within their property. One of them wrote through the officer for public health, the sanitary section to the Bamenda urban council saying:

> Sir,
> I have many times discussed this matter with the Urban Council Sanitary labourers to no avail. I am now appealing to the authority for removal of a dustbin placed at my door step which has been noticed to be injurious to the health of my family members, considering that even dead bodies of domestic animals and birds are sometimes dumped into the bin and which smell attract many flies. I shall be very grateful for quick action to be taken on this matter if my family is considered to be contributing to the population of this community (File No 460, p.140).

At the same period some private companies such as “County Hygienic Associates”, “Doyama and Sons Enterprises” and “Health Secured and Will Business Bureau” wrote several letters of intent to the Bamenda Urban Council expressing their wish to negotiate a contract to take over all or some aspects of the solid waste management of the city. None of these private companies has ever been awarded a partial or full contract to manage solid waste in BUC.

6.3.3.5 1980s-1995

The decade before 1995 had witnessed major events, which affected the waste industry directly. The Minister of Health in January 1987 signed a service note regulating the activities of the Municipal Hygiene Service and charging it, among other duties, to get councils to collect, transport, discharge and treat refuse on sites chosen by Mayors with collaboration of the chief of the Hygiene and Sanitation Service and the local technical services of the Ministry of Mines and Power (Appendix 5). Two important texts were signed in 1987, Law No. 87-015 of 15 July, and Decree No. 87-136 of 24 October. Both had a sharp focus on splitting the big city councils (Douala and Yaoundé) into four subdivisional urban councils each. Among other things, the law reorganised and named the city sub-divisions. It is the main law that governs all councils in the country. So all councils were affected.

This period also saw the emergence of the first multi-party politics and elections in the country at national, constituency and council levels in 1992. Economic crises followed by structural adjustment policies had taken a toll on all spheres of life including the urban councils. Another major change was the liberalisation of the economy and especially the making of Law No. 90.53 of 19 December 1990 relating to freedom of association. Finally, in late 1994 a team of students from Holland and one other post graduate student from Cameroon completed the last substantial research on municipal solid waste management in Bamenda Town. By the end of 1994 Bamenda City had concluded a cooperation agreement with Dordrecht municipality and was ready to start a new system of waste management for the city with their assistance. At this point the garbage unit broke away from the sanitation section to facilitate administration.

According to the 1994 research by Anschutz *et al.* (1995) and Nsoh (1994) the practice of MSWM for Bamenda at that period was not too different from the past. Nevertheless, increasing evidence reveals that the effects of the economic crises that plagued the country impinged on the waste management sector seriously. However, the results of the students' work and information from the BUC archives identify three dimensions to the problem of solid waste management in the city.

Before 1984 there existed metal waste bins with wheels, provided by the council. These bins were positioned at strategic places and emptied, as they got full. This system died with the emergence of the 1989 economic crisis, as the council could no longer maintain them. The old bins lie abandoned at the BUC premises.

After 1984, the use of two seven-ton Mercedes tipper trucks on a four-day week itinerary (Tuesday to Friday starting at 9 a.m.) was introduced. The inhabitants of each quarter came around at stipulated places and times to drop their refuse directly into itinerant tippers. After that the waste was carried off to the dump. Official dumps were the Old Fish Pond and one near the Government Bilingual High School (GBHS) (Figure 6.1). The main one was the Old Fish Pond site, which had the advantage of being very central, and the waste was being used to reclaim the site for a future central Food Market for the city. Evidence is overwhelming that this method had too many problems. It is said that the truck drivers hardly kept to time and were often not patient enough for people to drop in all their refuse. As a consequence, people who failed to reach the trucks in time, disposed of the waste they brought just anywhere. What is worth noting is that this time waste collection services were extended to cover some quarters along the major highway in Nkewn.

The last method involved waste collection at selected bare-earth spots designated by the waste management authorities. A front-end loader caterpillar or shovel bulldozer was used to load the waste into the tipper trucks, which stood steaming as the process went on. However, the use of wheelbarrows and spades to gather the waste strewed around also became necessary. Continuous scooping of the waste sites created deep holes that were at times filled with water. When waste was dumped into such spots bogs resulted and consequently made the collection and sanitary conditions unbearable. Crippled by the economic crisis the collection programme could hardly be maintained because as time went on the council could only send out the waste team when it had money to fuel the waste trucks. Nsoh (1994) estimates total waste collection at this period at 16.15 percent. Anschutz *et al.* (1995) report 4 tonnes collection per day with most waste at spots located by the valley or streamside simply pushed down and not collected. The number of illegal dumps in the city actually increased during this period.

6.3.4 Conclusion

Bamenda is a fast-growing provincial primate city and a focus for many levels of administration. Hemmed in a past characterised with political and economic difficulties, the city desperately sought conventional equipment to manage its solid waste. This did not solve the problem. International, national and local historical events, just discussed, had a profound influence on the course waste management had to take in the next decades starting from waste generation and ending with it final disposal.

6.4 Solid Waste Generation

6.4.1 Introduction

Some authors do not include waste generation as part of a solid waste management system analysis. For example according to Haapala (2002, p. 22),‘Solid waste management is proper collection, transfer, recycling and disposal of solid waste’. Such a definition suggests also the scope of solid waste management. Nevertheless, many authors including

Beede and Bloom (1995); Heeramun (1995) and Lardonois (1996) cited by Beukering *et al.* (1999, p. 2) believe that material flow begins from generation to ultimate disposal, comprising: generation, collection, transportation, processing and disposal. Moreover, it makes sense to know and understand the sources, nature, quantities and characteristics of waste that the system will manage. This is because such knowledge is indispensable in meaningful waste management system planning in terms of the policy, strategy and technology to be adopted. Despite the importance of having such useful knowledge, the method for arriving at accurate data, especially capturing the total solid waste quantities generated, is a thorny problem, and remains a great challenge in waste management studies (Yoshida 2000). Abandoning the measuring process because it is complex and hard to guarantee accuracy is even worse. Rather, researchers are comfortable with good estimates from systematic sampling and other estimates based on surveys and waste management records as in the case in question. Such techniques have been known to give useful data for theory and planning purposes. For the same purposes other characteristics explored under solid waste generation include the categories, density, spatial and periodic variation.

6.4.2 Types and Sources of MSW Generation in Bamenda

The sources of MSW are closely related to the definition and scope of the MSW system in question. There is no unique definition of municipal solid waste, therefore each system determines what solid waste the municipality should manage and consequently its source. The economic and socio-cultural activities of the urban areas also have a role to play in determining the sources and types of solid waste. However, there are common grounds for most urban solid waste sources. Heeramun (1995) identifies four main sources: residential, commercial, open spaces and treatment plans. This is not an exhaustive list. Appendix 1 gives the classification of solid waste (also called refuse) and illustrates the sources of such types of wastes. Bamenda experiences all these waste types, but field experience suggests the following are more relevant for the city: residential, commercial, institutional, and open spaces. Agro-forestry processing, craft works, light cottage industries and auto repairs constitute another significant source of waste in Bamenda. Examples identified in the field are: rice processing, corn milling, woodwork, brickwork, soap processing, auto repairs, brass and aluminium smelting. Vehicle bodies, hospital (hazardous waste), industrial, demolition and construction wastes are not managed by the BUC solid waste management jurisdiction.

Residential or household solid waste is made up mostly of food waste, rubbish, ash, bulky wastes and special waste, some of which are hazardous. Garden and hedge trimmings constitute residential solid waste. Commercial sources that generate waste include: market centres, restaurants, hotels, motels, snack bars, beer houses, print houses, cinema halls, and bus stations. Both private and public institutions generate solid waste. Some of these institutions are office buildings, schools, colleges, hospitals and clinics. The rest of the waste comes from open spaces such as roads, streets, alleys, vacant plots, stadia, ceremonial grounds, parks, playgrounds and motor parks. From all these sources, the principal types of waste remain similar. However, the proportion of each type varies with the source (Appendix 1).

6.4.3 Generation of MSW in Bamenda

6.4.3.1 Quantities

Table 6.7 summarises the outcome of monitoring an experiment conducted in Bamenda to collect, weigh and analyse municipal solid waste from household samples among different socio-cultural and economic quarters of the city.

TABLE 6.2

Solid Waste Generation in Sampled Households in Bamenda, April 2003

ANALYSIS OF BIO-DEGRADABLE & NON-BIODEGRADABLE SOLID WASTE, BAMENDA										
Quarter	Bio-degradable Kg.	Non-bio-degradable Kg.	TOTAL Kg for 3 days	TOTAL Kg-Per day	No. of House-holds	Average house-hold size-persons	Population	House hold per capita per day kg	TOTAL per capita per day* Kg *	Wet season Per capita per day kg
GRA-Up Station	46.20	5.85	52.05	17.35	12.00	4.92	59.00	0.29	0.32	0.43
Nda mukong	84.90	20.40	105.30	35.10	16.00	5.88	94.00	0.37	0.41	0.55
Nta-Mbag/ Old Town	198.15	78.66	276.81	92.27	47.00	5.79	272.00	0.34	0.38	0.51
Nchoubu	113.00	33.20	146.20	48.73	18.00	6.22	112.00	0.44	0.49	0.66
TOTAL	442.25	138.11	580.36	193.45	93.00	5.70	537.00	0.36	0.40	0.54
%	76%	24%	100%							

* Household generation plus estimates from other sources calculated at 10%

The result gives an average of 0.36 kg of household solid waste generation per capita per day in Bamenda. Quarter variations are as follows: GRA Up-Station 0.29 kg, Ndamokong 0.37, Ntah Mbag 0.34 kg and Nchoubu 0.44 kg. These figures do not represent the final rates for per capita generation for the city because the other waste generating sectors such as markets, institutions and industries, are not yet included. To arrive at a total generation rate, which presumably includes waste from other sectors, parameters from previous studies have been used to estimate.

Some studies in Africa such as the study of Tema-Accra (Ghana) by Asafo-Boakye and Partner (1992) in Asomani-Boateng and Haight (1999) indicate that households in that conurbation generate around 75 percent of the total municipal solid waste with 25 percent to the other sectors. Tema-Accra conurbation (3 million people) handles the main commercial, administrative, industrial and port functions of Ghana. According to recent studies, the conurbation handles 70% of Ghana's industries, provides 15-20% of its GNP and 10% of the country's employment (Mancheser 2003; NRTEE 2003). Studies carried out in the two biggest of Cameroon, Douala (1.5m) and Yaoundé (1.0m) reveal household rates equivalent to 81% and 87% respectively of the cities' total solid waste generated (Ngnikam *et al*. 1997). These three cases leave 25, 19 and 13% for Tema-Accra, Douala and Yaoundé cities respectively for non-household waste. Logically Bamenda (O.3 m) without industries should have an average not between Douala and Yaounde but below Yaounde's rate, which I estimated at 10 percent for non-household sources of municipal solid waste generated. This is far deviant from the 20 percent estimated made for Bamenda by Anschutz *et al*. in 1995. It is with this assumption that the last column (Table 6.2) is derived by extrapolating the total generation per capita by adding 10% and giving a per capita/day generation of 0.40 kg for the city. This addition accounts for the rest of the sources: commercial intuitions and industries, which were studied but attempts not made to quantify the generation rates. It is quite difficult to capture and measure all waste sources in a single study with limited resources and time such as this.

The Bamenda survey took place at the end of the dry season. Seasonal variations are an essential factor in waste management. To take account of these seasonal variations some more estimates have to be made. In the study of the two cities of Cameroon discussed above the dry and wet season variations averaged 34 percent. An extrapolation of this to the results in Bamenda would give another scenario-wet season per capita generation per day, which is 0.54 kg (Table 6.2). The per capita day generation is 0.40-0.54 kg.

The Bamenda city generates 120-160 tons of solid waste per day. Biodegradable waste is highly putrescible and represents 76 per cent (90-120 tonnes) while the non-biodegradable is 24 per cent (30-40 tonnes) (Figure 6.5). The minimum values represent the dry season rates and the maximum, the wet and harvesting season. About 90 percent of the waste comes from households. Different quarters generate different averages per day**.** The annual MSW generation rate is 40 000 –60 000 tonnes.

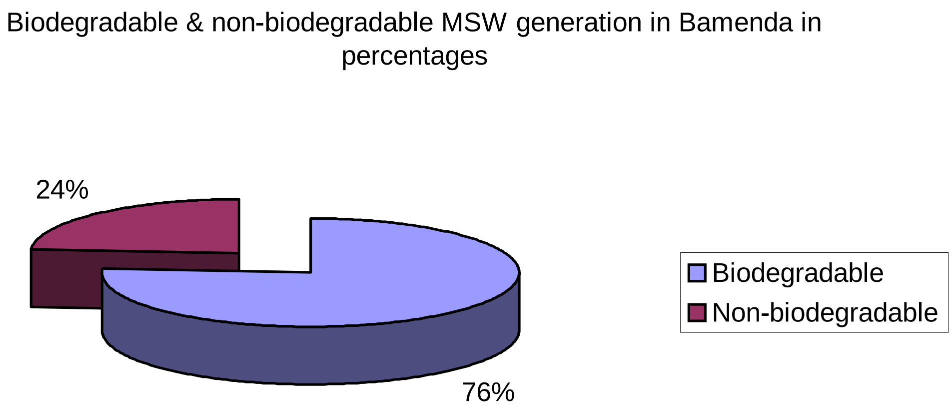


FIGURE 6.5: Biodegradable and Non-biodegradable MSW Generation in Bamenda
Sources: Field experiment April 2003.

6.4.3.2 Categories.

From the sorting and analysis of the household solid waste collected, certain patterns emerged. MSW in Bamenda falls into a variety of categories that also vary with the quarters. The two main categories are biodegradable and non-biodegradable. The first term is used to categorise the highly putrescible household waste mostly made up of food waste and compound green wastes. The non-biodegradable components include paper and cartons, plastics, bottles and glass, tins and cans, fibres and others. 'Others' is a sub-group comprising textiles, leather, soil and ash. The term 'non-biodegradable' is rather vaguely used because with time, paper, carton, leather, textile and fibre do decompose. Nevertheless, for convenience the term is used here to put into one group those wastes that are not readily decomposable by the biological agents such as bacteria, microbes and fungi. Categorisation of the two main groups follows.

6.4.3.2 (i) Biodegradable: The biodegradable waste bags were sorted, after weighing, for an overall appreciation of the variety and frequency of occurrence of each variety or group of varieties in various quarters. The results is shown in Table 6.3. The figures in the table represent the occurrences of each item as observed and recorded before being disposed for composting as seen in Plate 6.1.

Table 6.3 Frequency of Occurrence, Biodegradable Solid Waste Types in Sampled Households in Bamenda.

Waste/Quarter	**GRA Up-Station**	**Nchuobu**	**Nta-Mbag**	**Ndamukong**	**TOTAL**
Cocoyam peels	1	6	5	4	**16**
Green banana peels	2	6	4	2	**14**
Plantain peels	3	3	9	2	**17**
Plantain leaves	1	4	4	3	**12**
Leaf vegetables remains	4	5	13	3	**25**
Other vegetables (carrots, okra, beet root	2	2	4	1	**9**
Fruit peels (pine apple, water melon, paw paw, banana, avocado & lemon)	6	5	5	3	**19**
Corns hells	1	3	2	4	**10**
Yams & cassava peels	0	4	1	1	**6**
Others: egg, potato, rice, beans, sugar-cane, corn remains	2	5	5	4	**16**
TOTAL	**22**	**43**	**52**	**27**	**144**

Source: Household solid waste generation experiment Bamenda, April 2003

The results indicate that leafy vegetables, cocoyams, green bananas and fruit remains are very prominent in all the quarters. Plantain leaves are used as plates or for a traditional dish made from mashed boiled cocoyams and green bananas called ‘Achu’. That is why the three (cocoyams, green bananas and plantain leaves) have a strong positive correlation in occurrence. Plantain leaves are also used to serve or preserve one other traditional dish made from corn called ‘Fou-fou corn’. Regrettably, these environmentally friendly plates are being replaced nowadays by plastic wrappers. Lots of these leftovers from households were never given away as waste but retained as feed for pigs. What reached the research site was also used for composting after being analysed (Plate 6.1).

PLATE 6.1: **Variety of Biodegradable Household Waste in Bamenda, April 2003 (Ready for Composting)**

6.4.3.2 (ii) Non-biodegradable components: An analysis of the non-biodegradable components obtained by weighing and converting the results as percentages of all the non-biodegradable is presented in Figure 6.6.

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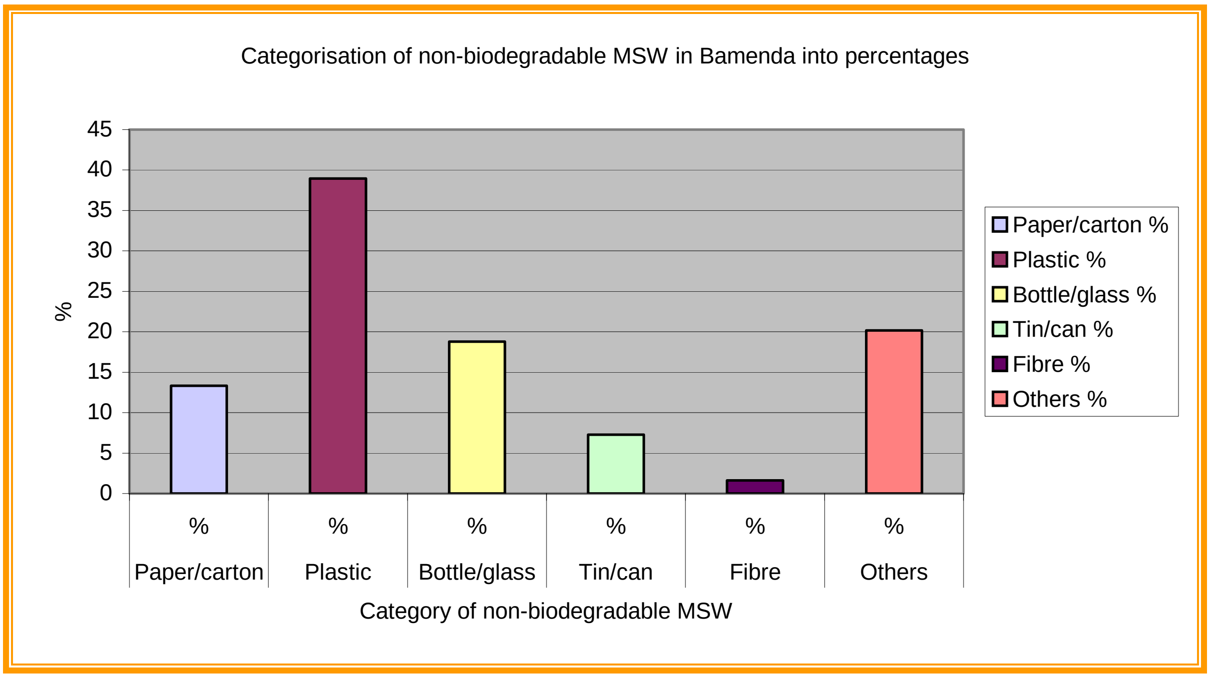

FIGURE 6.6: Categories of Non-biodegradable MSW in Bamenda (percentages).
Source: Analysed from household waste generation experiment Bamenda, April 2003

There is a remarkable dominance of plastic materials among the household waste. Bottles and glass; papers; cans and tins; and fibre generation follow in descending order**.** Trends resulting from survey analyses are also presented below in Figure 6.7. In the questionnaire survey the respondents were requested to rank the different types of waste their households generate using these proposed rating: too much, much, quite, or not much (chapter 4). The decoded, summarised and weighted results are graphically presented below. What is interesting to note is that the survey trend correlates positively with the experiment results above. The correlation is even higher with the case of Yaounde, or with the two cities (Yaounde and Bamenda) analysed together (Chapters Six and Eight). The difference between the waste generated and what is actually put away as 'waste' can be seen in this case. For example, the generation of fibre (mostly bags) is high on the survey rating but during the sorting and weighing at the experiment site it was realised that only four fibre bags were found (Figure 6.6 for the low percentage). This suggests a higher rate of reuse of fibre bags in Bamenda.

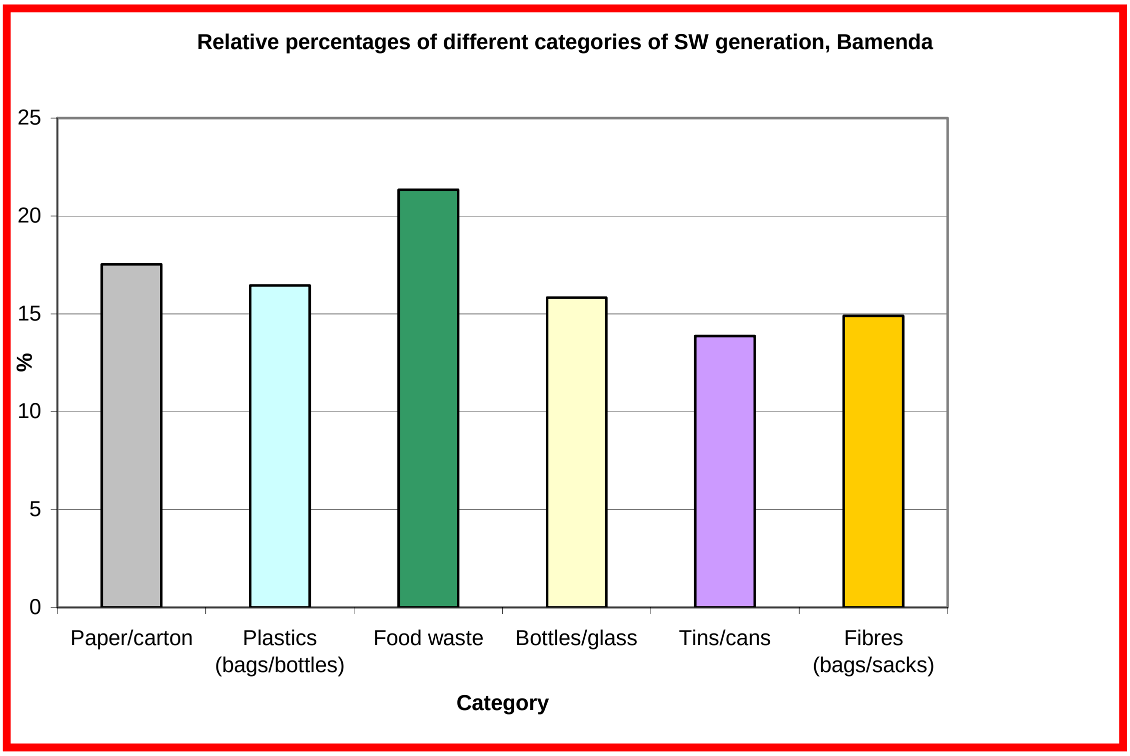

FIGURE: 6.7: Households Solid Waste Generation Categories in Bamenda
Sources: Derived from weighted scores of the household survey, 2003

The general trend towards increasing non-biodegradable materials is attributed to the growing tendencies towards globalisation of the economy. Increasing food packaging, bottling and the use if tins are common phenomena today in the cities and beyond. This has rendered the composting of household waste problematic.

6.4.3.3 Variations

6.4.3.3 (i) Spatial variations: From the analysis of the experiment one can also discern that there are spatial variations. The four quarters were proportionately chosen to represent different major socio-economic areas of the city: high residential, moderate, spontaneous, and peripheral. This classification was based on that of the department of provincial service of surveys and town planning, and what the population commonly believes. The sample size was based on population size of each group socio-economic group in the city as estimated from the available population data from the service of statistics. However, there are many changes going on in the city that challenge many of these former assumptions. GRA Up-Station, means Government Residential Area. It is the residential part of the administrative area of the city called Up-Station and located on top of the cliff overlooking the rest of the city spread on the foot of the scarp. Formerly, colonial administrators resided there and today, civil servants and military people of mixed classes and other rich individuals are believed to live here. The area is well planned with a good-tarred road running through it. GRA was believed to be more typical and chosen to represent the high residential zones, which are only two, the other being the Foncha Avenue area. Ndamukong represents the moderate, Nta Mbag the spontaneous settlements (largest sector) and Nchuobu, the peripheral quarter.

Spatial analysis from the experiment (Figure 6.8) indicates that the plastic component of non-biodegradable materials is highly represented in all the quarters with Ndamukong having the highest (53 percent). Bottle and glass are most prominent in the GRA-Station, fairly represented in Ndamokong and Nta Mbag but scanty in Nchoubuh. Paper and carton is also present in all quarters at almost similar proportions of 14 percent with Nta Mbag showing the lowest rate. Fibre bags are hardly ever thrown away so they show the lowest rates in all quarters.

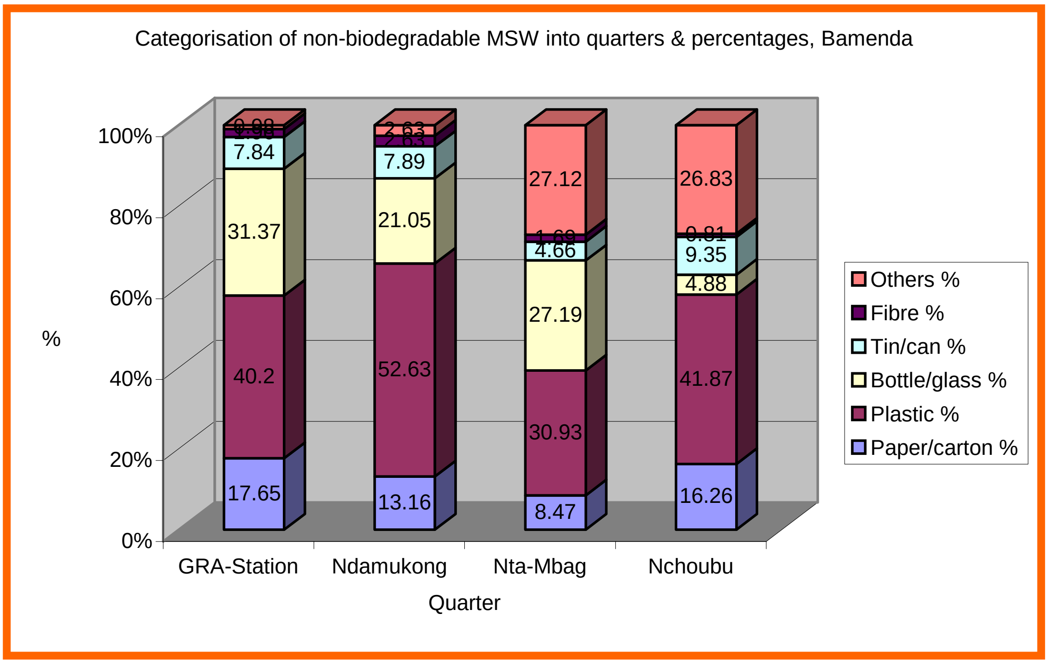

FIGURE 6.8: Categorisation of Non-Biodegradable MSW into Quarters and Percentages in Bamenda, April 2003

6.4.3.3 (ii) Seasonal and daily variations: There are significant differences in waste generation in terms of seasons and proliferation of types and weight. This may not have as much effect on the 'non-biodegradables' as on the 'biodegradables' whose types and quantities increase in the wet season (April to October) with the emergence of more fruits, vegetables and food production. The water content of the waste also increases in the waste stream. Compound trimmings also increase as hedges and grasses have to be cut quite often. Earlier studies carried out by Anschutz *et al*. (1995) gave the early dry season waste density at 0.35 and this could be much higher in the rainy season. Studies within tropical areas such as Bamenda demonstrate that the difference between the wet and dry seasons in terms of per capita weight might be as high as 29-39 % and humidity 50-65 % (Vermande *et al.* 1994; Ngnikam *et al.* 1997; Tanawa *et al*. 2002).

Field observations also show that there are daily variations. More waste is generated during the weekends and especially on Saturdays and Sundays when more cooking is done. Food waste generation is even higher on a traditional Sunday, which comes up once in an eight-day week[2]. Such a day is reserved for a rest and traditional rites. However one other main activity among the indigenes is preparing a traditional dish made up of pounded cocoyams and green bananas called 'Achu' and this explains the increased presence of cocoyam

[2] A week is eight days long and the last day is the traditional Sunday.

peelings, green bananas peelings and plantain leaves in the three more indigenous quarters (Nchoubu, Ndamukong and Nta Mbag). This equally reflects the influence of cultural on aspects of waste generation in Bamenda. The day set aside for the traditional Sunday varies from one village to the other. The city is made up of three main villages: Mankon, Medankwe and Nkwen.

6.4.4 Waste Storage

Many types of containers are used at the household level to collect and store waste for eventual disposal. The container size ranges from five litres to about 20 litres. Container size is limited by the ability of the carrier to lift it when full. The types are very varied from local woven baskets through fibre bags to old buckets or metal cans. The following results obtained from the field survey, display the variety of containers used and their spatial setting (Table 6.4).

TABLE 6.4

Distribution of Household Waste Containers by Quarter and Types, Bamenda

Container→	**Household waste containers**					
Quarter↓	**Carton**	**Basket**	**Old bucket**	**Plastic bag**	**Tin & can**	**TOTAL**
GRA	1	5	5	4	0	15
Nchuabuh	0	2	10	6	0	18
Nta Mbag	3	6	30	7	4	50
Ndamukong	0	5	7	7	1	20
TOTAL	4	18	52	24	5	103
TOTAL %	3.88	17.48	50.49	23.30	4.85	100

Source: Field survey April, 2003

The prevalence of buckets is well manifested by the results (>50%), followed by plastic bags. This is one form of recycling culture that is unconscious but strong amongst the people. The re-use is described as” unconscious” because when some respondents were asked whether they ever reuse old things, they normally answered “No” when their garbage bins were made of an old plastic bucket or plastic bag.

The waste is stored in several places outside the house or kitchen but away from rain. Domestic animals are a nuisance to the stored waste because they rummage among them for food. The survey in Bamenda revealed that only 13.6 per cent of the containers had some form of cover, while 86.4 per cent of the containers had no a cover. This is one reason for animal nuisance around the containers. GRA had relatively more covered bins than the other parts of the city.

6.4.5 Conclusion

Bamenda City generates huge quantities of heterogeneous solid waste every day. Totals range from 120 – 160 tons a day for the city and 0.40-0.54 kg per capita. The quantities and types vary among households, quarters and seasons. However, collecting and transporting this waste generated poses a great challenge to both the generators and the services that manage it.

6.5 Primary Solid Waste Collections and Transportation

6.5.1 Introduction

Collection is gathering municipal solid waste from its source of generation for subsequent recycling, incineration or landfilling**.** In most cities of the developing world including Bamenda, large parts of the city remain unattended to by the conventional waste collection actors. This is partly due to the fact that such areas, which are usually spontaneously-occupied by the poor, lack access roads to permit the use of large and heavy waste collection trucks that are characteristic of the conventional waste management sector. For this and other reasons, residents of these quarters have to primarily seek their own way of collecting, transporting and disposing of their solid waste, hopefully at an accessible place where secondary collection facilities are operational. For those who consider the facility too far, illegal disposal is the rule. This first level involes assemble, sorting, stocking, storing and transferring of waste from generation site to a treatment facility or collection for final disposal on the flow chain of municipal solid waste management is called the “primary collection” or “pre-collection”. It is this sub-sector that remains the greatest challenge to the urban waste managers and academics in the developing countries because a greater bulk of the waste is still trapped here and there is no sustainable solution yet available. This section examines the primary collection process in Bamenda.

6.5.2 Location of Primary Collection

Since the area occupied by primary collection is much bigger and more difficult to calculate than that of the secondary collection sector, it suffices here to define the primary collection area as the total city area minus the secondary collection portion**.** For Bamenda this consists of the areas along the official collection routes and 105 m on either side. 105 m is the average maximum distance inhabitants would wish to travel to dispose of waste (Table 6.6). This is derived from the analysis of the survey carried out in the city (Figures 6.13 & 6.14). The estimated area, which does have access to secondary collection, is 2.1 km^2 out of the estimated city areas of 36.07 km^2.

6.5.3 Methods, Frequency and Agents of Primary Collection

The method of primary collection is simple. The waste bin is positioned at one angle of the house or kitchen. It is gradually filled up with waste generated. Households move the waste on various itinerary from around the house to the nearest public skip or chosen illegal dump. Persons designated to dispose of waste vary from house to house. However, survey reports and interviews in the field show that children are most involved (59.2%) followed by their mothers (27.9%). The employment of people or institutions from outside the family to move waste is noticed, but not significant in Bamenda as in some other cities. Men are hardly involved in waste disposal. Their participation rate is 2.9 per cent. This suggests the low level of importance accorded to waste management by men who are in most cases the family head. Table 6.5 summarises the results.

TABLE 6.5
Remover of Household Waste by Quarters in Bamenda

Remover→	**Household waste to depots**					
Quarter↓	**Father**	**Mother**	**Children at home**	**House boy/girl or guard**	**Organised Association**	**Others**
GRA	0	5	6	5	0	0
Nchuabuh	1	7	8	2	0	0
Nta Mbag	0	12	35	1	2	0
Ndamukong	2	4	12	0	1	0
TOTAL	3	28	61	8	3	0
TOTAL %	**2.91**	**27.19**	**59.22**	**7.77**	**2.91**	**0.00**

Sources: Field survey Bamenda April 2004

Methods of transferring or carrying/moving waste from household to depot highlight the following means: by head or hand 81 cases (79.4%), wheel barrows 16 cases (15.6%), hand pushcarts 3 cases (3%) and motorised vehicle 2 cases (2%). The prominence of head and hand techniques can partly be explained by the inaccessibility of most areas. Wheelbarrows are passable on these paths. Some people own and use them for multi services but consider it unnecessarily expensive as a tool for carrying only waste. The frequency of disposing of waste is not same for all households (Figure 6.9). The general tendency for the city is that waste is removed every day (35%). Other frequencies are: once in three days (30%) and once in two days, (19%). Some respondents also said they remove their household waste once a week.

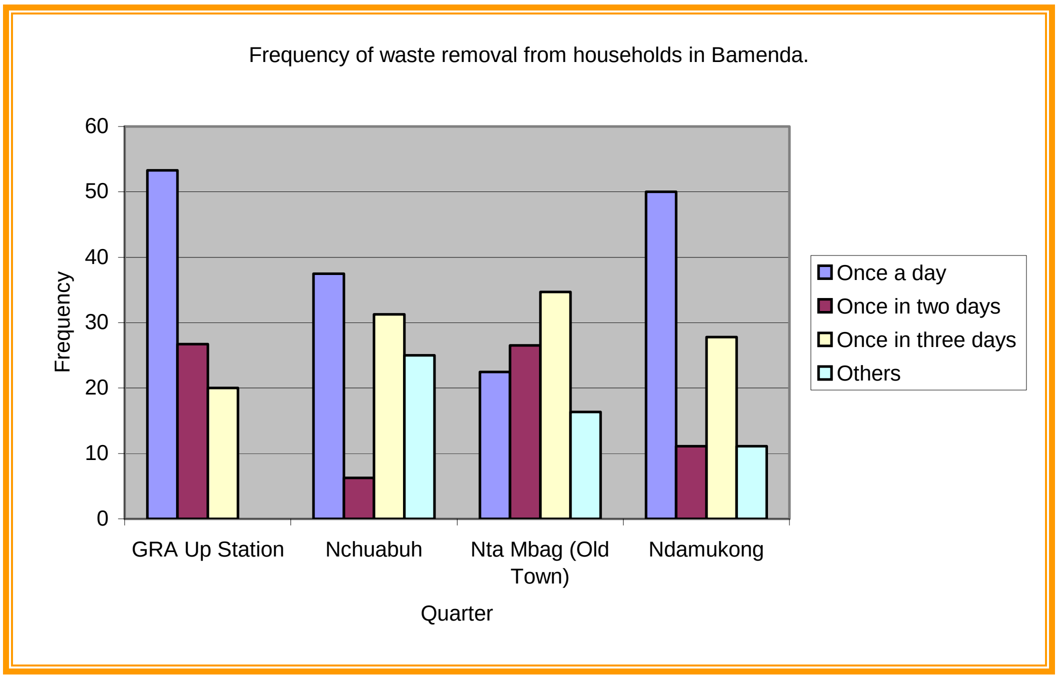

FIGURE 6.9: Frequency of Waste Removal from Households in Bamenda, 2003

Many factors influence how often waste would be removed, for example, the size of the container (determines maximum capacity); the disposal distance (if too far making infrequent trips is considered); and nuisance arising from the presence of waste (smell, leachate, aesthetics and animals). Estimated distances (in metres) from the house to the waste depot are presented in Table 6.6 and graphically presented in Figure 6.10 for a clearer and faster appreciation. Both are presented because they are vital for many other purposes.

TABLE 6.6
Estimates of Distances from House to Waste Depot in Bamenda

Distance Quarter	Cross tabulation data					Calculations of mid-point distance total				
	<50m	50-99m	100-200m	>200m	Total	25m	75m	150m	250m	Total
GRA	12	3	1	0	16	300	225	150	0	675
Nchuobuh	8	3	3	4	18	200	225	450	1000	1875
Nta Mbag	12	9	11	15	47	300	675	1650	3750	6375
Ndamukong	12	3	1	4	20	300	225	150	1000	1675
TOTAL	44	18	16	23	**101**	1100	1350	2400	5750	**10600**

Average distance= 106000/101=104.9505m =105m
Source: Household SW generation survey Bamenda April 2003

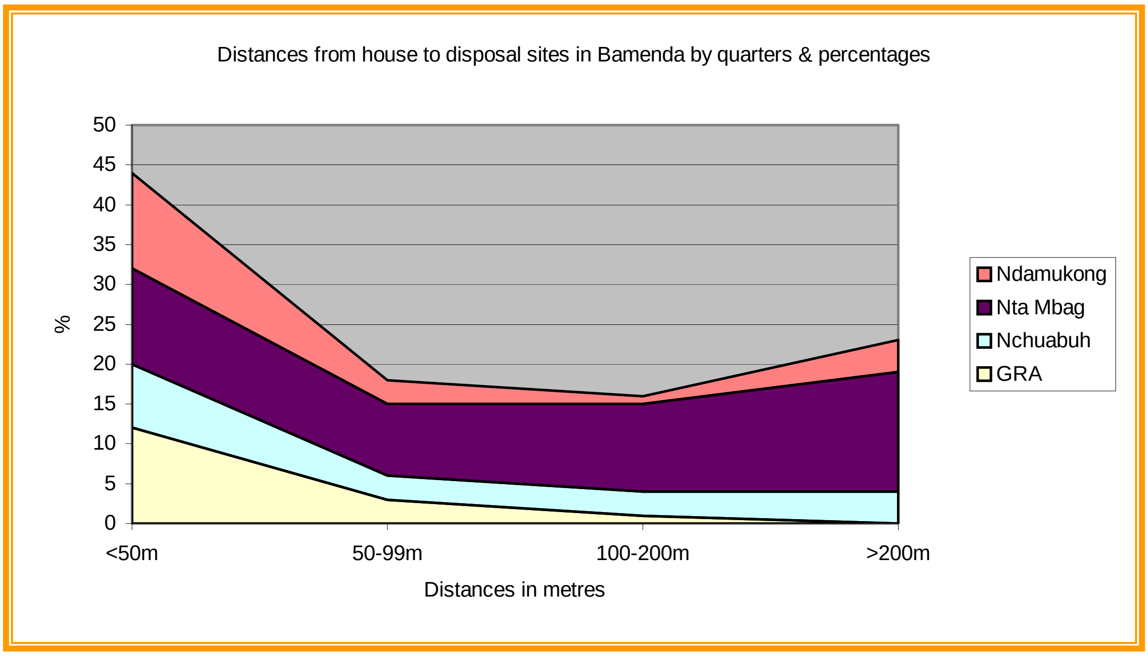

FIGURE 6.10: Distances from Households to Waste Disposal Sites in Bamenda
Sources: Household waste generation survey Bamenda April 2003

While about 44 % of the households are less than 50m from their waste dumps, the majority have to travel further than that to deposit waste. Calculations suggest that the average distance all people would like to move and dispose of waste is 105 m from their houses. From the data presented, the case of Nta Mbag demonstrates that the residents face long and short distances equally. The quarter is centrally placed and highly congested so the inhabitants have to go far to dispose of their waste especially if a free space is not available near to their households. However, this information does not disclose to us where the waste is disposed. The next paragraphs try to summarise that information.

Where does primary level disposal end? The crucial issue is where the waste is disposed of in the environment. The following paragraph is dedicated to summarising where the households put away the solid waste they have generated. The result shows the number of respondents who confirmed by answering, “Yes” or rejected by answering “No” to indicate where they dispose of waste. Even though it is against health legislation to declare depositing waste in illegal places, most of the respondents were honest in revealing their waste disposal practices. The results are presented in Table 6.7 below.

TABLE 6.7
Disposal Sites for Household Waste.

Quarter→ Household waste depot ↓	**GRA Up-Station**		**Nchuobu**		**Nta Mbag**		**Ndamukong**	
Responses →	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Waste put into the public skip	0	16	0	18	22	27	0	20
Into the itinerant waste van	0	16	1	17	2	48	1	19
In a valley/stream/lake sides	5	11	0	18	19	31	4	16
On the road/street sides	0	16	1	17	4	46	0	20
In open spaces/bushes around	6	7	3	15	11	39	10	10
Put in a hole in the compound	2	14	14	4	7	43	9	11

Sources: Household Survey Bamenda, April 2003

From the survey analysis a key finding is that only one of the four quarters on the sample enjoys the services of public skips. The lone quarter is Nta Mbag where three public skips in two separate locations (10 m apart) serve the large areas. This kind of situation reinforces the rest of the results. All the quarters are guilty of disposing of waste in valleys, streams or lakesides; in open spaces and nearby bushes; and holes dug around the households (Plate 6.2). All, but GRA and Ndamukong, accept dumping waste by the sides of the streets and roads. Sometimes this illegal dumping is done in defiance of the council’s written notices on the spot (Plate 6.2A). The urban council waste team has one other strategy of itinerary stopping at strategic spots to collect household waste directly into the waste van. Only four isolated cases in Nta Mbag, Ndamukong and Nchoubu were indicated even though all waste collected by the waste management team passes through the latter (Nchoubu) for the landfill at Ngomgham. One natural way of transporting waste is through streams and drains during heavy rains. Nta Mbag quarter demonstrates a contradictory scenario where both legal and illegal methods of disposing of waste are significantly practised.

A

B

PLATE 6.2: Illegal Dumps at a Valley (A) and Streamside (B) in Bamenda, 2003

Other major solid generators include the four urban markets, shops, schools and colleges, public grounds, restaurants and hotels, carpentry workshops, rice processing, and printing houses. A survey and observations were carried out in these areas. Most of their waste is put into the council's waste stream. The Markets have 14 communal waste skips. Hotels have large 100-litre general bins and small ones in individual rooms. The schools have waste dumps near by and waste is collected in half casks of 100 litres positioned near classrooms and offices. Hospitals have 100 litre bins distributed all over the hospitals.

Waste ends up in their dump or incinerator located near the hospital. Offices have bins but their waste is disposed of in holes behind the offices.

6.5.4 Problems of Primary Collection

There are many problems but the most troubling is the lack of good household waste bins with covers. The second, which is linked to the first, is where to dispose of waste generated by these households. Public skips are either few making residents travel long distances to access them, or simply non-existent forcing them to seek illegal disposal means and locations.

6.5.5 Conclusion

The primary municipal solid waste system is in serious crisis. It is informally organised and waste is equally informally disposed of. There are no coordinated efforts between the official waste management structure and the primary collection. All they are told over the radio communiqué is either “Wait for a garbage van at such a place at such a time” or“Keep Bamenda Clean” is on such a day or “Always put your garbage in the garbage bin”. The area of the city served with regular secondary collection facilities such as the public skips is too small.

6.6 Secondary Solid Waste Collections and Transportation

6.6.1 Introduction

The term secondary solid waste management sector represents the organization and management that continues from where the household or other primary waste generators’ legal disposal ends. The concept is applied mostly in situations where there is no door-to-door waste collection. If there were to be door-to-door or house-to-house collection, waste collected would be transported directly from the houses to the recycling or final disposal site In Bamenda the secondary sector is organised and carried out by the urban council.

6.6.2 Organisation

The 1990s mark a turning point in the solid waste management history of Bamenda. In 1995 the BUC embraced a new system adapted from Holland with a donation of two modern rear-loader waste compactor trucks and 58 one-thousand-litre caste iron skips from UNG International and the municipality of Dordrecht. The background to this consists of a cooperation agreement concluded between Bamenda and Dordrecht municipalities since 1992, the research work carried out on waste and drainage in Bamenda by a team of Dutch students (1994) whose recommendations were seriously adopted, the creation of garbage department within BUC structures, and the general flow of technical and administrative exchanges between the two municipalities. Nonetheless, the big driver behind all these developments remained the liberalisation of councils, the political scene and private associations, all of which made possible these associations with the Dutch, multi-party politics, entry of new ideas, strategy, technology and partners into the solid waste management industry in Bamenda. For the first time, partners other than the government departments joined the waste management venture in Bamenda. Since 1994 the garbage component was made a sub unit within the council's administrative structures given that it had extended to include foreign partners as well as local NGOs. A discussed on the equipment pool, the workers, waste collection and transportation arrangements and operations is developed below.

6.6.2.1 Solid Waste Management Equipment Pool

The garbage units' equipment pool consists of two rear-loader compaction trucks, two front-end loaders, four tipper trucks, 58 communal skips and manual cleaning and sweeping tools.

Compactor trucks: There are two rear-loader compactor trucks, which are used for daily collection and transportation of waste from communal skips positioned at strategic places in the city. The truck empties the skip from its rear by hooking to the skip sides and lifting it into the boot. Labourers assist this process. (Plate 6.4) According to the service head of this unit; one compactor can empty 40 skips in a go.

PLATE 6.3: BUC Rear-Loader Waste Compactor Truck, Bamenda (25/3/03)

PLATE 6.4: Waste Rear-Loader Compactor at Work in Bamenda (25/3/2003)

They are efficient and fast in collection but where there are overspills or deliberate dumping of waste outside the skips, much time is spent using manual techniques such as spades to pick up the waste from the ground into the truck The same source lament that the greatest problems faced are repairs and maintenance. All the spare parts including the tyres have to come from Holland and they are very bulky. Trucks are also difficult to repair. One trucks has a carrying capacity of 10 tones and does one circuit a day.

Front-end loader or shovel bulldozer: There are two and made available only during special occasions such as general clean-up programs. Front –end bulldozers load waste into tipper trucks for onward transportation to the city’s waste dump (Plate 6.5). They may also be used when waste bins have been drowned by waste or to load waste from official dump sites without skips being treated as transfer stations. This equipment is indispensable given the regular overflow of waste and the presence of many illegal dumps, all of which have to be cleaned up.

Tipper trucks: There are four tipper trucks, which are usually made available when needed especially during a general clean up, collection at overspilled waste bins or official dump sites (Plate 6.5). These trucks are also used for other council services such as street and road construction.

PLATE 6.5: Front-end Loader (Left) and Tipper Truck (Right) at Work in Bamenda. **(23/3/2003)**

Communal skips or bins: This phase started up with 58 one thousand litres galvanised waste collection skips. They had covers and wheels. The number is gradually reducing as bad ones cannot be repaired and locally made types do not last (Plate 6.6). Parts of the problems come from vandalism by some citizens. They not only remove their wheels but sometimes set fire on waste inside them. This helps to burn the bins and accelerate decay and rusting that is inherent on exposed metal-based equipment such as these skips. There were only about half the original number in the field. One of the greatest problems of waste management in Bamenda is the shortage of skips. On an average 10 000 people, share one public skip.

A. One local & three Holland made skips   B. Local skips deteriorate faster.

PLATE 6.6: Public Waste Skips in Bamenda (A: 13/3/03; B: 18/3/03)

6.6.2.2 BUC Waste Management Team

The operation team is made up of technical staff, garbage collectors, field-cleaning teams and drivers. The technical team does repairs and maintenance of the trucks and skips. The garbage collectors move with the truck drivers to assist in manipulating the rear-loading mechanical system. They also manually collect over flown waste from skips into the trucks using spades, rakes and wheelbarrows, and clean around the skips. Some sweeping is done using brooms around the streets and market centres. According to the head of the waste management department, there are 31 workers: 1 technician, 2 drivers, 8 garbage collectors and 20 field sweepers (Mr Morfor Linus, pers. Comm., E-mail 05/11/03.

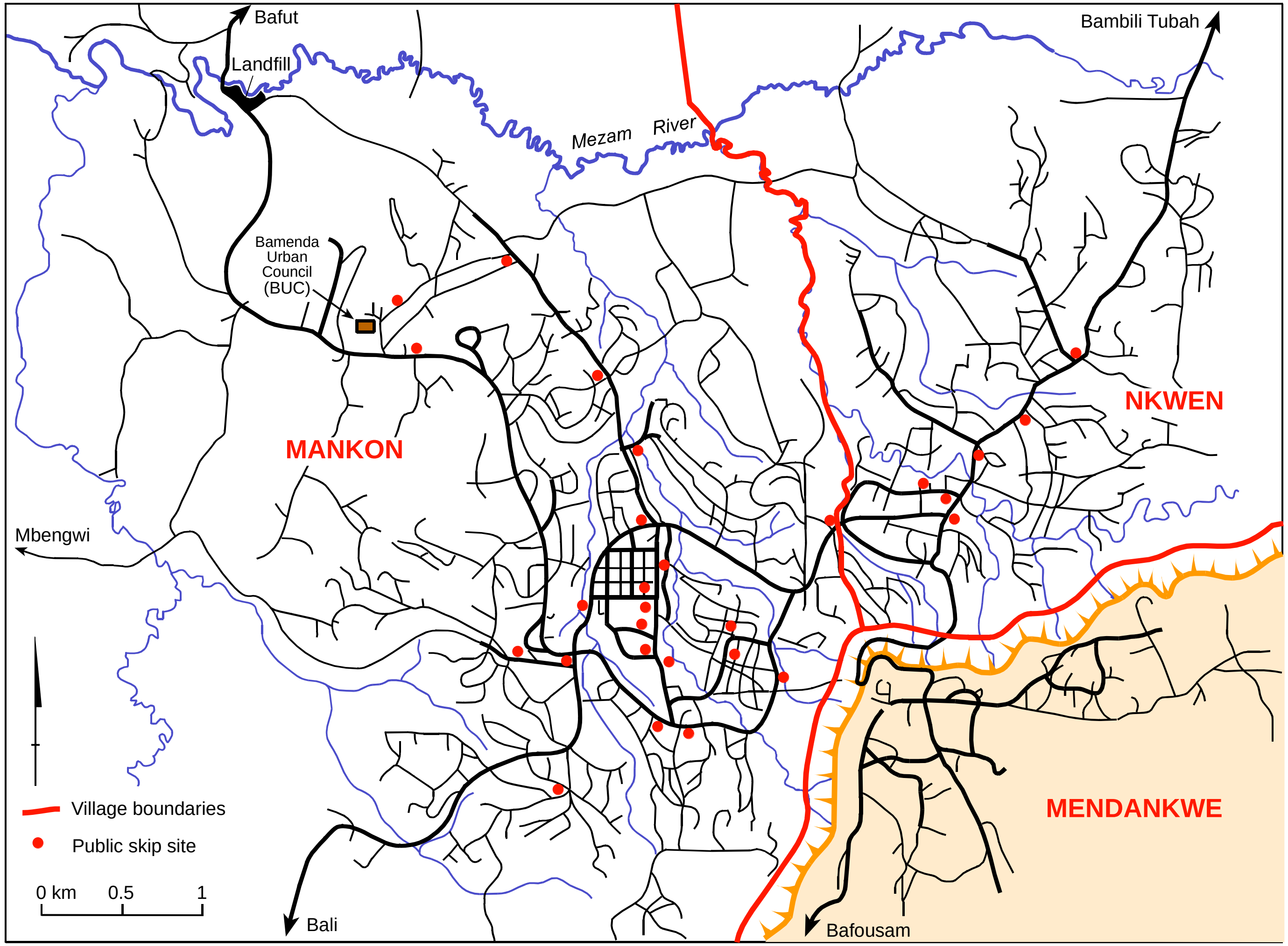

FIGURE 6.11: Location of Public Skips in Bamenda

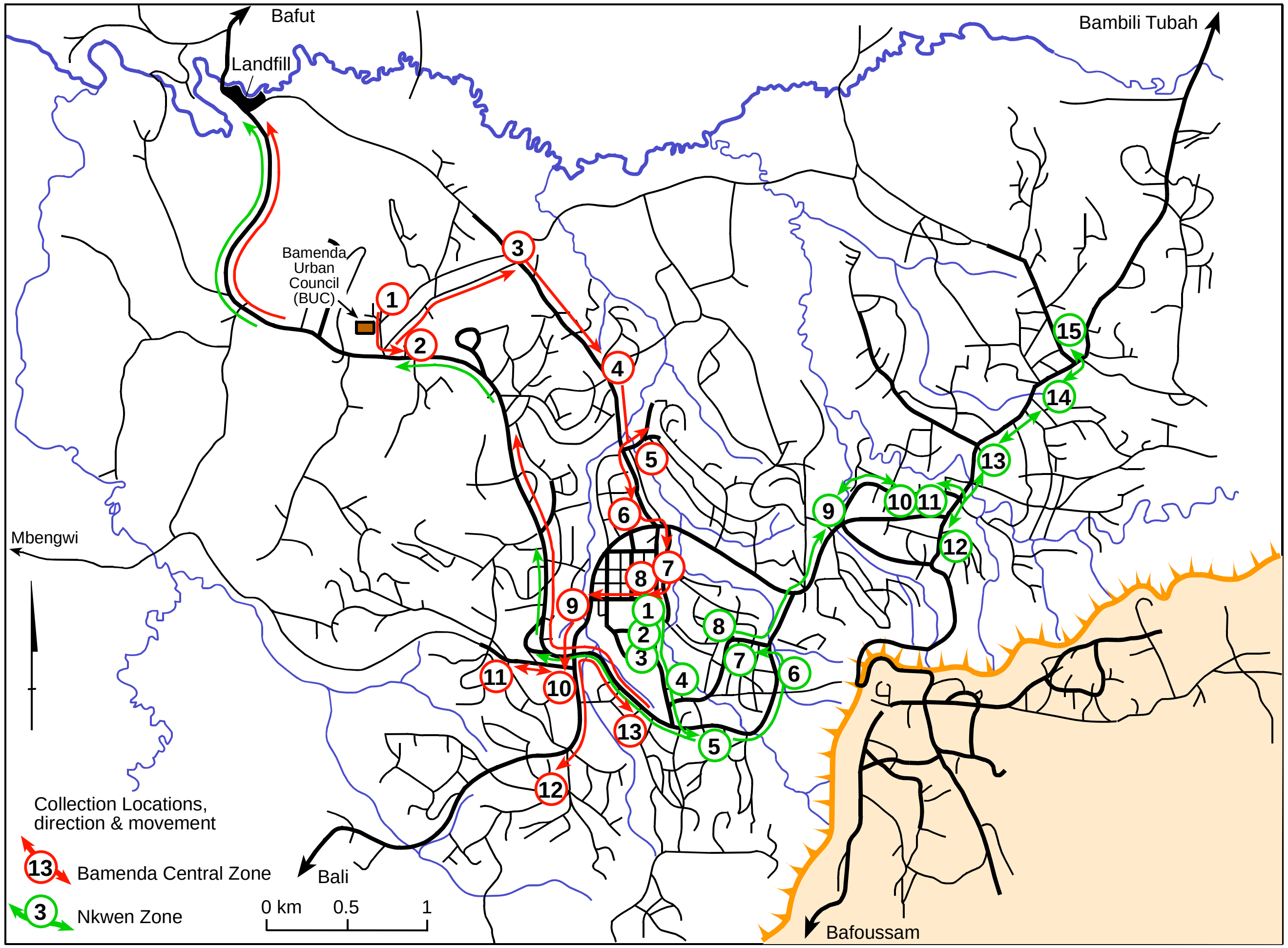

FIGURE 6.12: Organisation of Waste Collection and Transportation Routes-Circuits

6.6.2.3 Organisation of Collection and Transportation Routes-Circuits

There are three methods in place for collecting solid waste: daily circuits, general periodic clean up and itinerary stopovers. However, it is the circuit arrangement that is the main method. The other two methods are complementary and rather superficial, designed to fill some of the gaps created by the circuit system. Garbage collection, transportation and deposition is in principle organised on a daily basis starting at 8 a.m. The town is divided into two circuits: the Bamenda Central Zone Circuit and Nkwen Zones Circuit. A circuit is the total distance from the base (BUC) through all the skip sites to the disposal site at the landfill and back to the base (BUC). One circuit is responsible for collecting and transporting waste from skips positioned at specific spots on the major streets of one zone and disposing of it at the landfill at Ngomgham on the Airport road near Mezam River Bridge**.**

Bamenda Central Zone Circuit: A car and the GPS were used to track and register specific data for both circuits. This data is presented in Tables 6.8 and 6.9 and on the map (Figure 6.12). The map and tables display the area covered, route and direction of movement, distribution, inter-skip distances, altitude, location and distance to the disposal site.

TABLE 6.8
Bamenda Central Zone Circuit

NO.	Location	Lat.(N)	Long.(E)	Altitude (Meters)	Distance Cum.(Km)	Distance (Km)	Skips No.
B0	BUC	05 58 25	10 06 11	1281	00	00	-
B1	GS Ngomgham	05 58 31	10 08 20	1260	0.4	0.4	1
B2	Ntarinkon Park	05 58 07	10 08 35	1260	1.8	1.4	2 bad
B3	End of tar Longla	05 58 23	10 08 45	1259	2.6	0.8	None
B4	Musang Junction	05 56 12	10 08 55	1253	3.1	0.5	2
B5	Church C. Junction.	05 57 57	10 09 01	1230	3.6	0.5	2
B6	City Chemist	05 57 41	10 09 04	1246	4.4	0.8	2
B7	SDF Secretariat	05 57 35	10 09 06	1236	4.6	0.2	2
B8	Old Treasury Street.	05 57 27	10 09 03	1253	5.0	0.4	2
B9	Food market	05 57 24	10 08 52	1246	5.4	0.4	4
B10	H. Round about	05 57 14	10 08 49	1251	5.7	0.3	2
B11	Azire Old Ch. Jun	05 57 14	10 08 37	1256	6.1	0.4	None
B12	Atuakom Junction	05 56 49	10 08 48	1276	7.4	1.3	1
B13	Holiday Hotel Jun	05 57 02	10 09 05	1247	8.7	1.3	None
LF	Landfill (Dump)	05 59 05	10 07 44	1235	14.3	5.6	-
B0	BUC	05 58 25	10 08 11	1281	17.1	2.8	-

Sources: Field survey of 17/03/03

Basically this zone has 13 sites and covers the Mankon part of the city. The circuit is 17 km long and the inter-skip average distance is 700 m. By mid March 2003, field surveys gave a total of 20 skips in 10 sites. The empty sites might be suffering from withdrawal of skips for repairs or the spot is no longer suitable or because the skip had become too small to hold the waste. In the last scenario, the spot becomes an official dump from where waste is occasionally removed using tipper trucks and the front-end loader. If one compactor truck can empty 40 skips in a go, this suggests that each truck has only one circuit to do a day. However, the head of the garbage team says that some heavy waste generating places such as the markets are sometimes revisited later in the day. Each garbage truck weighs 6 tons when empty and 16-17 tons when full, giving a carrying capacity of 10-11 tonnes.

6.6.2.3 (ii) Nkwen Zone Circuit.

This zone covers parts of Mankon and Nkwen. It is 22 km long and has 15 sites with 17 skips by mid March 2003. However, loading distance (from first to last skip) is only 6.7 km, giving this circuit an average inter-skip distance of 400 m. Some skips had disappeared during the field study period for the reasons advanced above.

TABLE 6.9
Nkwen Zone Circuit

NO.	Location	Lat.(N)	Long.(E)	Altitude (Meters)	Distance Cum.(Km)	Distance (Km)	Skips No.
N0	BUC (BASE)	05 58 25	10 06 11	1281	00	00	-
N1	Entrance to Stadium.	05 57 23	10 09 02	1264	3.8	3.8	0 ??
N2	Entrance Congress Hall Road	05 57 19	10 09 04	1265	4.1	0.3	1
N3	Mankon Market Gate	05 57 12	10 09 06	1264	4.3	0.2	4
N4	Opposite Laking	05 57 09	10 09 07	1279	4.4	0.1	1
N5	Below Cathedra	05 57 01	10 09 15	1286	5.1	0.7	Dump
N6	Ayaba Hotel	05 57 07	10 09 29	1270	5.3	0.2	0 ??
N7	Old Town	05 57 18	10 09 21	1268	6.0	0.7	2
N8	GS Old Town	05 57 19	10 09 22	1272	6.1	0.1	1
N9	Ngeng Junction.	05 57 41	10 08 43	1253	7.2	1.1	1
N10	Good Samaritan	05 57 48	10 10 00	1244	7.8	0.6	1
N11	Total Nkwen	05 57 47	10 10 05	1248	8.0	0.2	1
N12	Way Out Nkwen	05 57 43	10 10 05	1266	8.2	0.2	1
N13	BAYELE Junction.	05 57 56	10 10 11	1255	8.6	0.4	1
N14	Amour Mezam	05 58 04	10 10 20	1258	9.0	0.4	1
N15	Foncha Street. Junction.	05 58 15	10 10 29	1283	9.5	0.5	2
LF	Landfill	05 59 04	10 07 43	1240	19.2	9.7	-
N0	BUC (BASE)	05 58 25	10 06 11	1281	22.0	2.8	

Sources: Field survey of 17/03/03

6.6.2.4 Special Activities: Periodic Clean-up Campaigns and Itinerary Collections

Two other methods of collection and transportation of waste resurfaced because of the inability of the circuit system to adequately remove waste in the city. One is the monthly general cleaning campaign called "Keep Bamenda Clean". The public is mobilised through a radio communiqué by the Divisional Officer or the Delegate to the Urban Councils (Appendix 7). On such mornings the trucks, loaders and operational staffs are all mobilised. The compactors do their normal circuits very early in the morning, keeping away from skips in places where overspills would be collected only by the tippers (Plate 6.3). Regular work is suspended in all private and public places in the city. These places remain closed to the public from 8-12 am (except hospitals and the public security). Movement by public transport is also banned. The inhabitants and workers clean their premises, offices, workplaces and drains during the period. All waste is dumped either by the roadsides for collection by the tippers and front end loaders or deposited in the semi-official dumps understood by the neighbourhood (Plate 6.5).

This practice runs throughout the history of waste management in the city. The monthly cleaning has helped alleviate some of the city's waste collection problems. Nonetheless the crucial problem here is that sometimes the waste remains on the street sides for days after the general cleaning day The key to successful general clean ups is adequate preparation of the removal process, and this is sometimes the problem in Bamenda. It is on such grounds that the DO for Bamenda Central Sub-Division called off one of such clean-up campaigns, previously announced by the Government Delegate to BUC, on the same day at 7.45 am, January 9, 2003. The cancellation not only caused confusion in the city but also seriously questions the public policy as concerns the day-to-day waste management in Bamenda as well as in other cities of Cameroon. Clean up campaigns has become a national policy. They now have a competition with prizes. According to the Government Delegate to BUC, Bamenda won the nation's first prize of 7 million CFA in 2001(Interview with Government Delegate BUC 4/8/2002).

The last approach to collect waste from households not served with public skips has been planned periodic stopovers along the main roads and at specific spots and time.

The truck driver hoots as he gets nearer to alert the inhabitants of the arrival of the van. When he does arrive waste is then dropped straight into the stationed van for transportation to the landfill. This method started in the city as early as the 1970s. In desperation it is being reintroduced even though it has many setbacks which were discussed earlier.

6.6.2.5 Areas of Secondary Collection

Based on the number of sites covered by the two trucks (28) doing two circuits, and using information about the distance households move averagely to dispose of their waste (105m) as the radius, we could calculate the secondary collection area by the formula, $28(\pi r^2)$. This gives a circular catchment area of 1.1 km^2 or 3.1% of the entire city area (Figure 6.13) that enjoys regular waste collection from BUC services. In practical terms the reality may be more complicated than this. One may expect an oval shape along the road because of the ease of movement rather than a circular pattern. In addition to the ease of movement problem there is also the diversified nature of the terrain. Even when the distance decay hypothesis problem is resolved another big issue is risks associated with crossing or not crossing the street to access the skip. It still poses a problem on the distance decision-making. However, for our calculations we presume an area with uniform terrain, equal ease of movement and total security, so a circular distribution is adopted.

We can examine another scenario, which assumes that during special occasions itinerant stopovers are made along the circuit for people to rush and drop their refuse into the van. If we assume a 105 m average travel distance by the inhabitant to drop waste into the itinerant van from either side of the road (i.e., 210 m diameter or width) we can make another calculation based on the total circuit length of 11.8 km (excluding repeated portions). This gives the city area coverage of 2.5 km^2 representing 7.1% (Figure 6.14). Both results demonstrate that the area served is too small (3.1-7.1%) for a city whose area including its peri-urban regions is estimated at 35.07 km^2. This is a strong reason for a proliferation of illegal disposal method of solid waste in the city. However, it is important to note that the BUC keeps trying hard to keep the skip areas regularly clean.

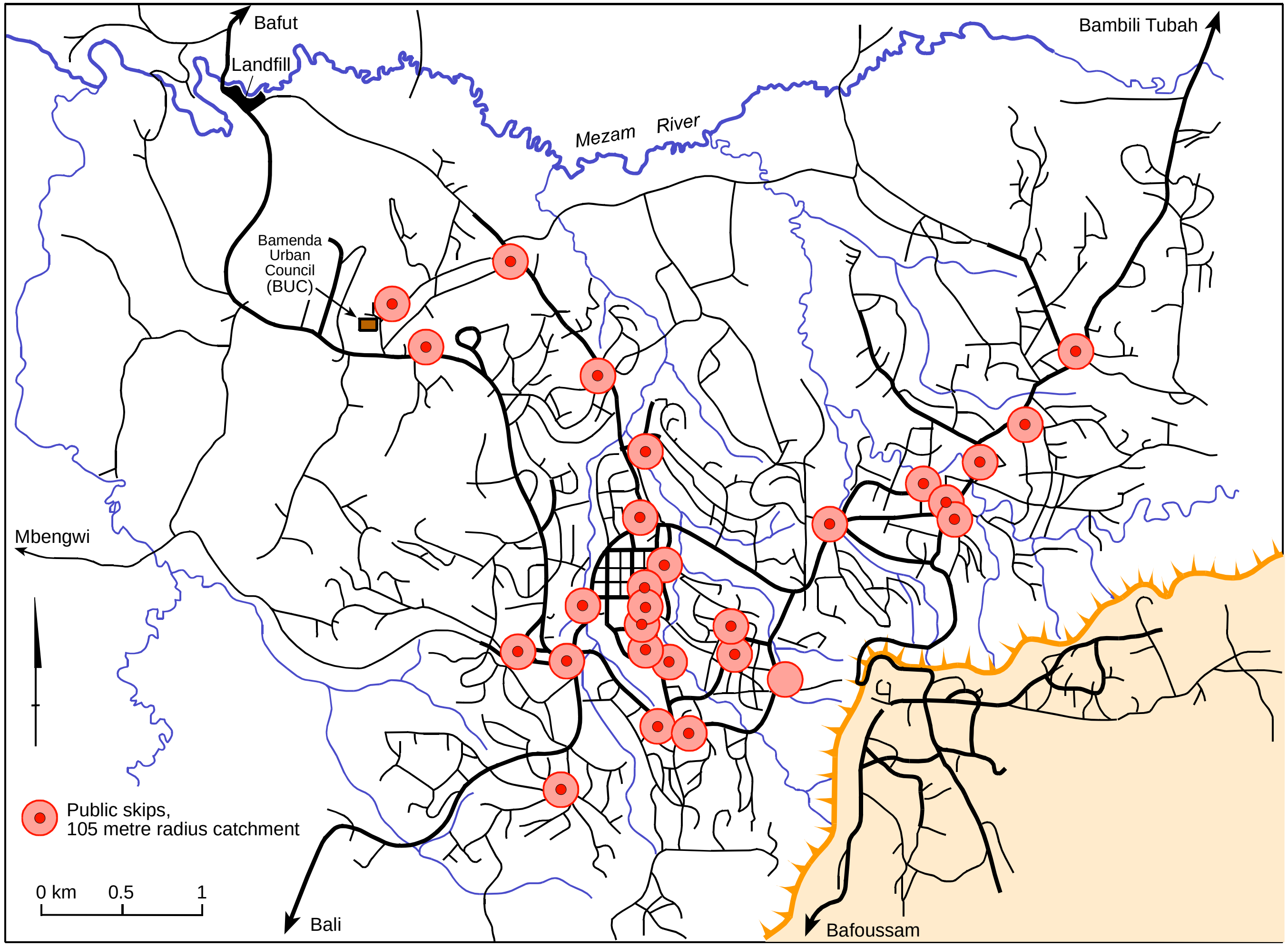

FIGURE 6.14: Areas Served by the Official Waste Management Collection Team: Linear Perspective

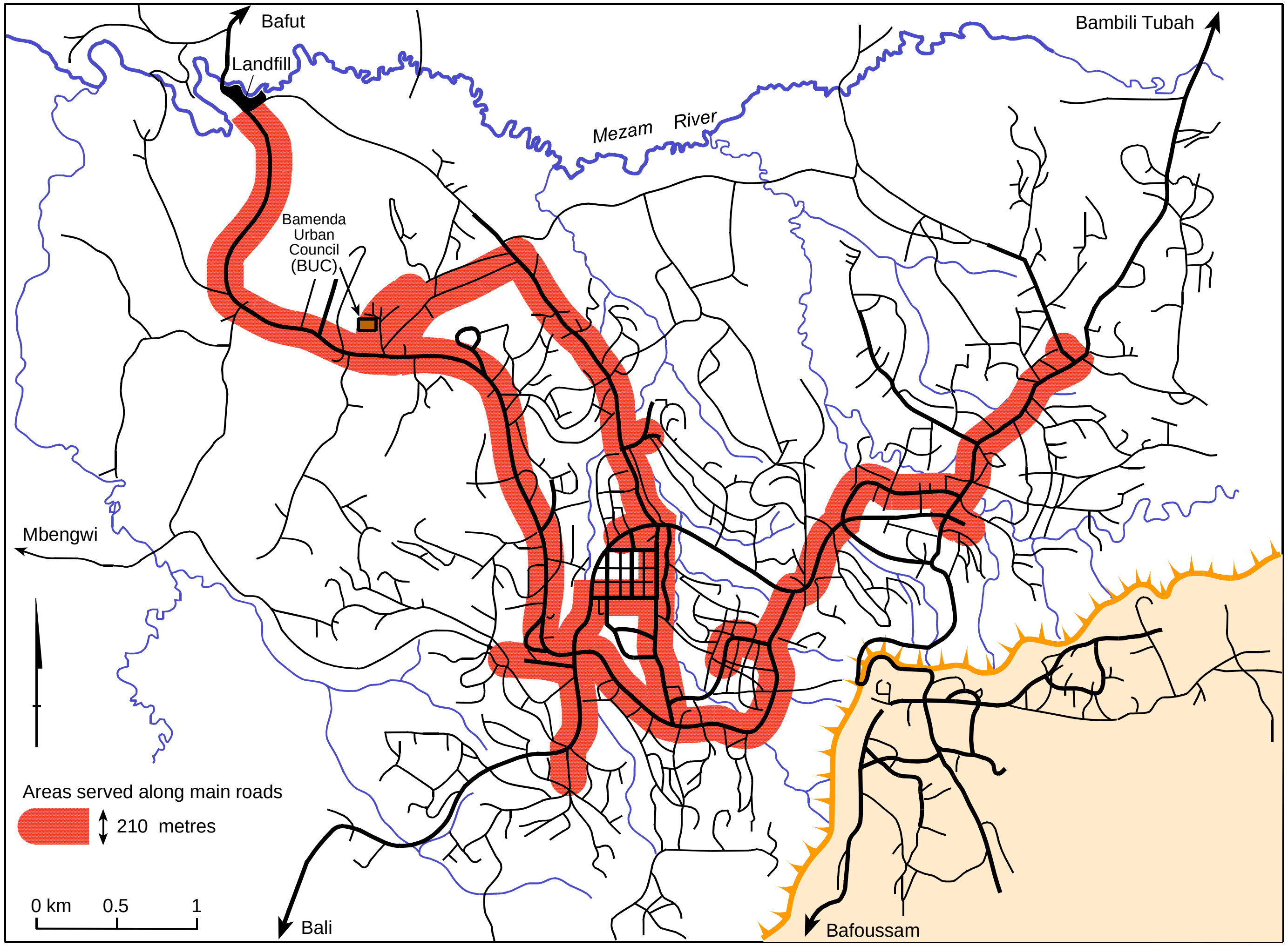

FIGURE 6.14: Areas Served by the Official Waste Management Collection Team: Linear Perspective

6.6.3 Partners

New partners other than government services have become involved in the waste management sector. They are not business partners but non-governmental and non-profit making organizations. They are of various levels, international, national and local. The most significant is the Municipality of Dordrecht and the UNG International. Their contributions have been discussed above. They are still offering expertise training and supplying equipment and spare parts for BUC solid waste management. Two new compaction trucks and more waste skips were to arrive Bamenda from Dordrecht by April 2003. At the time of writing they had not reached.

There are some local NGOs, which are still to gain prominence. Their activities, among other projects, are directed towards community sensitisation and education in environmental management. Two directly involved in municipal solid waste management are: Community Initiative for Sustainable Development (CAMINSUD) and 'Paradise on Earth'. While CAMINSUD has been organising partnership forums on environmental management in sampled quarters, Paradise on Earth concentrates on diverse solid waste recycling strategies including waste exchange programmes. Related government services are increasing with creation of more ministries, the last entry being the Ministry of Urban Affairs.

6.6.4 Problems Associated with Secondary Waste Management

A major concern experienced is the spatial distribution of collection spots in the city. Nkwen has seven while there is total absence of these facilities in one major part of the city, that is, Mendankwe, including the Government Station. No reason has so far been advanced for this negligence. However, history has it as a tradition that the government is supposed to take care of that part of the city. General remarks are that two compactor trucks available could be sustainable if well maintained and routines organised. The shortage of public skips makes this process of double handling time consuming because all overflows also have to be gathered manually.

 

PLATE 6.7: Overfull and Overspilling Skips Bamenda. 17/3/2003

Even though many respondents had no knowledge of what goes on around the skips (because they are responsible for emptying household garbage), survey cross tabulation analysis on the situation of the skips or bins as noticed by some inhabitants at the time of depositing their waste shows that more bins are generally always full and most always overfull (Table 6.10 and Plate 6.7).

TABLE 6.10
Capacity of Bin at the Time of Deposit- Cross tabulation Count

CAPACITY/ QUARTER/	Half full	Always full	Always overfull	Empty	Total
GRA Up Station	2				2
Nchuabuh	1	3	11	1	16
Nta Mbag (Old Town)	5	9	23		37
Ndamukong	3	5	9		17
	11	**17**	**43**	**1**	**72**

Source: Field Survey in Bamenda April 2003

Where the trucks fails to turn up for even a day the picture is not pleasant. It is more serious during the wet season. In the dry season the waste vans return to the base by 11 a.m. Waste is scanty not necessarily because the generation rate is low but more because people burn waste around their houses, in the neighbourhoods, inside the skips and at the dumps.

The inadequacy of public skips is demonstrated by this analysis. If we assume that per capita solid waste generation is 0.54 kg per day, with a population of 300 000, Bamenda should generate 162 000 kg a day. There are 37 one-cubic-metre skips, giving a total of $37m^3$ capacity available. Applying various scenarios of densities: $250/m^3$, $350/m^3$ and $500/m^3$, Figure 6.15 demonstrates the situation of needed and lacking capacities, if everyone had to dispose of their solid waste in the public skips.

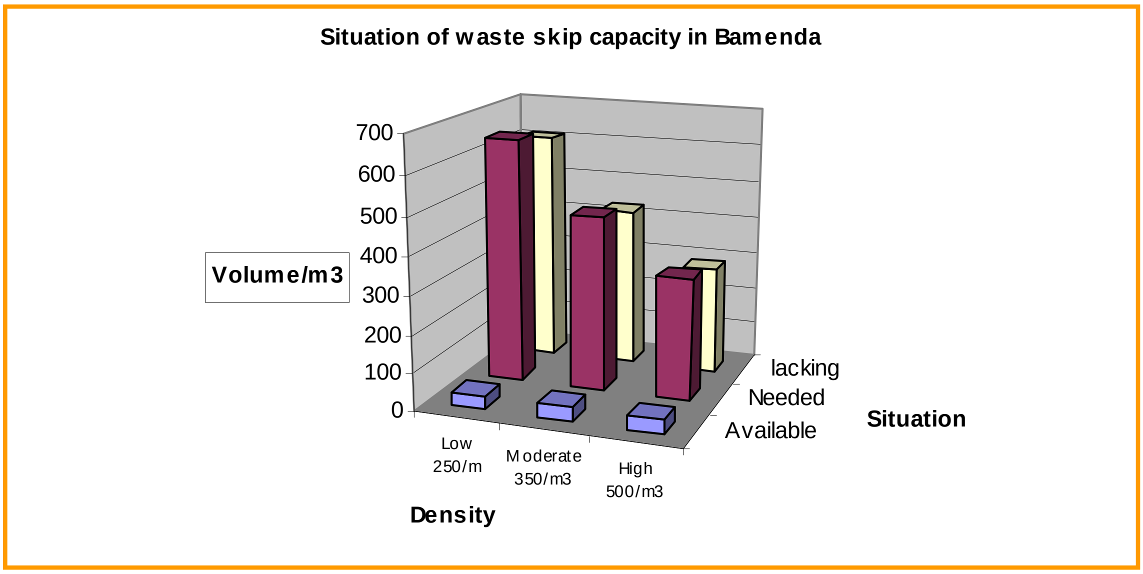

FIGURE 6.15 Situation of Waste Skip Capacity in Bamenda

From Figure 6.15 at low, moderate and high densities, Bamenda would need to increase the capacity by $648m^3$, $463m^3$, and 324m3 respectively or increase the lacking skips by 16, 11 and 8 times the present rate ($37m^3$), to cope with the volume of waste generated.

6.6.5 Conclusion

The secondary municipal solid waste collection system is an upgrade of the conventional system of the previous decades. The introduction of more sophisticated equipment and practices of periodic clean up campaigns have helped improve the collection and transportation problem of solid waste in the city, but not resolved it.

Not only is the space covered still small but so are the quantities removed. The city will need to increase the public skips 11 times and a commensurate number of trucks, to be sustainable. There has been the entrance of international and local non-governmental organizations (NGOs) into the waste industry, however the role of the local NGOs is yet to be felt. The local people or grass roots population are still far from the system in terms of involvement.

6.7 General Conclusion

Bamenda city generates 120-160 tonnes of municipal solid waste in a day or 0.4 - 0.539 kg per capita per day, 76 % of which is biodegradable and 24 % non-biodegradable. About 90 percent of all solid waste generated is from the households. The BUC, which is the statutory body to handle this waste, in its regular activities, covers only 1/10th of the city area and can barely collect and successfully transport waste from in and around its skips, averaging 30 tonnes a day, accounting for about 24 percent of total waste generated in a day. The rest of the waste ends up in illegal dumps spread all over the city, some in fragile environments such as wetlands and stream banks.

The waste collection and transportation systems in place are an upgrade of the same conventional strategy developed since the colonial era. The introduction of waste compactor trucks and a public skips circuit system, the reinforcement of periodic clean up campaigns and stopover waste collection practices, have helped to improve the situation. However, much still needs to be done, and fast too, to make waste collection and transportation in Bamenda sustainable, especially in the area of increasing skips to enhance more coverage. With an estimated population of 300 000 growing at an annual rate of 10 per cent in the last decade, policy and strategy need a drastic change. One key area identified for consideration is effective public participation. Attention and efforts have been focused more directly on waste collection and transportation, whereas the issue of municipal solid waste final treatment and disposal is still unresolved. This is discussed in the next chapter.

CHAPTER 7

Municipal Solid Waste Management in Bamenda: Treatment, Disposals and the Environment

7.1 Introduction

Collection and transportation of large quantities of municipal solid waste is a protracted problem facing many cities of the developing world and this partly explains why these city administrations concentrate much of their efforts there. But the bigger issue is what is done with this ultimate waste in terms of its treatment or final disposal so that the environment as well as human health and the city's aesthetics are not compromised. It is at this stage that the crux of contemporary waste management is evaluated. Growing opposition, increasing costs, environmental concerns and NIMBYism are increasingly making the location of new final disposal facilities (landfills and incinerators), extremely difficult. Strategies that have been developed focus on saving these facilities and the environment by minimising the quantities and toxicity of waste that must be disposed of. The solid waste management hierarchy concept is widely promoted and used to develop strategies for addressing these waste problems.

This chapter completes the discussions on municipal solid waste management (MSWM) system illustrated in Figure 6.3, Chapter Six. It examines the magnitude and intricacy of solid waste recovery, treatment and disposal using the conceptual solid waste management hierarchy that emphasises minimisation. Though this concept is widely adopted for use in many parts of the developed world, it addresses only a part of the system. Major forms of solid waste recovery and treatment: recycling repairs and reuse; the final disposal of the ultimate wastes at the official landfill and illegal dumps, are examined here. Environmental problems posed by the inefficiencies of the whole solid waste management system are also studied. The role of local/national governments and international concerns on addressing these issues is also discussed.

7.2 Solid Waste Treatment in Bamenda

7.2.1 Introduction

In Cameroon, the 1996 Law on the Environment (Section 42) stipulates that for sustainability, waste should be treated in an ecologically rational manner, to reduce its toxic effects on human, natural resources, fauna, flora and the general quality of the environment (Biya 1998). The solid waste management hierarchy model proposes actions to support the concept of sustainable solid waste management. As discussed earlier, the model accords priority action options for comprising from top to bottom (most to least preferred) prevention or avoidance, reuse, recovery, incineration (with energy recovery) landfill, dump and open dump. Bamenda is not much involved in the first two levels given that the city is not involved in manufacturing. Our discussion then falls back to treatment. This includes a wide variety of actions such as resource recovery, which includes all activities of waste segregation, collection and processing for their economic value and re-use and recycling which also provide an opportunity to capture some valuables from waste. While reuse is a simpler process involving utilisation of material in its end-use form without the necessity of reprocessing, recycling involves processing waste through manufacturing and conversion of parts in order to recover original raw material (Cointreau et al., 1984; Burkering, 1994 cited in Burkering, 1999; EPA 2002).

Field survey, experiment and observations revealed that all of these processes of resource recovery take place in Bamenda and at varying scales. Solid waste recovery takes place throughout the stages of the waste management cycle (Figure 6.3) but in Bamenda, much recovery goes on only at the level of generation, usually termed source recovery. This is because collecting items from waste facilities such as public skips or waste dumps is taboo and only associated with mentally sick people. Another reason is that waste streams are poor, given that many articles are used to exhaustion as much recycling takes place at the generation stage. However, exceptional cases always exist given that ‘one person’s trash can be another person’s treasury’ (Clark 1998, p. 60). At the landfill, isolated cases of people scooping manure or extracting parts from vehicle wrecks were noticed. Reuse of food waste, tins, fibre bags, plastic bags and bottles, glass, paper, cartons, metal, clothes, shoes, building materials etc. from various sources and for multiple purposes, is commonplace. Some are reused directly in their original forms, others repaired before being reused and the rest transformed into new products. Some recycling techniques such as burning vehicle tyres to recover wires cause environmental degradation.

7.2.2 Segregation of Solid Waste

This process involves separation of solid waste into “wet” and “dry” and a further sorting of the dry components into specific types such as paper, tin, plastic, carton, bottles, for easy recycling. This is an indispensable starting point for a waste management system that emphasises waste recovery and recycling in its programmes. There is no policy on municipal solid waste segregation in Cameroon. There is no formal source separation and all MSW is collected mixed and disposed of in the same manner. However, in hospitals, industries and research centres hazardous waste is by law supposed to be separated and treated specially. Nonetheless, separation of waste in Bamenda goes on almost instinctively, the driving force being the usefulness of the action. People would like to separate waste into categories if there is a convincing reason for doing that. For example, in the field survey in Yaoundé and Bamenda, respondents were asked whether they would like to separate biodegradable food/vegetable waste from non-biodegradable components. The aim was to test policy implications and public opinions. The results for Bamenda and its quarters are summarised in Table 7.1.

TABLE 7.1

Cross tabulation on ‘Whether Like to Separate Waste’: Bamenda & Quarters

Quarter	Yes		No		Total	
	Count	%	Count	%	Count	%
GRA Up Station	12	92%	1	8%	13	100%
Nchoubuh	17	94%	1	6%	18	100%
Nta Mbag (Old Town)	21	45%	26	55%	47	100%
Ndamukong	18	90%	2	10%	20	100%
Total	**68**	**70%**	**30**	**30%**	**98**	**100%**

Sources: Households survey in Bamenda March/April 2003

On an average 70% in Bamenda favoured separation. Further analyses of the Quarters’ attitude toward separation indicate that in high-density spontaneous settlements such as Ntab Mbag, more people (55%) do not favour separation. On the contrary more than 90% of the people in the peripheral and low-density middle level residential quarters prefer separation (Table 7.1). The main reason advanced by the respondents for waste separation is to derive material for agriculture (compost and animal feed) from the rest of the waste. The inhabitants of these areas practise animal husbandry, gardening and farming for which they need household waste for composting or as animal feed. This tendency was so strong in Bamenda that some households were reluctant to release their household waste for the research experiment, others refused outright and some demanded compensation. Meanwhile, people in the high-density areas have no space for agriculture and animal husbandry and understandably, would not like to separate waste.

Further, the ability to separate waste at quarter level was conducted by analysing household waste bags collected at the experiment. The results were as follows: the G RA (95%), Chuaobuh (90%), Ndamukong (79%) and Ntah Mbag the least (60%). The experiment results (ability to separate) and the results from the survey (desire to separate, Table 7.1) show a strong positive correlation of 0.91. In the survey results, 55% of Nta Mbag residents did not prefer separation, while in the other quarters more than (90%) preferred it (Table 7.1). The reasons advanced for not favouring separation were many: 55 % said they have no use for the materials, 36% said it was a difficult exercise, others (9%) had a variety of reasons looking more like an extension of the first, e.g. ‘no land to farm’. Household waste is separated into categories such as animal feed, compost items, for repairs, for recycling, gifts, plastic bags, tins, papers for reuse and items to be disposed of: burnt, buried or thrown away.

7.2.3 Reuse

There is a lot of reuse of items from households, hotels, restaurants, local processing industries and second hand imported goods. A survey of household attitudes toward recycling of specific items was conducted. Respondents were asked to indicate, “Yes” if they ever reuse, recycle, sell or buy, give or receive as gift the items suggested or “No” if they do not. The following results were obtained for Bamenda.

Table 7.2
Summaries from Reuse Cross Tabulations, Bamenda

Item	Yes		No		Total	
	Count	%	Count	%	Count	%
Bottles	80	*77*	24	*23*	104	*100*
Tins/cans	54	*52*	50	*48*	104	*100*
Plastics	69	*66*	35	*34*	104	*100*
Fibre bags	87	*84*	17	*16*	104	*100*
Metals	21	*20*	83	*80*	104	*100*
Shoes	76	*73*	28	*27*	104	*100*
Clothes	76	*73*	28	*27*	104	*100*

Sources: Field Survey Bamenda March/April 2003

Major indications from the household survey show that all these items are being reused. This suggests that recovery is high among the inhabitants of Bamenda. But some items are more recycled than others. In descending order of reuse are: fibre bags, bottles, clothes, shoes, plastics, tins and cans, and metals. Fibre bags are used for various purposes such as marketing, storing solid waste, storing food items, tool bags and farming bags[1] in the city. Beer and soft drink breweries (located in Bafoussam and Douala) usually take back their bottles. This is not in respect of any government policy such as Extended Producers' Responsibility (EPR) but an economic strategy that reduces costs to the breweries by simply collecting back the bottles for reuse. The reuse of clothes, shoes, plastic items, tins and cans is very common. There are lots of handed-down old items such as clothes and shoes from the city dwellers to relations and friends living in the villages as gifts. Metal is not very available at the household level.

Survey results from sampled hotels and restaurants in Bamenda also show that breweries that distribute their products usually take back used bottles. In the restaurants, food waste is recovered for use as animal feed. Green waste is separated for composting. Bakeries also produce charcoal as waste and it is sold out for grilling fuel. Waste bread is used as animal feed. Animal droppings are used as direct fertilizers or mixed with lawn trimmings, compound grass, trees and hedge clippings, and kitchen waste to produce compost.

There are many wood and food processing industries in Bamenda. The waste they produce is put to various uses as revealed from the field survey. Rice husks are used as fuel by households and blacksmiths and for animal feed, stables litter and mulch. Coffee peelings

[1] People who go to the farms use several of these bags to carry items such as farm tools, snacks, seeds, manure and water. On return raw foodstuffs and wood are carried home in the bags

are also used as fuel, stable litter and compost materials. The waste from corn grinding mills and palm kernel oil factories is used as animal feed. The municipality owns one modern abattoir, whose operation was recently privatised. Waste from this source includes dung used for manure, blood and bones used for animal feed, and horns for cups and decorative articles. Furniture-making industries are abundant in Bamenda and produce large quantities of sawdust and wood off-cuts. The sawdust is used for fuel; animal stable litter and for cleaning newly laid tiles. Wood cut-offs are used mainly for fuel. All these waste items are sold at highly profitable rates. Bamenda is situated in a grassland area and lacks wood fuel, so waste from industries serve as valuable sources of fuel for the area.

One major source of reuse of waste is imported second hand goods. These are other peoples' waste. Markets in the city are flooded with second hand goods ranging from household utensils through textile and leather goods to electronics and vehicles. This phenomenon gained and maintained momentum with the advent of the economic crisis, currency devaluation and cuts in salaries that started in the country in the late 1980s. These second hand goods cost less, often 10-20 times less than the cost of new items. Most of these goods are often near the end of their life cycle at the time of purchase. They do not last long and are soon discarded as waste. The Government enjoys good custom revenue from this process but its policy as concerns waste management is outlined in the CLE (Sections 42-53) even though its application is illusive at city level (7.4.4.3).

7.2.4 Municipal Solid Waste Processing

7.2.4.1 Repairs

The last category of recycling involves changing the state of the waste before reuse. This would include repair, transformation and composting. Repairs are made on nearly everything that is used. Plate 7.1 demonstrates how an industrious young man earns a living by repairing household goods. 'Doctor Walters' as the owner styles his business, says he is able to sustain himself by doing these repairs and that the customers are happy having the lives of their goods extended at an affordable price, and are also quite satisfied with the saving made by not acquiring a new item (Interview with Mr. Walters, 17-03-03). There are many such repair places including some for different types of good for example, vehicles, electronic goods, clothes and shoes.

PLATE 7.1: Household Goods Repair Workplace in Bamenda, 17/3/03

7.2.4.2 Transformation

In a city such as Bamenda that has no industrial base and consumes manufactured goods coming in mainly from outside the region or country, reprocessing waste for industrial raw materials is out of the question. Some of the waste is transformed into locally needed articles. Old vehicle tyres, most of which come in second hand, are further transformed into flower vase, ropes, slippers, shoes, and vehicle bushing The latter is a big industry in Bamenda City (Plate 7.3). Some of the tyres are burnt and the wires recovered for making baskets. Aluminium waste comes from roofing sheets, vehicle parts and old utensils. It is transformed into pots, boxes, buckets, watering cans, cake pans, charcoal-cookers and grills, and sawdust stoves (Plate 7.2). From metal waste, knives, hoes, cutlasses, spears, spades, masks and tourist articles are crafted.

PLATE 7.2: A Display of Goods from Recycled Metal Waste "For Sale", Bamenda 17/3/03

PLATE 7.3: Recycled Vehicle-tyre Products in Bamenda, 22/3/03

7.2.4.3 Composting of MSW Fraction

7.2.4.3 (i) Introduction: Composting is a biological method of treating solid waste including MSW. It is a controlled process of biological breakdown of heterogeneous organic solid waste materials by a mixed and naturally existing population of micro-organisms, in a warm, moist aerated environment to derive carbon dioxide, water, mineral and reusable components such as stabilised organic matter called compost or humus. The latter is usually used as soil amendment for agriculture and horticulture. Other uses include, landscaping, landfill cover and roadside fills. Recent technology is experimenting with the use of bigger decomposers such as worms for composting.

7.2.4.3 (ii) Concepts and debates: Many authors agree that 50-90 % of urban solid waste in developing countries is organic. Agriculture in the urban and peri-urban areas is also prominent. These two factors of supply and demand, more than any other consideration, make composting attractive as an option for managing urban organic waste. Bamenda shares these characteristics. Three quarters of its solid waste is biodegradable and agricultural activities are characteristic of the city and its surroundings. However, debate centres on whether composting of MSW actually makes sense. One group, e.g., Dickerson (1999); Hoornweg *et al.* (1999) and EPA (2003) points to the fact that composting is environmentally sound because it diverts waste from landfills, enhances recycling and incineration operations and provides valuable soil amendment, suppresses weeds and soil borne pathogens, reduces soil erosion, improves soil texture and absorption of air and water, and saves money.

Another group including Renkow and Rubin (1998); Ngnikam (2001); Furedy (2002) and Mbuligwe *et al.* (2002) argues that it is still a limited solution. 'The experience with compost plants however has been fraught with multiple problems of feedstock; plant operation; the quality and price of the product; marketing; consumer understanding, and institutional support' (Rosenberg and Furedy 1996 cited in Furedy 2002, p. 1). In the opinion of these authors and others including UNEP-IETC (1996), most large mechanical composting installed in Africa, Asia and the Middle East in the 1970s and 1980s failed. As an alternative experiments with small undertakings and private enterprises using small-scale, low -mechanisation techniques, and neighbourhood-based composting and vermin composting, were begun with the assistance of international bodies. This has still not proved sustainable as costs of producing compost are still as high as $US 1514 per ton[2] as experienced in a pilot plant in Bangalore, with hidden costs of $US 724 excluded. A public-private strategy in which the city council supplies the private company with waste at the composting site is currently being tried (Hoornweg *et al*. 1999, Chakraborty 2000 in Furedy 2002). Furedy still questions their significance in reducing waste that goes into the landfills and argues that the high costs have diverted the focus of compost producers from the ordinary needy urban and peri-urban farmers to rich consumers owning plantations, expensive hotels, golf courses, and farmers growing very profitable crops, many of whom may not even be local (Furedy 2002).

Other authors in both the developed and developing parts of the world still support the viability of composting MSW on the basis of environmental as well as economic sustainability (Nkotto *et al.* 1995; Asomani-Boateng and Haight 1999; Hoornweg *et al.* 1999; Hickman 2001; Mustafa *et al.* 2002; EPA 2003).

Arguing the case for composting Hoornweg *et al.* (1999, p.11) point out that:

> Composting rarely generate profits on its own. However, when viewed as a component of an integrated solid waste management program, composting can provide economic benefits on a much larger scale. The costs of composting include raw materials, production costs, marketing, and hidden environmental costs, whereas the benefits involve the market value of compost, savings from avoided waste disposal costs, as well as various positive environmental impacts.

These authors believe that the poor conventional accounting system has often been a misleading and a discouraging factor to composting because such accounting excluded these hidden costs and benefits of environmental and social externalities especially as they are difficult to quantify. Citing Selvam (1996), the authors regret the use of such a traditional accounting approach by some municipalities, which has caused the closure of composting facilities in the past. Some additional benefits include reduction of surface and ground water contamination, methane gas emission, nuisance potentials, transport costs, pollution from burning waste erosion and improved efficiency of synthetic fertilizers. When biodegradable waste is allowed into the landfill during the aerobic and anaerobic decomposition process, Landfill Gases (LGs)-mostly large quantities of carbon dioxide and methane and other gases-are produced. While carbon oxide causes the blanket effects as it rises into the atmosphere increasing global warming, methane, which is about 20 times

[2] Renkow, W. and A. R. Rubin (1998).give the average cost of composting of MSW in the US at $50 per ton. The reason for this high cost in Bangalore is not known.

more potential as a greenhouse gas than carbon dioxide, is also famous for breaking down the ozone layer. These have effects on climate change and human health. Contamination of water bodies or blockage by waste, and burning of waste has been known to cause various illnesses in humans (7.4). If the biodegradable fraction of the urban waste stream were to be composted all these problems would not arise. On the contrary there will be gains from composting. These other gains suggest that with certain safeguards, composting remains a viable option for recycling the large organic fraction in MSW and reducing the amount of waste that must be taken to the landfill, and the economic and social gains that go with it.

7.2.4.3 (iii) Types and Uses: The following methods are available the world over for composting: land application, open windrow, worm composting, enclosed composting, aerobic and anaerobic composting, fermentation. Apart from land application, which is the practice whereby organic waste is directly injected into the farm to increase the available nutrients in the soil, the other techniques are overly engineering, more complex and not common in the developing world. In Bamenda, the most common technique of using urban biodegradable waste is by land application in backyard gardens or in urban and peri-urban farms. Some farmers make small scale aerobic composting using household waste and animal dung (from cattle, goats, sheep pigs, rabbits and poultry). In Chapter 6 it was noted that the council requested citizens to apply for the garbage van to deposit waste collected in the city on their farm plots at a fee. Such a practice no longer exists because the town has grown bigger and waste contamination has increased.

There have been attempts by some local NGOs to compost MSW. For example, Paradise on Earth is experimenting with small scale composting by collecting biodegradable waste from households or market women involved with food making. The council waste van sometimes helps drops the waste bags at its experimental site Plate 4.1. Some of the waste comes in through its urban waste exchange programme. In the programme, various waste items are exchanged for regularly used household items such as safety matches and bars of soap. The NGO then recycles them, composting being a key activity. The final product is used to raise vegetables, spices and flower seedlings for sale.

7.2.4.3 (iv) Conclusion: The Bamenda Urban Council (BUC) believes that if it were able to cause waste to be separated at source and then collect the biodegradable and non-biodegradable waste fractions separately, this would encourage the private sector to apply for composting. But it claims there are no available means for that exercise now (Interview with Waste Management Service Head, BUC). Hence there is no policy for separation, collection and the composting of municipal organic waste fraction of the solid waste stream. Composting in Bamenda remains largely at the rudimentary farm application level. Community or large centralized composting does not exist. Hence there are very limited efforts to engage in significant composting that can help reduce the rate of landfilling and illegal dumping.

7.2.5 Conclusion

There are many rudimentary and informal recovery activities of valuables from waste through separation and subsequent recycling, reuse, repairs and reprocessing in Bamenda. These processes go on quite instinctively and informally among households and individuals, driven solely by the sheer personal economic benefits derived from the recovery of such materials, rather than a policy instrument put in place to minimise waste that must be treated as stipulated by the solid waste management hierarchy. However, composting which could salvage 76% biodegradable fractions of the municipal solid waste stream from the dumps has not been developed. In all, the recovery process is limited and does not significantly reduce the waste that must be disposed of. The government has no policy on it and consequently devotes no funds to this purpose.

7.3 Solid Waste Disposal Practices in Bamenda.

7.3.1 Introduction

According to Cotton *et al.* (2002 p. 1) ‘the following options are currently available, the world over, for solid waste disposal: uncontrolled dumping, sanitary landfilling, composting, incineration, gasification, refuse derived fuels and pyrolysis’. These options are only the legal means and do not seem to take into consideration illegal dumping, indiscriminate waste burning and burying that are continuously applied to managing waste in most cities of the developing world. In the preceding chapter, it was realised that at the primary level, waste is informally handled and for a greater part, illegally disposed of. The BUC disposes of and manages the fraction of the waste that gets into the official waste stream in some form of a legal landfill. Both scenarios are examined in (7.3.2 & 7.3.3).

7.3.2 Illegal Disposal Practices

In the previous chapter (6 3.3) it was realised that only about 20% of the population put their waste into the public skips and one per cent into the itinerant garbage vans. The rest of the waste is illegally disposed of by dumping it in valleys, streams, on lake and river banks, road sides, open bushes, vacant plots, or put into holes or burnt. Several plates such as 6.2 and 7.6, illustrate these illegal practices. The1996 Cameroon Law on Environment (CLE) in Section 46(2) bans illegal dumping and empowers the competent authorities to eliminate it. Their environmental effects are far-reaching and are discussed in sections 7.3 and 7.4 of this thesis. One other general disposal phenomenon is street littering with fruit peelings, nuts shells, sugar cane peelings, plastic materials, paper, and bottles, all emanating from irresponsible street eating. Cigarette butts and beer bottle tops are also ubiquitous.

There are regulations in place prohibiting illegal disposal including littering, but these are hard to enforce. The BUC authorities try to enforce illegal dumping regulations directly by apprehending those caught contravening. Dumping of waste by the side of the public skips has been noticed, especially among those who bring waste in wheelbarrows. These people cannot single-handedly lift the wheelbarrow and its contents into the bin, so they drop waste by the side of it. The council also usually impounds such waste transportation equipment if is being used for illegal dumping. The impounded articles are only released on payment of the stipulated fines. Though these activities s are legal, the situation breeds animosity between the council and the citizens. Even putting up official billboards prohibiting illegal waste dumping on certain spots does not seem to have any deterring effects on the citizens' actions because the practice persists (Plate 6.3). One observation emerges clearly from this situation. It is that, the council and the citizens have never had a forum in which these issues could be addressed.

7.3.3 The Concept of Official Landfilling Facility

According to Senior (1990 cited in EL-Fadel *et al.* 1997), historically landfills were initiated largely to protect the environment and society from adverse impacts of alternative methods of refuse disposal such as open-air burning, open-pit dumping, and ocean dumping. Today landfilling is the least preferred option on the municipal solid waste management hierarchy, even though it remains an indispensable part of a sustainable solid waste management strategy. This is because all the residue waste from separation, recycling and incineration must be ultimately disposed of here. Additionally, it is a relatively inexpensive method of disposal in terms of effort, technology and financial cost. Increasing awareness of their environmental and health effects, and consequent opposition to their location near peoples' neighbourhoods (NIMBYism), together with a strategy to encourage councils and governments to adopt more sustainable options further up the waste management hierarchy, have been the main reasons for discouraging landfilling. Such measures also help avoid the traditional and problematic "end-of-pipe pollution solutions" that usually entailed complicated waste treatment technologies to repair the damaged environment. These factors notwithstanding, in many countries of the developed and developing worlds, landfills are still the main method of disposing of municipal solid waste. These countries still bury huge fractions of their solid waste in landfills. Examples are the UK 83%, Italy 80%, Spain 74%, Norway 62% (Adam *et al.* 1998; Malcom 2000), Australia 96% (Hohnholt and Meyers 2002), and Canada 90% (Environics and Group 2002). In the developing world, with the insignificant presence of composting and incineration, the rate approaches 100%.

In a study of 500 final disposal sites in the developing world it was observed that:

> The open dump approach is the primitive stage of landfill development and remains the predominant waste disposal option in most of the countries visited. A default strategy for municipal solid waste management, open dumps involve indiscriminate disposal of waste and limited measures to control operations, including those related to the environmental effects of landfills. In Africa most of the landfills are dumps by official classification (Johannessen and Boyer 1999, p. 4).

These authors suggest that as open dumps are not an upgrading situation to landfill waste, they should not be considered as parts of the classification of landfills proposed in Table 7.3. The major criteria used by these authors for classification include: engineering measures (lining and siting); monitoring, inspection and registration of waste that come in;

soil cover thickness and compaction; gas control; collection and treatment of leachate; plans for closure and impact of scavengers at the site.

Table 7.3 not only gives the classification of landfills but also their characteristics together with a pointer to those areas of environmental concern. Certainly, many other combinations of various characteristics would give more classifications than the ones established on the table. The table also exposes a spectrum from which the level of a particular disposal system, as well as its place in relation to the standards practices in place, can be judged. Summarily, a landfill site should have a liner system, storage space for waste arranged in cells, a leachate and gas collection system and finally, a cover or cap over the waste on a daily basis. Also see WHO's checklist for evaluating landfills in Suess (1985).

TABLE 7.3

Landfill Classifications

	Engineering Measures	**Leachate Management**	**Landfill Gas Management**	**Operation Measures**
Semi-Controlled Dumps	None	Restricted Contaminant [a] release	None	Few, some placement [b] of waste, still scavenging
Controlled Dump	None	Unrestricted contaminant release	None	Registration and, placement / compaction of waste
Engineered Landfill	Infrastructure and liner in place	Contaminant and some level of leachate treatment	Passive ventilation or flaring [c]	Registration and placement/ compaction of waste, use daily cover
Sanitary landfill	Proper siting, infrastructure; liner and leachate treatment in place	Contaminant and leachate treatment (often biological and physico-chemical treatment)	Flaring	Registration and placement/ compaction of waste, use daily soil cover. Measures of final top cover
Sanitary Landfill with Top Seal	Proper siting, infrastructure; and leachate treatment in place. Liner as top seal.	Entombment [d]	Flaring	Registration and placement/ compaction of waste; use daily soil cover
Controlled Containment Release Landfill	Proper siting, infrastructure; with low-pearmeability [sic] liner in place. Potentially low-pearmeabilility final top cover	Controlled release of leachate into the environment, based on assessment and proper siting	Flaring or passive ventilation through top cover	Registration and placement/ compaction of waste, use daily soil cover. Measures of final top cover

a. Containing leachate and treating it before discharge so as to protect the environment.

b. Control and organisation of the tipping cells and front

c. Controlled burning of gases coming out of the landfill

d. Also known as “dry approach” aims to prevent water from coming into contact with the waste.

Sources: (Johannessen and Boyer 1999, p. 7)

7.3.4 The Bamenda Official Solid Waste Disposal Facility

The facility, which came into operation in 1995, is owned and managed by the Bamenda Urban Council (BUC). It is located on the northeast outskirts (10^0 07′44″E $05^0$59′05″N, 1220-1240 m altitude), eight kilometres from the city centre along the Bamenda Airport-Bafut tarred Road. This road bounds the approximate 10 ha facility to the east, River Mezam to the north and south by a loose-surface street that leads into Ngomgham Quarter (Figure 7.1 & Plate 7.4). The underlying soils range from the alluvium by the river valley in the north, to clay and laterite by the upper slopes to the south. The site is more than one km away from the nearest residential houses.

The waste disposal facility receives daily about 20 –50 tonnes of heterogeneous wastes from multiple sources including the council, institutions and individuals. There appear to have been no special engineering and siting considerations made. There is no natural or synthetic lining provided to organise leachate and gas flow and the front of the landfill is now on the river flood plain. While the council has a conceived "cell" plan for tipping waste, incoming waste from other users is neither monitored nor controlled, so it is dumped haphazardly on any available space within the dump. Tipping fees do not apply, whereas, in many other cities of the developing world an average of $US 10/ton tipping fees are charged and collected (Johannessen and Boyer 1999).

The management process is simple. There is no application of soil-cover on the waste deposited. When it accumulates in larger quantities or gets too close to the roads, a bulldozer or front-end loader is brought in to push the waste down slope, towards the river valley. In the dry season the waste is burnt to reduce its volume before the bulldozer does the pushing and levelling up (Plate 7.4 & 7.5). This is all the cost attributed to landfill management and when compared to collection and transportation costs, it is insignificant.

Attempts to monitor or collect landfill gases do not exist. Leachate flow has not been noticed in the dry season but in the wet season with rains and surface water ingress, especially as there is no drain that separates the facility and the loose-surface street leading into Ngomgham, leachates migrate laterally and flow out of the landfill front. Flies, mosquitoes and odour are permanent nuisances at the site. Apart from the occasional presence of a few auto repairers or manure miners at the dump to extract some valuables, scavengers and domestic animals are absent at the dump. The facility is not fenced rather it is open. These characteristics place Bamenda's disposal facility at the level of an open dump.

A Dry Season

B Wet Season

PLATE 7.4 The BUC "Landfill", 2003

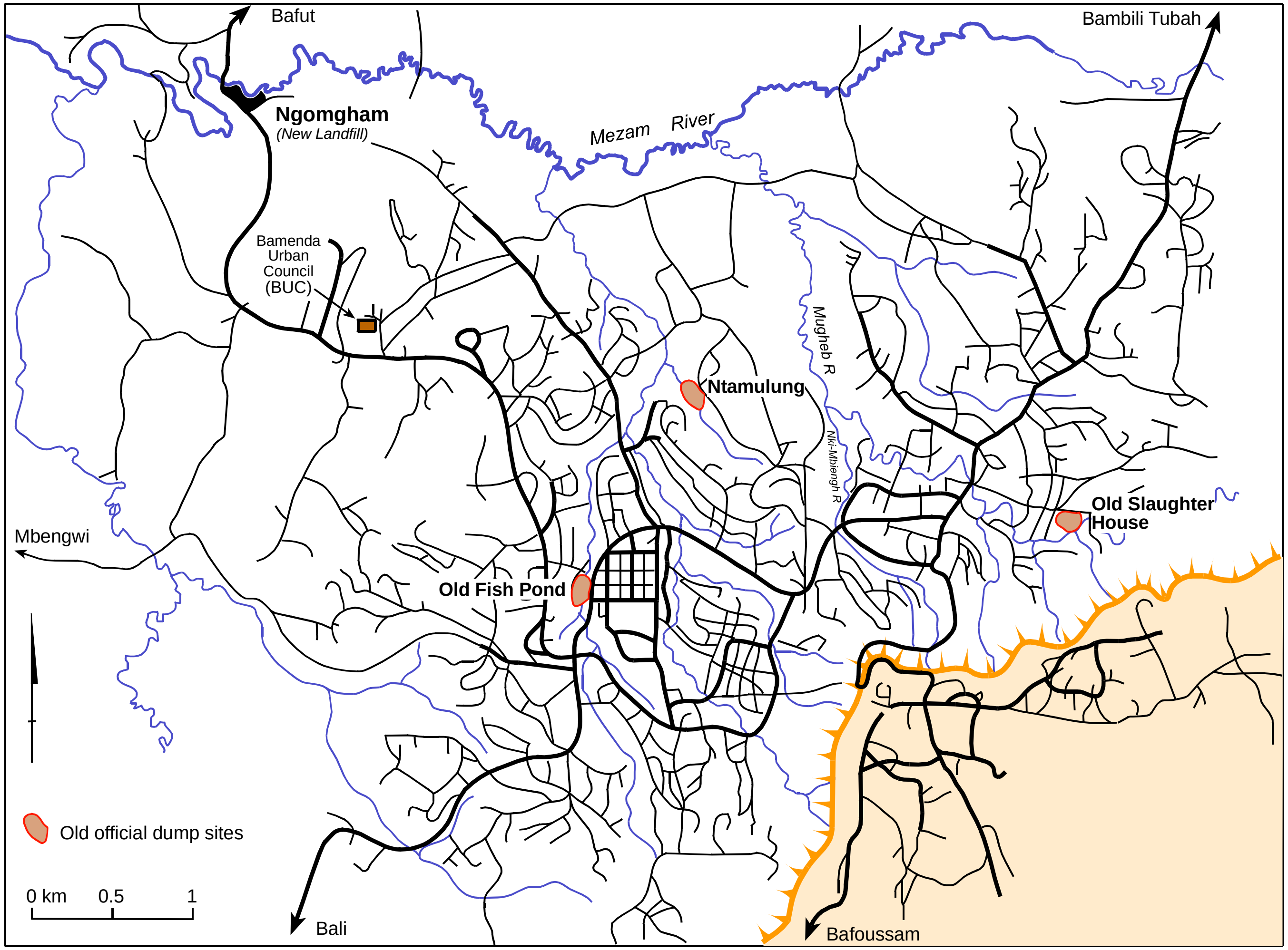

FIGURE 7.1: Old Official Waste Dumps in Bamenda

Old official dumpsites include the GBHS, Old Slaughter House, and Old Fish Pond Sites (Figure 7.1). These old sites have no remedial plans, neither have they completely ceased to be dumpsites for neighbouring residents. The parts that are not receiving fresh waste are converted into farms. A greater part of the Old Fish Pond site has been reclaimed and developed into the City's Food Market but one part of it is still an unofficial dump for market waste. This forces the council to constantly remove waste disposed of there. Sometimes it is simply burnt (Plate 7.5).

The present official dump at the Mezam River Bridge may soon be problematic because there are plans to create another urban market and vehicle park about three kilometres beyond the site on the Airport-Bafut Road. The site will cease to be isolated and peripheral to the city and its environmental impacts will be felt by many, consequently generating more protests for its closure. The council will have to face the new problems of getting a new site, balancing opposition form NIMBYism, long transportation distances and higher costs.

7.3.5 Conclusion

About 79% of MSW in Bamenda is illegally dumped in valleys, stream and riversides, road and street sides, open spaces, empty plots and holes. Burning is a prevalent disposal technique and littering is ubiquitous. The present official solid waste disposal site in Bamenda city receives about 20 000 tonnes of heterogeneous waste in a year. This facility is sited in a fragile environment- the valley of the biggest river that serves the city, the division and beyond. The operations at the site lack basic landfill requirements; hence it is classed as an open dump. The environmental impacts posed by these inadequate disposal practices are many, either present or potential. They have not been addressed, perhaps not thought of, or have simply been ignored or not seen as a priority by the authorities concerned. Discussions on these impacts follow.

7.4 Environmental Problems Associated with MSWM in Bamenda.

7.4.1 Introduction

Inefficient and inadequate MSWM in Bamenda has caused significant health and environmental problems, some of which are present and others threatening. According to the Kiev Report by the European Environment Agency {EEA} (2002), cause-and-effect relationships are quite established for some issues such as water and air, but for climate and waste, the impacts on health are often delayed or are the products of many environmental factors acting together. Hence the description of human health effects is often less precise, because of problems of exposure classification, small sample size, confounding and reporting bias, which is why many authors recommend a precautionary approach. In the same vein Rushbrook (2001) cited in the Kiev Report, argues that epidemiological studies on waste and health are seriously affected by confounding factors such as lifestyle, smoking, diet, house quality, susceptibility of ethnic, gender, or age groups to particular medical conditions.

However, recent environmental epidemiological studies by EUROHAZCON[3] investigated the incidence of congenital non-chromosomal anomalies within 0-3 km and 3-7 km of 21 hazardous landfill sites in Europe. The results suggested that women who lived within 0-3 km of the landfill sites were more likely (by 33%) to have a malformed foetus than women who lived further away from the sites. It was well-researched and confounding factors such as socio-economic status were investigated and found to have no links (Dolk *et al.* 1998; Kingman 2000; Department of Health {DOH} 2002). The chance factor was somehow cleared when the second study by the same team investigated congenital chromosomal anomalies including the Down Syndrome around 23 hazardous landfill sites in Europe Using the same distances, the second study still suggested an increased risk of chromosomal anomalies similar to that found for non-chromosomal anomalies in the earlier study (Department of Health {DOH} 2002; Vrijheid *et al.* 2002). Even though this does not exhaust the possibilities of some unidentified bias, it advances the debates on waste/health association especially as it helps identify more indicators.

[3] EUROHAZCON is a collaborative study among some Europe countries including England, Denmark, Belgium, France and Italy that investigates a number of congenital abnormalities related to hazardous waste landfills in Europe.

Drawing from established indicators, existing and potential human and environmental impacts of solid waste management as observed, surveyed and documented in the Bamenda field study, are described. The discussion of the impacts is divided into two levels: the ones emerging from the primary level and characterised mainly by illegal dumping, and those from the official disposal site including transportation. Both levels of waste management practices cause similar environmental and health effects that vary only in scale. The toxicity of the chemicals produced by waste-generated leachate, odour, gases, litter and dust, is examined. Toxicity has an inherent ability to impair health. It could be chronic (causing a health hazard after many years), or acute (causing immediate detectable and treatable health problems such as diarrhoea, nausea, convulsion etc). Chronic toxicity is difficult or impossible to treat and constitutes three main categories, also often used to study the waste/health association, namely: carcinogens (chemicals causing cancer), metagens (those that can change genes in chromosomes and consequently inheritance) and teratogens (those capable of producing birth defects).

7.4.2 Environmental Problems of Primary Solid Waste Management

7.4.2.1 Introduction

In the preceding chapter (6.4.4) it was noted that households used mostly old containers as receptacles for storing and transporting solid waste, 87.4% of which lacked covers. Most of these containers not only leak out leachate and odours to the environment but also attract flies, rats and domestic animals around the houses and the neighbourhood. A sample survey conducted to evaluate the environmental conditions at the public waste skip sites also suggests that these sites have always been unpleasant places to visit. The waste conditions mentioned above at the household level become more magnified at the skip sites and are further complicated by the presence of strewed waste beside skips. This is one reason why some people throw waste around the skip and not inside or why they would not even choose to go there at all. The following environmental issues around the public skip areas were investigated and the results are summarised in Table 7.4.

TABLE 7.4
Environmental Concerns Around Public Waste Skips

Environmental concern	Yes	%	No	%	Total	%
Skip well placed?	31	**37**	52	**63**	83	**100**
Dark flowing waster?	69	**68**	32	**32**	101	**100**
Presence of odours?	85	**84**	16	**17**	101	**100**
Mosquitoes/cockroaches?	81	**80**	20	**20**	101	**100**
Presence of fires?	15	**15**	86	**85**	101	**100**
Domestic animals?	76	**77**	24	**24**	101	**100**
Rats around skips?	38	**38**	63	**62**	101	**100**

Sources: Compiled from 2003 Bamenda survey cross tabulations

7.4.2.2 Vectors

From the survey 84% of the people experience the presence of odours, 80% mosquitoes, flies and cockroaches, 77% domestic animal, 38% and 68% dark flowing water (leachate), at the public skip sites. Flies sit on piles of rotting garbage and mechanically transmit fatal diseases such as Diarrhoea, Dysentery, Typhoid, Hepatitis and Cholera. Mosquitoes transmit Malaria, Yellow Fever, Trypansomiasis (Sleeping Sickness) and Filariasis. Meanwhile dogs, cats and rats are known to transmit diseases such as Plagues and flea bone fever carried from garbage sites. Domestic animals used for human food including pigs, goats, and sheep that rummage in garbage heaps equally act as hosts transmitting disease acquired from such sites to humans.

7.4.2.3 Waste Burning

According to Williams (2000), humans in Africa have since the advent of the Acheulian tradition some 1.5 million years ago, used fires to assist in accomplishing tasks such as farming and grazing. This practice has been extended to municipal solid waste management in most cities of developing countries. Fires are widely used to eliminate solid waste both in private and official waste facilities especially in the dry season. Old tyres are burnt to recover wires for baskets (7.2.4.2). Some of the fires are big and many appear only at night such as the one caught by the author’s camera at the Old Fish Pond dump (Plate

7.5). Burning contributes to environmental pollution through its obnoxious odour and black dense smoke in the immediate neighbourhood and to the general increase of greenhouse gases in the atmosphere and consequently the increase of global warming (7.4.4). Solid waste containing chlorine such as plastic, heavily present in the urban waste stream in Bamenda, produces dioxin during burning. Dioxin[4] is the most toxic man-made substance (second only to radioactive waste) and produces a remarkable variety of adverse effects on humans and animals including cancer, birth defects, decreased psychomotor ability, hearing deficits, congenital and behavioural alterations in infants, even at extremely low levels of exposure (World Health Organization 1999; Campbell 2003; WWF-Pakistan 2003). The International Agency for Research on Cancer (IARC) in 1997 based on human epidemiological data, categorised dioxin as a 'known human carcinogen' (World Health Organization 1999). Intake by humans is either directly through inhalation of tiny air borne specks, ingestion of that which settles on crops, lakes and streams directly or through primary and/or secondary hosts such as plants and animals consumed as food.

The council appears to be aware of some of these environmental and health issues and it actually discourages burning of waste. Apart from hospitals and research institutions there are no controlled burning MSW facilities, usually called incinerators. So it is not known who actually sets fires on their waste facilities. It is hard to have a waste-elimination fire void of plastic materials and consequently dioxin production. Burning is lethal yet the risk is not apparent so the action continues with impunity.

[4] Dioxins are mainly unwanted by-products of industrial processes (from chlorine-containing organic substances, smelting, bleaching of paper pulp, and manufacture of herbicides and pesticides) and naturally from forest fires and volcanic eruptions. Much of it comes from incinerations (WHO, 2003)

PLATE 7.5: Burning of MSW in Bamenda at an Illegal Dump (7 p.m. 19/3/03 near Food Market)

7.4.2.4 Illegal Dumping, Contamination and Floods

Dumping waste in streams, drains and general littering is a serious problem to the environment and public health. The waste contaminates the soils, ground water, and streams; it also blocks standing waters that serve as breeding places for disease-carrying mosquitoes. The 1996 Cameroon Law on Environment (CLE) Section 50(2) stipulates that ‘it is strictly forbidden to deposit waste on state property’. Section 25 classifies inland waters as state property and Section 28 prohibits all disposal practices, direct or indirect, that are likely to cause the degradation of surface and ground water by modifying their physical, chemical and biological characteristics. The laws are yet to be enforced as the following paragraphs illustrate.

Laboratory or on-site tests[5] to evaluate chemical and biological qualities of waste contamination of streams such those conducted by Anschutz *et al.* (1995) are beyond the scope of this study and were not carried out. However, direct field observation of physical characteristics of streams for environmental appraisal was done. It revealed high turbidity of streams with multi-colours, offensive smells, choked with floating and rotting waste.

[5] Such tests include: Spectrophotometer to measure suspended particles and turbidity; colour comparator for colour; glass electrode to calibrate pH. Diatom analyses are increasingly being used to determine quality of water. Olfactory-meter to test odours.

This suggests that the water may be even more polluted today given the increase in population since Anschutz et al's study in 1995 (Plates 6.2A & B, 7.6A & B). Departure from clarity depicts the level of contamination present and odour or smell is the result of decaying organic materials or solutions, the presence of organisms or of human waste.

The experiment by Anschutz *et al* (1995) along two tributaries of the Mezam River tested a few characteristics. Results show that as the streams flow through the city they are systematically contaminated, as measured by temperature change, organic matter in mg/l, pH, and iron (mg/l) at different points (Table 7.5).

TABLE 7.5

Some Chemical and Physical Parameters along Two Stream Points in Bamenda City

Place	Temperature	Organic matter (mg/l)	pH	Iron content (mg/l)
Stream A: Point 1[a] Ayaba	18.7	2	7.1	0.1
Point 2 Post Office	20.2	4.4	6.8	1.0
Stream B Point 1: Before Fishpond dump	21	5	8.4	0.4
Point 2: After Fishpond dump	21	5.2	8.4	0.4
Point 3: La Chance Bridge	20.1	3.0	7.1	0.1

a. Lower numbers represent the upper course of the stream.

SOURCES: (Anschutz *et al.* 1995, P. 33)

Table 7.5 shows that iron content, acidity, organic content and temperature increased steadily with distance as stream (A) flows past Ayaba, Old Town quarter and the Post Office to the Mezam River. Along stream (B) conditions before and after the dump remained unchanged, except that organic matter increased. However, about 800 m down stream at La Chance Bridge, levels of iron skyrocketed, acidity set in but a drop was noticed in the organic content and temperatures. The general trend suggests that as the streams flow through the city they gradually assimilate these chemicals and minerals from waste deposited directly into the water or on their banks.

These rates are not yet dangerous as illustrated from FEPA's maximum acceptable standards rates (footnote 5) in the study by (Aluko *et al.* 2003) carried out on the Omi stream dosed with leachates from the Ibadan landfill established in 1994. But the South West Public Health Observatory (2003) argues that in some substances such as polychlorinated biphenyls (PCBs), chronic low levels are more important than acute toxicity and concludes that: 'long term low level releases from waste management operations have the potential to lead to a substantial level in the environment and body' (South West Public Health Observatory 2003, p. 2). Moreover, gradual accumulation of these toxic elements within the food chain could be extremely dangerous to consumers up the food chain such as humans.

These Bamenda City streams are heavily used to irrigate vegetables and other farm crops especially during the dry season. The streams are generally used for fishing, bathing and other domestic functions. Palms from which local wine is extracted grow along these stream valleys. The people of this area heavily consume the wine. Intake of these chemicals through the food chain and other heavy metals such as cadmium, zinc, lead, mercury, (which were not analysed[6] in the Anschuts's study), could be very harmful to human health. It is hard to draw a correlation between waste management and specific illnesses but increasing literature such as that of WHO and other publications already cited suggest a positive relationship between poor solid waste management and some diseases (7.4.2.2; 7.4.2.3) while on going research is trying to prove that some of these relationships are not casual (Department of Health (DOH) 2002).

TABLE 7.6
Waste-related Health Concerns in Bamenda

Health concerns last 6 months	**Bought insecticide**		**Bought raticide**		**Had an illness**	
Quarter	**Yes (%)**	**No (%)**	**Yes (%)**	**No (%)**	**Yes (%)**	**No (%)**
GRA Up Station	7 (44%)	9 (56%)	4 (25%)	12 (75%)	5 (39%)	8 (61%)
Nchuobuh	8 (56%)	10 (46%)	10 (56%)	8 (44%)	13 (63%)	3 (37%)
Nta Mbag/Old Town	35 (71%)	14 (29%)	25 (51%)	24 (49%)	33 (67%)	11 (%)
Ndamukong	12 (60%)	8 (40%)	5 (33%)	15 (67%)	12 (63%)	7 (37%)
TOTAL	**62 (60%)**	**41 (40%)**	**44 (43%)**	**59 (57%)**	**63 (61%)**	**21 (39%)**

Sources: Field survey cross tabulation summaries, Bamenda March 2003

[6]Indicators and some standard rates: turbidity (ETF 5), dissolved solids (DS), Total Dissolved Solids (TDS) (2000 mg/l), chloride (600 mg/l), ammonia, dissolved oxygen (DO), sulphate, biochemical oxygen demand (BOD) (50 mg/l), phosphate, lead (<1 mg/l), nickel (<1 mg/l), cadmium (<1), manganese (0.5 mg/l), zinc (<1), suspended solids SS (30 mg/l), chemical oxygen Demand COD, Temperature (40 ^{0}C), iron (20 mg/l), pH (6-7), colour (HU 7) (Aluko *et al*. 2003).

A survey on the health situation and related preventive measures were investigated to assess not only how poor management of solid waste brings about illnesses but also how it increases indirect costs, as citizens spend money on buying insecticide and rat poison so as to keep away mosquitoes and rats attracted by the presence of waste. The summary in Table 7.6 suggests that more than 60 % of the people had bought insecticide and had some illness. In a follow-up question it was identified that the predominant illnesses were: malaria (80%), typhoid fever, diarrhoea and flu. The incidence tended to increase in areas with decreased waste management facilities. The per cent of respondents who purchased rat poison was lower. In the field we were told many people would have loved to use the latter, but were scared of the risk of children having access to it. Pesticides used for prevention pose considerable health risks.

One other danger of dumping waste in drains and in water ways is blockage of stream channels at bridges with such waste leading to serious flash flooding (Plate 7.6 B). The floods usually obstruct road transport, cause inundation and demolition of houses built with sun-baked bricks, which is a common mode of construction in the areas. In some places waste from the piggeries and sewage from households are sent directly into these streams. These actions infest the streams with bacteria and protozoa capable of transmitting diseases.

A. Contaminated streams (22/3/03)

B. Culvert blockage by flash floods bearing assorted solid waste (02/4/03)

PLATE 7.6: Environmental Problems Associated With Waste and Drainage, Bamenda

7.4.3 Transportation and Environment

Waste transferred in the compactor trucks is quite secure because it is well enclosed and only released at the landfill. Its danger lies in transporting fires hidden in skips to the landfill. However, the situation of waste transported during the special clean-up campaign days in tipper trucks that are used to evacuate waste removed from the gutters and the neighbourhoods to the disposal site, is more worrying. Since waste transported by these trucks is uncovered, some of it either falls over onto the roads or flies into the air causing pollution. The odour it emits as it moves through the city is also a nuisance.

7.4.4 The BUC Official Waste Dump and Environmental Problem

7.4.4.1 Introduction

The inevitable consequences of the practice of MSW disposal in landfills is the generation of landfill gases (LGs), odours and leachates, all created inadvertently by the processes of decomposition and fermentation. Factors influencing these processes at the landfill are: engineering, operational practices, age, climate, hydrographical conditions, composition of the waste and the size of the landfill. There is only one official dump receiving all sorts of MSW including hazardous types usually identified by their flammable, corrosive, explosive, toxic, pathogenic and generally harmful nature to humankind, the soil, water and air. Households contribute significant amounts of hazardous waste to disposal facilities through white goods, electronic goods, paints, pesticides, fertilisers, plastics, tyres and batteries. Landfills are a potential threat to human health and the environment. While accumulations of LGs can cause explosions, leachate has the potential to contaminate valuable ground and surface water. The negative human and environmental effects of these landfill products could be well outside the knowledge of the citizens and the landfill operators in Bamenda. Large illegal dumps in the neighbourhoods pose comparable threats, the difference being only that of the scale.

7.4.4.2 Landfill Odour

The Bamenda landfill emits offensive odours or smells. According to Young and Parker, 1983, 1994 in (EL-Fadel *et al.* 1997, p. 11), 'smell comes from concentrations of odorous constituents such as esters, hydrogen sulfide, organodulphurs, alkylbenzenes, limonene and other hydrocarbons in landfill gas emitted into the atmosphere'. The same authors note that the stage and rate of decomposition together with the nature of the waste and of microbial population would determine the emission of odours. Odour was earlier seen as a mere environmental nuisance rather than a health hazard, but recent studies such as that of Shepherd *et al.* (2001) confirm that odour can spread for more than a mile, causing unpleasant sensations, triggered by reflexes in the body and resulting in health effects such as nausea, vomiting, headache, upsetting of stomach or appetite, upsetting of sleep, shallow breathing, decreased heart rate and constriction of blood vessels in the skin and muscles, alteration of cells of olfactory bulbs of the brain, irritation of the eyes, nose and depression together with a general decrease in the well-being and enjoyment. Odour may also trigger asthma attacks and exacerbate pre-existing medical conditions including 'morning sickness' in pregnancy. It is worth noting that some gases such as methane, which have no odour or even colour, are also dangerous to human health.

7.4.4.3 Landfill Gases (LGs)

The major LGs are methane (40-60%) and carbon dioxide (30-40%). The rest are minor and include nitrogen and oxygen. In a simplified form, carbon dioxide (and waster) is given off during the initial and shorter phase mainly from the decomposition of organic matter by oxygen-using (aerobic) micro-organisms. In the later stages different micro-organisms (methanogens) continue the break down of the waste by the process of fermentation, in the absence of oxygen (anaerobic) but with sufficient moisture, producing methane gas. Landfills are the source of more than half of the world's anthropogenic methane. In the landfill both carbon dioxide and methane are either trapped within, migrate naturally into atmosphere or are vented out, used or flared in the case of methane. Methane can be collected and used to generate electric power. According to Shepherd *et al.* (2001), 1 million tonnes of MSW in the landfill can produce 300 cubic foot of landfill gas per minute (cfm). If successfully collected it can be used to generate 7 000 000 kilowatt hour (kWh) per year, enough energy to power 700 homes for a year. But if not collected it is a potential danger.

In addition to the impacts of LGs discussed through odours (7.4.4.2), methane and carbon dioxide are known to cause local smog and global warming with potential widespread effects on sea level rise, floods, drought and biodiversity. Methane is 21 times more potent than carbon dioxide as a greenhouse gas causing global warming. It is also a powerful ozone depleting substance (ODS). The effects of ozone depletion on humans include skin cancer and eye cataracts. The WHO (2000) confirm that:

> For each 1% decrease in stratospheric ozone, average annual percentage increase in the incidence of nonmelanoma skin cancer ranges from 1% to 6%, and for squamous cell carcinoma and basal cell carcinoma range from 1.5%-2.5%. Over the past decades it has become clear that UVB exposure can impair specific and non-specific immune responses (European Environment Agency {EEA} 2002, p. 18).

LGs can spread as far as two kilometres causing health effects to those working at the site and around it. The gases are also known to inhibit vegetation development during the restoration period of old landfills to other uses such as parks and agriculture. The old and new landfills of Bamenda have no mechanisms for extracting gases. A recent study in the UK using modelling techniques by Bridges *et al* (2000) noted that: 'landfills without gas collection pose a potentially higher risk than municipal solid waste incinerators performing to UK standards' (European Environment Agency (EEA) 2002, p. 12). Understandably, landfills and incinerators are inextricably linked because incineration ashes end up in landfills. The sizes and age of the Bamenda dumps notwithstanding, they are a potential danger from landfill gas explosions and other effects.

Landfill gases have volatile organic compounds (VOCs) and have been found to have clear teratogenic potentials or other reproductive effects even at smaller doses or exposures as proven from animal and human data.

TABLE 7.7

Health Effects of Landfill Gases-the VOCS

Compound	**NOAELa**	**Effects**
Benzene	32 mg/m^3	Reduced foetal weight Retard ossification
Tetrachloroethylene	2000 mg/m^3	Embryolethality Foetotoxicity
Trichloroethylene	0.2 mg/kg bw	Cardiac defects
Vinyl chloride	130 mg/m^3	Retard ossification Male testicular effects Reduced male fertility
1.3-Butadiene	88 mg/m^3	Reduced foetal weight
Carbon disulphide	----	Uncertain malformations
Chloroform	147 mg/m^3	Reduced foetal weight Retarded ossification
1,2-Dichloroethylene	0.025 mg/kg bw	Cardiac effects
Ethylbenzene	430mg/m^3	Embryolethal Foetotoxic Teratogenic
Formaldehyde	12 mg/m^3	Reduced foetal weight
Methyl chloride	525 mg/m^3	Cardiac effects

a. 'Non-Observed-Adverse-Effect-Level'. Shows the level above which the effects are dangerous.

Sources: "Health Effects of Landfill Gas" in (Shepherd *et al.* 2001, p. 4)

Table 7.7 gives a summary of the most significant effects yet studied. The risk of cancer around landfill sites together with leukaemia, lymphoma and liver cancer has been suggested but results are still undergoing scrutiny. Flaring of gases is one way of managing LGs but investigations have found that flaring produces dioxin. Dioxin itself creates a plethora of human health problems (7.3.3).

Another increasing source of gases and other toxic substances in the MSW system, including landfills, comes from electrical and electronic goods. They range from refrigerators, air conditioners, cellular phones and stereo sets to computers and their peripheries. The waste is usually called E-waste. These goods are problematic, firstly, because they contain more than 1000 different substances, many of them toxic, which pollute on disposal, during recycling, repairs or recovery of valuable parts. Secondly, they are generated at a high rate and get obsolete too soon making replacement easier and cheaper than repairs. These huge unwanted quantities of equipment are exported to the developing countries, including Cameroon, by businessmen or as gifts or donations to be reused, repaired or recycled. With the desire to join the globalisation wagon on the one hand and poverty impinging on the other hand, the use of these electrical and electronic goods is fast entering the normal lives of the people. But many of them are second hand and soon get to the end of their useful lives and beyond repair. They are either sent to the landfill, dumps or left to rot by the repair workshops or homes.

Freezers, refrigerator and air conditioners, usually imported, contain the chlorofluorocarbons (CFCs) used as coolant gas. This gas is one of the major ozone-depleting substances (ODS) and already banned by international conventions such as the Vienna Convention (1985), the Montreal protocol (1987) and the London Amendments (1990)[7]. The CFCs break down the stratospheric ozone layer, which shields the harmful ultraviolet-B (UV-B) radiation from the earth's surface. Increase in these rays in the earth cause increased risk of skin cancer on humans, harm to aquatic life such as phytoplankton, zooplankton and larvae of many fishes. Increased UV-B has been shown to reduce plant yield as well as altering the balance in competition between plants (Bergquist 2002).

A recent report by a coalition of environmental organisations in China, India and Pakistan warns against the dangers of the developed world exporting huge amounts of hazardous E-wastes into these countries, also see (Markoff 2002; Mohamed 2002; Kendra 2003). Cameroon receives them also, and consequently shares the state of affairs. A summary of major hazards in E-waste highlighted in the report: "Exporting Harm", is as follows:

[7] The conventions urged states to freeze CFCs at 1986 levels and scheduled for decrease to starting from 1993, complete phase out in the developed countries by 1996 and all countries by 2010.

> Although it is hardly well known, E-waste contains a witches' brew of toxic substances such as lead and cadmium in circuit boards; lead oxide and cadmium in monitor cathodes ray tubes (CRTs); mercury in switches and flat screen monitors; cadmium in computer batteries; polychlorinated biphenyls (PCBs) in older capacitors and transformers; and brominated flames retardants on printed circuit boards, plastic casings, cables and polyvinyl chloride (PVC) cable insulations that release highly toxic dioxins and furans when burnt to retrieve copper from the wires (Puckett *et al.* 2002, p. 9).

Section 44 of the 1996 Cameroon Law on the Environment (CLE), prohibits the introduction, discharge, stocking or transit of waste produced out of Cameroon considering its international commitments and specifically, Section 57(1), as with the 1989 Basel Convention, bans the importation of toxic and hazardous substances. The scenario described above presents a tricky way by which exporters as well as importers of varieties of waste are turning around the national laws, directives and international conventions to have a safety valve through which illegal waste is traded.

7.4.4.4 Landfill Fires

The landfill in Bamenda, like elsewhere, has huge quantities of inflammable materials such as tyres, plastics, batteries, dry leaves and grasses (Plates 7.4 & 7.7). Fires can originate accidentally, naturally or deliberately. Accidental fires come from deposing waste bearing undetected fire; fire from exhausts of waste disposal trucks or machine and workers smoking at the site or passing by. Natural fires may be caused by ignition from mixed hazardous waste, escaping gases or lightening. While deliberate ones might aim at reducing waste volumes, malicious fires are simply acts of vandalism.

In addition to impacts already discussed (7.4.2.4), landfill fires can cause serious injury such as burns. Explosions from sealed drums, cans, bottles, landfill gases can result in surface cracking, subsidence, injury and even death (Woodward 1997). Exposure to by-products of burning is dangerous and was discussed earlier. Gusty winds, which are prevalent during the Harmattan can spread these fires to neighbouring buildings and other property.

A: Burning

B: Contamination of River Mezam

PLATE 7.7: Environmental Problems at Bamenda Landfill

7.4.4.5 Landfill Leachate

Leachate is soluble organic and mineral compounds formed during chemical and biological process taking place in the landfill that flows to the surface assisted by gravity, precipitation, irrigation, runoff, ground water intrusion and initial moisture in the refuse. Natural or artificial liners are usually put underneath and along the sides of the landfill to prevent leachates and gases from infiltrating the soils and ground water. The characteristics of the leachates are determined by the management techniques, type of materials received, pH, temperature, precipitation, age and size of the landfill.

The Bamenda open dump is not yet experiencing serious leachate flow. It is small, relatively young and annual precipitation is relatively low with high evaporation especially in the dry season. Leachate has been noticed at the public bins (7.4). The official dumps that receive these wastes remain vulnerable to leachate production and its associated environmental and health impacts. Leachate seeps into the floodplain of the Mezam and into the river itself unnoticed and consequently neglected. This is dangerous to the soils, ground and the surface water and has already been discussed on stream contamination by illegal dumps (7.4.2.4). With globalisation, waste is also becoming global in character. Household, commercial and institutional wastes in Bamenda contain hazardous substances including chemicals. These chemicals enter the environment during recycling or when disposed of in landfills or illegal dumps and get to humans through various exposure routes. Potential health effects related to some of these chemicals and vulnerable group are summarised in Table 7.8.

TABLE 7.8

Potential Health Effects Attributed to Chemicals

Health effect	Sensitive group	Main chemical/pollutants
Cancer	Gender-related, elderly, adolescents (breast cancer), and children (leukaemia)	Asbestos, PAH, nitro-PAH Benzene, some metals, radon, natural dioxin, endocrine disrupters
Cardiovascular diseases	Especially elderly	Invalable particles, carbon monoxide, arsenic, lead, cadmium, cobalt
Respiratory diseases	Children, asthmatics	Inhalable particles, sulphur dioxide, nitrogen dioxide, ozone, hydrocarbons, solvents, terpenes
Allergy and hypersensitivities	Children	Inhalable particles, ozone, nickel, chromium
Reproduction	Foetus, young	PCB, DIDT, dioxins, phthalates, lead, mercury
Nervous system disorders	Foetus, children	Methyl mercury, lead, manganese, aluminium, organic solvents, dioxins, PCB
Osteoporosis	Elderly	Lead, cadmium, aluminium, selenium, endocrine disrupters

SOURCE: WHO 2001

7.4.4.6 Landfill Dust

During the dry season, air borne dust is commonplace. It is propelled into the atmosphere naturally by local cyclonic winds and North East Trade Winds (Harmattan) or mechanically by machines operating in or around the unpaved road at the landfill. The dust carries with it ashes, particles of chemicals, light plastics, leaves and papers. The dust not only chokes but also irritates the human eyes and the body. It combines with smoke from the landfill fires and machine fumes to cause smog that obscures the air, covering houses and vegetation for hundreds of metres and sometimes impairing visibility for vehicle drivers on the adjacent highway. This toxic dust may also settle on vegetables and fruits. Ingesting such contaminated food without careful cleaning can result in health problems.

7.4.5 Conclusion to the Environmental Impacts

Environmental and health impacts at the primary waste management level are associated with inappropriate and inadequate waste collection, transportation of household bins and illegal disposal practices. The bins are old broken containers, mostly uncovered, which leak odours and leachates and attract disease vectors that further transmit various illnesses to humans. About 79% of the waste is illegally dumped, burnt or buried. These actions produce multiple impacts such as soil, ground water and stream contamination, and air pollution. The transportation of uncovered waste in tipper trucks through the city to the disposal sites usually causes littering and air pollution through dust. The official waste disposal facility receives mixed waste from the city. It is an open dump characterised by odours, gases, fires, leachates and dust. Each of these emissions has existing and potential health and environmental problems, some of which are critical, yet unknown to the citizens and authorities concerned and consequently not addressed. Broad laws exist at the national level on waste and environmental protection. However, details at the city level remain sketchy, as orders are not rigorously enforced.

7.5. Financial Costs Estimates for MSWM in Bamenda

The use of equipment, materials, personnel and finances within council services is so mixed that it is hard to calculate costs for a single service such as MSW management. I derived a strategy by using the official open-market rates to estimate the financial costs incurred by the Bamenda Urban Council for MSWM in the city. The bulldozer works two days for five times spread over the year, levelling up at the dump. Front-end loaders and tipper trucks work on monthly clean-up day and the compactors, six days every week. The results are summarised in Table 7.9.

TABLE 7.9
Financial Costs Estimates of MSWM by the BUC

Type of equipment	Number of equipment	Daily hire cost (8hrs)*	Cost of fuel/day*	Total	Number of days/year	Total	%
Bulldozer DC8	1	500 000	117 300	617 000	10	**6170000**	**7.07**
Front end loader	1	280 000	78 200	358 200	12	**4298400**	**4.93**
7- ton tipper truck	3	70 000	39 100	109 100	12	**3927600**	**4.50**
Compactor truck	2	70 000	39 100	109 100	334	**72878800**	**83.50**
Total	7					**87274800**	**100**

* Official government rates including 18% value-added tax (VAT) confirmed by Mr. Egbe Robert (Engineer/architect Bamenda) 2004, pers. Comm., 02 April

The distribution of costs suggests a strong inclination on collection and transportation (91%) and too little (7%) on disposal treatment. This practice is unsustainable because there is no recovery and it places strain on resources as well as the environment.

7.6 General Conclusion

The treatment of waste is rudimentary and disposal is not only crude but also fraught with existing or potential environmental and health problems, many of which the people do not known. Waste minimization underpins the philosophy of the waste management hierarchy, which aims to reduce waste that goes for treatment, but such is far from the driving force behind the practice here. Recovery, treatment, recycling, repairs, and reprocessing are old practices carried out instinctively and informally at individual and artisan level and are motivated by economic interests rather any coordinated minimization policy by legislation. Composting, a viable option for reusing the large organic fraction of the NSW stream, is at the basic level of farm application of raw bio-waste. There is no official policy or investment by the state on recovery and recycling.

At the primary level inefficient waste collection and transportation create odours, leachates and facilitate transmission of diseases through vectors. Disposal practices are mainly illegal dumping, burning and burying. The official solid waste disposal site at Ngomgham receives huge quantities of heterogeneous and uncontrolled waste. It lacks basic operational and management attributes of a standard sanitary landfill, and by official standards, is an open dump. The poor management of the dump makes it fraught with a plethora of serious human and environmental problems emerging from landfill gases, leachates, odours, fires and dust. On the whole waste minimisation and disposal are accorded the least attention in terms of policy, management and financial expenditures compared with collection and transportation.

CHAPTER 8

Municipal Solid Waste Management in Yaoundé City: Generation, Storage, Collection and Transportation

8.1 Introduction

Yaoundé is the political and administrative headquarters of Cameroon, the Centre Province and the Mfoundi Division. Many international and regional organisations also have their headquarters here. Unlike Bamenda, the City Council is further divided into six sub divisional urban councils. Both council levels are responsible for MSWM in the city that is now contracted to a private company known by its French acronym as HYSACAM (Hygiène et Salubrité du Cameroun), Cameroon Hygiene and Sanitation. With the shrinking support of the government resulting from the emergence of the economic crises since the late 1980s, many donors, private initiatives and non-governmental organisations have joined the waste management industry in Yaoundé but with no coordinated efforts. This scenario makes MSWM in Yaoundé very complex**.** But what drives waste in Yaoundé? The special status of Yaoundé as the seat of government, diplomatic missions, international meetings and organisations, makes it imperative on the government to give special attention to the city's aesthetics and prestige by focusing on its cleanliness. The increasing awareness by the people, interest groups, the government and donors, of the need for a clean environment, together with economic interests drive waste management in Yaoundé.

This chapter examines the management of municipal solid waste management (MSWM) in Yaoundé including its generation, collection and transportation. Two levels of waste management (primary and secondary) and three broad groups that are involved in service delivery (the waste producers, the many formal and informal groups, and the official waste management contractors-HYSACAM) are evaluated. Major drivers and factors, such as the administrative organisation of the city together with its spatial extension, streets, socio-economic and population characteristics that have far-reaching implications on the performance of the city's waste management are also examined. Chapter 8 deals with the treatment, disposal practices and environmental problems associated with MSWM in Yaoundé.

8.2 The Organisation of Yaoundé City

8.2.1 The City, its Sub Divisions and Quarters

Yaoundé, being the national headquarters, houses all the levels of administrative and political organisation of the country ranging from central functions such as the presidency, the prime ministry and the ministries to external services including the provincial, divisional, sub divisional, urban council, village and quarter services as well as regional and international organisations.

Cameroon Law No. 87-015 of 15 July 1987 organising councils accorded Yaoundé and Douala, the highest status in urban organisation in the country called '"Communauté Urbaine" de Yaoundé (CUY)' headed by a presidential-appointed Government Delegate. Unique with this status was the creation of sub divisional urban councils within and under the city council which are headed by elected mayors. Four urban sub-divisional councils were created in Yaoundé comprising quarters and villages[1] as follows: Yaoundé I (44), Yaoundé II (57), Yaoundé III (49) and Yaoundé IV (54). Another presidential decree (No. 93/321 of November, 1993) created two more sub divisional urban councils, Yaoundé V from Yaoundé I and Yaoundé VI from Yaoundé III (Figure 8.1). Quarter or village chiefs, appointed by the central administration, head these quarters. These chiefs may also sub divide their areas into blocks and appoint block chiefs to administer them. These administrative levels are involved at every stage of municipal solid waste management in Yaoundé city.

[1] Presidential Decree No. 87-1365 of 24 September 1987, to set up the Yaoundé City Council.

8.2.2 Classification of the Quarters

Quarters in Yaoundé are not unique. Studies have been made and quarters' stratifications established according to the living standards of the population, their socio-economic activities, the characteristics of the roads, streets and the housing conditions (Vermande *et al.* 1994; Ngnikam 2001; Tanawa *et al.* 2002). Waste quantities, generation and management patterns in the city are also tied to these spatial characteristics. The survey carried out by the author used such zoning to select quarters for sampling. These zones are classified as follows:

Zone I: High-status Residential Quarters: These quarters are well planned and are served with good roads and streets. They also have fenced luxurious villas and apartment buildings with gardens, swimming pools, and street lighting. Average housing density is 40 persons per hectare. High-level civil servants, directors of enterprises and diplomatic missions and their residents, inhabit these quarters. Examples are Bastos, Ngoakele Lake Quarter and Ngosso.

Zone II: Moderate-status Residential: They are quarters that are made up of high-rise building blocks and bungalows planned and built by the housing real estate and land developers (SIC and MAETUR)[2] or the city council. Individuals have bought built plots or houses from these real estate companies. The quarters have good access by road and basic infrastructure such as tarred roads, piped water supply, electricity and sewage disposal. Some of these quarters are Biyem Assi, Cité Verte, Messa, Essos and Mendong. Middle level workers of the public and private sectors live there.

Zone III: Dense Spontaneous Settlements

The rest of the city is made up of spontaneously settled quarters. Here houses are compact and mainly self-built with makeshift or traditional materials. The settlement pattern is chaotic, hardly respecting building regulations. In some cases, the houses are sited on fragile and dangerous environments such as steep slopes, flood plains and railway corridors. A main road may pass through such quarters but the rest of it is

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[2] SIC:(Société Immoblière du Cameroun) Cameroon Real Estate Company
MAETUR: (Mission d'Aménagement et d'Equipement des Terrains Urbains et Ruraux) Urban and Rural Lands Development Authority.

accessed by footpaths or narrow seasonal streets. They lack basic infrastructure such as public waste skips, water, electric lighting, sewage and drainage facilities. These are indigenous quarters that have been engulfed by urban growth. They have densities as high as 110-400 persons (or about 32 houses) per hectare and constitute about 45% of the city area. Examples include, Nvog Ada, Nvog Mbi, Elig Effa, Elig Essono, Nlongkak, Gjoungolo and Melen.

Zone IV: The City Central Zone

A few average residential houses exist here but this zone is characterised mostly by administrative and commercial structures. Developed from the old colonial centre, this area is also planned and houses multiple storey ministerial blocks, banks, insurance companies, central and supermarkets, hotels and offices of international and regional institutions.

Zone V: Peripheral Quarters

The last category is the peri-urban quarters. As in zone IV, these are indigenous settlements engulfed by the expanding city. They have low-housing densities that are of average standing and have many indigenous people. However, these types of quarters are tending towards heterogeneity, and increasing housing and population densities. A main road may also pass through them but access into the quarter is usually by narrow paths. Amenities are also lacking. Some quarters in this group are: Ekono II, Nsam, Efoulan and Nkom.

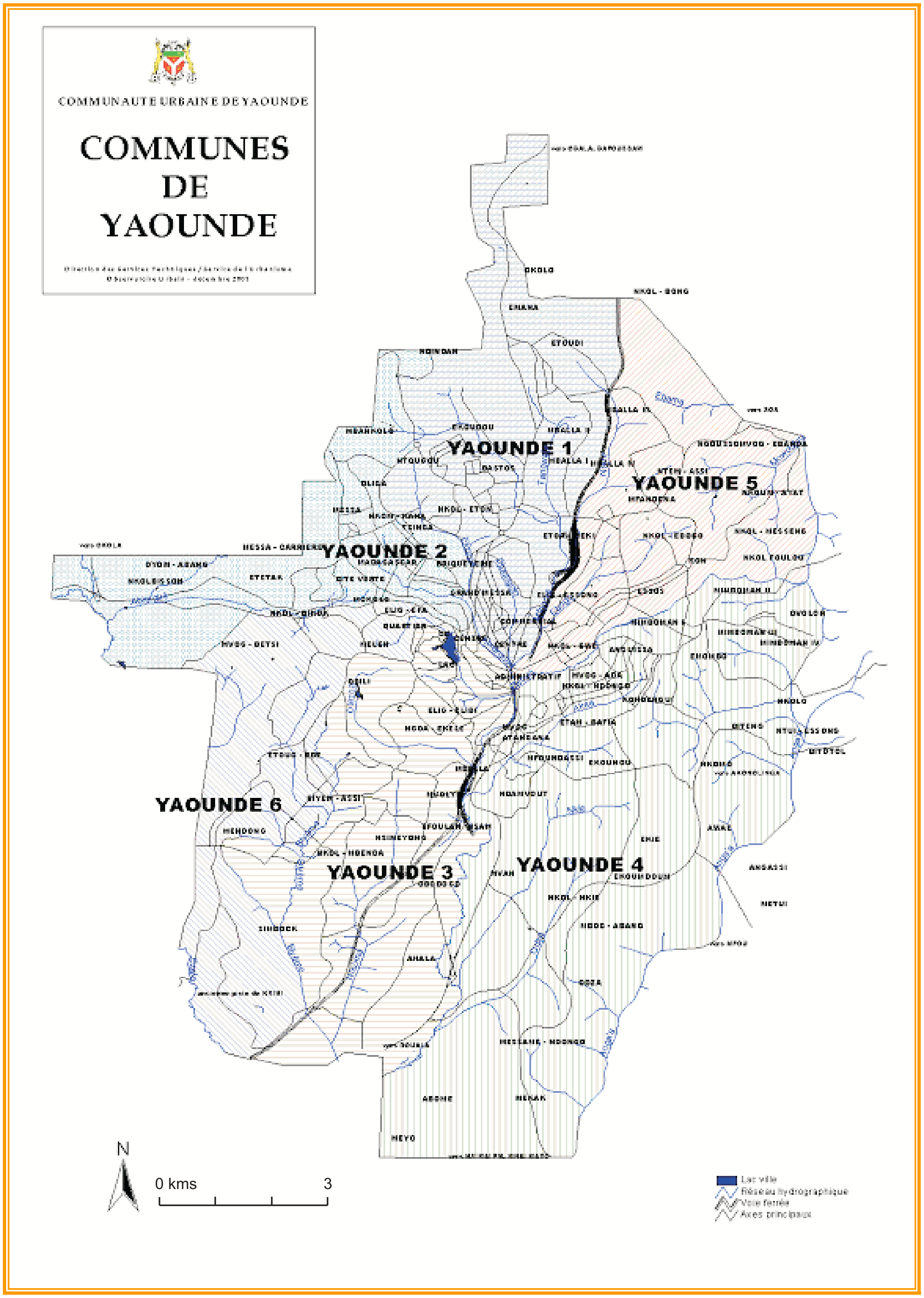


FIGURE 8.1: Map of Yaoundé City, Sub Divisions and Quarters
Source: Yaoundé City Council, 2003

8.2.3 Population, the Economy and Spatial Growth of Yaoundé

Total quantities of waste generated are a function of population size, with one key source of increasing waste management problems in Yaoundé being the rapid population growth. Between 1960 and 2002, the city's population has not only increased fast from 100 000 to 1.4 million (Figure 8.2) but also had a spurted annual average rate of population growth (AARPG) of more than 6% within the period with the only slight slowing down at the onset of the economic crisis in the late 1980s (Table 8.1). These rates are alarmingly high given that Africa with 3.8% is the world's fastest urbanizing region while the entire developing world experiences 2.7% (Section 1.1.1). These rates of growth are too fast for urban governments to cope adequately with the delivery of basic urban services including solid waste. The number of households in Yaoundé is estimated at 277 981 (DSCN 2002).

TABLE 8.1
Population Growth in Yaoundé 1960-2002

Year (1)	Year (2)	Population (1)	Population (2)	AARPG[3]
1960	1976	100 000	318 706	8.51%
1976	1987	318 706	649 252	6.68%
1987	1999	649 252	1 201 900	5.27%
1999	2002	1 201 900	1 438 087	6.16%

Source: Compiled from DSCN 1999, 2002. Percentages calculated by the writer.

This rapid growth can partly be explained by the fact that Yaoundé's status as the seat of a strong centralised system of government provides it with many administrative and political functions ranging from local through city to division and province to national including international. It has developed as a transport hub and an intellectual centre together with commercial, processing and industrial functions. All these functions have pulled people into Yaoundé.

[3] AARPG=((P2/P1)^ (1/N)-1)*100

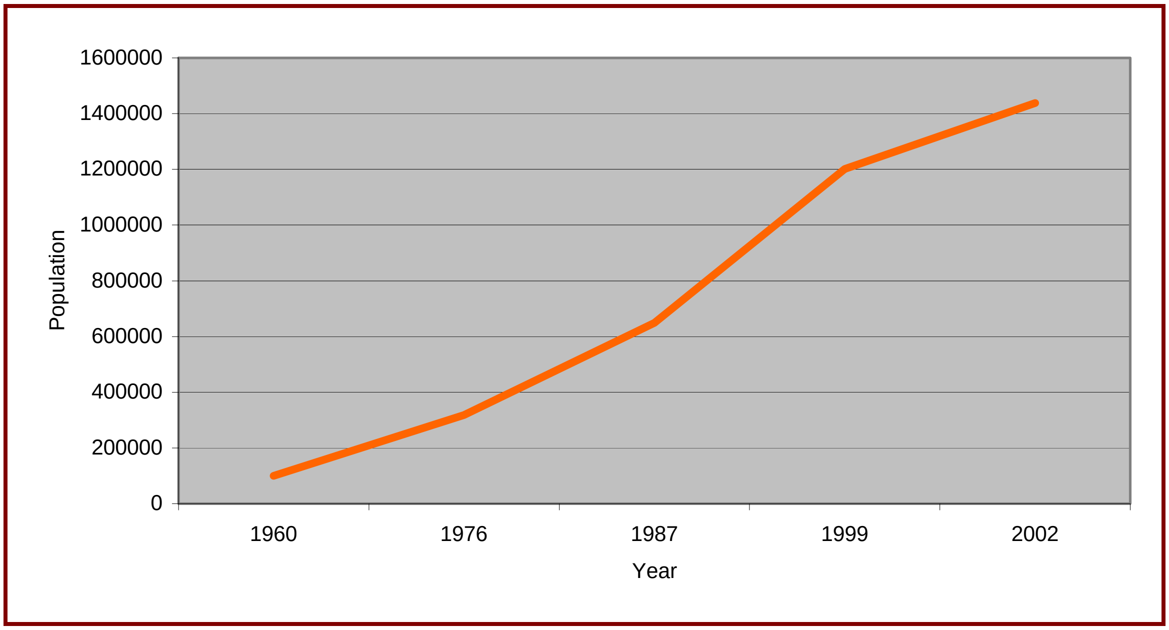


FIGURE 8.2: **Graph Showing the Evolution of Yaoundé City Population 1960-2002**
Source: Derived by the author from Table 8.1

Along with the rapid population growth came also a corresponding spatial sprawl of the city's area from 1 200 ha in 1961 through 18 000 ha in 1995 to 25 600 ha in 2001 and an estimated 28 000 ha for 2005 (Vermande *et al.* 1994; Communauté Urbaine de Yaoundé 2001; Tanawa *et al* 2002). The last source notes that the provision of road infrastructure to access these areas is grossly inadequate as only 30% of the estimated 800 km is tarred and that Yaoundé has only 4 km per km^2 of good road whereas standard street network is supposed to be 15 km per km^2. The un-tarred streets are further rendered impassable by constant erosion caused by rainfall. The field survey data by the author demonstrates that accessibility is still a problem (Table 8.2).

TABLE 8.2

Sampling Quarters and Percentage of Access Conditions/Types in Yaoundé

Quarter/access Condition	Bastos	Efoulan	Nvog Ada	Cité Verte	Total	%
Footpath	0	9	34	0	43	25
Path passable with pushcart/wheelbarrow	0	5	11	0	16	09.3
Loose surface motorable all seasons	1	12	17	0	30	**18.4**
Loose surface motorable dry season	1	4	4	1	10	5.8
Tarred in good state	1	1	2	0	4	2.3
Tarred in bad state	30	1	7	31	69	40.1
Total	33	32	75	32	172	99.9

Source: Households survey cross tabulation analysis by the author, Yaoundé 2003

Table 8.2 demonstrates that 34.3% accessibility is by paths; 32.2% loose-surface streets, and 42.4% tarred roads with only 2.3% in a good state. These averages obscure the spatial variations within the city's quarters and consequently hide the reality. Of the tarred streets, 88% are in Bastos and Cite Verte and barely 12% in Efoulan and Nvog Ada. There are no paths in Bastos and Cité Verte while Nvog Ada has 79% and Efoulan 21% together with the dominance of loose-surface streets (Table 8.2). A lack of accessibility by vehicles is a problem that hinders effective MSWM. It is so true that the rate of solid waste removal has a positive correlation with the availability of access roads (Chapter 9).

Yaoundé has a diversified economy but is dominated by tertiary activities. Apart from a few processing industries such as the Cameroon Breweries, British-American Tobacco Company (BAT), sawmills, animal feed and plastics, the city is the seat of politicians, administrators, civil servants, diplomats, business people, dossier chasers, financiers, tourists and school goers. Trade and commerce booms with 45 000 traders registered in 1994 (Vermande *et al.* 1994) functioning in the 22 city malls, super markets, specialised shops and handling a variety of goods such as textiles, leather, electronics, hard ware, automobile spare parts, building materials, books, fish, meat, poultry and foodstuffs. The informal sector is prominent especially in commercial hawking activities. The peri-urban area abounds with agricultural activities such as market gardening, cocoa, bananas, plantains, foodstuffs and fruits. The inter city transport is active moving civil servants and government contractors from all over the country to Yaoundé to ‘chase dossiers’ or files in government offices in order to receive their dues.

8.2.4 Brief History of MSWM in Yaoundé

Sometimes lessons are learned from history, this applies to municipal solid waste management in Yaoundé. A history of MSWM is well documented and is consistent in publications by this team of researchers (Vermande *et al.* 1994; Monkam *et al.* 2000; Ngnikam 2001; Tanawa *et al.* 2002). The following section summarises that history according to these authors.

1960-68. In the early years of independence (1960–68), Yaoundé had a mixed population of 100 000 people living on 1250 ha of land. Waste collection was done mainly around the major road axis, administrative, commercial and high standard residential areas of the city. The city council managed the waste collection and treatment. Much of the waste was disposed of in farms, open spaces and illegal dumps.

1968-90: HYSACAM won a contract to manage waste in the city for a three-year period subject to renewal. It started at the cost of 65 millions francs CFA a year but the amount gradually grew to 1.5 milliards twenty years later. The state gave two-thirds and the Yaoundé City Council (YCC) one-third. About 300-400 tonnes of solid waste were removed daily (Vermande *et al.* 1994).

1990-93: This period marked the exit of old and entry of new partners. The 1987 law created urban sub divisional councils (USC) with executive powers headed by Mayors. The 1988/89 economic crisis set in and state subventions grew lean and finally stopped in the 1990/91 budgetary year. HYSACAM abandoned it contracts for non-payment of accumulated debts owed to the company. Each USC was given two tippers by the YCC. USCs in turn contracted the waste management to small and medium-size enterprises (SMEs). With lack of expertise these enterprises filled the valleys around with waste and collected very small amounts. In 1992 the Prime Minister (PM) stepped in and contracted MSWM to another company, SECA, an affiliate of HYSACAM. After six months of operation the company ceased its activities for non-payment of contract bills. In January 1993 two others, one a private company, ‘Dragages Cameroun’, and the other a government public works department, tried but retired prematurely in July because of lack of funds.

1993-98 Things grew progressively worse. The YCC gave contracts to small enterprises at 37 millions Francs CFA a month (474 million a year). With no experience they again filled the valleys with waste. NGOs, institutional and quarter associations emerged for collection, transportation, recycling, composting and treatment. Formal composting and recycling were introduced. In 1994 The World Bank/State came in with the Structural Adjustment Programme (SAP) encouraging NGOs and giving contracts to groups to clean streets first, then remove mountain of waste that defaced the city. In two years 2700 workers were employed and they removed only 15% or 120 tonnes of waste a day that was ubiquitously disposed of in illegal dumps around the city.

1998-2004 In 1998 waste management reverted to the YCC and the formal style of 1968-90 period was renewed. HYSACAM was re-invited and a contract of 1.5 Millard Francs CFA a year signed with the state to collect and treat the city’s solid waste. This means the sub divisional urban councils were no longer directly responsible for waste management, but they had to contribute financially to the management of waste in their areas of jurisdiction (Section 5.6.2.3).

8.3 Organisation of MSWM in Yaoundé

8.3.1 Introduction

Primary or pre-collection includes the initial processes of assembling, recycling, storing and moving solid waste from the source of generation to the nearest official facility (public skip, ground dumps, waste collection van) for onward treatment (transportation to the transfer station, recycling, incineration or/and final disposal). The continuation of the process from the public facility is via the secondary sector. The main participants are the households, markets and institutions at the primary sector, the waste management company at the secondary level and a multitude of formal and informal institutions complementing the tasks of both.

The administrative structure of MSWM was discussed in chapter 4. This included the general policy-making levels as well as the deliverers of the services. Here we are most concerned with the delivery of the solid waste management services as is in Yaoundé. A new element that emerges here and which was not experienced in Bamenda (Chapters 6 & 7) is that, with the inability of the official waste management company to cover the entire Yaoundé City and to limit its activities only to the accessible quarters, a wide range of actors from individuals, associations, NGOs to local groups emerged, independently to carry out direct or indirect activities related to municipal solid waste management in neighbourhoods of Yaoundé. This was made possible by the liberalisation of the economy and freedom to create associations and the increasing desire of households, institutions and business places to have their waste collected so as to have a clean environment. Many of these providers are involved at the pre-collection levels but a few extend their activities to the secondary level. However, waste management remains the sole responsibility of the city council who together with the support of the urban sub divisional councils,

- Mobilises and coordinates financial and human resources for MSWM
- Settles disputes between HYSACAM and other service providers
- Locates public bins
- Validates contracts executed
- Sensitises and runs campaigns

The roles attributed to the City Council and the sub divisional urban councils are not clear. Law No. 87/015 of 15 July 1987 charged the City Council with the duties of hygiene and sanitation for the entire city while the sub divisional urban councils had the duties of removing and treating waste. These roles are ambiguous as shown by the problems with their application.

8.3.2 The Organisation of MSWM Delivery in Yaoundé

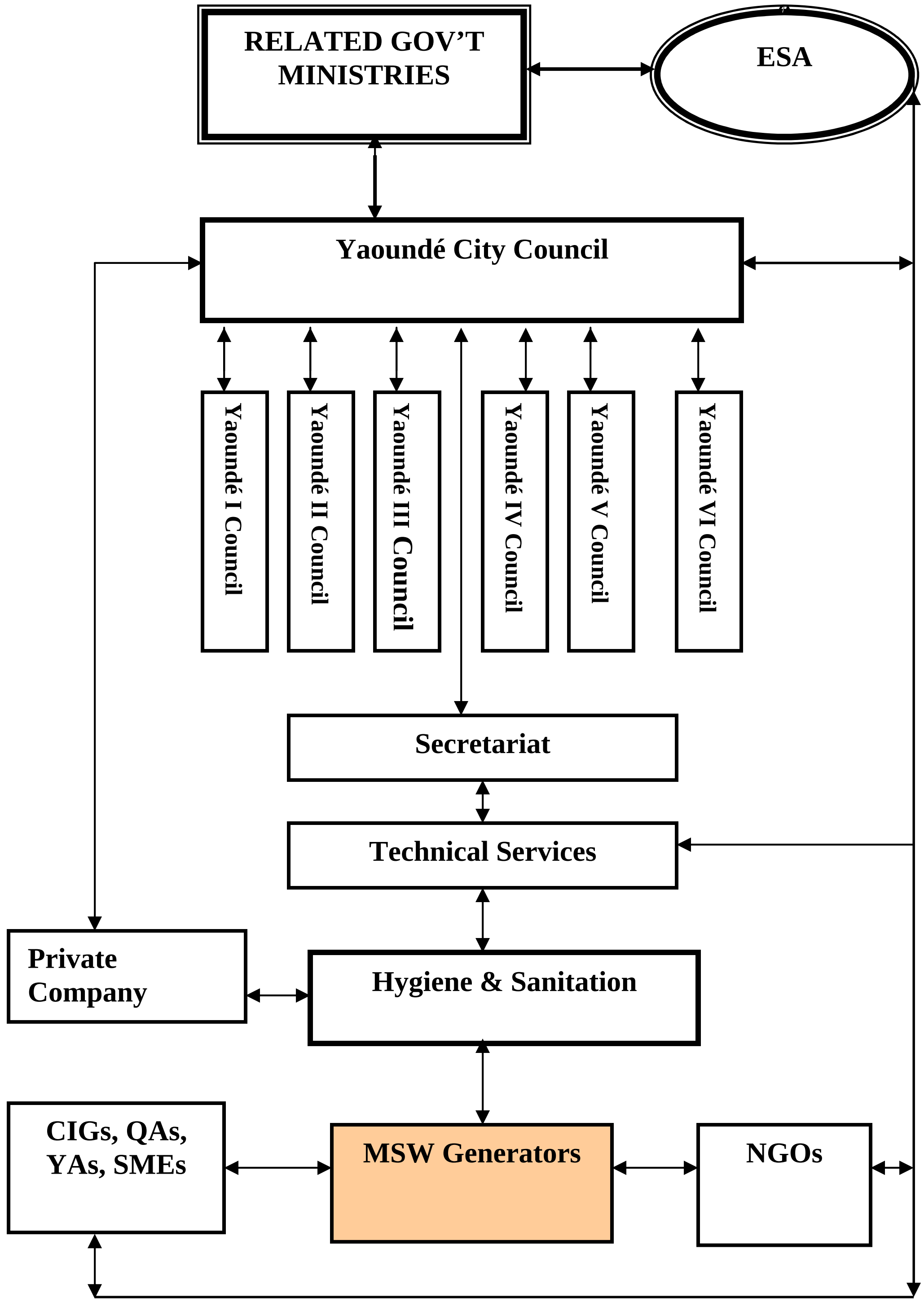


FIGURE 8.3: The Organisational Structure of MSWM in Yaoundé
Sources: Compiled from relevant official texts by the author

Figure 8.3 shows the flow structure of the waste management delivery and the linkages between the actors in Yaoundé. These actors are becoming many, together with the increasing role of the external support agencies (ESAs). The waste generators have no direct links with the official private company responsible for waste management, or the urban sub divisional councils and the supportive groups (Figure 8.3). These weak linkages, and at times antagonistic relationships amongst the actors and the passive role of the generators, constitute a big problem. One notices the emergence of an important NGO by its French name, (Environnement Action Recherche au Cameroun {ERA-Cameroun}), i.e., Environment, Action Research in Cameroon, involved in the process of finding ways to addressing parts of these problems.

8.4 Generation and Storage

8.4.1 Generation

Municipal solid waste generated in Yaoundé varies in quantities, types, humidity and density, according to the days of the week and seasons as well as between various sources such as residential zones, industrial areas, institutions and commercial places. Many authors agree, with very slight variations, on the quantities of solid waste generated and detailed analysis of their content. A greater discrepancy lies in population figures that remain estimates as the last population census was conducted in 1988. According to Tanawa *et al.* (2002), Yaoundé generates an average of 840 tonnes y of MSW per day, 725 tonnes (86%)[4] from households, 83 tonnes (09.9%) from markets, 30 tonnes (03.6%) from industries and 5 tonnes (00.6%) from hospital. These authors indicate it represents 0.75 kg per capita per day generation, but point out that weekend days may produce as much as 0.9 kg. per capita per day. Studies by Monkam *et al.*(2000) and Ngnikam (2001) indicated the average per capita daily generation rate for the city calculated from the quarter figures was 0.79 kg per capita per day, only 0.04 kg greater than the former. This average is derived from the dry and wet season production rates indicated by these

[4] The author has calculated the percentages.

authors respectively as follows: high-status residential quarters (0.95-1.31 kg), moderate status (0.78-1.12kg), municipal buildings (0.73-0.98 kg), spontaneous settlements (0.5-0.8 kg) and peri-urban quarters (0.63-0.95 kg). They estimated the MSW densities at 0.25-0.49 and humidity, 50-65 % for the dry and wet seasons respectively. Based on the current population, I estimate the daily generation rate at 1200 tonnes for the entire city.

In another study by Ngoma (2001), solid waste composition for Yaoundé (975 tonnes per day) was analysed thus: organic material 80%, paper and carton 07%, glass 04.7%, plastics and rubber 04.3%, textile and leather 02.2%, and iron and metal 01.7%**.** Ngnikam (2000) further analysed variations of solid waste types generated among quarters and the markets (Figure 8.4). Major findings show a preponderance of biodegradable waste in all zones increasing in markets and less affluent quarters. Fines are fairly present in all quarters while plastic material is consistent with greater amounts found in moderate and spontaneous quarters.

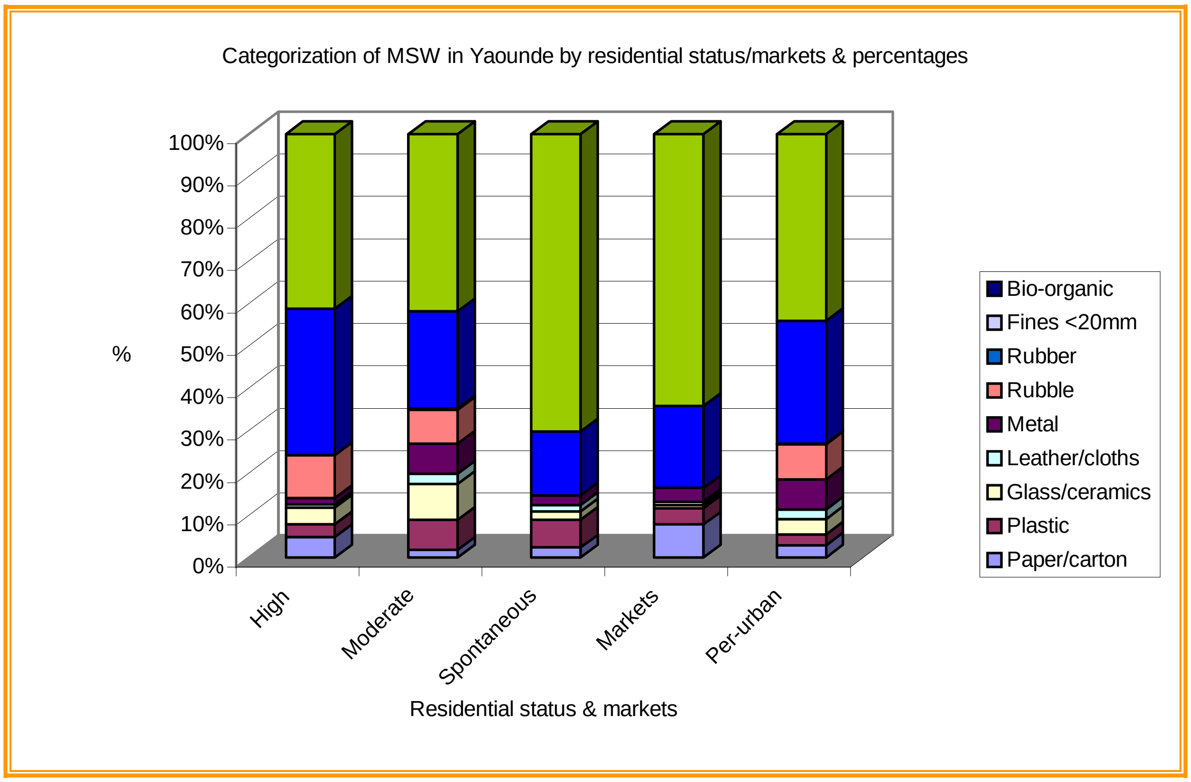


FIGURE 8.4 Categorization of MSW in Yaoundé by Residential Status, Markets & Percentages
Source: Derived from Ngnikam 2000

Market waste comes from the 22 city markets with the six largest, Mokolo, Nfoundi, Essos, Central, Ekounou and Nvogt-Mbi, generating about three quarters of all the market waste, estimated at 83 tonnes, emanating mostly from foodstuffs with a 0.1 to 4.76 per capita per day generation rate (Tanawa *et al.* 2002). According to the same source, industrial wastes constitute 516 tonnes mostly from breweries, tobacco, milk and meat factories. Hospitals generate 5 tonnes and 90% is conventional waste and ends up in the MSW stream.

8.4.2 Methods of waste collection and storage

Household survey results and field experience show that, but for a few classic bins, many containers used for the collection and storage of household waste are made from recycled materials (Plate 8.1). The prominent ones are old baskets (76.7%), plastic bags (11.6%), tins and cans (8.2%), and to a lesser extent, cartons and baskets (Table 8.3; Plate 8.1). Further analysis show that only 68 out of 103 sampled containers (66%) had some form of cover over them. There was also a spatial variation in cover provision by households with Bastos and Cite Verte having 50%, Efoulan 38.5% and Nvog Ada 22%.

TABLE 8.3
Household Waste Collection Containers in Yaoundé

Quarter/container	Carton	Basket	Old Bucket	Plastic Bag	Tin & Can
Bastos	0	0	21	4	8
Efoulan	2	1	25	2	2
Nvog Ada	1	1	58	12	3
Cité Verte	0	1	28	2	1
TOTAL	3	3	132	20	14
%	**1.7%**	**1.7%**	**76.7%**	**11.6%**	**8.2%**

Source: Household survey cross tabulations, 2003 Yaoundé

A Two plastic buckets

B Conventional bin with cover

C Bamboo basket

D Fibre bags

E Half 200 L drum bin (Schools)

F Conventional bin (Offices)

Plate 8.1: **Waste Collection Containers in Households & Public Institutions, Yaoundé 2003**

8.4.3 Primary Waste Transfer

Waste produced at the households, markets and institutions such as offices and schools is primarily moved to a secondary official waste collection facility or illegal disposed.

Various groups are involved in the primary MSWM in Yaoundé and they use different methods for transferring the waste to the official waste collection site. Survey reports summarised by the author indicate that at the household level various transportation methods are used to move waste to the depot (Table 8.5). Head or hand portage dominated the method used (91%), followed by wheelbarrows (8.4%). Pushcarts are present but not prominent. Motorised movement of waste is absent but sources in the field indicate that some private individuals and establishments such as Bob's Foundation and Yaoundé Propre, which collect waste from some households in Bastos quarter, use pick-up vehicles.

TABLE 8.4
Methods of Household Waste Transportation in Yaoundé

Quarter/method	Head/hand	Wheelbarrow	Pushcart	Motorised	Others
Bastos	28	3	0	0	0
Efoulan	26	4	0	0	0
Nvog Ada	69	4	1	0	0
Cité Verte	28	3	0	0	0
TOTAL	152	14	1	0	0
%	**91%**	**8.4%**	**0.6%**	**0%**	**0%**

Sources: Field survey cross tabulations by the author, March 2003 Yaoundé

Table 8.7 summarises the scenario of persons most often responsible for removing waste away from the household and Table 8.7 indicates where the household waste is disposed of. From Table 8.7 it could be suggested that the children do more than three-quarters of waste removal from the households. The modal distribution shows mothers coming in the second place but the mean distribution put the group of house-boys, girls and guards as occupying the second place, influenced by the high occurrences in Bastos (Table 8.7). The use of guards and specialised groups to collect waste increased in some sensitive areas such as diplomatic missions, after the terrorist attacks of 11 September 2001 in the United States. The only examples of men moving waste comes from Nvog Ada spontaneous quarter, suggesting that men minimise the importance of waste management and hardly get involved in it. The term 'others' in Table 8.5 represents organised groups that work with households and such cases are examined in Section 8.5.2. The waste removed from households is disposed of in the public skips, itinerant waste vans or illegal dumps. Table 8.7 summarises the destination of these wastes.

TABLE 8.5

Persons Responsible for Removing Household Waste: Cross Tabulation, Yaoundé.

Quarter/Person	Father	Mother	Children in household	Houseboy/girl, servant/guard	Others
Bastos	0	1	10	21	0
Efoulan	0	4	27	0	1
Nvog Ada	3	12	60	0	0
Cité Verte	0	6	18	8	0
TOTAL	3	23	115	29	1
%	**1.8%**	**13.5%**	**67.3%**	**17.0%**	**0.6%**

Sources: Field survey by the author, March 2003 Yaoundé

Table 8.7 presents the results of field surveys on distances travelled to dispose of waste by households including the mean distances. Such data were transformed from responses made to questionnaires requested households to estimate distances they travel to dispose of waste using the number of electricity poles covered. Interval between electricity poles is constant and usually 50 metres. The results were grouped and the mean distance calculated. It is 87.3 m (Table 8.7).

TABLE 8.6

Distances Travelled in Yaoundé to Dispose of Household Waste & Calculation of the Mean Distance

RAW DATA					***CALCULATIONS***			
Distances Quarter	**<50m**	**50-99m**	**100-200m**	**>200m**	***25m***	***75m***	***150m***	***250m***
Bastos	8	9	6	2	*200*	*675*	*900*	*500*
Efoulan	12	10	7	2	*300*	*750*	*1050*	*500*
Nvog Ada	29	25	13	8	*725*	*1875*	*1950*	*2000*
Cité Verte	10	14	5	3	*250*	*1050*	*750*	*750*
TOTAL	59	58	31	15	*1475*	*4350*	*4650*	*3750*
				163				**14225**

Mean distance=14225/163=87.3 m

Source: Field survey data by the author 2003

Figure 8.5 illustrates the spatial variations in the distribution of percentages and distances travelled by people to dispose of their waste. Generally all the quarters experience a small percentage of people that move less than 50 m. More residents of Cité Verte travel between a 50-100 m range while for Bastos and Efoulan it is the 100-200 m groups. Nvog Ada has a fairly equal distribution of its population travelling 50-100 m, 100-200 m and 200 m and more. In addition Nvog Ada experiences the highest percentage of people who travel the greatest distances to dispose of their waste (Figure 8.7). These variations are due to the waste infrastructure constraints such as availability of skips, waste trucks and accessibility. There is a maximum distance that every household would be prepared to go to dispose of waste. If the official waste facility is considered out of reasonable travelling distance other sites may be sought. Table 8.7 summarises the field survey report on the variety of sites used by the households to dispose of their waste.

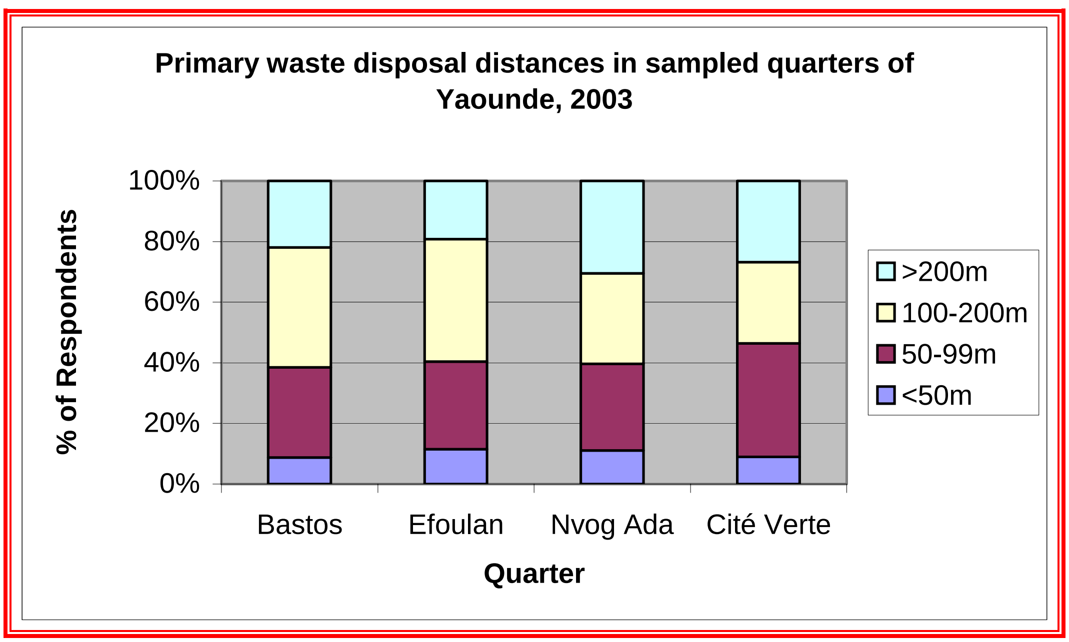


FIGURE 8.5: Household and waste disposal distances in quarters of Yaoundé
Source: Transformed from survey cross tabulation on distances travelled to dispose of waste, Yaoundé 2003

TABLE 8.7
Primary Disposal Sites for Household Waste in Yaoundé

Quarter→ **Household waste depot ↓**	**Bastos**		**Efoulan**		**Nvog Ada**		**Cite Verte**	
Responses →	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
In the public skip	**39.4**	**60.6**	**0.0**	**100.0**	**70.7**	**29.3**	**96.9**	**3.1**
Into the itinerant waste van	**60.6**	**37.4**	**37.5**	**65.5**	**17.3**	**82.7**	**0.0**	**100.0**
In a valley/stream/lake sides	**3.0**	**97.0**	**0.0**	**100.0**	**8.0**	**92.0**	**3.1**	**96.9**
On the road/street sides	**0.0**	**100.0**	**15.6**	**84.4**	**0.0**	**100.0**	**0.0**	**100.0**
In open spaces/bushes	**3.0**	**97.**	**40.6**	**59.4**	**9.3**	**90.7**	**3.1**	**96.9**
In a hole in the compound	**0.0**	**100.0**	**6.3**	**93.7**	**2.7**	**97.3**	**0.0**	**100.0**

Sources: Household Survey Yaoundé March 2003 (Percentages transformed from 'Yes" and 'No' responses

Unlike in Bamenda, all quarters sampled in Yaoundé benefit from the services of the official waste management company though at various scales. However, all the quarters equally practise various forms of illegal disposal (Table 8.7). Bastos enjoys both the fixed collection system (from skips) and the itinerant waste van system. Cité Verte has only the fixed collection but has a fairly efficient collection system. Illegal disposals are greatest in Efoulan (Table 8.7 and Plate 8.2) followed by Nvog Ada. Efoulan has no skip in place and the residents describe the itinerant waste van system as irregular. Nvo Ada has one $16m^3$ waste skip in place as well as the itinerant van programme. In Nvog Ada, both systems are very inadequate. The analysis suggests that the ease of accessing the official waste disposal facility, the available space for illegal dumping, and the perception of waste management service providers by the households, play an important role in deciding where waste will be disposed of. Long distances to access official waste facilities pushes waste producers to look for alternatives, for example, empty space for disposal and such decision-making is further influenced by the level of environmental and health education of the people. The Yaoundé City council sources identified and documented 177 prominent heaps of illegal dumps of various sizes, large (21), medium (58) and small (98) ubiquitously distributed in the city in 2001 (Communauté Urbaine de Yaoundé 2001). However, there are far more illegal dumps than that number. There are many more illegal dumps than public skips in the city. Plate 8.2 also illustrates open space illegal dumps in Efoulan Quarter in Yaoundé.

A

B

PLATE 8.2:Open-space Illegal Dumps at Efoulan Quarter, Yaoundé 13/3/2003

8.4.4 Problems Associated with Primary Collection

The first problems of primary waste collection, storage and transfer are linked to the poor state of most containers. Secondly the waste collected is either disposed of at an official secondary facility or disposed of illegally in heaps on vacant spaces, drains, water bodies or street sides. The main reasons for this problem arise from shortage of equipment such as skips and collection trucks, inaccessibility and inadequate concerted efforts between the waste generators and the waste managers.

8.4.5 Conclusion

Solid waste generation in Yaoundé is increasing in quantities and variety influenced mainly by population growth and socio-economic development. The quantities generated and the characteristics vary with parts of the city, days of the week and times of year. An average of 0.79 kg per capita per day has been registered with more than three-quarters of the waste biodegradable. Collection and storage of waste is poor as mostly old containers without covers are used. Disposal of waste collected by households is done by informal or some organised groups but huge quantities remain disposed of at illegal dumps spread all over the city and only small quantities end up in public bins from where secondary management takes over. In all, the ease of accessing the official waste disposal facility, the available space for illegal dumping, and the perception of waste management service providers by the households, play an important role in deciding where waste will be disposed.

8.5 Secondary Level Waste Management

8.5.1 Introduction

HYSACAM is the officially contracted company that is responsible for removing and treating municipal solid waste in Yaoundé. However, since the 1990s many other partners joined to complement the waste management business not only in the primary levels but also at the secondary level. The involvement of foreign partners has also become increasingly prominent**.** This section examines the role of these external support agencies (ESAs), complementary institutions and the official waste management company, HYSACAM, in addressing the problem of MSWM in Yaoundé**.**

8.5.2 Complementary and Supportive Partners

Table 8.8 summarises the categories of complementary and supportive partners involved in MSWM together with their functions, areas of operation, status and composition. Some of their activities cover both the primary and secondary waste management levels. In the field we identified many more groups such as Vindapol (Efoulan) that exist and operate haphazardly but directly with households in the neighbourhoods that are not mentioned in Table 8.8. The organisation and functioning of Hysacam, the contracted private company that manages MSW, is discussed later. The following categories of partners in MSWM were identified: Non-Governmental Organisations (NGOs), Common Initiative Groups (CIGs), Small and Medium-size Enterprises SMEs, Quarter Associations (QAs), Youths' Associations (YAs), Individuals and private business group associations.

No 92/006 of 14 August 1992 authorised the creation of Cooperatives, Common Initiative Groups (CIG) and other groups of economic interest such as the Small and Medium-size Enterprises (SMEs). The SMEs operate to make profits. The NGOs were created by Decree No.99/914 of 22 December 1999 and authorised free operations in a wide range of jurisdiction from environment, social activities, culture, sports, and education to humanitarian including human rights organisations. They were all simply advised to register and operate with respect to the national laws. Profit was not expected to be a key issue even though the NGOs would be expected to be sustainable. It is hard to make a clear distinction between these groups' activities in terms of profit and non-profit making. However, they all intervene in various aspects of MSWM in Yaoundé.

TABLE 8.8

List of different organisations involved in solid waste management in Yaoundé

Nº	Organisation	Type*	Created*	Members*	Area(s) of operation*	Major activities*
1	Association des Volontaires du Developpement (ADV)	AT	1997	20	Mfoundi Market	Collection of market waste
2	Association des jeunes de Melen (ASOJEM)	YA	1999	31	Melen V (near National Gendarmerie)	Fight dirtiness by practising daily human investment.
3	Association TAM-TAM Mobile	YA	1997	40	Nvog Beti	Reflection on Youths' misery and unemployment. Cleaning & clearing street sides
4	Association de jeune dynamiques de l'EMIA	YA	2001		Melen !	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 le progress social SAEKAN ZOUMOUNTI	YA	1994	13	Briqueterie Quarter	Collection of waste and gutter cleaning
7	Association des residents de Mbenda (AREM)	QA	1990	40	Mbenda (Simeyong 11)	Quarter Cleanliness
8	GIC Jovelec	GIC	1997	5	Zibi, Nkolzié, SIC Mendong	Door-to-door waste collection, composting & agriculture
9	CIPRE	NGO	1996		Etoug-Ebe	Buys and sells plastic waste; Public sensibilisation on plastic separation
10	Cercle de Jeunes de Melen Polytechnique	YA	1995	25	Melen 4	Encourage quarter cleanliness through daily human investment.
11	Club de Volontaires de Mvog Ada (CVM)	NGO	1993	6	Mvog Ada	Cleaning of streets, gutters and waster courses
12	FOCARFE	NGO	1992	7	Elig Essono	Waste collection, canal and waster courses cleaning, 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 Sanitaire (CASS)	NGO	1978	36	Nkoldongo	Youths training for micro- employment projects and sports
17	ACADE PRO	NGO	1985		Mimboman	House to house waste collection to public bins
18	ENICAM (entreprise de nettoye industriel du Cameroun SARL)	MSE	1991	40	Elig Essono	Cleaning industries, collection of waste in specific individuals
19	Ets BOB'S Foundation (SARL)	MSE	1987	36	Nkolfoulou Road (near SAPLAIT)	Collect waste in households, enterprises, cleans industries
20	Ets MEIDO	MSE		1	Nvog Mbi	Hires hysters
21	Yaoundé Propre	SME		2	Bastos	Waste collection in specific households in Bastos Quarter

* The translations into English are by this author.

AT: Association of Traders
GIC: Common initiative Group

NGO: Non-Governmental Organisation
QA: Quarter Association
SME: Small and Medium-size Enterprise
YA: Youths' Association
Sources: (Environnement Recherche Action au Cameroun 2002)

Waste generators' organisations such as the Association of Traders in Mfoundi Market, quarter people, student and youth groups, voluntarily contribute to the cleanliness of their environment by gathering and collecting waste from their premises, streets, gutters and watercourses. This waste is disposed of in public skip containers. A few groups are involved in recycling and are discussed in Chapter 9. The other groups (Table 8.8) are involved in many activities including moving waste from household, offices, institutions and industries to the public skip, which is primary level activity, or to the landfill using their own vehicles, hence secondary level of waste management. An example is Bob's Foundation Establishment that collects waste in enterprises such as SNI, BEAC (Headquarters and residence). More examples include MSW from the Yaoundé Central Hospital, British American Tobacco (BAT) industry and residence, TIGRE Supermarket, Fokou Soa and some residences and embassies in Bastos where waste is collected and transported to the landfill by individual business enterprises using pick-ups and trucks (Environnement Recherche Action au Cameroun 2002). In both primary and secondary waste activities, there is direct negotiation on payment rates between the generators and the waste removers. The rationale that underpins these activities is to complement the activities of HYSACAM.

There are more than 30 in number and many not only informal but their activities remain uncoordinated, zones of operation undefined, their practices unchecked and at times resulting in conflicts and illegal dumping. This partly explains why an NGO by name "Environnement Recherch-Action au Cameroun (ERA-Cameroun)" emerged in 2001 with the objective of putting in place and coordinating a pilot scheme aimed to give selected NGOs or CIGs already involved in primary solid waste collection and recycling in five quarters located in Melen and Mbenda areas, material, financial, technical and administrative support to enable them to establish themselves in their zones of operation through functioning sustainably and cooperating smoothly with the other partners, especially HYSACAM. An evaluation report through a survey shows that the project is a success but notes that the people's willingness to pay has paradoxically dropped from 1000-1300 franc CFA to 600-800 franc CFA as at the start of the project. This situation creates a deficit of 35% needing an augmentation from elsewhere, presumably the City Councils or HYSACAM. The French Ministry of Foreign Affairs financially sponsors the project with collaboration from the INSAVALOR POLDEN group, the Yaoundé City Council, Yaoundé VI and HYSACAM (Environnement Recherche Action au Cameroun 2002)

8.5.2.1 An example of CIG: Tam Tam Mobile

Tam Tam Mobile Association is a common initiative group (CIG) involved in mobilising youths towards gainful employment including primary solid waste collection and recycling in Melen-Mokolo quarters Yaoundé (Plate 8.3). Founded in 1997, it is one of the most organised CIGs and operates by organising and collaborating with households that are not accessed by the official waste management organisation to collect their waste at an agreed fee. The waste is collected, recycled and the ultimate waste disposed of at the public skip

PLATE 8.3: Tam Tam Mobile (CIG) at work, Melen Quarter, Yaousnde 13/3/2003

According to the coordinator, the households pay around 1000-1500 francs CFA per month and that many households are happy with it. Getting all on board is a gradual process that will have to go along with patience and educate them (Interview on site with the coordinator, Mr. Sama Simon, in Melen Yaoundé 13/3/03). The coordinator works three days a week with the field staff to demonstrate the art and solidarity. They use wheel-borrows and pushcarts where path permits access or place the equipment on the main roadside and move waste there by hand portage where only foot paths exist (Plate 8.3). Tam Tam Mobile Association, along with GIC Jovelec Mendong, were chosen for the ongoing ERA-Cameroun pilot project on urban waste management and hygiene for Yaoundé called "Putting in place the structures of pre-collection and treatment of urban solid waste in a tropical city: the case of Yaoundé".

8.5.3 External Support Agencies (ESAs)

External Support Agencies (ESA) include foreign national governments such as assistance under the French Cooperation in Cameroon e.g. Funds for Social Development (FSD), German Development Services (DED) and the Dutch Cooperation (CORDAID). Regional Unions, e.g. the European Union through its Funds for Urban Organisations and Micro Initiatives (FOURMI) Fonds aux organisations urbaines et aux micro initiatives) intervenes by supplying waste collection materials especially in disfavoured quarters. The PDM (Programme de Developpement Municipal)/Urban Management Programme for Africa has it headquarters in Cotonou and Zimbabwe and organises training sessions on maintenance and urban infrastructure management including municipal solid waste management. International organisations for example the UNDP and NGOs such as Research and Technological Exchange Group (GRET) are involved at various levels of solid waste management in Yaoundé (Chapter 8). Their interventions are in the areas of finance, material (Plate8.3) and technical assistance including policy orientation through funding policies.

8.5.4 Secondary Waste Management Company-HYSACAM

8.5.4.1 Introduction

Secondary solid waste management is mainly executed by the company, Hygiène et Salubrité du Cameroun (HYSACAM), through a contract signed by mutual agreement between it, the Yaoundé City Councils and the Government of Cameroon. This contract (No. 165/GG/68-99) stipulates a daily manual and mechanical sweeping of some streets, avenues and boulevards (369kms); public places and the markets in Yaoundé City area every working day. It includes a daily or once-in-two days collection and treatment of solid waste from households, public roads, paths, markets; public institutions such as schools, hospitals, small businesses, artisans and offices. The contract excludes wastes from exploitation of public works, factories and industries, construction and demolition, commercial, slaughter, anatomic or infectious wastes from hospitals and clinics i.e. hazardous waste (Communauté Urbaine de Yaoundé *et al.* 1998). The company is responsible for collecting and transporting waste brought to the official collection point for disposal and treatment. A limited number of individuals, groups and private business people are gradually getting involved in the secondary sector (Table 8.8).

8.5.4.2 Organisation and Management

The organisation and management are based on the terms of the contract and it revolves mostly around public waste skips. HYSACAM has three methods in place for collection and transporting waste namely from skips in fixed spots, ground depots and an itinerant waste collection van system. The arrangement follows the administrative urban subdivision, each of which has sectors or circuits serving a number of public skips or ground depots located at strategic sites. The type of skip located at a place depends on the characteristics of the waste generated, density of population in that area and the state of the access roads. These skip locations very much depend also on what the city council had decided before the award of the contract. There are three common types of skips, 1000 litre skips, $6m^3$ and $16m^3$. Eight $9m^3$ skips have been added to supplement the $6m^3$ skips. The contract recommended the house-to-house itinerant collection system using compactor trucks and the Paris Tipper type for accessible areas with far-spaced public skips or none. High population density areas with good roads were to have $16m^3$ skips

A.1 m^3 skip **B. Compactor truck loading a 1m^3 skip**

C. **6m^3 skip** **D. 9m^3 skip**

E. 6m^3 skip & truck at weighbridge **F. Loading a 6m^3 skip at Bastos**

PLATE 8.4: Types of Public Skips in Yaoundé, 2003

carried by roll-on roll off-trucks called “Ampliroll” or $6m^3$ carried by dumpster trucks equipped with chain-hydraulic lift systems. Market waste was planned for collection in $16m^3$ skips and carried by the Ampliroll tipper truck. According to an evaluation report by Monkam *et al*. (2000) and field experience by the author there have been a few spatial and numerical adjustments in skips placing by HYSACAM but much revolves around the original allocations.

Table 8.9 and Figure 8.6 summarise the field distribution of the public skips and circuits in Yaoundé City. Plate 8.4 displays the different types of skips available. In addition some ground sites have been created by residents where skips ought to be but are lacking. In establishments such as schools and hospitals, half drums with a capacity of 100 litres are used to collect and store waste Plate (8.1 E). A visual inspection of skip distribution in Figure 8.6 suggests that the provision of these facilities declines systematically from Yaoundé I to Yaoundé VI that lacks the 1000 L bins. HYSACAM did some adjustment to the contract specifications by adding or reducing some skips (Figure 8.7). But when this distribution is subjected to more scrutiny by introducing more parameters such as the population and skip sustainability (Figure 8.8), our appreciation changes and we question the bases on which contract specifications and field adjustment were made.

TABLE 8.9

Distribution of Public Skips and Waste Collection Circuits in Yaoundé by Urban Subdivisions

Sub Division	Popu-lation	$1m^3$ No.	$6m^3$ No.	$16m^3$ No.	Total No	1m3 TV+	6m3 TV	16m3 TV	TV Avail.	T waste kg	*TV Needed	TV Lacking	No. of Times
Yaoundé 1	244264	**78**	**22**	**7**	**112**	78	132	112	322	192968.6	771.87	449.87	2.4
Yaoundé 2	299560	**39**	**25**	**8**	**74**	39	150	128	317	236652.4	946.61	629.61	3.0
Yaoundé 3	249301	**42**	**20**	**2**	**67**	42	120	32	194	196947.8	787.79	593.79	4.1
Yaoundé 4	273108	**17**	**16**	**7**	**43**	17	96	112	225	215755.3	863.02	638.02	3.8
Yaoundé 5	161642	**14**	**14**	**5**	**36**	14	84	80	178	127697.2	510.79	332.79	2.9
Yaoundé 6	192344	**0**	**18**	**6**	**26**	0	108	96	204	151951.8	607.81	403.81	3.0
Total	1420219	190	123	43	374	190	738	688	**1440**	**1121973**	**4487.89**	**3047.89**	**3.1**

- TV=Total Volume in m^3.
- Calculated as population of each sub-division x per capita generation (0.79 kg)/density (250 kg/m3)

Sources: Compiled by the author from the (Cahier des Charges) Contract Specifications Book

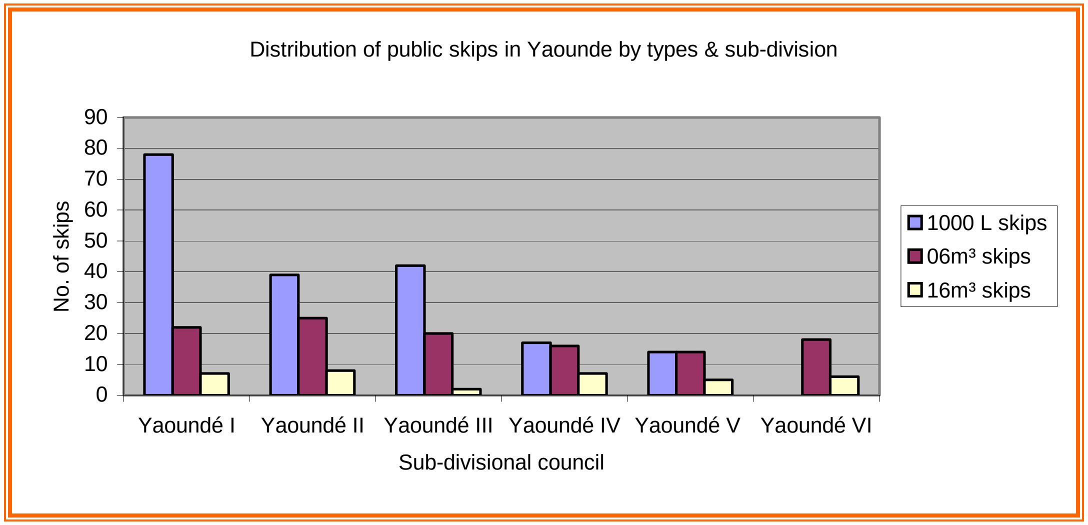


FIGURE 8.6: Distribution of Public Skips by Type & Sub Division, Yaoundé

Source: Compiled by the author from contract prescription and field data

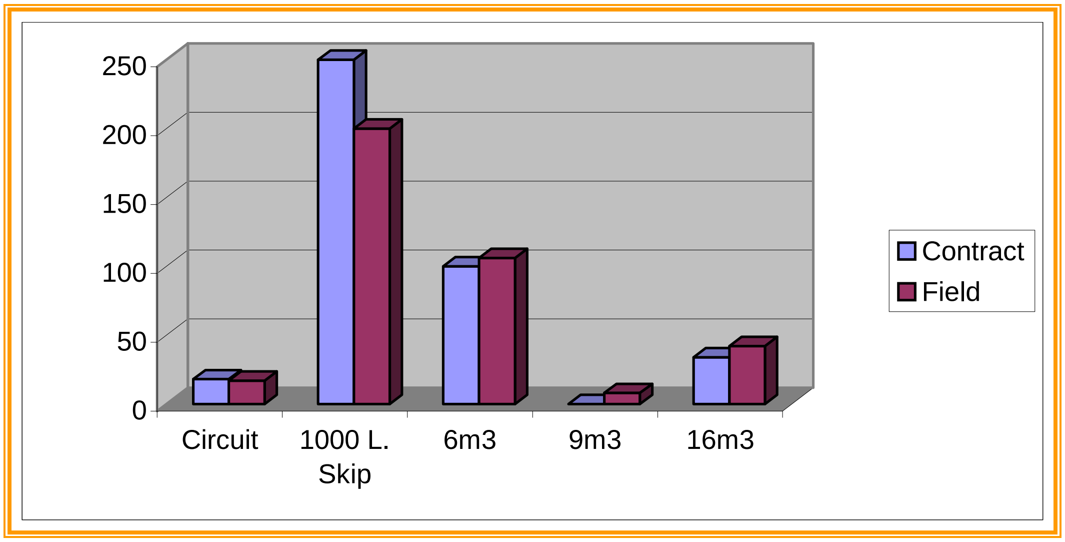


FIGURE 8.7: Comparison of Public Skips and Waste Collection Circuits with Contract Specifications and Field Experience, Yaoundé
Source: Made by the author from contract and field data 2003

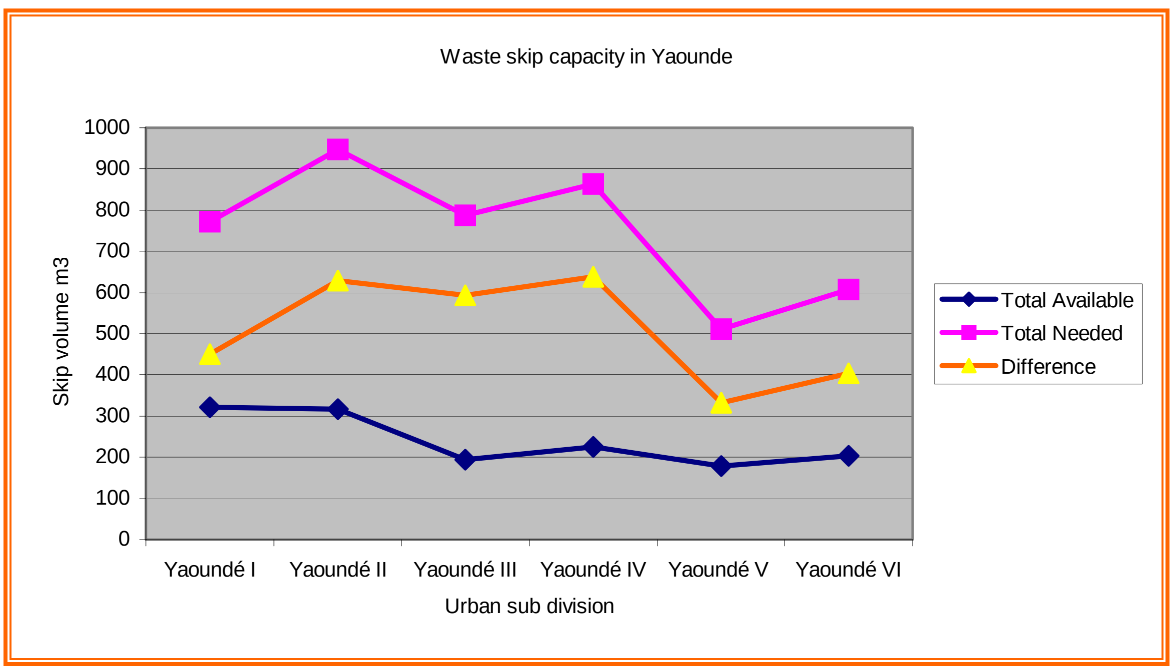


FIGURE 8.8: Public Waste Skips Capacity in Yaoundé, 2003

Figure 8.8 presents a synthesis that demonstrates the state of waste skip capacities (in volume m^3) in each sub-division in Yaoundé, that is, the availability, total needed and the shortage. The 'total available' is calculated from total available skip volume, type notwithstanding, and the 'total needed' (i.e., sustainable volume assuming all solid waste generated were to be put into the public skips) is got by finding the total waste generation by the total population of each city sub-division (Institute National de la Statistique 2003) and converting it into volume as a function of density: 250 kg/m^3 (Vermande *et al.* 1994; Environnement Recherche Action au Cameroun 2002; Mississippi Department of Environmental Quality 2002).

The results suggest that no sub-division is yet sustainable in the volume of skips needed. The number of skips needed to be increased in each sub division ranges from 2.4-4.1 times. The most served is Yaoundé I followed by Yaoundé II that together with Yaoundé IV is most needy. The least served with capacity is Yaoundé V that paradoxically needs the least quantity of skips to be sustainable. Meaningful planning could best be directed towards the needs of each urban sub division rather than a general scheme that focuses on the whole city, or else the spatial realities will be blurred.

8.5 4.3 HYSACAM's Waste Collection and Transportation Vans

Article 8 of the contract shows that HYSACAM is responsible for the collection and treatment of the waste defined in the contract to the public landfill at Nklofoulou (Soa). The next article stipulates that the operation consists of collection of the waste from one place to another and the transportation of these waste to the treatment place, the landfill (Communauté Urbaine de Yaoundé *et al.* 1998). Understandably this is the transportation to the landfill and treatment of MSW that has been collected, stored and moved from the source of generation such as households, institutions and markets to a public collection spot usually a skip container or a designated ground site. Collection and transportation are therefore the greatest activities of HYSACAM.

HYSACAM has sophisticated waste transport vehicles designed with specification systems to manipulate the various types of public skips available or even ground waste depots. Where the mechanisms fail, as they often do, support is given manually. Collection is organised into 18 sectors or circuits distributed among the six sub divisions of the city (Table 8.9). Waste collection within the circuits is executed by a variety of specialised collection vans. These include rear loader compactor trucks; lift tippers or roll-on trucks, heavy tippers fitted with scooping cranes, tippers with closable top called the Paris Type and ordinary tippers. They make a number of trips varying from three to six each a day.

PLATE 8.5: Rear Loader Compactor Truck
Source: Photo by the author, 03/4/2003, Yaoundé

The rear loader compactor (Plate 8.5) has a large enclosed container in which waste is mechanically or manually fed from its rear with 1000 L bins and compressed within using a hydraulic ram to reduce space. Garbage collectors assist by manually loading the bins or using spades to collect waste overspill from bins (Plate 8.5). It has a capacity of $12m^3$ and serves areas with moderate waste generation and good roads such as Zone V (e.g. Bastos) and I & II, (e.g. the SIC areas, Central City and Melen areas).

There are many roll-on roll off “Ampliroll” or lift tipper trucks (Plate 8.6) that are assisted by hydraulics and chains to manipulate the $6m^3$, $9m^3$ and $16m^3$ skip containers. At the landfill the truck tips the waste and carries the empty skip to the next spot where the empty skip is swapped and the one with waste lifted or rolled onto the van for the landfill again. The process is so fast that such vans that execute the service are termed ‘waste taxis’. However, manual labour is applied to clean waste from around the skip spot. They are prominent in areas of heavy waste production and good access roads for instance, Zones II, III and market places.

PLATE 8.6: Lift Tipper Truck Swapping $6m^3$ Skips, Yaoundé 03/4/2003

HYSACAM has six heavy-duty tipper trucks with either $16m^3$ or $20m^3$ capacity containers mounted with scoop clam cranes for collecting waste from ground-dumped sites and accessible illegal dumps (Plates 8.7 & 8.8). They could be very helpful in eliminating illegal dumps but such dumps are usually found in very inaccessible places.

PLATE 8.7: 16m^3 -Capacity Tipper Fitted with Crane and Waste Grabbing Device 14/3/2003 Obili , Yaoundé

PLATE 8.8: 20m^3 -Volume Tipper Fitted with Crane and Waste Grabbing Equipment, 03/4/2003 Yaoundé

There are three open ordinary tipper ‘bennes entrepreneuses’ (BTP) that are used sparingly with the use of a front-end loader or manual labour to collect ground waste, tree branches and palm fronds. Two mechanical sweepers also exist. Generally the amount of equipment needed is far more than was perceived by the contract. For example, only two crane-mounted tippers were previewed but with increasing illegal and ground dumps the number has been increased to six. However, the sizes of the vans suggest they can only collect waste dumped on good access roads whereas many illegal dumps remain remote. In addition, many of these trucks are usually broken down so it is not easy to get exact figures for the equipment. The continuous maintenance of almost completely broken down public skips on the circuit suggests that there is a dire need for more skip containers (Plate 9.5).

8.5.4.4. HYSACAM’s Waste Management Team and Operations

The operational staff includes 4 engineers, 2 senior administrators, 10 maintenance agents, and 385 workers such as drivers, conductors and labourers (Ngoma 2001). According to HYSACAM sources and experience in the field, the first shift of waste collection works from 6 am-12 pm and the second from 2-5 pm. One other driver told me they also have night shifts. Roads, street and public places are swept between 6pm-1pm while markets are cleaned 10 pm-6 am, Monday to Saturday. An evaluation report by Monkam *et al.* (2000) shows that 128km of sweeping yielded 20-30 tonnes of waste a week and the cleaning of the 22 city markets removed about 45 tonnes a day, accounting for only 52%of all market waste (Monkam *et al.* 2000).

8.5.4.5 Zones of Secondary Collection

The circuit areas determine the zone of operation of the secondary waste collection. The area served has a close relationship with the distribution of the skips illustrated in Figure 8.6. Yaoundé 1 dominates in the waste facilities. It is here that the Presidency (Etoudi), Batos (highest standing quarter), one urban sub divisional, the Divisional and Provincial headquarters, the city council, National Radio and TV station (Mbala II) and the central commercial and administrative functions are situated. It also has the largest population. Yaoundé III and II closely follow this zone.

Shortage of bins is characteristic of Yaoundé IV and the two new urban sub divisional councils, V & VI. This shortage is complemented with the itinerant waste truck system. In this system the waste van moves according to a planned stopping schedule to collect waste from generators at specific spots along certain routes in the city where public skips are lacking. The system avoids the problems associated with double collection of waste such as nuisance created around public bins, e.g., leachate, flies, rats, odours and domestic animals. However, field experience especially in Efoulan Quarter suggests that the system is fraught with many inconsistencies such as late arrival and impatience on the part of the truck drivers leading to frustrations by householders who sometimes respond to these irregularities by depositing their waste on the road sides instead of carrying it back home or by choosing illegal dumps in the first place. Our field survey results by the author suggest that the average distance the Yaoundé population is prepared to travel to dispose of their waste is 87.3 m. If the stopping interval by the waste van does not respect this average distance, by stopping close to a 174.6-metre interval, many people might prefer other systems such as private contractors. According to calculations by the author (Table 8.9 & Figure 8.8) the current total volume of the skips (1616 m^3) is 2.8 times less or only 36% of the sustainable volume needed to handle the city's solid waste. Table 8.10 illustrates the expenditure pattern of secondary waste management by HYSACAM. It suggests that nearly 80% goes on collection and transportation and very little on treatment.

Table 8.10: Summary of Estimated Costs of MSWM by HYSACAM in Yaoundé

Service	**Costs in Millions of Franc CFA**	**Percentage***
Headquarters	89,33	03.02
Administration	21,30	00.72
Exploitation (collection & transportation)	2 323,80	78.59
Treatment	419,40	14.18
Garage	103,20	03.49
Total	**2 957,03**	**100.00**

* This author calculated the percentages.

Source: Ngoma (2001, p. 19)

8.5.5 Problems Associated with Secondary Collection

HYSACAM is gradually increasing it fleets of waste vans and public skips but the amount of such equipment are far less than the amount need. Huge quantities of waste remain uncollected in public skips and many areas are poorly served by skips. The itinerant waste collection programme is plagued with irregularities. In addition, the problems HYSACAM has to cope with include ageing vans, rusting skips, long distance hauls, poor access roads and non-collaboration of waste generators.

8.6 General Conclusion

Yaoundé generates about 1200 tonnes of solid waste a day, three-quarter of which is biodegradable. However, the management of this waste remains a problem as only small areas of the city are served with about 40-50% of waste collected and disposed of at the landfill. The rest is illegally disposed of. The problem is known. Waste producers, formal and informal groups, the waste management company-HYSACAM together with the government through the city councils and external support agencies are all involved in trying various strategies to solve the problem. The continuous heavy financial assistance by the government to safeguard the national capital’s prestige cannot go on forever. What emerges clearly from the study is that there is a shortage of equipment, a lack of a clear role, rules of the stakeholders and poor coordination between the generators and the service deliverers. While increase in the use of machines is desirable, it is limited by access roads and other problems linked to adaptability such as climate. Thus, increasing efforts must be made to involve waste generators in the management of the waste that they generate including the treatment, which for now has been given very little attention.

CHAPTER 9

Municipal Solid Waste Treatment, Disposal and the Environment in Yaoundé

9.1 Introduction

Municipal solid waste treatment including disposal practices is vital to sustainable solid waste management in terms of policy, strategy and practice. Treatment through recovery and recycling converts some of the would-be waste to useful products hence, saving money, the environment, and human health. It also helps prolong the life of final disposal facilities such as incinerators and landfills. Inadequate attention accorded to this sector, as is the case with Yaoundé, causes a plethora of economic, environmental and health problems. For example, the estimated expenditure on waste collection and transportation by HYSACAM, the main waste management company is 79.59%, while treatment including disposal, only amounts to 14.18% (Table 8.10).

It was also noted from field observations that the term “treatment” is applied to mean the process of burying waste at the landfill including leachate management, whereas the landfill site plan and contract specifications suggest on-site recycling. Recycling, which is a major means of waste treatment is therefore not being implemented except for a few scavengers who are allowed to extract valuable items from the landfill. However, on a limited scale, households, artisans and some NGOs in Yaoundé treat MSW by recycling.

In this chapter I discuss three main issues. The first is formal and informal waste treatment and policy, which are examined, in a wider context to include waste minimisation strategies. This is followed by a study of waste disposal practices. Lastly, I examine the environmental and human health impacts of solid waste management in the city. The chapter completes the examination of MSWM in Yaoundé started in Chapter Eight.

9.2 Municipal Solid Waste Treatment in Yaoundé

9.2.1 Introduction

The term 'treatment' is used to encapsulate all actions taken on solid waste after it is declared unwanted by the last user. Such actions include separation for recycling, all forms of recovery and disposal strategies. The following section examines these aspects of MSW handling.

9.2.1 1 Separation

Waste minimisation underpins the modern concept of sustainable solid waste management**.** Resource recovery and recycling is a key strategy that meets such goals and starts with the crucial stage of waste separation into specific components: biodegradable, non-biodegradable and toxic. The author made a survey of waste separation practices in Yaoundé, the results of which are summarised in Table 9.1.

TABLE 9.1

Cross Tabulation on Willingness to Separate Waste in Sampled Quarters of Yaoundé

Quarter	Yes		No		Total	
	Count	%	Count	%	Count	%
Bastos	6	**18.2**	27	**81.8**	33	**100**
Efoulan	11	**39.3**	17	**60.7**	28	**100**
Nvog Ada	3	**4.0**	72	**96.0**	75	**100**
Cite Verte	10	**31.3**	22	**68.8**	32	**100**
Averages		**23.3**		**76.8**		**50**

Source: Field survey by the author, Yaoundé March 2003

The results suggest that less than a quarter of Yaoundé's population advocated separation of waste into biodegradable and non-biodegradable components so as to facilitate further recycling. Reasons advanced by respondents for not liking separation were overwhelmingly that they have no need for so doing (Bastos 68%, Efoulan 57%, Nvog Ada 87% and Cité Verte 37%). Thirty-six per cent indicated that waste separation is a difficult exercise. A further reason given was a lack of space for agriculture; so separating biodegradable waste for the purpose of manure was not necessary. This partly explains why in a low-income and a high-density centrally located quarter such as Nvog Ada only 4% advocated separation and 96% were against. Eighty-seven per cent of those who were against further declared they had no use for separated materials. The opposite is true for peripheral low-density quarters such as Efoulan and Cité Verte, where some form of agriculture, including farming gardening, and animal rearing are practised. Respondents never considered toxicity as a possible reason for separation of waste at source.

9.2.1.2 Informal Waste Recovery and Recycling

Non-separation of MSW means that waste is disposed of mixed. There is no policy on waste separation or on recycling. However, as in Bamenda (7.2), there is informal recycling at the source especially as scavenging is not a common phenomenon in the city. Figure 9.1 illustrates the general recovery flow diagram for Yaoundé and Figure 9.2, shows the level of household waste recycling.

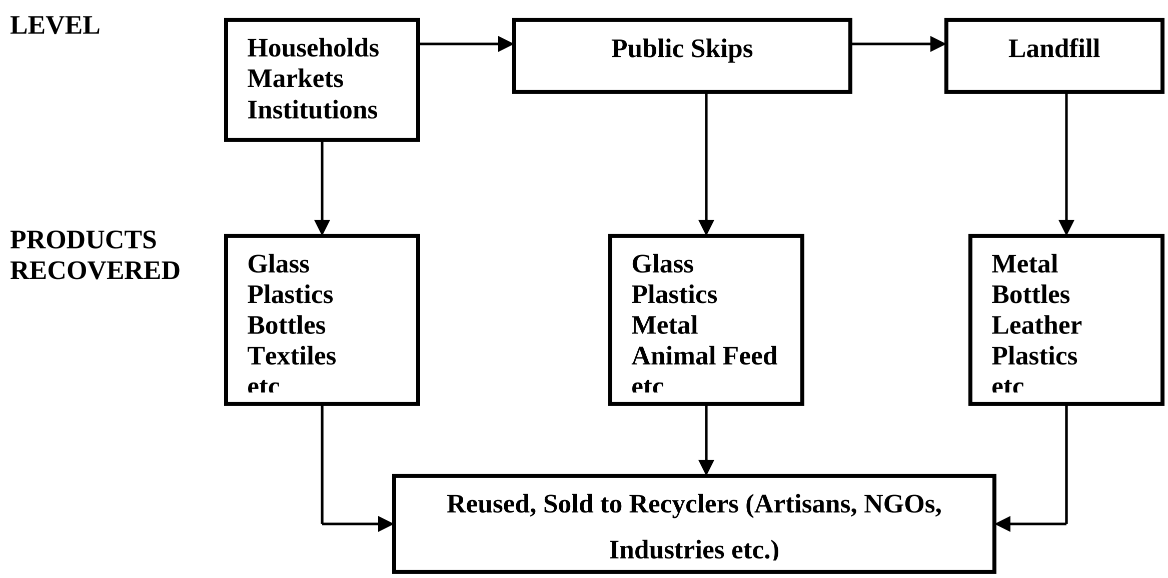


FIGURE 9.1: General Waste Recovery Flow Diagram for Yaoundé
Source: Adapted from Ngoma (2001)

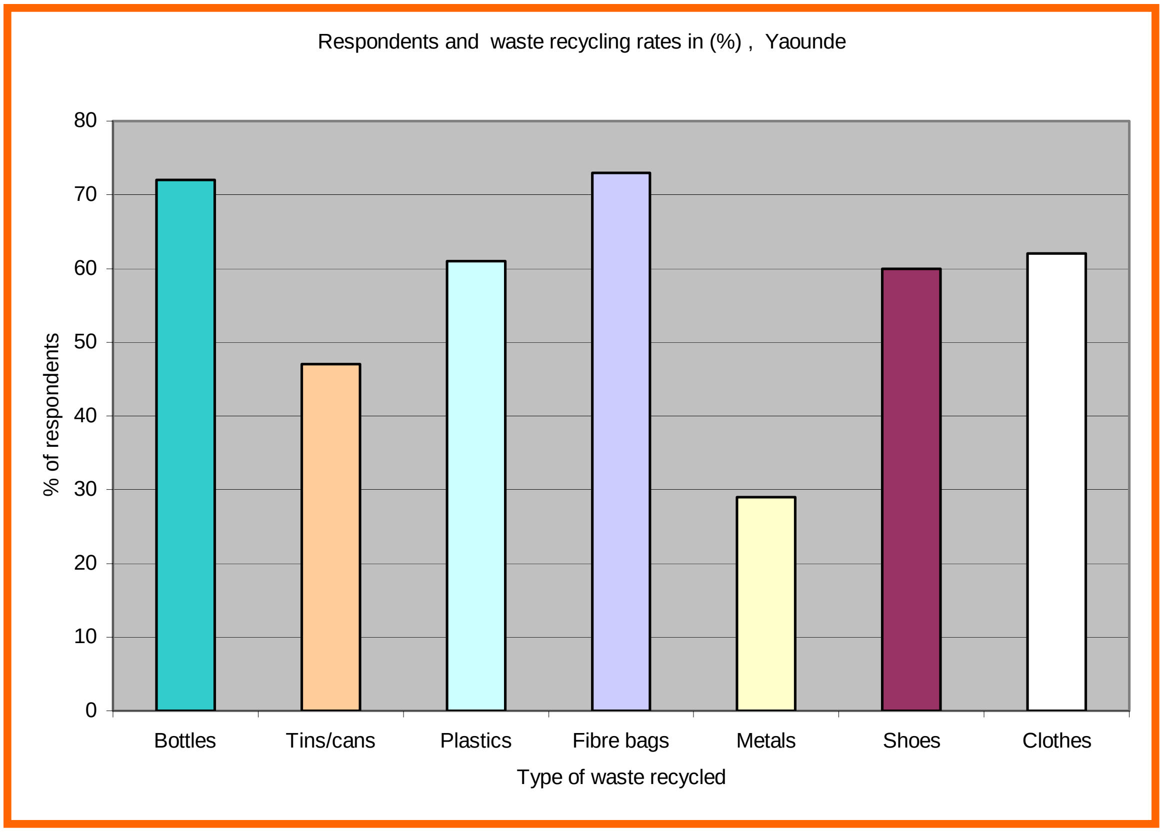


FIGURE 9.2: Household Non-biodegradable Solid Waste Recycling in Yaoundé
Source: Summarised from reuse survey cross tabulations by the author, March 2003

Both figures 9.1 and 9.2 indicate that there is recovery at each level of the SWM-generation, public skip and landfill. The survey results demonstrate that informal recycling of household goods in Yaoundé is even greater. Fibre bags, bottles, plastics, tins, cans, clothes and shoes are highly recycled, i.e., reused, repaired, given out or received as gifts or sold out to higher order recyclers (Figure 9.2). Generally the least recycled item is metal even though aluminium scraps are highly reused. Mostly old containers such as buckets, paint tins, plastic and fibre bags are reused as solid waste receptacles (Plate 8.1).

Waste recovery at the public waste facilities such as skips and the landfill exists but it is not significant. At the public skips a few scavengers were noticed sorting through some skips for valuables. This phenomenon is common among people who collect food waste to feed pigs. HYSACAM's contract with the government (Section 9) stipulates that: 'This operation consists of waste collection from places to the treatment site at the landfill' (Communauté Urbaine de Yaoundé and Hygiène et Salubrité du Cameroun {HYSACAM} 1998). But, apart from HYSACAM treating waste by burying it at the landfill, only scavengers at the landfill recover an insignificant quantity of valuable items. There are 10-18 scavengers who irregularly work at the landfill. Five have developed small huts within the landfill. The others come from the city and the neighbouring Nkolfoulou village. They extract items such as bottles, textiles, copper wires from old motors of white and brown goods[1], which they either use or sell (Plate 9.2). Scavengers living within the landfill also use some organic solid waste to make compost for their gardens.

9.2.1.3 Formal Recycling and Transformation

Yhdego (1995) argued that the greatest problem facing recycling is the lack of local or national markets for the recyclables. In Cameroon most manufactured goods are imported which is why closed-loop recycling is not common except for bottles used by breweries located in the big cities of the country including Yaoundé. Nevertheless, some waste items are transformed into new products by artisans for local use in Yaoundé, e.g., smelting of aluminium cans and scrap metals into household utensils; transforming old car tyres into shoes, ropes, flower pots; and paper and plastic waste articles into tourists' products (section 7.2.4). Paper and cartons are transformed into newsprint. Cullet[2], household bio-waste, rubber and plastic waste recycling have received more formal attention in the last decade especially by some NGOs.

9.2.1.3 (i) Plastic Materials and Rubber: An NGO known as CIPRE (Centre International de Promotion de la REcuperation) International Centre for the Promotion of Recovery, recycles rubber and plastic materials at its site in Etug Egbe Quarter, Yaoundé VI. CIPRE was created in 1996 and has a general objective of alleviating environmental

[1] Brown goods are electronic equipment such as computers, printers, televisions, etc. White goods include large enamel electric and electronic goods e.g. refrigerators, coolers, air conditioners and washing machines
[2] These are mixed colour, broken or crushed glass that can be used to make new bottles. That is an example of closed-loop recycling.

pollution and poverty through the recycling of plastic waste. The latter was identified as a nuisance since it is non-biodegradable, litters easily through wind action, emits dangerous gases when burnt and accounts for 4.3% of Yaoundé's MSW. The organisation's ambition was to collect 350 tonnes of plastic waste per month, recycle 80 per cent, repair 2 per cent and send 28 per cent of the ultimate waste back into the waste stream. This accounted for one percent of Yaoundé's MSW (Tchuente *et al.* 2000).

Today, with a permanent staff of 17 and many casual workers, CIPRE buys and collects 10 tonnes of plastic waste from 50 sites located all over the city every month for recycling. There are 10 collection agents shared among the 50 sites. A ten-point circuit collection, using a pick-up truck, is made on each five- day working week (Interview with CIPRE's General Secretary, 10/10/02). CIPRE buys by weight, type and state of the plastics and rubber waste. It recycles by cleaning, classifying, repairing and transforming the waste into new products. By November 30 2001, 307 tonnes of plastic waste were recovered, 130 tonnes recycled, 34 780 objects directly recovered and sold for reuse, for example, shoes and buckets (CIPRE 2002). New waste-derived products are: beanbags, footstools, face-hats and manikins moulded out of melt plastics. They also process gum, varnish and paint from plastic materials. The bulk of the products is sold to industries as raw materials. Their products are very affordable. CIPRE's activities also include sensitisation of the public to environmental issues. HYSACAM, by agreement, accepts their residual waste at the landfill.

The activities of CIPRE are supported 30% by its members and 70% externally by the Yaoundé VI council including foreign donors such as the France-Cameroon Cooperation (Fonds Sociale de développement {FSD}), Social Development Funds; German Development Services (DED) in Cameroon and the Catholic Organisation for Relief and Development Aid (CORDAID) of the Netherlands. Technical assistance is from an international NGO, (Groupe de Recherche et d'Echange Technologique {GRET}) (CIPRE 2002). Though CIPRE is expanding it activities to Douala, the largest city of the country, shortage of finance remains it greatest impediment. However the organisation has had significant recognition at home and abroad, winning the November 2000

International Cooperation Grand Prize Award organised in France (Interview with CIPRE's General Secretary 10/10/02; CIPRE 2002).

9.2.1.3 (ii) Municipal Solid Waste Composting: Yaoundé and its environs have an active agricultural sector that uses huge amounts of fertilizers. Until the late 1980s, when the country started facing an economic crisis, these fertilizers, mostly the chemical type, were imported. The economic crisis was characterised by currency devaluation, suspension of subsidies and doubling of imported fertilizer prices. This further led to increasing unemployment, abandonment of waste management by the official contractor and the consequent "drowning" of the city in waste. The city council in May 1994 under the Government-World Bank's Structural Adjustment Programme (SAP) plan, invited all the NGOs to jointly seek solutions to these pressing problems. It was then that one NGO, FOCARFE (Fondation Camerounaise pour une Action Rationalisée des Femmes sur l'Environnement) created in October 1991, emerged with a multiple-objective project to intervene in the municipal solid waste sector using the population to compost household MSW. Its target was to use the population to clean the city of its waste, reduce illegal dumps, reduce unemployment and produce a cheaper substitute for imported mineral fertiliser. In addition, items such as aluminium, bottles, glass and rubber were recovered and sold (Interview with the director of FOCARFE, 4/02/03).

FOCARFE mobilised the mass of unemployed youth to collect and compost waste from 15 quarters. It used 65 composters to transform 11000 tonnes of household waste into 3800 tonnes of compost per year (Nkotto *et al.* 1995; Mpandjo 2001). The project realised that 100 kg of household waste can give 30 kg compost. The costs of producing compost were less than 20 000 Francs CFA per ton within a 200 km radius. This was comparable with imported mineral fertilizers that cost 120 000 Francs CFA for the same quantity. This project was realised with technical expertise and collaboration gained from two civil engineers from the National Advanced School of Engineering (ENSP), University of Yaoundé I, who had conducted successful composting trials in the Melen and CRADAT quarters of Yaoundé in 1992/93 (Interview with the director of FOCARFE, 4/02/03).

Chemical analysis of the compost examined by Ngnikam *et al.* (1993) showed that heavy metals such as lead, copper, mercury, and nickel were present at normal quantities. However, in some quarters lead concentrations in composts were found to be greater than normal and consequently the use of such composts for market gardening was discouraged. In the same vein, Nkotto *et al*. (1995) revealed that Macky's comparative economic analysis in 1995 of compost and chemical fertilizer applications versus some crop yields in Cameroon suggested that:

- Compost is cheaper within 200 km radius from the point of production than chemical fertilizers.
- Mineral elements are retained more in compost than mineral fertilizers
- One compost application can support three or more successive croppings
- Compost ameliorates the physical properties of the soil (increases the water retention capacity of the soil, the capacity to retain the cations and facilitates the action of microorganisms through aeration of the soil. All these lead to an improvement in the growth of crops such as tomatoes, maize, lettuces, and watermelons.
- Compost could be made richer in nitrogen by adding waste from the breweries or fowl droppings that are both rich in nitrogen (Nkotto *et al.* 1995).

The composting operation went on for two years only. According to the FOCARFE director the population had to make a permanent contribution to offset the costs of collection and transportation but they soon interpreted it as another form of taxation. Further research also revealed that the need for manure in the tropical rainforest areas such as Yaoundé was lower than in savannah regions, for example, Bafoussam or Garuoa in the Sudan. The same sources discovered that out of 180 tonnes of compost manure produced in Yaoundé at one time, only 8 tonnes could be sold, contrary to the situation in Bafoussam and Garoua where all that was produced was sold even though the sale covered only 25% of the total expenses incurred. (Tanawa and Ngnikam 1997). However, declining finances and materials support, more than other reasons, caused the end of the project in 1996 (Mpandjo 2001). This project was sponsored by many foreign bodies, for example, (Mission Française de Cooperation et d'Action Culturelle {MFCAC}) the

French Cooperation and Cultural Mission; the Global Environment Facility (GEF) small grants of United Nations Development Programme (UNDP); African Development Foundation (ADF); Hanns Seidel Foundation; Canadian-Cameroon Cooperation and Friedrich Foundation (Mpandjo 2001).

9.2.1.3 (iii) Cullet: In general, all local breweries and soft drink factories, for economic reasons, institute a bottle take-back marketing strategy. However, companies that sell imported beer, wines, spirits and champagne do not recover their empty bottles after sale. Field observations and interviews indicated that SOCAVER (la Sociéte Camerounaise de Vere) recycles bottles broken (cullet) at the breweries, but breakages that occur elsewhere are disposed of with other waste. A local wine-bottling company such as SOFAVIN Yaoundé buys empty wine bottles from hotels, restaurants, bars and individuals. There is no environmental law such as the Extended Producer Responsibility (EPR) or an Integrated Product Policy (IPP) that could respectively compel these breweries to take back the end products of their goods from the consumers or to produce goods with environmentally friendly waste.

9.2.1.4 Conclusion.

In Yaoundé there are many recovery and recycling activities operating at the levels of waste generation, public skips and landfill. A greater part of recycling including separation, remain informal, rudimentary and at the artisan stage and driven by economic motives. However, a few formal groups such as NGOs recently emerged to recover and recycle waste with economic as well as environmental objectives. These groups included FOCARFE that was composting biodegradable city waste and CIPRE, which is recovering and recycling plastic waste. FOCARFE is no longer in operation, so the entire three-quarters organic fraction of the MSW stream is buried in the landfill where it further produces hazardous landfill gases such as carbon dioxide and methane (see 9.4.6.3). CIPRE is making enormous efforts to stay on. Both NGOs have relied heavily on external funding and such funding never lasts for ever. The total fraction of solid waste diversion from final disposal is insignificant and there is no government policy yet in place to correct this situation, so that most solid waste produced ends up in final disposal facilities, both legal and illegal.

9.3 Municipal Solid Waste Disposal

9.3.1 Introduction

There is always an end to the life of a good, the rate of waste diversion and recycling not withstanding. This results in waste that cannot be put to any further use. Such is called the ultimate waste and usually recommended for disposal in such a way that the environment and human health will not be compromised. Many recommended options exist (7.3.1) but in cities of developing countries such as Yaoundé, easier but hazardous disposal methods exist alongside the officially recommended ones. Two major solid waste disposal methods can be distinguished in Yaoundé: illegal widespread indiscriminate dumping in the city and official controlled landfilling at Nkolfoulou.

9.3.2 Illegal Disposal Methods

A more general form of illegal disposal of MSW is littering. Littering involves careless throwing of waste around houses, offices, markets, streets, public places and utilities including parks. In Yaoundé it consists mainly of paper, cigarette butts, sweet wrappings, plastics, fruit peels, nutshells and beer tops. The main sources of this type of waste are people, business places, waste transportation vans and the landfill. Wind may facilitate litter dispersal. But in situations where a permanent spot is chosen for continuous disposal of waste in a neighbourhood, rather than the public bin, an illegal dump results. In many areas of Yaoundé, illegal dumping is common (Table 9.2).

TABLE 9.2
Household Waste Disposal Destinations

Quarter→ Household waste depot ↓	**Bastos**		**Efoulan**		**Nvog Ada**		**Cité Verte**	
Responses →	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Waste put into public skip	13	20	0	32	53	21	31	1
Into the itinerant waste van	20	13	12	20	13	62	0	32
In a valley/stream/lake sides	0	33	0	32	6	69	1	31
On the road/street sides	0	33	5	27	0	75	0	32
In open spaces/bushes	1	32	13	19	7	68	1	31
Put in a hole in the compound	0	33	2	30	2	73	0	32

Source: Field survey by the author Yaoundé, March 2003

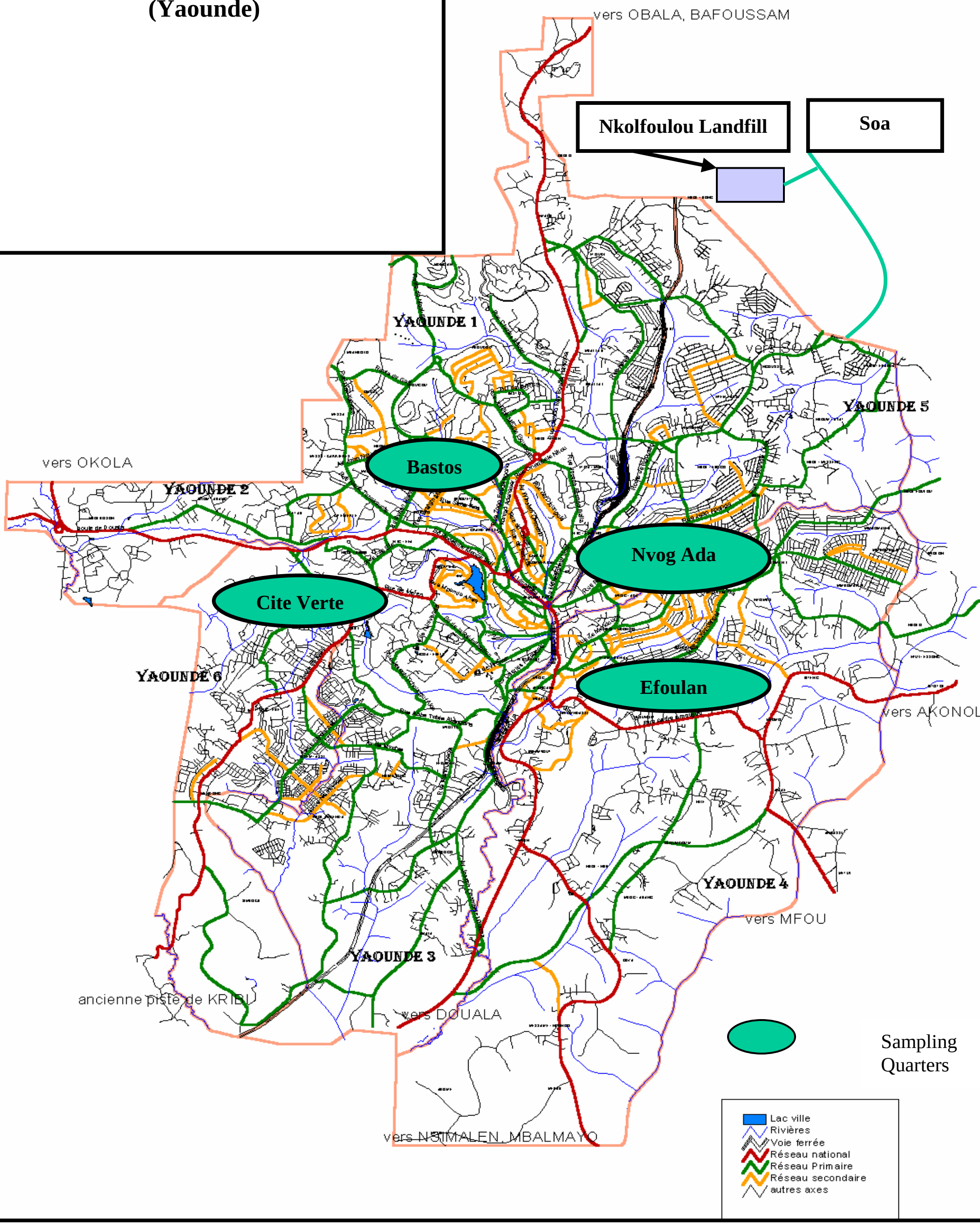
Information from data in Table 9.2, suggests that illegal dumping is common in all the quarters sampled. However, the tendency to dump illegally is higher in Efoulan and Nvog Ada than in Bastos and Cité Verte where collection facilities (public skips and itinerant waste collection services) are better delivered. In June1992, 26 illegal dumps of approximately 100m^3 were identified and in 1994 about 100 tonnes of MSW was disposed of daily in illegal dumps (Vermande *et al.* 1994). The Yaoundé City Council sources also identified and documented 177 prominent heaps of illegal dumps of various sizes: large (21), medium (58) and small (98) ubiquitously distributed in the city in 2002 (Communauté Urbaine de Yaoundé 2002). The distribution demonstrates that no part of the city is spared its illegal dumps. Several plates, for example, Plates 8.2 and 9.4 also confirm the presence and magnitude of illegal dumps in Yaoundé. Sometimes the waste generators simply dispose of their waste in runoff produced during heavy rains. This waste ends up blocking drains and stream channels and cause floods such as the serious floods that occurred in down town Yaoundé in February 2000.

9.3.3 The Official Landfill for Yaoundé

The official landfill is located at Nkolfoulou Village (Soa sub division, Mefu & Afamba division), 25 km from the city centre in the north-eastern part of Yaoundé (Figure 9.3). The 56-hectare piece of land sited in the Valley of the Foulou River was acquired through negotiations between the village people of Nkolfoulou and the Yaoundé City Council (YCC) in the late 1980s and came into use in 1990. It replaced the old sites at Ngousso and Nkoléwoé. The facility is a state utility, managed by HYSACAM. The major attractions of this site were its isolation (2 km away from nearest residential areas), the large size (allowing use for at least 20 years), the gentle slope (permitting natural flow of leachate) and sufficient clean fill lateritic soils (to cover waste) (Interview with the director of exploitation at HYSACAM Douala & Yaoundé**,** Yaoundé 03/04/03).

Entry into the facility is controlled at a gate 2 km away. Figure 9.4 shows the site topography and distribution of various service zones within the landfill area. This distribution makes clearer the facts that waste recovery (zone 2) and solid waste treatment by landfilling (zone 4) were together envisaged as important aspects of the waste treatment. The presence of an agricultural experimentation zone (5) suggests that composting of the organic stream fraction was also foreseen. Leachate is currently treated at the three ponds located to the western front of the landfill in zone 4. Zone 6 is planned for liquid waste treatment, but it is not known whether this liquid waste treatment is leachate. Zone 1 is for offices and 3 for clean fill extraction.

FIGURE 9.3
Roads & Streets hierarchy,
Sampling areas & the Landfill
(Yaounde)



Source: Technical Services, Department of Urban Observatory Yaoundé City Council, 2002

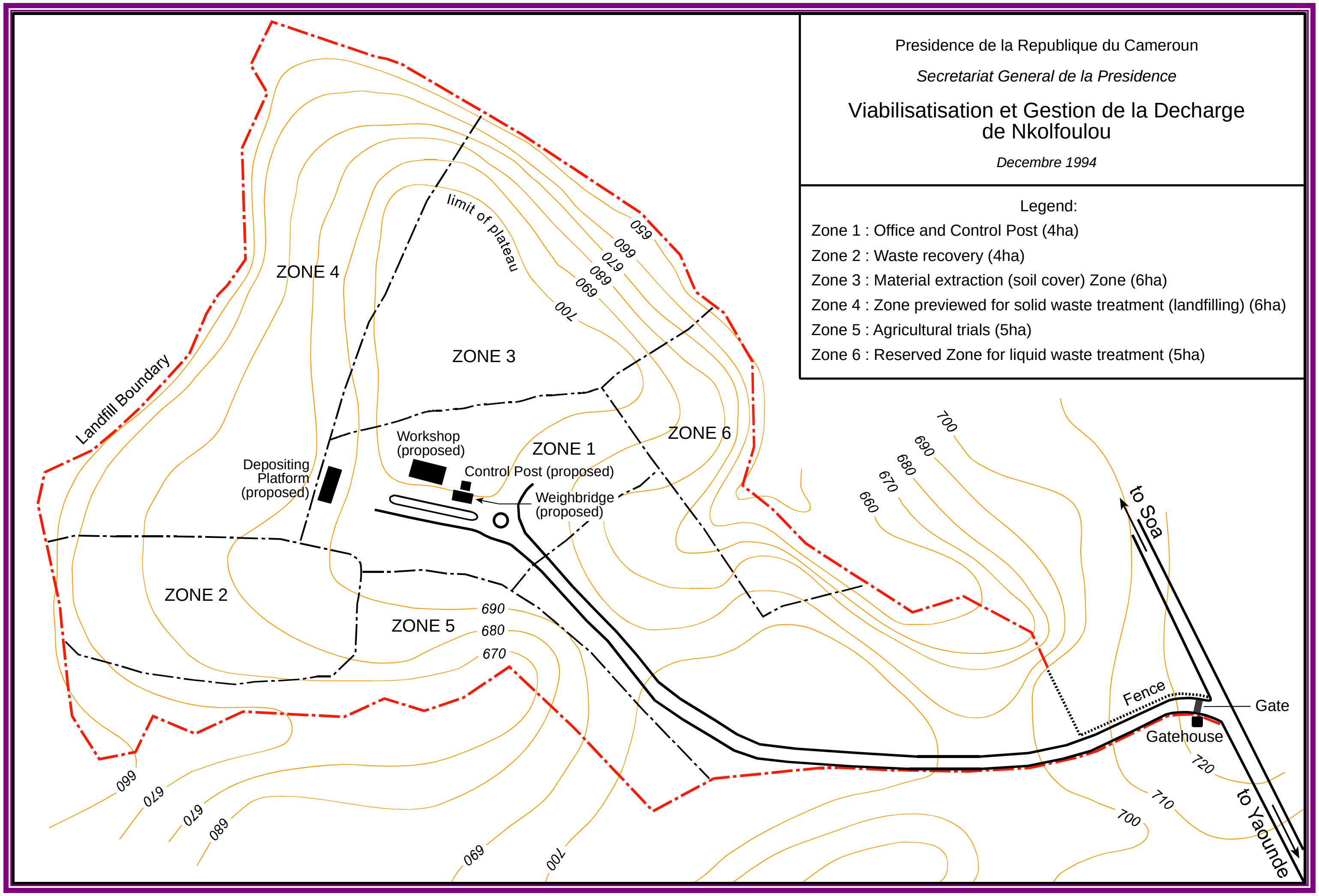


FIGURE 9.4: The Site Plan of Nkolfoulou Landfill, for Yaoundé City
Source: Presidency of Cameroon (GOC) in Ngnikam 2000

Nkolfoulou sanitary landfill receives 700-800 tonnes of mixed solid waste every day (the weigh bridge operator 03/04/03). In addition to the waste that HYSACAM collects and transports to this landfill, waste is also received from the other partners discussed in Section 8.5.2. In principle, construction and demolition waste (DW), hospital hazardous waste, radioactive, toxic, explosive, corrosive and bulky wastes such as vehicle bodies (Plate 9.5) are excluded. In practice, many of these unwanted wastes enter the landfill unnoticed or mixed in conventional MSW from households, offices, hospitals and other authorised sources. Some of these dangerous substances come from white and brown goods, fertilisers, pesticides, insecticides, weed killers, rat poisons, batteries, paint and thinners, solvents, kerosene, motor oil, brake and transmission fluids, coolants, cosmetics, lamps, thermometers, glues and plastics. In the long run the landfill becomes toxic with chemicals such as mercury, lead, cadmium and phenols. These are hazardous especially when carried along in leachates.

Nkolfoulou facility has 11 workers including one health civil engineer who is in charge of the landfilling operations and one person at the head of the personnel and deals with legal issues at the landfill including environmental management. The workers operate and maintain the machines, control waste vehicles, inspect compactness and clean the office environment. The equipment includes a 48-ton caterpillar compactor, a 25-ton bulldozer caterpillar and an 18-ton front-end loader. There is a weighbridge assisted with a personal computer. An independent water supply facility exists on the site. There are two houses at the landfill, one for administrative purposes and the other for storing equipment.

Incoming waste is inspected at the gate and brought to the weighbridge before it is taken to the tipping cell. When the waste is newly tipped scavengers rummage in it after which the bulldozer levels up by pushing the waste toward the front overlooking the valley. After this process clean fill is spread over the waste and trampled upon by the compactor and waste vans alike (Plates 9.1 and 9.2). The tipper truck returns through the weighbridge again for the empty vehicle’s weight to be registered and subtracted for the former (weight with waste load). According to the contract, a daily soil-cover/waste rate

PLATE 9.1: Tipping of Waste at Nkolfoulou Landfill, Yaoundé, 04/3/03

PLATE 9.2: Nkolfoulou Landfill: Caterpillar and Scavengers at Work Yaoundé, 04/4/03

of respectively 30% to 70% and a clean-fill thickness of 50 cm with a slope of 3% was recommended ((Monkam *et al.* 2000). This was more ambitious than the normal 15 cm clean fill layering that usually constitutes the main treatment activity at the landfill and often quite expensive. This exercise is essential because it prevents exposure to health hazards, checks the spread of fires, reduces windblown litter, contains odours, minimises the amount of surface water infiltration into the landfill, keeps away disease vectors such as mosquitoes, insects, rats, and birds, and limits the activities of scavengers and increases ease of movements for waste vans to the tipping cell. The use of adequate daily soil-cover together with the presence of base liners distinguishes modern sanitary landfills from open dumps. I also noticed that daily soil covering at Nkolfoulou was just a formality and neither liners nor gas management facilities exist at the landfill, resulting in a number of environmental and health problems (Section 9.4). Drains are built to direct leachate into three-stepped purification ponds built at the front of the landfill. Leachate flows like a stream from the landfill through these ponds into the River Foulou. Weighing these characteristics *vis à vis* the landfill classifications provided in Table 7.3 this landfill can be classed between a controlled and sanitary landfill.

9.3.4 Conclusion

The problem of MSW disposal in Yaoundé is crucial. Even though the Nkolfoulou official landfill receives about 700 tonnes of MSW per day, greater quantities remain disposed of illegally in dumps, buried, burnt or littered. The official landfill disposal is undergoing improvement but it was started without basic engineering techniques such as liners, gas collection and monitoring, leachate management and post closure planning. Both the official and illegal disposal sites are potentially dangerous to the environment and human health as they receive a mixture of conventional municipal solid waste including the toxic types (Section 9.4).

9.4 Environmental and Health Problems Associated with MSWM in Yaoundé

9.4.1 Introduction

The environmental and health problems associated with MWM start at the generation and storage stages through the public skips, to littering, dumping and landfilling. The implications for the environment and public health at each level are very similar, but increase in magnitude as the waste management progresses from generation through disposal at skips and transportation to the final disposal. Some recovery and recycling activities also exhibit potential hazards.

9.4.2 Environmental and Health Problems at Generation Points and the Public Skips

Environmental problems associated with waste collection at the primary level (households, markets and institutions) are closely related to the bad state of most waste collection and storage bins. These bins are mostly old receptacles, many (34%) without covers that attract odours, mosquitoes, rats, domestic animals and leaking wastewater called leachate. Waste is also collected mixed implying that toxic waste is sent to the final disposal facilities.

At the public skips many hazards with imminent risks were identified in the field by the author. Table 9.3 summarises the respondents' observations on the presence of some of these environmental and health concerns around public skips. On average, more than half of the respondents observed the presence of environmental risk indicators such as those in Table 9.3. Many more observed the presence of disease vectors such as mosquitoes, rats, and domestic animals, and other hazards including fires, odour and leachate. Plates 9.3A & B, summarise visible environmental problems at skip sites, namely: waste overspill, fire and smoke, leachate flow and poor skip placement that obstructs pedestrians' pathway and invisible ones such as gases and odours. Their consequences are far-reaching and were discussed in Chapter 7 and apply also to Yaoundé. The presence of people at skips is a feature of recycling and is discussed later (9.4.5).

TABLE 9.3

Environmental and Health Concerns Around Public Waste Skips in Yaoundé

Environmental concern	Yes	%	No	%	Total	%
Skip well placed?	32	**28.6**	84	**72.4**	116	**100**
Dark flowing water?	46	**32.4**	96	**68.6**	142	**100**
Presence of odours?	112	**79.5**	29	**20.6**	141	**100**
Mosquitoes/cockroaches?	127	**89.5**	15	**10.6**	142	**100**
Presence of fires?	38	**26.5**	104	**73.5**	142	**100**
Domestic animals?	95	**66.9**	47	**33.1**	142	**100**
Rats around skips?	97	**69.5**	45	**31.6**	142	**100**
Scavengers at skips	69	**49.3**	71	**50.7**	140	**100**

Source: Compiled from 2003 Yaoundé survey cross-tabulations by the author.

A Source: Photo by the author 03/4/03 Yaoundé

B. Source: Photo by the author, Yaoundé 04/4/04
PLATE 9.3: Environmental Problems Around the Public Skips

9.4.3 Environmental and Health Problems at Illegal Dumps

9.4.3.1 Introduction

Throughout this thesis we have observed that not all the solid waste generated ends up in the public skips or the official landfill. Part if it is disposed of in illegal dumps, burnt or buried. At the base of these actions is the inadequate official waste collection coverage characterised by shortage of public skips; failure in the delivery of the itinerant waste collection system; long distances to public bins; availability of open spaces and the sheer bad behaviour of waste generators including unchecked activities of some formal and informal waste management groups.

There are many illegal dumps in Yaoundé and some of them are located in very sensitive zones such as lake and streamsides where contaminants not only sink into the adjacent

A 13/3/03

B 13/3/03

PLATE 9.4: Illegal Solid Waste Dumps in Efoulan, Yaoundé

soils and the water but are also carried over long distances. Fires, flies, mosquitoes, odours, leachate, rats and domestic animals are also associated with these dumps. Medical sharps, metals, bamboos, faecal matter and broken bottles or glass are a potential health hazard through injury and infection, especially, to people visiting such dumps with bare feet and hands (Plates 8.2 and 9.4). Parasitic, enteric and viral infections such as human immunodeficiency virus (HIV), hepatitis B (HBV) hepatitis C (HCV) and tetanus infections are potential health dangers from these sources (Cointreau-Levine 2000; Johannessen *et al.* 2000).

Dumps, as with landfills, also leak leachates containing heavy metals into the soil, ground water and surface water including lakes, streams and rivers in the city. Garbage, rags, plastic materials and dead animals are often seen floating on these water bodies. These physical characteristics suggest these water bodies are contaminated and are hazardous, yet these sources of water are used intensively in the city for irrigation of gardens, fishing and domestic purposes. Greenhouse gases (GHGs) including methane and carbon dioxide are also emitted from dumps. Dumps, unlike sanitary landfills, do not have a soil cover and consequently have more atmospheric emissions and relatively less gas build up within the dump. The health and environmental impacts were discussed in 7.4 and in 9.4.6, however the magnitude here is greater given the larger population in Yaoundé.

9.4.3.2 Flooding

Dumping in drains causes blockage and standing water in which disease-carrying mosquitoes and insects breed. In some cases, dumping of waste in stream channels causes clogging that results in severe flooding such as the February 2000 downtown flooding in Yaoundé. Lambi *et al*. (2001) confirmed this when they explained that the flood was neither caused by an increase in precipitation nor in the magnitude of overbank flow; rather they emphasised, it was the blockage of the junction of the Nfoundi River and its tributaries by solid waste that caused the water to pond backwards creating the severe flooding. The traditional cartons made out of local bamboo called ‘kenjas’ (5-150 L volume) are used as packaging to supply dry fish, livestock, foodstuff and vegetables at the Central and Nfoundi Markets. Traders in these markets discard the waste kenjas

(Plates 8.1C & 9.4A right bottom corner) into the Nfoundi River that flows beside the markets to the downtown area. This is one of the major sources of the waste that causes the blockage including chicken feathers dumped upstream by those preparing the chickens for cold stores (Interview with the Head of the Hygiene and Sanitation Service YCC 15/10/02). The flood paralysed transportation for many hours, as this area of the downtown is the transport hub of the whole city.

9.4.3.3 Illnesses

In Chapter 7 we noted that the causal relationships between poor solid waste management and health problems are difficult to establish because of confounding factors. However, it was also established that increasing evidence suggested that there are highly likely associations between some illnesses with various types of waste. Certain illnesses were identified as common among the residents of Yaoundé (Table 9.5). There is a strong positive correlation between prevailing illness and the indicators of efficient waste collection and disposal in the sampled quarters studied (Table 9.5). These indicators included the availability or non-availability of public skips or itinerant waste van services and poor practices of solid waste disposal. The relation shows that the quarters with good waste collection facilities and fewer illegal practices such as Bastos and Cite Verte demonstrate fewer illnesses than Efoulan and Nvog Ada where the contrary holds true. This study does not conclude that the direct cause is poor waste management but suggest that there is an association.

TABLE 9.5
Prevalent Illnesses Reported by Respondents, Yaoundé

Illness/ Quarter	Malaria	Typhoid	Dysentery/ Diarrhoea	Cold/cough flu	Headache	Others
Bastos	18	0	0	1	0	0
Efoulan	30	0	3	9	4	0
Nvog Ada	56	9	4	16	4	7
Cité Verte	22	2	2	7	1	0
TOTAL	126	11	9	33	9	7
%	**65**	**6**	**5**	**17**	**5**	**4**

Source: Field Survey March 2003, Yaoundé

A survey was conducted on prevention of waste-related diseases through the practice of eliminating the disease vectors. The results show that increasing indirect costs resulting from poor waste management are been incurred as people spend much money buying chemicals to keep away disease vectors such as mosquitoes, insects and rats. As many as 79.2% of the respondents indicated that in the past six months they had bought insecticides and 55.9%, rat poisons. The respondents also revealed they would like to use more of the latter (rat poisons) but were scared of its risk to children. These chemicals also get into the waste steam, landfill or dump as toxic and hazardous waste, causing contamination of the soils, ground and surface water.

9.4.4 MSW Transportation, the Environment and Human Health

To prevent waste from leaking, blowing, dropping, falling over and causing littering during transportation from skip to the landfill, covering must be provided. HYSACAM makes efforts to cover waste carried in open tipper trucks by using nets designed for the purpose, but sometimes these nets are either too small for the skips or are torn. At other times, the skips are in an advanced state of decay and have too many holes (Plate 9.5). Even though attempts are made to wrap these broken skips before moving them, such efforts are futile. When waste trucks transport such broken bins through the city, litter passes through the perforation and is blown about creating a nuisance for people and the environment. Another problem associated with waste transportation is the odour from waste that is carried in open trucks. Increased traffic congestion and pollution as a result of many diesel-driven waste vans travelling toward the landfill is also problematic.

A 03/4/03

B 05/4/03

PLATE 9.5: Decaying Public Skips, Yaoundé

9.4 5 Recovery, Recycling and Environmental and Health Concerns

9.4.5.1 Introduction

Epidemiological studies of occupational health aspects of waste recyclers, municipal solid waste workers, complementary groups or scavengers in Cameroon including Yaoundé City do not exist, but information from such studies is crucial to MSWM improvement. But Maartje (1997) believes that even where such studies have been conducted, "It appears to be difficult to draw straightforward conclusions concerning health effect of workers with waste, mainly due to methodological problems and lack of scientific information"(p. 5). Nonetheless, some successful studies have been conducted and the conclusions are overwhelming that waste workers experience a higher incidence of health hazards and social marginalisation than other target groups (Cointreau-Levine 2000; Johannessen *et al.* 2000).

For example, a comparative study of health data between solid waste workers and construction workers in 1994 Metropolitan Accra concluded that: 'The solid waste workers experienced a higher incidence of sick days, work-related incidents and mortality than the local construction workers" (Meinel 1994, cited in Cointreau-Levine 2000, p. 7). The author established that solid waste workers reported sick during the year were 48.6% vs 33.0% for all construction workers; sick days consumed 0.7% of the time for waste staffs versus 0.5% for construction staff and death for waste staff was 3.6% vs 0.6% for construction staffs. In the same vein, survey results of waste workers' health conditions before and since being waste workers in Kathmandu revealed increased higher disease levels for diarrhoea, parasitic diseases, dysentery, stomach troubles, cold, eye trouble, and headaches by more than 200 % on average, and ranging between 60-666% (Cointreau-Levine 2000). These problems worsen down the hierarchy from municipal waste workers, through organised associations to dump and street waste pickers (Maartje 1997). The last two groups (dump and street pickers) are not prominent in Cameroon cities, but they are gradually emerging, needing attention in policy and planning.

Some waste recycling activities in Yaoundé generate solid residue, part of which is hazardous, that either ends up in clandestine dumping or legal disposal facilities.

Meanwhile toxic gases and liquid emissions are also by-products from such processes. Some of these wastes from waste recovery processes create many environmental and health hazards (Chapter 7).

9.4.5.2 The Yaoundé Experience

Concerns I am raising here include recovery and recycling processes that are carried out without due protection by the workers. This includes the workers at composting facilities; plastic recycling; recovery through smelting, forging, casting and furnace processes; rummaging at skips, dumps and landfill for valuables including swine feed, leading pigs to became disease vectors. Diseases or disease-causing agents infest humans through contacts, vehicles, air and vectors. The major avenues used are absorption, inhalation, ingestion and injection. From the field experience by the author it was realised that most of these activities, especially the informal ones, are undertaken without dust masks, gloves, protective clothing and safety boots. There appear to be no regulations on this issue and if they exist they are not enforced. These protective devices do not entirely stop the risks but could significantly reduce them. Strong regulation and enforcement are necessary because elsewhere, experience shows that waste workers furnished with such protective equipment have either sold them or simply refused to use them on grounds of discomfort (Maartje 1997).

While composts have received wide attention as incineration and landfilling are increasingly coming under public attack, care must be taken to evaluate not only the presence of pathogens but also the toxic chemical content, especially the concentrations of heavy metals and metal loids in the composts (Woodbury 1993). For this reason, according to Nkotto *et al.* (1995), the chemical analysis of Yaoundé composts was carried out in 1993 by Ngnikam. The results showed that the presence of heavy metals such as lead was higher than permissible in some quarters and such composts, the findings recommended, should be avoided for market gardening (Ngnikam *et al.* 1993). High temperatures that naturally occur during the decomposition process are able to kill pathogens. However, in Yaoundé nematodes were identified as a problem likely to arise from composting. Experience from FOCARFE also indicates that the compost workers regularly complained of the following health problems: respiratory and skin diseases; vision, digestive and teeth problems; and headaches (Mpandjo 2001)

9.4.6 Environmental and Health Problems at the Yaoundé Landfill

9.4.6.1 Introduction

Landfills are final waste disposal facilities at which waste is buried between layers of clean fill, usually earth. They remain a favourite disposal system in terms of cost, ease of management and indispensability. They are indispensable because residual wastes from other management systems are brought to the landfills. But if not well managed they can pose a high potential danger to the environment and human health. To mitigate such hazards the landfill bottom is usually lined with impermeable material that helps prevent seepage of landfill-contaminated liquids such as leachate from reaching the ground water and soils. For a sanitary landfill to be successful it must have the Landfill Environmental Management Plan (LEMP)(City of Adelaide 2001). Such a plan not only provides the site and its operations with a suitable environmental management system but also puts the control measures in place to minimise potential environmental impacts. The plan also needs to show the proposed monitoring programs including contingency and reporting procedures. These include rehabilitation methods and post-closure management such as final cap, continuous gas, ground waste and vegetation management for about two decades. Failure to do this can lead to future disaster.

9.4.6.2 The Law, Environment and Landfills in Cameroon

Cameroon has a general national environmental management plan embedded in the Cameroon Law on the Environment (CLOE) (1996). The CLOE (1996) (Part III, chapter II, section 17) has prescribed the carrying out of an environmental impact assessment (EIA) for all development projects, works, equipment or installations that pose a threat to the environment as a result of their size, nature or impacts of their activities on the natural environment. Such impacts to be assessed, the text notes, must conform to the prescriptions of all aspects of the project. More, the study helps evaluate the direct and indirect impacts of the project as regards the ecological balance in the immediate and remote zone of operation, the quality of life of the population and the impacts over the general environment. Section 19 says the impact study must indicate the original physical state of the site and its environment, the reason for the choice of site, the envisaged consequences of the project on the site and the natural environment and the human population. It must prescribe measures to suppress, reduce or compensate these consequences caused by the project on the environment, including the corresponding costs and other possible solutions. A landfill is one of such projects that has serious potential impacts on the environment and therefore needs an EIA; a LEMP would normally be embodied within such an EIA, but the Nkolfoufou landfill did not have one prior to its utilisation.

It could be argued that the creation of the landfill antedates the existence of the 1996 EIA laws on the environment but there have always been similar provisions by law such as the Decree No. 76-372 of September 2, 1976. In that decree, article 2 required that as a pre-condition of opening a classified factory[3] the presentation of a global plan of the project that enables the appreciation on the one hand of whether:

> .. the projected material dispositions sufficiently taken care of its impacts on the convenience of the neighbourhood, security, insalubrity, public heath, agriculture and fisheries, and on the other hand of measures taken to comply with hygiene requirements (Bintondo 2000, p.35).

The Minister of Health's Notice (No D69/DN/MSP/DMPH/SHPA of 20 August) 1980 also related to collection, transporting and treatment of industrial waste, household waste treatment plants, and sanitary sewage matters. A further similar notice (No.D69/NS/MSP/DMPH/SHPA of 5 January 1987) emphasised sanitation of urban areas including the safe collection, transportation, discharge and treatment of refuse at chosen sites in collaboration with the chief of hygiene and local technicians of the ministry of Mines and Power. More, the 1994 constitution in its preamble recognises the right of the people of Cameroon to a healthy environment and the protection of that environment as a collective responsibility. The Ministry of Forests, Wild Life and Fisheries was created in 1994, and had as one of its main functions the protection of these

[3] E.g. Factories that must necessarily be located far from housing areas, or those that are near, must have defined adequate preventive measures. Landfills are surely in the first category.

organisms and their environments. The landfill authorities should have reviewed their activities in the light of these new environmental developments.

It was with this knowledge that Djeutcheu (2001) conducted a general environment audit, though titled an environmental impact assessment, of the landfill after ten years of its operation, using the parameters laid down in Sections 19 & 21 of the EIA recommended for Cameroon developers and the prescriptions for solid waste management as defined in the contract for Yaoundé's MSWM. He concluded that no pre-studies of environmental impacts were made and as a consequence environmental problems at the landfill have not abated, and notes that only a few simple measures have been put in place to reduce the risk of pollution.

9.4.6.3 Field Experiences

9.4.6.3 (i) Landfill Dust, Noise, Vibration and Odour Pollution: This author, through field observations and monitoring, became aware of many existing and potential environmental and health problems at the landfill. The main sources to these problems are linked to poor daily soil cover or lack of liners (9.2), absence of landfill gas management and inadequate leachate treatment. The landfill area was cleared of the original flora and fauna leaving behind a large bare surface with loose soil vulnerable to rain splash and wind erosion. Winds and the operation of equipment at the site cause huge clouds of dust to rise from this bare area, especially in the dry season, that spread a distances for about 2 km radius. Odours from vaporising landfill gases (LGs) are awful and sometimes mix with dusts to produce suffocating conditions. Machine activities such as levelling, compaction, tipping and frequent trips (6 per hour) made by waste vans not only increase dust with diesel fumes but also create vibrations and noise pollution.

9.4.6.3 (ii) Landfill Gases (LGs): The major greenhouse gases, carbon dioxide (40-45%) and methane (55-60%) are produced and emitted respectively from aerobic decomposition and anaerobic methanogenic processes on degradable organic materials that account for about 76% of Yaoundé's landfill waste. The global warming potential (GWP) of gases is conventionally compared with the GWP of carbon dioxide, which is constantly one throughout the time scale usually based on 20, 100, and 500 years. Greenhouse gases (GHGs) either have longer warming lifetime at the near-time scales (20 years) and decline through the middle (100 years) to the long-periods (500 years) or vice versa. Methane's GWP declines at various time scales thus: 56-110, 19-43 and 9-16 years respectively for 20, 100, and 500 year time scales, with a life time average of 12-18 years (Energy Information Administration US 2004); or on average 56, 21 and 6.5 years with a life time average of 14.5 ±2.5 years (Moore *et al.* 1998). Once produced methane migrates, is emitted, oxidized, or stored within the landfill. If methane is left to build up in the landfill without any extraction facility it could cause explosions and fires. And if these fires add to the vehicle tyres that are often burnt at the landfill the situation could be catastrophic including subsidence. In the air methane concentrations of 5-15% can cause combustion or explosion and carbon dioxide can cause unconsciousness and death in humans through suffocation at concentrations of 9% (Cointreau-Levine 2000).

Using estimates based on calculations by Shepherd *et al.* (2001)[4], I suggest that the 3 million tonnes of waste buried over fourteen years in Yaoundé landfill (at an average of 682.5 tonnes/day for the 312 working days of each year), would be emitting 900 cubic foot per minute (cfm) of methane gas. This might even be more given that landfills in cities of tropical developing countries produce more LGs than in the developed regions such as North America and Europe with carbon dioxide emissions being twice as much (Hettiaratchi *et al.* nd). The Yaoundé case, by the same estimate, can be producing up to 21 000 000 kilowatt-hour. According to some authors the Yaoundé landfill, produces 70 kg of methane from one ton of raw household waste put into the landfill and this translates to 1715 kilograms carbon dioxide equivalent (kgCO_2E)[5] which will be emitted into the atmosphere presumed at the near time scale (20 years) (Ngnikam *et al.* 2001). These same authors elsewhere, and using a different time scale of over 40 years, note that one tonne of dry organic waste matter dumped at the Yaoundé landfill will produce 225

[4] According to these authors, 300 cubic foot of methane landfill gas can be produced per minute (cfm) from 1 million tonnes of municipal solid waste in a landfill site. If this gas is successfully collected it could generate 7 000 000 kilowatt-hours (kWh) per year. This is enough energy to power 700 homes for a year (in the developed societies).

[5] 70 kg multiplied by 24.5, which is the atmospheric middle-time scale (100 years) global warming potential (GWP) of methane chosen by that author.

kg of methane which they convert to 4.95 tCO_2 or 1.35 tEC (carbon ton equivalent) (Tanawa and Ngnikam 1997). These figures suggest the landfill contains large amounts of methane and carbon dioxide gases that are major concerns for environmental, health and economic reasons.

In the same vein, and considering that 76% of the 3 million tonnes is biodegradable waste, at a production rate of 30 kg compost from 100 kg waste (Nkotto *et al.* 1995), about 900 000 tonnes of compost would have been produced. Such a waste diversion could safeguard the environment in many ways, for example, reduce odours, leachate, vectors, increase lifespan of the landfill by about one-third of the projected time and reduce the landfill gas emissions by huge amounts.

9.4.6.3 (iii) Vectors: There are disease carrier-transmitters such as flies, mosquitoes, birds and rats at the landfill. They feed on waste because landfill daily cover is inadequate. They either transmit disease directly or as vectors. According to Djeutcheu (2001) the rat population became so great that they had to be fumigated at the landfill and the Nkolfoulou village. Rats and other rodents spread diseases such as leptospirosis caused by exposure to their urine and hanta virus also spread from their droppings as well as the bubonic plagues of 1993/94 were said to be caused by rats (Cointreau-Levine 2000). There are increasing fears that viruses may now be jumping species from animals to humans, such as the recent deadly Severe Acute Respiratory Syndrome (SARS) and Bird Flu Viruses outbreak.

9.4.6.3 (iv) Landfill Leachate: Yaoundé landfill’s bottom and sides have no liners. A major problem arising from this is the contamination of soils, sub-soils, ground and surface water by leachate that increases in the rainy season. None of these aspects have been studied to determine the degree of contamination of this important water catchment area. Leachate treatment aims to isolate contaminants from the water. Common leachate treatment options include neutralisation, gravel filtration (bio-filter), waste stabilization ponds, construction of wetlands (Aluko *et al.* 2003) and recirculation of the leachate all over the landfill. This landfill uses the waste stabilization ponds system in which leachate flow is directed into three successively stepped ponds of about 40 m^2 each and then into the Foulou River. This natural process relies on micro flora (algae and bacteria) using sunlight to minimise the pollutants present in leachate and sedimentation together with anaerobic metabolism to further purify the leachate. Eco-toxicological studies were not made but with the presence of toxic and hazardous components present in landfill waste such as batteries, consumer electronics, ceramics, light bulbs, paint, lead foils, used motor oils, pesticides, thermometers, plastics, and inks, it is highly likely that the leachate also bears heavy metals, for example, lead, cadmium, lead, nickel, chromium, mercury and zinc, and other dangerous contaminants including pathogens.

Early studies have demonstrated the reasons for municipal landfill toxicity. Brown and Donnelly (1988) in a comparative study of leachate from 56 conventional municipal waste landfills to leachate from officially classified hazardous waste landfills such as Love Canal landfill concluded that:

> There is ample evidence that the municipal waste landfill leachates contain toxic chemicals in sufficient concentration to be potentially as harmful as leachate from industrial waste landfills (Rachel's hazardous waste news 1988, p. 1).

The report also revealed that municipal waste landfills had 133 different toxic chemicals (32 of which cause cancer, 10 cause birth defects and 21 cause genetic damage) and the hazardous landfills had only 72 such toxic chemicals. Attempting an explanation of the abundance of toxic chemicals in municipal landfills, these authors suggested it is no surprise given that ‘the entire spectrum of consumer products ends up in municipal landfills, whereas hazardous landfills serve a limited number of industries within the region’ (Rachel's hazardous waste news 1988, p. 2).While these toxic chemicals may be present, their direct relationships to some of these waste-related illnesses are still under debate (Section 7.4.1). Multi colourings were seen floating on the Foulou River surface, suggesting the presence of leachate contamination. This river is heavily used for fishing, agriculture and household activities alerting fears of direct and indirect uptake of toxic substances through the food chain.

9.4.6.4 Landfill Recycling

There is no significant on-site recycling programme. According to Djeutcheu (2001) 99.5% of the waste is treated by landfilling, 00.5% by informal composting by resident scavengers and 00.01% through occasionally incinerated small quantities of hospital waste in a 200 L drum. On site recycling by scavengers is done under deplorable conditions. They do not put on any protective devices before work which includes collection of bottles, leather and textile goods including recovering of parts from white and brown goods some of which possess many toxic substances and so are hazardous. Burning was also noticed at the site. The potential and present health-related diseases arising from these environmental and health problems are discussed in 6.4 and apply to Yaoundé with a greater magnitude given its larger size waste.

Generally, the social-economic impacts of the surroundings of the landfill include increased traffic on Soa Road, reduction of property value and intergenerational impacts. Although Nkolfoulou village suffers the greatest brunt of the landfill through loss of their land, natural spring water, aesthetics with an increase in mosquitoes, rats, odours and dust pollution, they have gained employment, piped water and a regular waste collection system as a compensation for having the project on their land.

9.4.7 Conclusion

The potential and existing environmental and health impacts associated with MSWM in Yaoundé increase from the waste generation and storage levels through collection at public skips, recycling to disposal at the landfill. At the household level, it is the poor state of waste collection containers that promotes environmental and health problem. These problems increase at the public skips where leachate, fires, odours, waste overspills, insects, and animals are a nuisance. Inadequate waste collection and disposal characterised by shortage of skips; poor organisation, transportation and collection coverage by the official waste management team; bad disposal practices and poor collaboration among waste generators, and private formal and informal waste collection groups, has resulted in the proliferation of illegal dumps in the city. Both illegal dumping and official landfilling pose considerable environmental and health threats from landfill gases, mostly methane and carbon dioxide, leachate, noise, dust, vibrations, odours, disease vectors and the general aesthetical devaluation of the waste facility sites. Recycling activities also produce health and environmental hazards given the toxic nature of some of the waste and the lack of protection by recyclers. General policies on environmental management including waste are in place but detailed strategic plans such as the Chad/Cameroon Oil Pipe Line Construction Project Waste Management Plan (EssoChad 1999)[6], do not exist. Article 43(2) of the CLOE (1996) promised such a detailed plan in a subsequent decree but it is not yet in place. Hence there is no legislation or any other policy instrument by the government encouraging recycling.

9.5 General Conclusion

Informal and artisan treatment ventures of MSW through recycling by households and individuals exist in Yaoundé. Some non-governmental organisations (NGOs) recycle (d) waste namely, FOCARFE that formerly made composts from household biodegradable waste and CIPRE currently recycling plastic and rubber wastes. All recycling accounts for less than 5% waste diversion from final disposal activities that are mainly littering, illegal dumping and sanitary landfilling. The city has one official sanitary landfill at Nkolfoulou that receives about 700 tonnes of mixed waste a day and about the same quantity ends up in illegal dumps spread all over the city. There is no separation at source, so collection, recycling, transportation and disposal come face to face with mixed MSW streams, including the toxic type, all of which pose considerable hazards to the environment and human health.

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[6]In this plan, detailed management of specific waste, their inventory, the approved management facility and method, recycling programme, treatment and disposal technologies and waste storage consideration were carefully worked out and documented. Each waste was defined, categorised, source defined, safety considerations examined, waste minimisation options proposed and preferred management option for each waste presented. The plan was executed to the latter and not a sweet wrapper could be found within the Pipe Line project area (Interview with Mr.John Fru a worker of the Safety, Security, Health and Environment (SSHE) Department 23/03/03)

Solid waste recovery, reuse, recycling, composting and most importantly, prevention are good management practices as they not only safeguard the environment and protect human health but also delay waste, create jobs, and contribute to the local economy. But emphasis on waste prevention today is being laid on minimisation at the production stage where both the reduction of end-waste quantities and toxicity could have a significant positive impact on the discard management phase. Management of waste at the consumer products end is an end-of-the-pipe solution and most certainly futile if manufacturers do not eliminate superfluous parts and packaging or toxic substances. Countries such as Cameroon that import most of their manufactured goods and have no control over production specifications will have limited waste management options in dealing with volume, variety and toxicity of solid waste. Yaoundé city, therefore, has to rethink first the need to increase waste separation that will enable a sensible way to increase recovery, and so improve collection, reduce quantities to be disposed of, and minimise environmental and health impacts. The Chad/Cameroon Pipe Line example (9.4.7) suggests this is possible.

CHAPTER 10

Comparisons and Discussions on Municipal Solid Waste Management Findings in Bamenda and Yaoundé

10.1 Introduction

Comparing solid waste management in two cities of different hierarchies such as Bamenda and Yaoundé raises many questions especially as many people believe it is axiomatic that a bigger city will have higher generation rates and quantities, and most probably, better management. While this may be true, there are many other indicators that can be studied at different levels within the cities to determine the sustainability of the municipal solid waste management (MSWM) system vis-à-vis the other cities irrespective of the size.

This chapter compares MSWM in Bamenda, the North West Provincial headquarters and Yaoundé, the national headquarters, both in Cameroon**.** In the chapter I demonstrate that even though MSWM in cities of developing countries including Cameroon has many things in common, nevertheless each city is unique and this should be reflected in the policies, strategies and practices adopted at city, state, national and inter regional levels. I examine the different factors that drive solid waste management in both cities. I compare waste generation and their characteristics including the management strategies and practices applied at the primary and secondary levels to collect, transport, recover and dispose of such waste in both cities. Although institutional issues are centrally determined, I focus on the organisation, service delivery, financing, participation, socio-cultural dimensions, policies and legislation, as they operate in either city to highlight differences or similarities. In so doing, this chapter also summarises and discusses some of the key findings of this research.

10.1.1 General Factors that Drive MSWM in Bamenda and Yaoundé

Municipal solid waste management is a complex issue and it is affected by nearly every natural phenomenon and human development in the city. Table 10.1 summarises some of the main drivers that underpin waste management comparisons made later in the chapter**.**

TABLE 10.1

Some General Factors that Drive MSWM in Bamenda and Yaoundé

Bamenda	**Driver**	**Yaoundé**
Total: 294 873 ~300 000 (2004) Growth rate: 10% per annum	**Population (2002)**	Total 1 438 087 ~1500 000 (2004) Growth rate: 6.2% per annum
4	**Position in urban hierarchy**	2
37.07	**City Area (km^2)**	256.00
Province, division, (1) sub division, urban council	**Administrative Headquarters**	Nation, province, division, city council, (6) urban sub divisions, international organisations and diplomatic missions
Social Democratic Front (SDF)-Main opposition	**National Political Headquarters**	Cameroon Peoples' Democratic Movement (DPDM)-Ruling party
British Colonial & multi-traditional	**Cultural heritage**	French Colonial & multi-traditional
Capitalistic- facing economic crisis and structural adjustment policies	**Economy**	Capitalistic-facing economic crisis and structural adjustment policies
Politics, administration, socio-cultural, commerce, crafts agriculture (no industries)	**Major functions**	Politics, administration, commerce diplomacy, socio-cultural, industries, education, agriculture
 Faulted plateau 1230-1470 m 2596 mm (203 days) 15.0^0-$23.8\ ^0C$ 60-90% (2) Dry & wet Tropical grassland Equatorial-Cameroon type River Mezam & tributaries	**Physical condition-** Relief Rainfall Temperature Relative Humidity Seasons Vegetation Climate Main drainage system	 Concave topography 600-1100 m 1596 mm (105 days) 23.5^0-$25.0\ ^0C$ 70-90% (4) Dry, wet, dry and wet Tropical rainforest Guinea equatorial River Nfoundi & tributaries
10%	**Approximate tarred street/road network**	30%

10.2 Waste Generation and Characteristics

10.2.1 Generation

At the city level there is a significant difference between the per capita per day solid waste generation for Yaoundé and Bamenda. Y Yaoundé's MSW generation rate is far more than that of Bamenda. While Yaoundé's per capita per day waste generation stands at 0.79 kg, Bamenda's is 0.54 kg. However, low-income central and peripheral quarters in Yaoundé such as Nvog Ada and Efoulan respectively demonstrate waste generation rates similar to those of Bamenda. Another big difference between Yaoundé and Bamenda lies in the range between the different quarters. In Bamenda the range is insignificant at 0.40-0.54 kg per capita per day, whereas in Yaoundé it is 0.50-1.3 kg, a difference of almost three times. This great range in Yaoundé is obvious given the social and economic status variation among its residents. This encompasses from top to bottom, the President of Cameroon at Etoudi quarter, through diplomats, business people and ministers at the Bastos high-residential quarter to street hawkers in spontaneous and low-residential quarters of Nvog-Ada. Quarter distinctiveness exists in Bamenda but it is not as sharp as previously thought. The daily total municipal solid waste generation rates for Yaoundé are estimated at 1200 tonnes, while Bamenda's range is 120-160 tonnes.

10.2.2 Characteristics

The composition of the municipal solid waste in Yaoundé and Bamenda is similar, but varies in distribution. In both cities, the biodegradable fraction is high with Bamenda having 76.0% and Yaoundé, 61.7%. The non-biodegradable fraction is however increasing and gradually reducing the fraction of the former in the municipal waste stream. Yaoundé with more administrative, commercial, industrial, socio-cultural functions, and more purchasing power is also more globalised; hence it generates more non-biodegradable waste (38.3%), for example, paper and carton, plastics, glass and ceramics than Bamenda, which has 24%. Households generate 86% and 90% of the total MSW in Yaoundé and Bamenda respectively.

Physical conditions (Table 10.1) influence waste characteristics and the management strategies including collection frequency. For example, high temperatures, precipitation and humidity increase waste density, weight, decomposition rate, leachate and gas production. The climate influences the vegetation including the type of food produced and fuel used. The web of rivers and streams impedes road network construction, as well as providing sites for illegal dumping. The numerous stream networks together with the heavy rains, hilly topography and numerous narrow unpaved streets, jointly exacerbate the problem of waste collection and transportation. Both cities have an average solid waste density of 350m^3/kg but Bamenda has a higher rainfall and far more wet days (203) than Yaoundé (105) suggesting higher densities during this long period of rains for Bamenda. The dry season in Bamenda is characterised by very dry N E Harmattan winds, which reduce the waste density drastically. Yaoundé has an annual average temperature of 23.5 ^{0}C, while Bamenda's is 19.5 ^{0}C. The main difference in waste characteristics is that Bamenda has extremely high waste densities in the long wet season and very low in the dry season. Bamenda faces a more difficult topography than Yaoundé. Higher temperatures in Yaoundé cause more rapid decomposition of waste than in Bamenda. These differences in the physical environment play an important role in planning waste collection, for example, in terms of weight, frequency of collection, the type of waste van to be used and what level of waste compaction to be applied.

10.3 Waste Management Strategies and Practices

10.3.1 Primary Level Management

The primary level of solid waste management entails the assembly, storage and transfer of such waste to the secondary management facilities including the public skips, treatment plants or final disposal. Waste generators are solely responsible for the handling of their waste at this initial level. In Yaoundé household waste is collected and stored mostly in improvised containers such as old baskets (76.7%), plastic bags (11.6%), and tins and cans (8.2%). About 66% of the receptacles in Yaoundé had some form of covers. Bamenda residents also use recycled containers for waste storage in the following order of importance: old buckets (51%), plastic bags (23%) baskets (18%), tins and cans (4.9%), with 86.4% having no covers. Both cities use mostly improvised waste containers that are small, polluting and needing regular emptying at disposal sites. Table 10.2 illustrates the frequency of household waste disposal in Yaoundé and Bamenda. More than half of the Yaoundé respondents dispose of their waste daily, 26% once in two days, while in Bamenda 35% dispose of its waste daily and 50% once in two days. The rapid rate of decomposition assisted by high temperatures and the resulting pollution that comes with it is the key to determining the frequency of waste removal from households. Other factors include the size and condition of the container.

TABLE 10.2
City * Regularity of Emptying Household Waste Containers Cross tabulation Count & Percentages

Frequency City	Once a day	Once in two days	Once in three days	Others	Total
Yaoundé	85(54.1%)	42(26.8%)	23(14.6)	7(4.5%)	157(100%)
Bamenda	34(34.7%)	18(18.4%)	30(30.6%)	16(16.3%)	98(100%)
	119(46.7%)	60(23.5%)	53(20.8%)	23(9.0%)	255(100%)

Persons responsible for disposing of household waste vary between the cities. Children play the greatest role in removing waste from households, accounting for 67% in Yaoundé and 59% in Bamenda. In Bamenda, the mothers removed 27%, 8% is by house aids and 3% by the fathers. In Yaoundé, house aids and guards constitute 17%, mothers 14%, fathers 2%, and others 1%. The fathers in both cities play a negligible role in waste management at this level because they do not see it as their duty to do so. Some interviewees said that children dispose of waste as a contribution to the household chores and this was also advanced as another reason for household heads not being willing to pay extra money for waste removal. The preponderance of children's participation in household waste disposal in both cities is an indication that skip heights should be low enough to permit ease of access for those who visit it most. It also draws attention to addressing issues such as messing up skip sites, which is more likely to come from children than adults.

From the source of generation, waste is further disposed of in both legal and illegal facilities. Legal facilities include the direct disposal into itinerant waste vans or public skips. The conditions vary in both cities but survey results, observations and reports demonstrate that illegal dumps are ubiquitous. Respondents in all sampled quarters in both cities acknowledged disposing of their waste in one or more types of illegal sites namely, dumps, roads, rivers, lakesides and open spaces. Yaoundé has 177 large illegal dumps. In Bamenda only 21%, and in Yaoundé 40-50% of the municipal solid waste generated, enters into the official secondary waste collection system, the remainder is dumped elsewhere. The average distances travelled by households to dispose of these wastes, either in official facilities or illegal dumps, are 87 m in Yaoundé and 105 m in Bamenda. I also call this distance, 'the primary waste transportation distance'. The waste is collected and transported for landfilling. There are no transfer stations or formal treatment centres such as bailing, recycling and composting.

10.3.2 Recovery and Recycling

Practices of recovering valuable items from would-be waste, informally at domestic and artisan levels, for example, by reusing, transforming, repairing, giving out as gifts, are longstanding. These activities include items such as bottles, tins, cans, bags, clothes and shoes. The tendency to recover and reuse is similarly strong in both cities as demonstrated by Table 10.3.

TABLE 10.3
City * Recycling/Reuse/Recovery Cross tabulation 'Yes' counts & percentages

Counts									
	Bottles	Tins/cans	Plastics	Bags	Metal	Clothes	Shoes		
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Total	Average
Yaoundé	124	80	104	124	49	106	102	172	
Bamenda	80	54	69	87	21	76	76	104	
Total	204	134	173	211	70	182	178	276	
Percentages									
Yaoundé	72.1	46.5	60.5	72.1	28.5	61.6	59.3	400.6	57.2
Bamenda	76.9	51.9	66.3	83.7	20.2	73.1	73.1	445.2	63.6
Total	73.9	48.6	62.7	76.4	25.4	65.9	64.5	417.4	59.6

Sources: Field survey 2003 Yaoundé and Bamenda.

Formal recycling of MSW is absent in Bamenda. Composting of MSW by some NGOs was experimented with both cities in the 1990s but soon failed. There is only one NGO, CIPRE[1], which recycles plastics and rubber waste in Yaoundé. In both cities the waste recovery activities account for less than 10% of the total waste generated.

[1] CIPRE=Centre International de la Promotion de Recupération/International Centre for the promotion of waste recovery

10.3.3 Municipal Solid Waste Management at the Secondary Level

10.3.3.1 Collection and Transportation

A major difference between Bamenda and Yaoundé is that while in Bamenda municipal solid waste management is undertaken directly by the government through the Bamenda Urban Council (BUC), in Yaoundé it is privatised to HYSACAM**.** However, both cities concentrate on conventional collection and transportation systems as in the industrialised countries. Both cities define municipal solid waste in the same way and have similar collection practices. They both collect and transport only household and institutional solid waste put in public bins, itinerant waste vans or official ground depots. They use various specialised waste trucks such as compactors and roll-on roll-off skip carriers. Bulky waste from construction and demolition sites, vehicle bodies, agricultural processing, craft and woodwork and laboratories including hazardous waste, are the responsibility of the generators. Vehicle bodies abandoned, such as in Plates 9.5 A & B, lying by the sides of public skips, demonstrate the contradiction in the policy. No one seems responsible for such leftover waste by the public roadsides.

Table 10.4 presents a summary of the main collection and transportation activities of MSWM in Yaoundé and Bamenda. The summaries demonstrate that Yaoundé has a greater solid waste management capacity and performance than Bamenda in terms of equipment, waste workers, skip capacity; percentage of waste collected and transported, and landfill waste treatment. This is true not only when looked at the scale of the city levels but also when Bamenda, which is one sub division, is compared with individual sub divisions in Yaoundé. However, absolute uncollected quantities of municipal solid waste in Yaoundé outstrip that of Bamenda by five times.

TABLE 10.4
Waste Collection and Transportation

Bamenda	Item	Yaoundé
Conventional: Daily collection by waste vans from public skips/ground depots or itinerant van collection General monthly clean-up	**System**	Conventional: Daily collection by waste vans from public skips/ground depots or itinerant van collection. Mechanical & manual sweepers
Government-BUC	**Mode of management**	Privatised-HYSACAM
2 compactor, 2 front-end loaders	**Daily-used equipment**	7 bin remover truck, 6 ampli-rolls, 6 Paris dump trucks, 2 front-end loaders, four 16 & 20 m^3 carriage & scoop equipment waste vans, 15 waste compactor trucks, 2 mechanical sweepers
4	**Total equipment units**	44
4	**Average per sub division**	7
31	**City waste team**	400
1:10 000	**Ratio: Worker/population**	1:4 000
$1m^3$	**Types of skips**	$1m^3$, $6m^3$, $16m^3$
$37m^3$	**Waste skip capacity available**	1440 m^3
8-11 times (at densities 350-500 kg/m^3)	**General lack for the city**	3 times (at density 250 kg/m^3)
$37m^3$	**Ratio: capacity/sub division**	$240m^3$
0.12L	**Per capita capacity available**	1.1L
2.16L	**Per capita capacity lacking**	2.1L
120-160	**Total generation**	1200 (978 in 2000)
2	**Collection zones or circuits**	18
1	**Daily trips per waste van**	2-7
20-30 tonnes (17-25%)	**Daily collection estimates**	480-600 tonnes (40-50%), measured: 312 tonnes in 2000
1 worker to 0.8 tonnes	**Worker/collection per day**	1 worker to 1.4 tonnes
115 tonnes	**Not collected**	540 tonnes
92.93%	**Collection and transportation as % of total costs**	78.59%
7%	**Treatment at landfill as % of total costs**	14%

While making comparisons at the city level I discovered that Yaoundé has 44 units of six specialised waste trucks with corresponding types of waste skips to match. In Bamenda, there are 2 compactor trucks of the same type and the $1m^3$ skips that go with them, plus two front-end loaders. The ratio of waste workers to the population is 1:10 000 in Bamenda and 1:4000 in Yaoundé. The skip capacity available for Bamenda is 37 m^3 while in Yaoundé it is 1440 m^3, both of which are inadequate, lacking 465 m^3 and 3048 m^3 respectively.

Bamenda is a sub division similar in size and population to one of Yaoundé's subdivisions. Measures at per capita levels also illuminate the trends. Comparisons at these levels make more sense. The indivisibility of heavy equipment and highly skilled personnel notwithstanding, Yaoundé's sub-divisional averages for equipment and personnel are 7 trucks and 66 workers as against 4 and 31 respectively for Bamenda. The available and needed per capita waste skip capacities are widely different in both cities. The daily per capita skip space needed in Yaoundé is 3.2 litres. In fact 1.1 litres is available and 2.1 litres or 66%, lacking, while Bamenda needs 2.26 litres, has 0.16 litres and lacks 2.1 or 95%.

The private company, HYSACAM in Yaoundé collects about 40-50% (480-600 tonnes) daily of the city's solid waste generation and leaves behind similar quantities while in Bamenda, about 17-25% (20-30 tonnes) are collected by BUC authorities with about 115 tonnes illegally disposed of. In terms of rate, Yaoundé collects more than Bamenda but leaves behind the same quantities as the collected ones. This leftover waste draws more public attention than what is removed, because it impacts on the city's aesthetics and poses immediate environmental and health hazards. It also scares tourism and debases the prestige of the city.

10.3.3.2 Disposal of Municipal Solid Waste

In Yaoundé and Bamenda there is no official waste separation policy or programme, so waste is collected, mixed, and disposed of in the same manner. Recycling and recovery activities are very limited in both cities, hence, more than 90% of all waste generated is burnt or buried in official facilities or illegal dumps. The official solid waste disposal facility in Bamenda is an uncontrolled open dump. It is located on an ecologically fragile environment, at the flood plain of the Mezam River in Ngomgham Quarter, 8 km from the city centre. As the name suggests it is not controlled and there is no landfill gas or leachate management. It receives about 30-40 tonnes of waste a day from the municipal waste collectors and other sources.

Yaoundé has a sanitary landfill located in Nkolfoulou village in Soa sub division, 15 km from the city centre. The facility is fenced, controlled, provides a daily soil cover over waste landfilled and collects and treats leachate but not landfill gases. It is also located on a river valley -the Foulou. It receives an average of about 800 tonnes of solid waste a day. Both facilities are state property, but while the government manages that of Bamenda, in Yaoundé it is HYSACAM, the private contractors for the city's waste. The sizes are proportional: 10 hectares for Bamenda (one sub division) and 54 hectares for six subdivisions of Yaoundé City. Bamenda has no scavengers at its waste dump, while Yaoundé has 10-15 who irregularly visit the landfill. Both facilities pose considerable environmental problems.

10.4 Institutional Issues

10.4.1 Organisation and Service-Delivery Mode

The central government/administration formulates policies and plans to guide health and sanitation including other environmental concerns in the entire country. The external services located at provincial, divisional, sub divisional and city levels strengthen, monitor and coordinate these policies and plans originating from the central government. While Bamenda Council areas constitute one city within one subdivision, Yaoundé City Council area is a full division enclosing six subdivisions. There was once decentralization of waste management to these sub divisions that did not work out well for various reasons (8.2.4). Today, municipal solid waste (MSW) in Yaoundé is centralized under the city council and contracted to a private company, HYSACAM, while in Bamenda it is government-managed (Table 10.4).

Though the modes of management are different, one government and the other private, the strategies are the same. Both cities use conventional waste collection technologies and organizational style. Both cities apply the system whereby waste generators assemble their waste in public skips placed along the roadsides for eventual removal by the waste management team. These waste collectors use conventional waste trucks to collect waste on well-planned routes or circuits. Municipal waste, according to council definition, is that which is deposited in these public bins for collection, transportation and disposal. It is at the level of the public skips that the official waste management relates with the waste generators.

10.4.2 Financing Municipal Solid Waste

Developing and implementing a sustainable waste-financing strategy is a challenge to cities of developing countries. Waste user charge rates in Cameroon are determined by the central government and collected alongside other urban service taxes by local agents for the central treasury. The yearly rates are as follows: non-employees of the public and private sectors 50-250 CFA[2], employees of the public and private sectors 150-10 000 CFA and licensed institutions 2500-30 000 CFA. These contributions are insignificant (7.6% for Yaoundé and 5% for Bamenda) compared to total expenditures on waste collection, transportation and disposal (Tables 5.2). This partly explains why the central government feeds the councils with general running budgets based on what it is able to provide, irrespective of how much tax is collected under each activity and what the expenditure for such activities would be. Inadequate funding has been the common occurrence**.** Both councils have to turn elsewhere, be it nationally or overseas, for extra support.

As noted earlier, since 1995 the Bamenda Urban Council (BUC) has had strong cooperation with the Municipality of Dordrecht in Holland, in urban waste management. Dordrecht provided Bamenda with personnel training, waste compactors and the public waste bins the city uses today. Bamenda continues to receive support in the forms of spare parts, training and more equipment from Dordrecht. In Yaoundé, since 1998, the central government of Cameroon has safeguarded the national headquarters from the deteriorating waste situation that was exacerbated by the economic crisis, by making an annual special financial donation of 1.5 Millard CFA (2.3 million Euros). This represented two-thirds of the total costs, leaving one-third to be shared among the city councils and the six urban sub divisional councils. Some years the central government is

[2] 1 Euro=655.957 CFA; 1 AUD =375.652 CFA; 1 USD=538.167CFA (18/09/04).

poor too and is unable to afford all or part of its share. Yet collection is still at 50% and limited mainly to the accessible quarters. For how long this is going to continue remains unclear. The practice is simply not sustainable.

In Yaoundé quarters that do not receive regular official waste services make extra arrangements with formal and informal community-based initiative groups to collect their waste at a negotiated fee. This does not exist in Bamenda. About thirty such formal and informal groups are operating independently in Yaoundé neighbourhoods collecting household wastes at average rates of 1000 CFA per month. They have not been integrated into the mainstream waste management system. Citizens would be willing and are able to pay an additional cost to the normal garbage service tax if their waste could be effectively removed. A survey was conducted in Yaoundé and Bamenda to determine respondents' ability and willingness to pay for waste services per month. The results at the city level are summarised in Tables 10.5 & 10.6.

TABLE 10.5
City * Proposed Monthly Waste Service Payment Cross tabulation-Count & Percentages.

	<500 Frs CFA	500-699 frs CFA	700-999 frs CFA	1000-1500 frs CFA	>1500 frs CFA	Total
Yaoundé	56(37.8%)	15(10.1%)	29(19.6%)	18 (12.2%)	30(20.3%)	148(100%)
Bamenda	37(38.5%)	10(10.4%)	7(07.3%)	10(10.4%)	32(33.3%)	96(100%)
Total	93(38.1%)	25(10.2%)	36(14.8%)	28(11.5%)	62(25.4%)	244(100%)

TABLE 10.6
Average Monthly-Proposed Amounts For Waste Service Payment In Yaoundé And Bamenda

Rates CFA	Mid point Rate CFA	Yaoundé		Bamenda	
		No. of Respondents	**Total**	**No. of Respondents**	**Total**
<500	250	56	14000	37	9250
500-669	550	15	8250	10	5500
700-999	875	29	25375	7	6125
1000-1500	1250	18	22500	10	12500
>1500	1750	30	52500	32	56000
Total		**148**	**122625**	**96**	**89375**

Averages

- Yaoundé =122625/148=828.5473 CFA or **829 CFA**
- Bamenda =89375/96=930.9896 CFA or **931 CFA**

Earlier analysis at quarter levels (Table 5.5) demonstrated that the ability to pay, especially higher rates, correlated positively with the socio-economic status of the quarters, but inversely to distances travelled to dispose of household waste. At city level, Tables 10.5 & 10.7 show that many citizens would be prepared to pay every month, the amount government proposed for a year, so that their waste could be collected. The average rates vary, with Bamenda proposing a higher amount (931 CFA) than Yaoundé (829 CFA) (Table 10.6). In all, the result suggests that the smaller city with greater lack of service delivery is generally willing to pay more and travel longer distances to dispose of their waste.

The willingness of households to pay depends on other factors such as long distances to the disposal site, lack of house aids or children, level of income, environmental awareness and trust that the work will be done as paid for. Households pay for water and electricity supply to the companies concerned even though they pay council water and electricity taxes. It may be that the consumption of waste services cannot be measured as with water and electricity. On the other hand, substitute disposal sites exist and householders have never had a forum with the government to discuss waste management matters including payment for the service.

10.4.3 Participation

Key factors in sustainable municipal solid waste management are recent information, consultation and participation of all stakeholders, including industry, trade, and particularly households, in the conception, organisation and management of the entire system. No matter how sophisticated a waste management system may be, waste generators must sort, separate and streamline waste for effective collection, recycling and disposal. One source of non-sustainability comes from both Yaoundé and Bamenda councils' monopolistic approach to the planning and implementation of waste management. Public meetings, environmental awareness raising or consultation with the public are absent. Public participation is limited to the insignificant garbage tax those on a pay roll contribute. Or occasionally, there are government-made announcements over the television, radio or banners hung across roadways, informing the population to dispose of their waste in public skips. My survey results in Bamenda show that 80% of the respondents received such information and in Yaoundé, 49%. In both cities non-participation is demonstrated by results from the survey carried out to determine who decided the location of the public skips they use. The result is overwhelming that the decision was single-handedly made either by the urban council in the case of Bamenda, or the city council and/or HYSACAM, in the case of Yaoundé.

10.4.4 The Socio-Cultural Dimension of Waste Management Sustainability

Socio-cultural dimensions of waste management sustainability address issues such as social justice, equity and respect for cultural aspects of the community in service delivery. This index may be hard to judge. However I used some hard indicators to determine socio-cultural dimensions: the degree of access to waste facilities measured by the distribution pattern of waste facilities, for example, public skips, the frequency of service delivery and the way waste workers relate to citizens.

Judging from the distribution of skips, both Yaoundé and Bamenda cities demonstrate biases in distribution. Some areas are served with preference, driven by the principle of self-preservation. In both cities the sub division or quarter that hosts the council headquarters has disproportionately more skips, and consequently better services, than any other parts of the city. In Yaoundé it is Yaoundé I (Figure 8.1), and in Bamenda, the Mankon part of the city (Section 5.6.2.3). City markets are owned by the city councils and such markets are also well served by public skips. Some low-income quarters either lack official waste services or are served with an itinerant waste programme, where residents have to rush to, or wait for, a roving van to dispose of their waste as in the Efoulan quarter in Yaoundé.

Monkam *et al.* (2000) studied differences at Yaoundé quarter levels and noted that the high-income residential quarters had 2.1 litres per capita/day of skip space available while peripheral low-income quarters had only 0.3 litre available, constituting a lack of seven times their 2.5 litres daily needed capacity (Monkam *et al.* 2000). In Bamenda one part of the city is not served at all. This is paradoxically the government station, which houses the top government officials and administrative functions of the division and province. The tradition developed from history where the government departments located there managed their waste and not the local council that manages waste today. The fault scarp (1300-1425 m) (Figure 6.1), which separates that part of the city from the others, is an additional impediment to waste compactor trucks originally adopted for use in flat Holland.

Table 10.7 demonstrates how respondents in Bamenda and Yaoundé appreciate the attitude of waste workers towards the households they serve.

TABLE 10.7.
Waste Workers Attitude Towards Waste Generators in Yaoundé & Bamenda

Workers' Attitude/Quarter	Yaoundé					
	Bastos	**Efoulan**	**Nvog Ada**	**Cite Verte**	**Total**	**%**
Respectful	20	14	40	12	86	**63.2**
Fair	5	10	17	10	42	**30.9**
Disrespectful	3	2	1	2	8	**5.9**
Total	28	26	58	24	136	**100.0**
Workers' Attitudes/Quarters	**Bamenda**					
	GRA	**Nchuobou**	**Old Town**	**Ndamukong**	**Total**	**%**
Respectful	2	4	6	4	16	**18.8**
Fair	2	9	26	11	48	**56.5**
Disrespectful	1	3	13	4	21	**24.7**
Total	**5**	**16**	**45**	**19**	**85**	**100.0**

Table 10.7 shows that 65% of respondents in Yaoundé appreciate waste worker behaviour as 'respectful' and 30 % as 'fairly respectful'. Only 6% described them as 'disrespectful'. The evaluation is different in Bamenda. A greater number (57%) think they are only fair and 24% evaluate them as disrespectful. There are many confounding factors that influence waste workers' attitudes. Firstly, the work is not glamorous and it is also stigmatising; people often do not respect waste workers. Hence, the waste workers tend to develop low-working ethics (Bulle 1999), and fight back by not also respecting the waste generators. This also results, at times, in poor performance on the part of the waste worker.

These notwithstanding, could the difference in attitudes between Bamenda and Yaoundé workers be attributed to the mode of service delivery, that is, government (Bamenda) and private (Yaoundé)? Or is it a reflection of the animosity that reigns among political parties in Bamenda City? Or the fact that Bamenda is stricter in the application of sanitation laws than Yaoundé? For example, in Bamenda waste disposal containers and wheelbarrows found being used to strew waste around public skips are usually impounded and only released after the payment of a fine. Such law enforcement may be termed a disrespectful attitude by people in the city. However, low waste workers' wages, which are characteristic of the public sector, and non-collaboration from waste generators, can cause waste workers to be more disrespectful as is the case with Bamenda. Privatisation, as is the case with Yaoundé, separates the functions of waste management from that of general supervision and litigation of both waste managers and waste generators. The department of sanitation and the environment in the Yaoundé City Council administration carries out that function. In Bamenda the garbage department does all. This is most likely to result in unsatisfactory conflict resolution, as the offended party is also the judge.

10.4.5 Waste Management Policy and Application

Policies on municipal solid waste management are common to all city councils within the national territory. These policies are based on a bi-colonial heritage, for example, the English Colonial Public Health Ordinance, Vol.5, Section 17 & 18, for West Cameroon, 1958 (Appendix 4), to which Bamenda belonged, and the French colonial law of October 1, 1937 that applied to Yaoundé in the French Cameroon. Both laws addressed MSW as an issue of public health. For example, Article 12 of the 1937 law recommended a fine of 5000-1 000 000 CFA or 15 days to 6 months imprisonment for persons apprehended for committing acts of nuisance that led to health and environmental pollution (Nsoh 1994). In the 1958 Ordinance, Sections 17 and 18 charged owners or occupiers of any tenement with the responsibility for total cleanliness of the premises including undergrowth, weeds, filth, rubbish, and refuse, and further prohibited dumping and littering. Defaulting either section attracted a fine of one pound (Appendix 4). It is generally believed that laws were more rigorously applied in the British Cameroon sector by the famous Sanitary

Inspectors (SIs) and accepted by the people. That spirit of good hygiene lingers on today among these people now in the South West and North West provinces.

After political independence, waste management policy in all council areas of the country, was addressed through the Minister of Public Health's Service Note of 1987 that regulated the functions of the Municipal Hygiene Service. The service note charged the councils with the responsibility for waste management in cities including overseeing and 'ensuring collection, transportation, discharging and treatment of refuse at sites chosen by the mayor in collaboration with the chief of the Hygiene Service and local Technicians of the Ministry of Mines and Power' (1 a ii), cleanliness of urban areas, private establishments and public places, and town greens (Appendix 5). Law No. 80-17 of 15 January 1980 had fixed maximum annual rates for direct council tax on garbage, earlier noted (10.4.2 and 5.6.3.3), and followed by the national Law on the Environment (LOE) 1994 based on global agendas of sustainability. The LOE is general and its local applicability has never been defined. Subsequent laws organised and attributed functions to municipal councils, one of which is solid waste management.

Flexibility is not encouraged; rather red tapping is commonplace. The immediate representative of the central administration resident in the city, that is the Divisional Officer (DO), must ratify any additional measures such as general periodic city clean-up campaigns conceived by the urban council. The contributions realised from applying the law on garbage tax, is less than 10%. Implementing these rules has been hard to achieve as these cities have expanded beyond the original small colonial cities. The cities are not only large but also fast growing and urban councils find it difficult to employ adequate staff to enforce these regulations. However, the rare culprits apprehended by the sanitation department in the councils for defaulting over waste rules, are usually fined.

In both cities the administrative authorities appear to live in the spirit of colonial laws, which were based on an adversarial culture (Section 2.2.6) of settling waste matters by control-command, legal and regulatory process. There is no forum for addressing waste management issues. Waste generators are merely informed of where to dispose of their waste (public skips) or when to come out for general city cleaning. This in no way downplays the importance of a legal and regulations system in place. The point is that these issues should be addressed together by all stakeholders and not highhandedly passing down orders that must be obeyed or face sanctions. The theory of citizen ladder of participations (Arnstien 1996) and case studies demonstrate that such low-level token involvement breeds apathy (Section 5.3).

Both cities follow centrally promulgated laws and regulations on MSWM. However, Bamenda has instituted a permanent monthly half-day-a-month general cleaning of the city of its solid waste. The complementary measure keeps the city clean. The economies of small city size and cooperation from the government police units make it possible for the order to be enforced. In Yaoundé this may be hard to realise given its large size and difficulties involved in mobilising resources to enforce such orders. In 2001, Bamenda won the first prize of 7 million CFA for the National Cleanest City Award competition (Interview with the Government Delegate to the BUC, 4/8/02). This practice does not exist in Yaoundé. There is no known government policy on waste recovery and recycling.

10.5 Environmental Concerns

High solid waste generation rates and resulting huge amounts do not indicate the level of environmental impacts such waste may pose on the city. It is the way such waste is collected, transported, treated and disposed of that determines how the environment and human health will be impacted upon. The methods of waste management in both cities, from the sources of generation to disposal are fraught with many inadequacies. The quantities of waste left uncollected, dumped, burnt, buried or illegally disposed of, are much greater in Yaoundé than Bamenda. This situation suggests that there are, most likely, greater solid waste-related environmental problems in Yaoundé than in Bamenda.

10.6 Conclusion

The factors that drive waste generation and management in Bamenda and Yaoundé cities are different. Such factors include the area, population, functions, socio-economic status, infrastructure, climate and vegetation, topography and drainage. Waste generation rates and composition are different. Yaoundé generates 0.79 kg per capita per day with 61.7% biodegradable and 38.3 % non-biodegradable, while Bamenda generates 0.54 kg per capita per day, 76.0 % biodegradable and 24.0 % non-biodegradable. Yaoundé and Bamenda generate an average daily total of 1200 and 140 tonnes of MSW respectively. Waste densities are high in both cities but increasing in Bamenda with heavier rainfall, while higher temperatures in Yaoundé encourage faster rates of decomposition. Both cities face road infrastructure problems but that of Bamenda is increased by the presence of a more difficult topography.

Waste management processes at the primary level have variations and similarities. About 90% of waste generators use improvised containers to collect and store their waste, 80% of which is emptied within the first two days in Yaoundé and 53% in Bamenda. Removal is mostly by children, 58% in Bamenda and 67 % in Yaoundé and average distances to disposal sites are 105 m and 87 m respectively. Only about 21 % in Bamenda and 40-50% in Yaoundé reach official waste facilities, waste van, bins or official ground depots. The remainder is illegally dumped by the roadside, open spaces, river and lake sides and drains, because recycling and recovery activities are limited to informal reuse at household and artisan levels.

At the secondary level, the waste management methods are different. It is government-managed in Bamenda and privatised to HYSACAM in Yaoundé. But both cities use conventional methods whereby imported specialised waste vans collect waste from corresponding public skips or official ground depots on a daily basis following planned routes. The available public skips have a capacity to hold only 33% of municipal solid waste in Yaoundé and 5% in Bamenda. Yaoundé and Bamenda both apply itinerant programmes in some quarters without public bins. Yaoundé has more equipment, personnel, and management capacity than Bamenda. However both systems rely on extra national and international support for survival because the garbage tax collected by the state accounts for less than 10% of waste management costs. While Yaoundé relies on the state for two-thirds of its waste management costs, Bamenda has equipment and expertise support from a foreign city, Dordrecht in Holland, with running costs trickling in from the central administration. Yet Yaoundé removes only about 600 tonnes and Bamenda 20-30 tonnes of solid waste a day from central and highly accessible areas and leaving behind 600 tonnes and 115 tonnes uncollected respectively. Yaoundé has a sanitary landfill and Bamenda an uncontrolled open dump. Both primary and secondary level waste management in the cities pose considerable environmental and health risks.

Policies on MSW management are very limited as demonstrated by the garbage tax law. The waste management legislation is centralised, fragmented and ineffectively applied at the local level owing to a lack of capacity by such local council authorities to cope with the rapidly growing urban populations. Participation of waste generators, small and medium enterprises (SMEs), neighbourhood-based organisations and NGOs that operate independently in Yaoundé, in waste organisation and planning, is non-existent.

Yaoundé's MSWM has a lead over Bamenda's in terms of waste generation rates as well as management, equipment, personnel, and service provision, even when compared at city and urban sub division levels. At quarter levels, low-income residential quarters in both cities have similarities in waste generation rates and service delivery. In absolute terms the quantities of uncollected waste or that, which end ups in illegal disposal sites at Yaoundé far, outstrip those of Bamenda. While Bamenda leaves 115 tonnes uncollected daily, Yaoundé leaves 600 tonnes. Whereas increases in collection rates might suggest trends in the progress of a waste management system, nevertheless, it is this uncollected fraction of the urban waste stream that is the immediate threat to the city's aesthetics, environmental and human health. Progress is very important and it must be monitored, recognised and encouraged but serious consideration needs to be made for the uncollected waste fraction. A threat posed by one kilogram of uncollected waste does not relate to the quantities that have been removed. The general public, visitors and politicians tend to judge the waste management system by what waste is seen lying around. In the first place they may not even know what fraction of the waste has been removed. Both cities demonstrate solid waste management trends that are unsustainable but Bamenda, being a provincial headquarters, is more vulnerable than Yaoundé, the national headquarters that may always have a rescue from the national government.

CHAPTER 11

Recommendations and Conclusions

11.1 Introduction

This thesis aimed to study the sustainability of municipal solid waste management (MSWM) in Yaoundé and Bamenda. At the beginning, specific objectives were also outlined. The research considered MSWM to include all activities starting from generation and ending with the final disposal. Municipal solid waste (MSW) was defined to include all urban non-liquid materials no longer required by an individual, institutions or industries such as all domestic refuse and non-hazardous commercial, institutional, industrial waste, construction debris and street sweepings. Sustainability was defined as a system that is appropriate to the local conditions in which it operates from a technical, social, economic, financial, institutional, and environmental perspective, and capable of maintaining itself over a long time without reducing the resources it needs (van de Klundert and Anschutz 1999). Such a MSWM system must also be integrated, that is, be using a range of inter-related collection and treatment options, at different habitat scales, involving all stakeholders, the governmental or non-governmental, formal or informal, profit- or non-profit orientated groups and taking into account interactions between the waste management system and other urban systems.

This chapter summarises the objectives realised to achieve the overall aims of the thesis. The chapter also includes recommendations that argue in favour of increase in MSWM research, improvement in policy, strategies and practices. Effective participation that could, in turn, trigger and increase interest, environmental awareness and raise the willingness and ability to pay, and collaborate for MSWM are recommended. The strong links between interests and participation and MSWM improvement were demonstrated in concepts and cases presented earlier in this thesis (Wilson *et al.* 1998; Bulle 1999; van de Klundert and Anschutz 1999; Wilcox 2001).

11.2 Major Objectives Achieved

The objectives are so interwoven that it is hard to deal with one without encroaching onto the others. However, the objectives have been achieved through critically assessing, analysing and comparing the major policies, strategies and practices following a municipal solid waste management flow path (generation to final disposal), and employing qualitative and quantitative sustainability indicators derived from using several method-triangulations, as a gauge to measure and evaluate the systems. These methods included a solid waste collection and analyses experiment and questionnaire surveys in sampled households selected from stratified quarters, field observations, interviews and a review of secondary sources. The objectives are realised within chapters arranged under each city and following waste management flow, but ordered in this section according to each objective subheading.

The first objective was:

- To generate major original data especially on MSWM in Bamenda and supplementary data for Yaoundé.

This research has produced original vital data, especially for Bamenda, that could give valuable input to policy, planning strategies, practices, and evaluation and monitoring of the system performance trends with reference to targets using some quantitative measures. These data are self-evident as derived and used to develop arguments in various chapters and especially in chapter nine where such data are summarised and applied to compare waste management in both cities. For example, it is now known that in Bamenda, the per capita per day MSW generation rate is 0.40-0.54 kg or 120-160 tonnes for the entire city, 76% of which is biodegradable and 24% non-biodegradable. Only 20-30 tonnes of the waste are removed daily and serving an area of less than 10%. Some of the key data realised for both cities include household waste recycling attitudes and rates, household waste container type and conditions, frequency of waste removal from households, average primary waste disposal distances, public skip capacity and distribution, collection rates, waste worker productivity and relationship with waste generators, ability and willingness to pay for waste and appraisal of the systems.

The second objective was:

- To critically examine MSWM cycle in both cities from generation to disposals within the framework of sustainability.

Findings from this research show that MSWM in both cities is facing increasing waste generation rates, quantities, and varieties. Major driving forces behind these increases include the rapid urban population growth, spatial expansion, improved affluence and consumption among the top social classes. This study has also revealed that the management techniques in both cities have improved within the last decade but this improvement still falls far short of sustainable levels.

MSWM in Bamenda improved from a daily collection of 4.4 tonnes in 1994, from ground depots using tipper trucks and a front-end loader, to a collection of all the waste in and around the 37 centrally located 1000 L public skips, accounting for about 20 tonnes, and using waste compactor trucks. However, based on the city population, area and per capita waste generation, the current management practice is very far from satisfactory because barely 17-25% of the waste is collected in a day, limited to areas along the major roads and constituting only $1/10^{th}$ of the city area.

In Yaoundé the waste management situation has also improved, judged by collection rates that increased from zero tonnes at the onset of the economic crisis and subsequent withdrawal of HYSACAM in 1991, through 120 tonnes (1994) during the structural adjustment programmes years, to 540 tonnes per day in 2004. There has also been a significant increase in the number of new equipment items acquired and workers employed. These notwithstanding, HYSACAM collects just about half of the city's solid waste from the public skips that are insufficient and inadequately distributed. The rest is disposed of by waste generators in undesignated sites such as open spaces, rivers, roads, lake sides, open spaces and drains.

Bamenda and Yaoundé have both maintained and developed the traditional MSW system started in the colonial era whereby management is focused on waste collection, transportation and dumping of waste out of sight. MSW is collected from public skips located at strategic points along some main access streets following planned routes and using specialised conventional waste vans. The collected waste is disposed of at the landfill or dump. Emphasis is placed on improving the acquisition and the use of machines, while the effective harnessing of waste generators' participation is sidelined. Participation by waste producers is superficial and limited to the insignificant garbage tax and to supplying of solid waste to public skips for collection. The tax contributes 5% and 7% of the waste management costs for Bamenda and Yaoundé respectively. Hence, both waste management systems are barely surviving and relying heavily on extra support from the Cameroon government in the case of Yaoundé, and from a foreign partner, the Municipality of Dordrecht in Holland, in the case of Bamenda. This suggests that both municipal solid waste management systems are financially unsustainable.

This study shows that the existing policies and legislation on MSWM are very limited in content and in their application. Many sectors are implicated in MSWM but their jurisdictions and roles, such as in the 1987 law on city council and urban sub divisional council regarding MSWM, are not only blurred but also uncoordinated resulting in conflicts, duplication and negligence. Article 43 (2) of the 1996 Law on the Environment promised a subsequent implementation decree of that law detailing the conditions under which waste collection, separation, storage, transportation, recovery, recycling and all other forms of treatment including final waste disposals would be accomplished so as to avoid over waste generation, wastage of recyclables and safeguard the environment from pollution. This promise, as with decentralisation, is not yet fulfilled. No national, regional or city-level plans for integrated sustainable MSWM have been found. Decentralisation of administration and funds remains in theory. Power and funds are highly centralised at the top but the responsibility for MSW operations are devolved to councils with insufficient funds and limited authority to initiate local strategies that could make them function sustainably. Public policy concentrates on waste collection and transportation. Municipal solid waste minimisation strategies such as recycling, composting and recovery are neglected by policy and are carried out informally and rudimentarily at household and artisanal levels. The informal groups involved in municipal solid waste management exist in Yaoundé, but they have not been incorporated into the city's mainstream waste management system. Yet, the highly centralised authority in Cameroon limits the administrative and fiscal powers of individual city councils to address local waste management issues using local initiatives. For example, there are sketchy laws in place that treat waste under public health issues but the councils are unable to enforce these laws effectively owing to a lack of resources. MSWM plan, strategies and priorities that are so important do not exist. Proper disposal is not yet considered a priorit*y.* A lack of development and integration of each of these separate but related processes into the waste management system has rendered the overall system unsustainable.

Throughout the study this researcher realised that the inadequacy of a good street and road network is an impediment to the efficient collection of waste. But this is less critical than the need for increased equipment, especially public skips. There are many paved streets in Yaoundé and Bamenda cities that are not served by public skips. The proliferation of official ground waste depots and the continuous use of bad skips (Plates 6.6B, 9.5A & 9.5B) in both cities are further clear indicators of this dire need for more public skips. Another crucial problem is linked to the ailing economy whose situation was exacerbated by the economic crisis, which started in the late 1980s, followed by the structural adjustment programmes. Both events and their ramifications affected the MSWM sector to the extent that in Yaoundé HYSACAM withdrew and in Bamenda waste collected became very irregular.

A third objective was:

- To compare MSWM in the Yaoundé and Bamenda cities.

Comparisons conducted in this research show that Bamenda differs from Yaoundé in terms of physical conditions and status, and this is reflected in the waste characteristics, management and nature of support. Bamenda and Yaoundé generate respectively 0.40-0.54 and 0.79 kg per capita or 120-160 and 1200 tonnes of municipal solid waste in a day. This research has found that a major difference between MSWM in Bamenda and Yaoundé is the mode of management. While the system in Bamenda is public, in Yaoundé it is privatised, but both systems demonstrate the same approach, namely, using conventional waste collection technology and organisational style. Bamenda organises a half-day monthly cleanup to complement its system. Yaoundé has many formal and informal private-initiative groups operating independently at neighbourhood levels that are yet to be incorporated and coordinated into the mainstream system.

Findings show that the management system in Yaoundé has an edge over that of Bamenda as regards waste collection rates, area coverage, equipment, personnel size, productivity rate, skip capacity available and disposal techniques. But in absolute terms Yaoundé leaves behind every day larger amounts of uncollected waste (~ 600 tonnes) than Bamenda (115 tonnes). Findings suggests that Yaoundé's relatively better situation is due more to the special attention and support given it by the central government as the national headquarter than the fact that its solid waste management is privatised. Findings suggest that the choice of private or public option would depend on the financial and human resources available to the city in question. Small and less wealthy cities or poor urban sub divisions of a big city, are less likely to be attractive to private waste management investors whose activities are profit driven. On the other hand, small cities or poor sub divisions have a weak administrative and financial base and may not have the necessary resources to draw up contracts, supervise them and monitor the private contractors. This is the problem poorer sub divisions in Yaoundé would mostly likely face and address if decentralisation and privatisation became imminent or if Bamenda went private.

Another finding from the study suggests that relations between waste workers and waste generators are better under private management than public. On the whole, there is not enough evidence to suggest that Yaoundé's lead over Bamenda is because the private system is better. However, reviewed literature confirms that the worse scenario is a combined public-private venture, usually called the ‘Parastatal’. Parastatals are known to place undue emphasis on personnel expenditures that take colossal sums of waste management monies.

The fourth objective was

- To evaluate the environmental impacts of the MSWM systems.

The environment bears the brunt of unsustainable municipal solid waste management and the impacts are passed on to humans. Findings throughout the stages of waste management cycle in Yaoundé and Bamenda demonstrate that environmental problems are implicated at all stages of the MSWM. The environmental problems start with leaky uncovered waste containers at generation points, through indiscriminate illegal dumping, burning, burying, to unsafe disposal of mixed waste at a sanitary landfill in Yaoundé and in an uncontrolled open dump in Bamenda. Both official disposal facilities are sited on river valleys. These facilities produce landfill gases, leachates, odours, fires and dust that harbour, transmit disease vectors or cause direct illnesses. Carbon dioxide, methane and dioxins produced from indiscriminate burning of plastics were identified as especially dangerous to the environment and human health. Findings from this study suggest that waste generators and managers are not aware of many of these present or threatening solid-waste-related diseases. This thesis has illuminated such hazards posed by poor solid waste management practices as an accomplishment of one of its objectives.
Environmental legislation that governs all stages of municipal solid waste management including generation, storage, collection transportation, treatment and final disposals was not discovered during the study.

The fifth objective was:

- To assess the place of the waste management hierarchy in MSWM using the two cases examined.

This research was started with enthusiasm to explore, evaluate and apply waste management theories such as the waste management hierarchy promoted in western literature. At the end of this research it is found that the waste management hierarchy does not significantly address the waste management issues in these cases for two major reasons. Firstly, the waste management system being studied, as in most developing countries, is still rudimentary and concentrates its limited resources on waste collection and transportation ‘out-of-sight, and hence, out-of-mind’. Waste recycling, recovery, reduction and safe disposal, which are central to the waste management hierarchy are non-existent or are accorded little attention. Secondly, upstream waste prevention through the elimination or reduction of superfluous bulk, packaging and toxicity during the manufacturing process, is out of the reach of cities in developing countries such as Cameroon that consume such imported manufactured goods designed out of their countries. These countries have to deal with the ‘end-of- pipe solutions’ to their waste problems. In all, given the constraints these cities are facing, the use of lower level facilities (by the waste management hierarchy classification) such as landfilling is most likely to continue for a long time. Hence upgrading such facilities to mitigate hazards may be a more plausible approach in these areas.

11.3 Implications of the Study Findings for MSWM Policy and Strategy

- Policies

This research has identified that there are four important and interrelated parts of a MSWM system that need to be addressed with equal importance in policy, planning, strategy and practice. These include the primary level, the secondary level (made up of collection and transportation), waste minimisation activities and the final disposal, sometimes called the tertiary level. Policy and practice have so far focused on collection and transportation, and to a very limited extent, disposal; neglecting the primary level that is responsible for avoiding, generating or reducing the waste; and for providing the indispensable waste containers and stocking them with waste after separation. This stage is crucial to a MSWM system that seeks to collaborate, improve collection, avoid environmental and health conditions at source of generation, as well as increase recycling and reduce waste for disposal. A new policy focus is necessary in this direction.

Minimisation policies and strategies such as waste prevention and reduction at source, recovery through reuse, composting and recycling that are emphasised by the waste management hierarchy do not yet find a strong place at this level of MSWM in Cameroon and the countries of the developing world. The said policies and strategies are important because they could help reduce waste that must be disposed of and by extension, create jobs, contribute to the local economy and prolong the life of the landfills as well as safeguard the environment. There is no official policy and legislation that regulates such activities, consequently, no funding is provided, for municipal waste minimisation activities at primary, secondary and tertiary levels. The practice remains informal and rudimentary. The official method of final waste disposal in both cities is landfilling. Legislation on these final disposals is not clear. I would recommend that MSWM policy and strategic planning in Cameroon, as with other developing countries, should address all the solid waste management sectors with equal force. MSWM is an integrated system and the neglect of one area renders the entire system unsustainable.

- Strategies and practices

Even though efforts are concentrated on waste collection and transportation, less than half the waste generated is collected in less than 30% of the city area. To meet this target extra national and international support is sought by both cities because the garbage service tax contributes less than 10% of the waste management costs. This clearly demonstrates that the system is not financially self-supporting, and suggests that a review of the January 1980 Decree that instituted the garbage tax is essential. Such a reviewed decree should envisage presenting the full waste costs already discussed. My survey results show that waste producers in both cities are capable and are willing to pay an extra monthly charge equivalent to the per capita garbage tax stipulated for one year. With education and environmental awareness-raising programmes, waste generators' interest and support would be kindled. Interest, either at individual or collective level, is the key to participation and progress in MSW management.

This study has generated vital original data that could give valuable inputs to planning strategies, practices, and evaluation and monitoring of trends. These major findings include the rates and quantities of waste generation, characteristics, average primary waste disposal distances, types and conditions of household waste containers, frequencies of waste removal from generation sites, the prominence of child services for waste disposal, willingness and ability to pay and the exposure of health and environmental risk posed by poor solid waste management. Each of these factors has implications for strategic planning and practices. For example, the knowledge of the waste characteristics will determine choice of management strategies and technologies, average primary waste disposal travel distances will influence sustainable inter-skip location distances; the prevalence of children's participation in waste removal will suggests skips with doors or low heights; disposal frequencies will determine collection itinerary; and in order to avoid exposure to environmental hazards more sensitisation, education and environmental awareness-raising programmes are needed.

The study critically examined the situation of public skips and generated new data and important information, which is useful to MSWM. Public skips are the meeting point of the waste generators and the official waste managers and have a direct relationship to the quantities of waste collected in an area of the city. Analyses made in this thesis demonstrate that public skips are not only grossly insufficient but are also poorly distributed. I recommend an increase in their number and a fair spatial distribution based on needs. At the household level water-tide containers with fitting lids are recommended. Waste picking is a taboo in Cameroon and scavengers who have significantly contributed to MSWM in many cities of the developing countries are absent or insignificant. Waste policy, planning and strategy must understand and deal with these socio-cultural aspects.

11. 4 Recommendations for Further Research

In Bamenda, solid waste was collected, measured and analysed for generation quantities, rates and characteristics in sampled households that contribute more than 80% of municipal solid waste. The waste generation rates and quantities from institutions, motor-repair garages, processing factories, open spaces and market places were only estimated based on observations and information from earlier studies. Even though these sectors constitute a very small fraction of the city's municipal solid waste stream, similar detailed research is essential.

For Yaoundé, more research on MSWM in the city should be directed to waste management at urban sub divisional level for two reasons. Firstly, research findings suggest that data averages at the city level obscure the spatial reality of waste management at sub divisional level; and secondly, the future of MSWM sustainability in Yaoundé lies in the effective administrative and fiscal decentralisation of the service to the urban subdivisions.

In both cities, as for the whole country and cities of developing countries, the costs of MSWM have been misunderstood by waste generators and managers to mean removing and transporting waste out of sight. This is demonstrated by the lack of formal recycling activities and the low costs attributed to waste treatment at disposal dump or landfill. Research and policy should advance to studying costs to include all levels: primary waste management (source of generation level), secondary collection and transportation (the current emphasis), treatment or forgone treatment such as non-recycling, landfilling of waste and lastly, the environmental waste-related degradation costs or what this researcher would like to call 'eco-costs'**.** These will determine the real solid waste management total costs and policy should determine what mix of instruments and strategies needed to sustain such a MSWM taking into consideration the city-specific context as well as the socio-economic differences within the cities. This policy will require reconciliation between conflicting principles of having service consumers pay and their ability to pay sustainable rates given their socio-economic conditions. The central administration would always subsidise social services such as waste management but citizens' effective participation would reduce the burden that the government bears now.

As an extension of the preceding point, recycling, and especially composting is an important area needing more investigation as the biodegradable organic waste in both cities constitutes more than two-thirds of the total waste stream. Composted material is good as soil amendment, but such researches must address the recurrent issues of compost quality, market demands, and health and environmental problems associated with the activities. The biodegradable MSW fraction when not recovered produces gases and leachates that are potentially dangerous to the environment and human life.

11.5 Conclusion

When we pull together all data and information on what both systems have accomplished, their inadequacies, and consider all dimensions -institutional, financial, social, economical and technical and environmental- we can confidently conclude that the current practices of MSWM in Bamenda and Yaoundé cities are unsustainable. Both systems are not appropriate to the local conditions within which they operate and they are incapable of maintaining themselves despite targeting only very limited activities within the MSW hierarchy and with huge extra support. This support has its own constraints and would never last forever. If citizens put all their solid waste into public skips, as they are usually called upon to do, the waste managers and councils would be overwhelmed with the full extent of the collection, transportation and disposal problems.

But all is not lost. The management systems demonstrate characteristics of the first stage of an integrated sustainable MSWM hierarchy (2.2.4). This study has discovered that a city need not follow all the stages to attain an integrated sustainable system. It can be developed immediately. Findings from this thesis are intended to make this possible. Cameroon towns and cities are relatively small. Each of the bi-primate cities has less than 2 million people and each of the remaining cities and towns has less than half a million people. Waste stakeholders and the general public are enthusiastic to collaborate in the management process of their waste. This is demonstrated by their use of private waste collector services and willingness to pay for the service indicated by field survey results. It is the best time for Cameroon to proactively put in place short and long-termed national, regional, city policies and strategic planning that addresses some of these MSWM crucial issues, clearly discussed in this thesis, before they get out of control. Such planning should demonstrate enough flexibility to be capable of taking care of city-specific contexts and integrating all stakeholders for a sustainable municipal solid waste management.

This research has also identified that crucial to successful MSWM are financial, technical institutional, policy, and socio-economic and environmental sustainability**.** Such sustainability presupposes urban governance usually recognised by its transparency in managing public affairs, reliability and timely information, public participation, formal redress procedures, regular opinion survey, public meetings and official channels. Without such good governance demonstrated by genuine democratisation that decentralises power and financial resources from the state to regional and city levels, entrusting the responsibility of municipal solid waste management to local councils will continue along the present unsustainable path.

APPENDIXES

APPENDIX 1

General Classification of Municipal Solid Waste (Refuse Materials)

<table>
<tr><td rowspan="13">Refuse
(Solid
Waste)</td><td>Garbage</td><td colspan="2">Wastes from the preparation, cooking, and
Serving of food
Market refuse, waste from handling,
Storage, and sale of produce and meats</td><td rowspan="4">From
households,
institutions,
and commercial
concerns such
as:
hotels,
stores. restaurants,
markets, etc.</td></tr>
<tr><td rowspan="2">Rubbish</td><td>Combustible
(primarily
organic)</td><td>Paper, cardboard, cartons
Wood, boxes, excelsior
Plastics
Rags, clothe, bedding
Leather, rubber
Grass, leaves, yard trimmings</td></tr>
<tr><td>Non-
combustible
(primary
inorganic)</td><td>Metal, tin cans, metal foils
Dirt
Stones, bricks, ceramics, crockery
Glass, bottles
Other mineral refuse</td></tr>
<tr><td>Ashes</td><td colspan="2">Residue from fires used for cooking and for heating
buildings, cinders</td></tr>
<tr><td>Bulky
Wastes</td><td colspan="2">Large auto parts, tires
Stoves, refrigerators, other large appliances
Furniture, large, large crates
Tree, branches, palm fronds, stumps, foliage</td><td rowspan="5">From:
streets,
sidewalks,
alleys
vacant lots, etc.</td></tr>
<tr><td>Street
refuse</td><td colspan="2">Street sweepings, dirt
Leaves
Catch basin dirt
Contents of litter receptacles</td></tr>
<tr><td>Dead
animals</td><td colspan="2">Small animals: cats, dogs, poultry, etc
Large animals: horses, cows, etc.</td></tr>
<tr><td>Abandoned
vehicles</td><td colspan="2">Automobile, trucks</td></tr>
<tr><td>Construction
&Demolition
wastes</td><td colspan="2">Lumber, roofing, and sheathing scraps
Rubble, broken concrete, plaster, etc.
Conduit, pipe, wire, insulation, etc.</td></tr>
<tr><td>Industrial
refuse</td><td colspan="2">Solid wastes resulting from industrial processing and
manufacturing operations,
Such as: food-processing wastes, boiler
House cinders, wood, plastic, and metal
Scraps and shavings, etc.</td><td>From:
factories,
power plants, etc</td></tr>
<tr><td>Special
wastes</td><td colspan="2">Hazardous wastes: pathological wastes,
Explosives, radioactive materials
Security wastes: confidential documents,
Negotiable papers, etc.</td><td>Households,
hospitals,
institutions,
stores,
industries, etc.</td></tr>
<tr><td>Animal and
Agricultural
wastes</td><td colspan="2">Manure, crop residues</td><td>Farms,
feed lots</td></tr>
<tr><td>Sewage
treatment
residue</td><td colspan="2">Coarse screenings, grit, septic tank sludge,
dewatered sludge</td><td>Sewage treat-
ment plants,
septic tanks</td></tr>
</table>

Source: Michaels, 1966 p. 15

Appendix 2: Household Survey Questionnaire for Bamenda and Yaoundé Cities

THE UNIVERSITY OF ADELAIDE, SA 5005

Department of Geography and Environmental Studies

Municipal Solid Waste Management Household Survey by

ACHANKENG ERIC PhD Research Student

N.B. The information requested is purely for academic purposes and will be treated confidentially. Thank you for accepting the questionnaire.

You are free to answer only the questions you like

Please, do not write here.

A. GENERAL INFORMATION

Household Survey Number ________________ HHNO [ ][ ][ ]

Interviewer: ____________________________

City: ____ Yaounde [1] Bamenda [2] CTY [ ]

Subdivision:

1. Bamenda Central [ ]
2.
3.
4.
5.
6.

SubD. [ ]

Quarter
1. GRA -Up Station [ ]
2. Nchuabuh [ ]
3. Nta-Mbang [ ]
4. Ndamukong [ ]

Qter [ ]

Street: _________________________ ST [ ]

Type/condition of the Street

1. Footpath [ ]
2. Path usable by wheel barrow/push-push [ ]
3. Loose surface motorable all seasons [ ]
4. Loose surface motorable in dry seasons [ ]
5. Tarred road in a bad state [ ]
6. Tarred road in a good state [ ]

STCON. [ ]

Relief of area

1. Sloppy [ ]
2. Flat land [ ]
3. Swampy [ ]

Topo [ ]

Dwelling

1. Modern Villa [ ]
2. Apartment/unit [ ]
3. Story building [ ]
4. Detached house [ ]
5. Compound [ ]

DWELL [ ]

---

1. Could you please tell me whether you are the proprietor or tenant in this house?

1. Proprietor (landlord) [ ]
2. Tenant (self paying) [ ]
3. Tenant (lodged by the state/organisation) [ ]

V1

---

2. I n which year were you born? ___________

V2

---

3. What sex do you belong to?

1. Male [ ]
2. Female [ ]

V3

---

4. How many persons are currently living in this house? __________

V4

---

5. How many are less than 15 years? ________

V5

---

6. How many are more than 15 years? ________

V6

---

7. Do you have the following in your house?

1. Electricity	1 Yes [ ]	2 No [ ]	V7
2. Pipe-borne water	1 Yes [ ]	2 No [ ]	V8
3. Water-system toi.	1 Yes [ ]	2 No [ ]	V9
4. Pit toilet	1 Yes [ ]	2 No [ ]	V10
5. Bicycle	1 Yes [ ]	2 No [ ]	V11
6. Motor cycle	1 Yes [ ]	2 No [ ]	V12
7. Car(s)	1 Yes [ ]	2 No [ ]	V13
8. Radio	1 Yes [ ]	2 No [ ]	V14
9. TV	1 Yes [ ]	2 No [ ]	V15
10. Video/VCR,CDPlayer	1 Yes[ ]	2 No [ ]	V16

---

8. Could you please tell me where your monthly earnings fall?

1. Less than 50.000frs [ ]
2. Between 50.000 and 100.000frs [ ]
3. Between 100.000 and 150.000frs [ ]
4. Between 150.000 and 200.000frs [ ]
5. Greater than 200.000frs [ ]
6. Won't tell you [ ]

V17

---

9. Which of the following factors do you think are a problem in this city and what is their degree of seriousness?

Problem	Degree of Seriousness					
	Extremely	**Very**	**Quite**	**Not very**	**Not at all**	
1. Safety & Security	1	2	3	4	5	V18
2. Water portable	1	2	3	4	5	V19
3. S. Waste management	1	2	3	4	5	V20
4. L. Waste management	1	2	3	4	5	V21
5. Noise pollution	1	2	3	4	5	V22
6. Poor housing condition	1	2	3	4	5	V23
7. Traffic congestion	1	2	3	4	5	V24
8. Flooding	1	2	3	4	5	V25
9. Landslides	1	2	3	4	5	V26
10. Crime	1	2	3	4	5	V27
10.others: specify	1	2	3	4	5	V28

B. SOLID WASTE COLLECTION

10. What type of solid waste comes out of your household and to what extent?

	Too much	much	quite	not much	
1. Paper and carton	1	2	3	4	V29
2. Plastics (bag/bottles)	1	2	3	4	V30
3. Food waste	1	2	3	4	V31
4. Bottle/glass	1	2	3	4	V32
5. Tins/cans	1	2	3	4	V33
6. Fibre bags(sac & motor)	1	2	3	4	V34
7. Others Specify:______________________________					V35

11. In what type of container do you collect your waste from the house?

1. Carton [ ]
2. Basket [ ]
3. Old bucket [ ] Estimate in L.________
4. Plastic bag [ ]
5. Tin/Can [ ]

V36

12. Do you have cover for your container?

1. Yes [ ] 2 No [ ]

V37

13. How often is the house waste container emptied?

1. Once a day [ ]
2. Once in 2 days [ ]
3. Once in 3 days [ ]
4. Others [ ] specify:_____________

V38

14. Where do you usually put away this waste?

1.In the public bin	1 Yes [ ] 2 No [ ]	V39
2. In the itinerant waste van	1 Yes [ ] 2 No [ ]	V40
3. By the valley/stream/lake side	1 Yes [ ] 2 No [ ]	V41
4. By the road or street side	1 Yes [ ] 2 No [ ]	V42
5. On the open space/bush around	1 Yes [ ] 2 No [ ]	V43
6. In a hole in the compound	1 Yes [ ] 2 No [ ]	V44

15. Who usually removes and carries away this waste from the house?

1. Father [ ]
2. Mother [ ]
3. Children in the house [ ]
4. House boy/girl/servant/guard. [ ]
5. Children moving around [ ]
6. Organised association/NGO/CIG. [ ]
   Name__________________________

V45

16. How much do you pay per month for the service?

____

V46

17. If your waste is transferred to the public bin, how far do you estimate the distance from your house?

1. A distance of 1 electricity pole [ ]
2. A distance of 2 electricity poles [ ]
3. A distance of 4 electricity poles [ ]
4. More than 4 electricity poles [ ]

V47

18. By what method is the waste container usually transferred from the house to the place of deposition?

1. Head or hand [ ]
2. Wheel barrow [ ]
3. Push-push [ ]
4. Motorised vehicle [ ] Type:____________
5. Others [ ] Specify:___________

V48

---

19. How often is the public near you bin emptied?

1. Once a week [ ]
2. Twice a week [ ]
3. Thrice a week [ ]
4. Every day [ ]
5. Others [ ] Specify:__________

V49

---

20. How do you usually meet the public bin?

1. Half full [ ]
2. Always full [ ]
3. Always overfull [ ]
4. Empty [ ]

V50

---

21. How would you best evaluate the collection and transportation process of waste at the public bin?

1. Very good [ ]
2. Good [ ]
3. Average [ ]
4. Fair [ ]
5. Bad [ ]

V51

---

22. If you had someone or association to remove all your waste from the home to public bin, how much would you be prepared to pay in a month?

1. 500frs [ ]
2. 500 – 700 frs [ ]
3. 700 – 1000 frs [ ]
4. 1000 – 1500 frs [ ]
5. 1500frs and above [ ]

V52

---

23. How would you describe the attitude of the waste collection team to the public?

1. Respectful [ ]
2. Fair [ ]
3. Disrespectful [ ]

V53

---

24. Who decided the placement/location of the public bin?

1. The Urban Council (UC) [ ]
2. HYSACAM [ ]
3. The Quarter people [ ]
4. The Quarter people and HYSACAM [ ]
5. UC,HYSACAM, the quarter people [ ]

V54
V55
V56
V57
V58

---

25. How can you best evaluate the state of the public bin around you? Would you say it is…?

1. Rusting/ rotting 1 Yes [ ] 2 No [ ]
2. In a good state 1 Yes [ ] 2 No [ ]
3. Adequate size 1 Yes [ ] 2 No [ ]
4. Well placed by the street 1 Yes [ ] 2 No [ ]
5. Adequate height for all 1 Yes [ ] 2 No [ ]

V59
V60
V61
V62
V63

C. ENVIRONMENTAL CONCERNS

26. Do you ever notice the presence of the following in and around the waste bin or waste dump?

1. Dark flowing water 1 Yes [ ] 2 No [ ] V64
2. Odour 1 Yes [ ] 2 No [ ] V65
3. Mosquitoes & cockroaches 1 Yes [ ] 2 No [ ] V66
4. Fire 1 Yes [ ] 2 No [ ] V67
5. Domestic animals 1 Yes [ ] 2 No [ ] V68
6. Rats 1 Yes [ ] 2 No [ ] V69
7. Scavengers 1 Yes [ ] 2 No [ ] V70

27. Have you experienced the following in the last 6 months?

1. Bought insecticides 1 Yes [ ] 2 No [ ] V71
2. Bought raticides 1 Yes [ ] 2 No [ ] V72
3. Had an illness 1 Yes [ ] 2 No [ ] V73
   Which?:______________________
4. Flood in your quarter 1 Yes [ ] 2 No [ ] V74

28. Which illnesses are common?

____ V75

29. How do you rate street sweeping in the city? V76

1. Good [ ]
2. Average [ ]
3. Fair [ ]
4. Bad [ ]
5. Non existent [ ]

D. SENSITIZATION / EDUCATION

30.a) Have ever had any sensitization / education on waste management?

1 Yes [ ] 2 No [ ] V77

b) Through what way?

1. Over radio 1 Yes [ ] 2 No [ ] V78
2. Over T.V 1 Yes [ ] 2 No [ ] V79
3. In quarter meeting 1 Yes [ ] 2 No [ ] V80
4. In school 1 Yes [ ] 2 No [ ] V81
5. On posters 1 Yes [ ] 2 No [ ] V82

c) How often? _______________________ V83

d) Who organized it?

1. The council 1 Yes [ ] 2 No [ ] V84
2. Waste management company 1 Yes [ ] 2 No [ ] V85
3. An Academic 1 Yes [ ] 2 No [ ] V86
4. A NGO 1Yes [ ] 2 No [ ] V87
5. Others [ ] specify:________________ V88

e) What was the main message?

____

____________________________________ V89

E. RECYCLING AND REUSE

31. Do you ever reuse, sell, give as presents, or receive as gifts, any of the following old things?

1. Bottles 1 Yes [ ] 2 No [ ] V90
2. Tin/cans 1 Yes [ ] 2 No [ ] V91
3. Plastics 1 Yes [ ] 2 No [ ] V92
4. Bags 1 Yes [ ] 2 No [ ] V93
5. Metal 1 Yes [ ] 2 No [ ] V94
6. Shoes 1 Yes [ ] 2 No [ ] V95
7. Cloths 1 Yes [ ] 2 No [ ] V96

---

32. What do you do with the food wastes, leaves and trimmings that come out of your house?

1. Make compost [ ] V97
2. Apply directly on the farm/garden [ ] V98
3. Throw away with other waste [ ] V99
4. Burn [ ] V100
5. Others [ ] Specify:_________________ V101

---

33. Would you like to separate decomposable food/vegetable waste from non-decomposable manufactured waste?

1 Yes [ ] Go to Q.34. 2 No [ ] Go to 35 V102

---

34. Why would you like to separate?

____

____ V103

---

35. Why would you not like to separate the waste?

1.I have no use [ ]
2.It is a difficult exercise [ ]
3. Other reasons [ ] V104
Specify______________________________

---

36. How do you evaluate the state of solid waste management in your city?

1. Has improved [ ] Go to Q37
2. Remains the same [ ] V105
3. Has deteriorated [ ] Go to Q38

---

37. How has the situation improved?

______________________________________ V106

---

38. Which of these may be contributory factor to waste management deterioration, and to what degree?

Problem	**degree** Extreme	very	quite	not very	not at all	
1. Organisational	1	2	3	4	5	V107
2. Finance related	1	2	3	4	5	V108
3. Non-collaboration of parties	1	2	3	4	5	V109
4. Lack of sensitization/educ.	1	2	3	4	5	V110
5. Technical/human know-how	1	2	3	4	5	V111
6. Others	1	2	3	4	5	V1V

END

39. How can the waste management situation in this city be improved upon? (use page provided)

Thank you. Date…../…./03

APPENDIX 3

An Example of Institution Questionnaires, Bamenda 2003

THE UNIVERSITY OF ADELAIDE, SA 5005
Department of Geography and Environmental Studies

Municipal Solid Waste Management Hotel Survey- Bamenda by
ACHANKENG ERIC, PhD Research Student

N.B. The information demanded is purely for academic purpose and will be treated confidentially. Thank you for accepting the questionnaire.

1.Name of Hotel ____

2.What type of waste do you generate? ___________________________________

3.Quantity per day/week____

4.In what type of containers do you put the waste?______________ Size_____L

5.How many of such containers are there? **________________________________**

6.Where are they placed? ____

7.What do you or some people use the waste for?
a)____
b)____

8.Who are some of these people or associations?
a) ____
b)____

9.What do you do with what cannot be utilized?
a) ____
b) ____

10.What problems do you face in managing the waste you collect here?
a) ____
b) ____
c) ____

11.What relationship do you have with the council waste management group?
a) On advice? ____
b) On waste collection? ____
c) On health? ____

12.What complain(s) do neighbors give about your business?
____
____

Answered/ filled by:____________________________Date ____________________

APPENDIX 4

Pubic Health Ordinance, Vol. 5, Section 17 and 18, West Cameroon, 1958

Section 17 (a) Every owner or occupier of any tenement shall clean and keep clean from all undergrowth, weeds, fifth, rubbish and refuse of any description, the street at front, back or either side of such tenement, with the drains, gutters or channels and facing each other, the owner or occupier of such tenement shall be responsible for keeping clean the drain, gutter and channel nearest to his or her tenement.

(b) Every owner of occupier who fails to comply with the provisions of this section shall for each offence be liable to a fine of one pond.

Section 18 (a) Any person who throws or lays on any street or tenement, whether occupied or not, or on any space (except at such places as may be set apart by the proper authority for such purpose), rubbish or any offensive or wholesome matter; or commits any nuisance in any street or in any open space or in any place being an appurtenance of or adjoining a dwelling house, shall for each offence, in addition to any liable damage at the suit of any person aggrieved, by liable to a fine of one pound.

(b) Any person found committing any offence under this section may be taken into custody without warrant by any policy officer, sanitary inspector or person whom we may call to his aid, or by the owner or occupier of the property on or with respect to which the offence is committed, or by any person authorized by him, and may detained until he can be delivered into custody of the police officer.

Sourced from Nsoh (1994)

APPENDIX 5

Functions of the Municipal Hygiene Service Decision by the Cameroon Minister of Health, 1987

MINISTRY OF PUBLIC HEALTH REPUBLIC OF CAMEROON

……………… PEACE-WORK –FATHERLAND

No.D69/NS/MSP/DMPHP/SHPA.-

<u>SERVICE NOTE</u>

<u>Subject:</u> Functions of the Municipal Hygiene Service.

Placed under the responsibility of a health officer or sanitary technician, the municipal hygiene service has the following functions:

<u>1.TO CONTROL AND TO PREVENT TRANSMISSIBLE DISEASES:</u>

(a) (1) It oversees

-the sanitation of the urban areas:

-the cleanliness of private establishment:

the cleanliness of public places and town greens and supervises the evacuation of waste water.

(ii) It ensures:

-the collection, transportation, discharge and treatment of refuse at sites chosen by the mayor in collaboration with the chief of the hygiene service and the local technical service of the Ministry of Mines and Power.

(iii) It checks on the cleanliness of market places, eating and drinking houses and the state of drinking water; and the rearing of domestic animals in the townships.

(iv) it checks the cultivation of food crops, particularly water bearing plants within the urban areas.

(b)The Municipal Hygiene Service carries out campaigns to kill both larvae and adult insects of public health importance.

<u>© The Service collects relevant information.</u>

On contagious diseases for immediate declaration and epidemiological surveys, and takes necessary measures for isolation and disinfections in collaboration with other interested services.

2.TO ENSURE THE HYGIENE OF BUILDINGS

(a) by the strict application of rules and regulations affecting the cleanliness of public and private buildings;

(b) by ensuring the evacuation of waste waters from buildings either by the provision of a drainage system or by the installation of septic tanks and the provision of good hygienic standards of new buildings by the careful study of building plans and sites before building permits are issued;

(c) by the development of a programme for construction of latrines with the help of the councils concerned;

(d) by the education of the population on the technical construction of concrete slabs for pit latrines in semi-urban areas;

(e) by the regular inspection of these installations to ensure their proper functioning and use.

3.THE CONTROL OF FOODS BY

-surveillance of the conditions of sale, transportation and the preservation of food;

-the carrying out of expert examination and the collection of samples where necessary;

-the seizure and destruction of foods unfit for human consumption

4.THE CONTROL OF SWIMMING POOLS AND PUBLIC BATHS;

5 THE CONTROL OF INHUMATION, EXHUMATION AND TRANSPORTATION OF CORPSES, THE ISSUE OF BURIAL PERMITS FOR ALL DEATHS OUTSIDE HOSPITALS AS WELL AS THE CONTROL OF CEMETERIES.

Finally, permit me to draw your attention to the dispositions of circular-Note No.D67/NC/MSP/DMPHP/SHPA of June 1978 defining the functions of Health Officers and Sanitary Technicians put at the disposal of each council

Yaounde, le 5 Janvier 1987

LE MINISTRE DE LA SANTE PUBIQUE

Pr.Victor Anomah Ngu.

APPENDIX 6

Clean-Up Campaign Appeal Letter to DO Bamenda

An appeal letter by the Government Delegate to the Bamenda Urban Council to the Divisional Officer for Bamenda Central to institute a monthly clean up campaign

21 APR. 1993

BUC File No.460/Vol.4/87

<u>CLEANING OF BAMENDA TOWN</u>

The Divisional Officer
Bamenda Central

It is becoming extremely difficult for the Bamenda Urban Council to clean the town for several reasons among which are:

1. The difficulties of getting fuel and lubricants due to problems of liquidity;
2. The frequent break down of our vehicles and difficulties in maintaining them;
3. The incivic behaviour of some citizens who do everything to dirty the town;
4. The congestion in streets by traders.

I am therefore suggesting that you consider instituting a clean up campaign once a month, probably on the last Friday of each month. This will give an opportunity for citizens to come out and help clean the town while the Bamenda Urban Council strives to carry the garbage. I also suggest that on any such days drivers of tippers lorries be made to carry ar least one trip of refuse before going to their other jobs.

If you consider it is necessary, you may convene a meeting of related services to examine the situation.

GOVERNMENT DELEGATE
BAMENDA URBAN COUNCIL
Tanjou-Tadzong Abel Ndeh

CC
-The Governor
North West Province
-The Senior Divisional officer
Mezam
For Information

APPENDIX 7

An Example of a Clean-Up Campaign Decision for Bamenda

REPUBLIC OF CAMEROON	SUB-PREFECTORAL DECISION NO 43/1989
PEACE-WORK-FATHERLAND	CONCERNING THE ORGANISATION OF
MINISTRY OF TERRITORIAL	CLEAN-UP
ADMINISTRATION	CAMPAIGN ON MONDAY 27th NOVEMBER
NORTH WEST PROVINCE	1989
MEZAM DIVISION	
SUB-DIVISIONAL OFFICE, BAMENDA	Ref. No E.29/01/73/Vol.2/730

THE DIVISIONAL OFFICER OF BAMENDA CENTRAL SUB-DIVISION

Mindful of the constitution of 2nd June, 1972 as amended by subsequent enactments;
Mindful of Decree No. 72/349 of 24th July, 1972 relating to the Administrative organisation of the Republic of Cameroon and Decree No. 83/390 of 22nd August, 1983 creating New Provinces in the Republic of Cameroon;
Mindful of Decree No. 78/485 of 9th November, 1978 defining the powers and duties of Heads of Administrative Units as completed by Corrigendum No. 79/024 of 18th January 1979;
Mindful of Decree No. 88/426 of 27/9/88 reorganising the Ministry of Territorial Administration;
Mindful of Decree No. 88/772 of 16/05/88 organising the Government;
Mindful of Decree No. 88/774 of 16/05/88 appointing Members of the Government;
Mindful of Decree No. 85/1128 of 13th September, 1985 appointing Mr. Shadzeka Lazarus Ngah as Divisional Officer of Bamenda Central Sub Division;
CONSIDERING the necessity of Clean Environment;

HEREBY DECIDES AS FOLLOWS
Article 1/- That there shall be a Clean-Up campaign in the Bamenda Central Sub-Division with special emphasis in the Bamenda Urban Council Areas of jurisdiction, on Monday 27th November 1989.

Article 2/-That except the Hospitals, Health Centres, the Courts and the Offices of the Forces of Law and Order, all other offices, Government and Para-Public, Markets and all the Business premises shall remain closed form 6 am to 1 pm. on Monday 27th November, 1989.

Article 3/- That persons, services/establishments, workers not-with-standing, seen loitering and/or failing to participate in the Clean-Up campaign shall be arrested, detained and eventually tasked to perform an equivalent number of hours of work at a place to be determined by the Divisional Officer of Bamenda Central Sub-Division.

Article 4/- That the circulation of all taxis and vehicles in general within the Bamenda urban Town shall not be allowed between 6 am and 1 pm except on a special permission issued by the Sub-Prefect of the Bamenda Central.
Article 5/- That the Clean-Up campaign shall be carried out as below [allocation of cleaning areas to educational institutions in the town]

Article 6/- [educational institutions in the rural area to join the rest of the population for cleaning].

Article 7/- That all roads within the various quarters shall be kept perfectly lean by the inhabitants of that said quarter and all workers within their quarters.

Article 8/- That the Government Delegate, Bamenda Urban Council shall ensure that the Council vehicles carry away all the dirt removed from the gutters by the schools and citizens.

Article 9/-The principals of colleges, Headmasters and their staff, Fons, Quarter heads, Councillors of Bamenda Urban Council, and CPDM and Branch Presidents are all entrusted with the supervision of the Clean-Up campaign. Names of defaulters shall be submitted to the sub Prefect by all supervisors.

Article 10/-That the Forces of Law and Order, and the provincial Chief of Section for Preventive Medicine and Rural Health Services are charged with the execution of this DECISION.

Article 11/- That this decision shall be registered and communicated wherever necessary.

At Bamenda…20/11/89….

(S*igned*)

SHADZEKA LAZARUS NGAH
DIVISIONAL OFFICER
BAMENDA CENTRAL SUB-DIVISION

DISTRIBUTION
-MINAT/YAOUNDE
-GOVERNOR/NWP/PREFECT/MEZAM DIVISION
-ALL SUB PREFECTS/MEZAM DIVISION
-DISTRICT HEAD/TUBAH
-PROV. CHIEF OF SECTION PREVENTIVE MEDICINE & RURAL HEALTH SERVICES/B’DA/FORCES OF LAW & ORDERS/BAMENDA
-FILE/FLOAT/ARCHIVES.-

APPENDIX 8

Municipal Solid Waste Strategic Planning Guide

Source: Planning Guide for Strategic Municipal Sold Waste Management in Major Cities in Low-income Countries. Prepared by Environmental Resources Management for World Bank/DSC. By Wilson, D. C., A. Whiteman and A. Tormin (1998).

This 7-step example is targeted towards waste management at the city scale. For use at other scales adjustment would be necessary, but the general stages would remain the same.

Step 1: Mobilising the Planning Process
Step 1 is concerned with how to get started with the strategic planning process. Guidance is structured in two areas, the 'political' mobilising support and the 'functional' organising the work. Step 1 provides the political and operational arrangements for developing the strategic MSWM Plan.

A worksheet aids in identifying the key players that need to be involved. (See: Worksheet: Stakeholders).

Step 2: Definition the Baseline

Step 2 is focused on understanding the baseline situation and likely future requirements for MSWM in your city. Aspects to be addressed include:

General guidance on data collection
Measurement of waste quantities and waste composition
Reviewing waste management options
Predicting future capacity requirements
Understanding shortfalls and constraints

Output from Step 2 are presented at two stages: A Baseline Study or Audit of MSWM in your city should be prepared in time to feed into definition of key issues. During the remaining stages data gaps are filled and more detailed information collected to supplement this initial Baseline Study.

Step 3: Establishing the Strategic Planning Framework

Step 3 covers the range of issues that need to be established at the outset of the planning process to determine the framework for the Strategic MSWM Plan. Aspects to be addressed include:

Defining the strategic vision
Status of the strategic plan
Sleeting the planning area and period
Selecting waste types to be recovered by the plan
Defining service levels
Defining key issues
Setting objectives and targets

The output is an agreed Strategic Planning Framework

Step 4: Identifying and Evaluating Options

Step 4 can in many ways be regarded as the core of the planning process. Here, identifying and evaluating options are required to address the key issues being faced. Five sub Steps are suggested:

Step 4a Institutional Framework
Step 4b Waste collection and Recycling
Step 4c Waste Treatment and disposal
Step 4d Finance Sustainability
Step 4d Public Awareness and Participation

Step 4 provides information and analysis to support both development of the strategy (Step 5) and preparation of the action plan (Step 6).

Step 5: Developing the Strategy

The strategy provides the 'umbrella' under which to progress with more detailed work required for the Action Plan. Defining the strategy will involve an initial evaluation of options required to address key issues. Aspects to be addressed include:

- Nature of the strategy
- Building consensus and ownership
- Defining the Strategy
- Preparing and finalising the Strategy

The output is a straggly, which has been agreed by all key stakeholders and can act as a 'framework' for preparation of the Action Plan.

Step 6: Preparing the Action Plan

Step 6 develops the Action Plan required to turn the Strategy into practical reality. The Action Plan will involve detailed evaluation and selection of options to be pursued. Aspects to be covered include:

- Nature of the Action Plan
- Pre-feasibility studies
- Preparing an Immediate Action Plan
- Preparing an Investment Plan
- Gaining formal approval

The output will be an Action Plan, Immediate Action Plan and Investment Plan, which combined with the Strategy, will form the Strategic MSWM Plan.

Step 7: Implementing the Strategic Plan

Strategic planning of MSWM is not an end in itself; the agreed plan must be effectively implemented. Three aspects should be addressed:

- Moving from planning to implementation
- Revising and updating the plan
- Performance monitoring

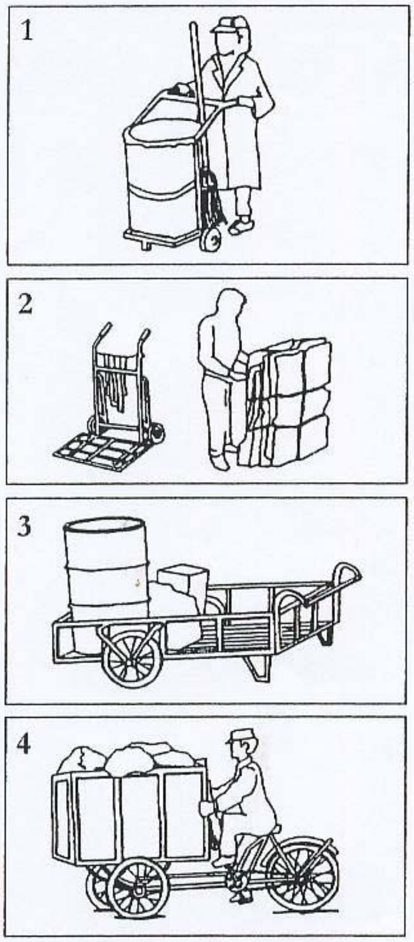
Show early improvements on the ground

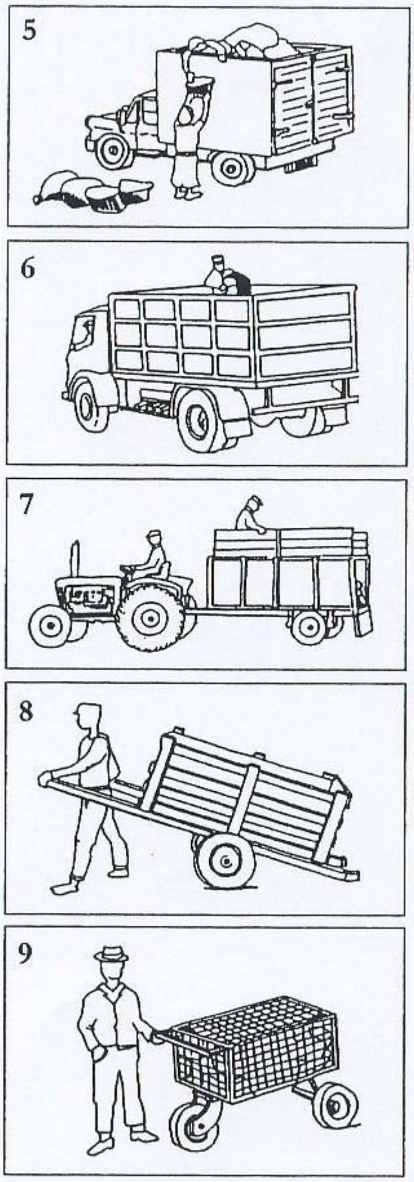
Both the public and many other stakeholders in MSWM are likely to regard the municipal authorities as part of the problem in MSWM, as well as part of the solution. Therefore, it is important that the authorities establish credibility during the planning process of the municipality to improving their commitment to action.

Relatively small, simple and low cost measures can be implemented at the ground level to raise the profile of waste management and demonstrate the commitment of the municipality to improving its services.

APPENDIX 9

Examples of Adapted and Low-Cost Vehicles for Solid Waste Transportation





1 Equipment used by the street sweeping micro-enterprise in the district of Miraflores, Lima, Peru.
2 Hand cart used for household waste collection by a micro-enterprise in La Paz, Bolivia.
3 Collection cart used in El Salvador.
4 Collection cargo tricycle used in Peru.
5 Pick-up truck used for collection in various countries.
6 High-sided truck used in various countries for collection.
7 Farm tractor and trailer used in Costa Rica and Cajamarca, Peru. A mini-tractor is used in Niteroi, Brazil.
8 Cart used by the waste pickers in Brazil and Colombia.
9 Three-wheeled cart used for collection in Cochabamba, Bolivia.

Source: Arroyo Moreno, Jorge, Francisco Rivas Ríos and Inge Lardinois (1999), *Solid Waste Management in Latin America: The Role of Micro- and Small Enterprises and Cooperatives*, IPES, ACEPESA and WASTE.

Figure 6.1 *Examples of different solid-waste collection vehicles used by micro and small enterprises and cooperatives in Latin America*

Source: Hardoy *et al*. 2001. p. 229

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