



Brandenburg University of Technology Cottbus

**CONSTRAINTS TO SUSTAINABLE SOLID WASTE
MANAGEMENT IN GHANA**

**Approved by the Faculty of Environmental Sciences and Process
Engineering of the Brandenburg University of Technology Cottbus for the
award of the degree of**

PhD

Submitted by

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Brandenburgische Technische Universität Cottbus

**GRENZEN EINER NACHHALTIGEN ABFALLWIRTSCHAFT
IN GHANA**

**Von der Fakultät für Umweltwissenschaften und Verfahrenstechnik der
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Dedication

To the memory of my late Dad whose dictum lives on.
“.....and when you know you have done your best, accept results and move on”
Charles Babanawo

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COTTBUS, GERMANY**

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**CONSTRAINTS TO SUSTAINABLE SOLID WASTE
MANAGEMENT IN GHANA**

BY

RAYMOND BABANAWO

**A DISSERTATION SUBMITTED TO THE DEPARTMENT OF ENVIRONMENTAL AND
RESOURCE MANAGEMENT IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF **PhD** IN ENVIRONMENTAL AND RESOURCE
MANAGEMENT**

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DECLARATION

I Raymond Babanawo hereby declare, that apart from supervisory input and suggestions from other professors and colleagues of BTU, Cottbus, at many of our research seminars, this dissertation is my own work and that all literature used in this production has been appropriately referenced.

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The Undersigned certify that they have read and recommended to the Department of Environmental and Resource Management for acceptance a dissertation entitled **“Constraints to Sustainable Solid Waste Management in Ghana”** submitted by **Raymond Babanawo** in partial fulfillment of the requirements for the degree of **PhD** in Environmental and Resource Management.

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ABSTRACT

In the quest of finding sustainable solution to solid waste management problems in Ghana, this research formulated as its goal, to mitigate policy constraints to sustainable solid waste management in Ghana. This research goal and objectives were addressed through an empirical study that involved interviews and administration of two sets of questionnaires, one set to members of parliament and the other to members of the general public. The development of questionnaires was influenced by a conceptual policy development model “The Bridge Model of Policy Development”.

Administration of questionnaires to members of the general public was accomplished through random sampling within churches and mosques in three cities in Ghana; Accra, Kumasi, and Takoradi. The percentage response for members of the general public was 38.9% and that for members of parliament was 18%. Prioritization of policy options was achieved through “Differentiated Perception Ranking”, a method devised by this research process. The results revealed the relative importance of constraints to sustainable solid waste management in Ghana, the relative difficulty of mitigating constraints, and the relative difficulty of implementing policy options among others. These results were integrated with the principles of sustainability into producing a policy package for sustainable solid waste management in Ghana.

Zusammenfassung

Das Hauptziel dieser Forschungsarbeit ist die Entwicklung von politischen Auflagen für eine nachhaltige Lösung der Abfallmanagementprobleme in Ghana. Grundlagen dieser Arbeit bilden die Befragung von Mitgliedern des Parlaments und der breiten Allgemeinheit. Für die Befragung sind spezielle Fragenbogen nach einem konzeptionellen Entwicklungsmodell mit dem englischen Namen „The Bridge Model of Policy Development“ entwickelt worden.

Die Befragung wurde willkürlich in den Kirchen und Moscheen in den Städten Accra, Kumasi und Takoradi durchgeführt. 38,9 % der Befragten gehören der allgemeinen Öffentlichkeit an und 18% sind Mitglieder des Parlaments. Eine Priorisierung der politischen Handlung konnte erreicht werden durch eine Aufstellung einer Rangfolge, bei der während dieser Forschung entwickelten Methode zum Einsatz kam. Die Ergebnisse enthüllen die relativen Vor- und Nachteile von Auflagen bei einem nachhaltigen Abfallmanagement in Ghana und unter anderen die Schwierigkeiten bei der Umsetzung von politischen Optionen. Bei der Entwicklung von politischen Bausteinen für ein nachhaltiges Abfallmanagement in Ghana wurden die Ergebnisse dieser Forschungsarbeit integriert.

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1.0 Introduction

Though the need for solid waste management became necessary ever since nomadic life was discarded (Pfeffer, 1992), the initial concern of society was on movement of waste out of the immediate human settlement. Because waste substances were mostly biodegradable and populations were small and relatively isolated, and the waste generated was within nature's capacity to nullify unwanted substances, such simple waste management strategies as isolation in waste piles, uncontrolled incineration, and dilution by disposal in rivers, lakes and oceans were employed successfully. Increasing technological and scientific advancements, however, have resulted in increased complexity and toxicity of waste and increasing population and improvement in standards of living have also contributed in increasing the volume of waste. These developments (increased complexity, toxicity, and volume of waste) have long rendered ineffective and detrimental any waste management strategies dependent on nature's capacity to nullify waste substances.

While most modern societies have banned disposal of waste in surface water bodies, disposal on land (in sanitary landfills and in waste dumps) and incineration (in both controlled and uncontrolled facilities) have remain the two principal means of getting rid of materials regarded as waste. Waste disposal on land has the potential of contaminating not only the land, but also in many instances, the ground water basins underlying waste dumps (sanitary landfills included) and consequently drinking water supply. Incineration has its own associated problem of air pollution besides the need to eventually dispose of the incineration ash. Society therefore, is eventually adversely affected directly or otherwise regardless of the medium of waste disposal. As a result of this perspective, waste management has developed and moved beyond the mere focus on disposal to include concern for waste generation; storage; collection; transfer and transport and processing. The problems associated with each of these phases are multidimensional and complex. Solid waste management therefore has included in its scope all administrative, financial, legal, planning, engineering, and many other associated disciplines in finding solutions to all problems of solid wastes (Tchobanoglous et al., 1993).

Beyond the engineering complexities, solid waste related problems ramify into public or collective goods problems. Once services aimed at addressing solid waste problems are provided

to a section of a given society, the benefits become available to all members of the same society at no extra cost and it is technically impossible to exclude some members from enjoying the benefits of such services even if these members do not contribute to it. As a result of these attributes and the inherent limitation of the market economic system to deal effectively with public goods, nations around the world have relied on government policies at local, state, national, and international levels to address solid waste management problems and other environmental and resource related problems. Ultimately, however, it is the actions of individuals and groups that are needed to bring about the desired changes in finding solutions to waste management related problem. What is necessary therefore is the creation of a policy environment that encourages individuals and organizations (including corporate bodies) to take initiatives aimed at addressing public goods problems. This should be accompanied by the creation by government of a policy environment that facilitates the attainment of policy goals and objectives.

Since the United Nations Conference on the Environment and Development (UNCED) in 1992, many nations around the globe agreed to be guided by the principles of sustainability in national policy development to address local, national and international problems. Though the concept of sustainability has been variously interpreted (Lumley and Armstrong, 2004), any interpretation and application of the concept should necessarily include the need to enhance or at least maintain developmental opportunities available to future generations through the enhancement of the physical environment on which human life depends. In solid waste management, the relevance of the concept of sustainability cannot be overemphasized. The principal reason is that waste originates as “unwanted” part of production and or consumption processes, two main attributes of society that can not be avoided. This presupposes that waste can not be completely eliminated. The trend in world development is one characterized by increasing standard of living associated with increasing volume and complexity of waste generation (Lidgren, 1981). The developed countries with high standard of living produce generally about three times more municipal waste per person than developing countries, and significantly higher quantities of hazardous waste (Cointreau et al., 2000). From global perspective therefore, waste generation is expected to increase in both complexity and volume as individuals strive to increase their standards of living in both the developing and developed countries and hence the global concern for the need for effective waste management. At the Seventh Meeting of the Conference of the Parties to the Basel Convention in Geneva, Switzerland, the focus was on solid waste management with the

theme '**Partnership for meeting the global waste challenge**' (OP, 2004). Because of the adverse impacts of increased volume and complexity of waste, a sustainable management policy framework is necessary to insure that individual strive for improved standard of living does not in any way compromise the collective strive of society to improve its standard of living and hence the relevance of the principles of sustainability in solid waste management.

Although there appears to be a parallel between the level of economic development and the efficiency of waste management with special reference to waste collection, transport and disposal, the development and implementation of the necessary policy has always provided the direction and framework. In the 1990s, Israel embarked on an integrated waste management policy that involved the closure or upgrading of more than 500 unregulated waste dumps, promotion of reuse and recycling including composting and introduction of waste to energy technologies (Nissim et al., 2005). In the United Kingdom, policy measures to curb indiscriminate waste disposal in the late 1880s included the passing of the Urban Sanitary Act that prohibited the throwing of solid waste into ditches, rivers, and waters. About 20 years later, in 1899, the River and Harbours Act was passed in the US for the same reason (Tchobanoglous et al., 1993). In Germany the enactment of the Federal Epidemic Act in 1900 was in response to pollution by private waste disposal activities (Fischer and Petschow, 2000).

With the background that solid waste management should be approached from sustainability perspective, it is pertinent that a policy framework be developed to provide the direction and necessary focus. According to Kraft and Vig, 2003, societal recognition of an issue as a problem accompanied by action and exertion of public pressure with respect to the issue(s) in question is a necessary condition for the development of policies by government to address the problem(s). Even though solid waste management is a serious problem for the global community, the developed countries seem to have made considerable progress in solid waste management with reference to waste collection, transport, transfer, and final disposal. As has been the case, the World Bank and the International Monetary Fund (IMF) have been providing assistance to many developing countries in the areas of improvement of solid waste management and general sanitary conditions in the urban centres of these developing countries. In many cases, however, this support although is able to bring temporary relief to the waste management sector of the recipient country, has not been sustainable. The approach therefore is to determine the factors

that influence policy development in the developing countries and to ascertain how these can be oriented towards sustainable solid waste management. This therefore is the focus of this research.

1.1 Problem Statement

Though the solid waste management technologies working effectively in the developed countries (waste collecting containers adapted for mechanical waste collection; waste compactor vehicles; sanitary landfills) can be adopted and adapted to various local conditions in the developing countries, these have not been very successful. Almost all developing countries have serious problems with solid waste management with the urban centres characterized by poor sanitary conditions (Gwebu, 1997; Songsore, 1997; Agunwamba 1998; Sharp et al., 2005). While various reasons can be advanced for these developments, central to these is the absence of a policy framework capable of eliciting the participation of the general public for the attaining of sustainable solid waste management objectives and goals through the cultivation of proper waste disposal habits and the creation of a policy environment that encourages the general public to contribute in monetary terms towards the disposal of waste they generate. In developing such a policy framework, environmental, economic and social considerations should be integrated into each phase of the policy development cycle.

Ghana like most developing countries is faced with serious solid waste management problems. All over the country solid waste is ultimately disposed of in both authorised and unauthorised waste dumps. “All kinds of wastes, regardless of their nature, are being dumped indiscriminately into depressions, sand pits, old quarries, beaches, drains and even in certain areas, along streets, without due regards to the nuisance and harm caused to the environment.” (GEPA, 2002). In 1999, the Ministry of Local Government and Rural Development produced an Environmental Sanitation Policy document which sought to reform the solid waste management sector and allowed private sector participation in solid waste collection, transport and disposal in the major cities. This new policy reforms did not come with the anticipated efficiency. The Solid Waste Management sector is still characterized by problems typified by indiscriminate waste disposal attitude of the general public and the creation of unauthorized waste dumps. Table 1.1 is a summary of the existing solid waste management situation and the anticipated conditions to be attained by the implementation of a policy package that this research aspires to put forward.

Table 1.1 Current and Anticipated Solid Waste Management (SWM) Perspectives in Ghana

	Current Solid Waste Management Situation in Ghana	Anticipated Solid Waste Management Situation in Ghana
1	Irregular waste collection from communal waste receptacles	Regular and consistent collection of waste from waste receptacles
2	Indiscriminate public waste disposal habits	Disposal of waste only at designated disposal facilities
3	Unconcerned public attitude towards indiscriminate waste disposal	Concerned and conscientious public waste disposal habits
4	No or relaxed legal regulations on solid waste management	Effective and efficient rules and regulations on solid waste management
5	Disposal of waste in environmentally unfriendly manner (open incineration and waste dump)	Final waste disposal in environmentally friendly manner
6	Lack of initiative to make people contribute to SWM through appropriate taxes	Appropriate taxes and charges to make people pay for the disposal of the waste they produce
7	Lack of efficient and transparent administration in solid waste management	Efficient and transparent administration in solid waste management.
8	No or minimal waste reduction, reuse and recycling initiatives	Increased waste reduction, reuse, recycling, and waste transformation initiatives
9	Lack of local initiative to turn waste into resources to encourages individuals to play active roles in SWM activities	Increased and sustained interest of the general public in SWM through the creation of monetary incentives and conversion of waste into resources
10	Low coverage of waste collection services	High coverage of waste collection services

1.2 Research Goal and Objectives

The formulation of the goal and objectives of this dissertation (research) is influenced by the solid waste management situation in Ghana and by the following background information and knowledge related to solid waste management elucidated in the foregoing introduction:

- i. in many countries, the development of relevant policies has provided the framework and direction for addressing solid waste management problems,
- ii. societal recognition of an issue as a problem accompanied by action and exertion of public pressure with respect to the issue(s) in question provide the impetus for the development of policies by government to address the problem(s), and
- iii. the consciousness within the global community to orient solid waste management towards sustainability goals.

Research Goal:

From the foregoing, the goal of this dissertation is formulated as follows:

To Mitigate Policy Constraints to Sustainable Solid Waste Management (SSWM) in Ghana

Research Objectives:

The goal of this dissertation as stated above will be realized through the accomplishment of three specific objectives, and these are as follows:

1. To Assess Obstacles to the Implementation of Sustainable Solid Waste Management Policies in Ghana.
2. To Propose a Policy Package for the Attainment of Sustainable Solid Waste Management in Ghana
3. To Propose a New Policy Implementation Framework for Sustainable Solid Waste Management Policies in Ghana

These research goal and objectives will be achieved through:

1. A review of working and relevant solid waste management policies and programmes of other countries for a compilation of experiences to serve as guidelines in policy design to address solid waste management problems in Ghana.
2. Administration of questionnaires to members of parliament and to a cross section of the general public to ascertain perceptions on policy options and programmes.
3. Interviews with solid waste management officials and with members of the general public for the identification of constraints to sustainable solid waste management in Ghana.

1.3 Organization of Research

The preceding chapter introduced the background to this research. The chapter ended with the stipulation of the goal and objectives of this research. Chapter two is a review of related literature on solid waste management. Topics covered include: Development of Solid Waste Management, Modern Perspective of Solid Waste Management, Global Overview of Solid Waste Management, Functional Elements of Solid Waste Management, Policy Instruments and Solid Waste Management (Command and Control Policy Instruments and Economic Instruments), Sustainability and Solid Waste Management, the chapter ended with a review of Policy Analysis, Design and Implementation.

Chapter three is concerned with Ghana and solid waste management in Ghana. Under this chapter, some country information is provided in addition to an overview of the solid waste management situation in the country. Chapter four is focused on research design and methodology. Issues discussed include design of questionnaire and sample design as well as administration of questionnaires. Chapter five is associated with results and analysis of results. Chapter six is related to development of a sustainable solid waste management policy package for Ghana. Summary and conclusions are presented in chapter seven.

References follow chapter seven. These are the literature used in this work. Foot notes are used for references within text. Appendices follow references from page 175 to 202. Items included here are sample of questionnaires, tables referenced from literature and tables produced from literature.

2.0 Literature Review

2.1 Development of Solid Waste Management

Within the European Union, under the Waste Framework Directive (75/442/EEC), waste is defined as any substance or object which the holder discards or intends to discard, must or required to discard. Solid waste is any waste arising from human and ecological activities that is normally solid and is discarded as useless or unwanted. Solid waste management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid waste in a manner that is in accordance with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitudes (Tchobanoglous et al., 1993). Although solid waste management has today included in its scope administrative, financial, legal, planning, and engineering functions involved in finding solutions to all problems of solid wastes, the initial focus of solid waste management had been to move waste out of the immediate human settlement. According to Tchobanoglous et al., the most commonly recognized methods of final waste disposal that were employed in the history of solid waste management include: dumping on land, dumping in water, ploughing into the soil, feeding to animals (hogs), and incineration.

2.1.1 Waste Disposal on Land (Sanitary Landfill and Waste Dumps)

Enlightened solid waste management, with emphasis on controlled tipping (now known as “sanitary land filling”) first began in the United Kingdom immediately after World War I and two decade later in about 1940 in the United States (Blumberg and Gottlieb 1989; Tchobanoglous et al., 1993). According to Tchobanoglous et al., The development of sanitary landfill requires considerable initial capital investment. A life span of at least 20 years is recommended for economic reasons and because landfills represent a “permanent” modification of the landscape, careful planning is necessary. In most parts of the world land disposal of waste constitutes the major form of waste disposal. In the United Kingdom, disposal of waste in landfills varies between 67% in the North East region, to 95% in the North West region as at 1999 (Read, 1999), and in Canada the percentage was also about 95% in 1988 (Bonomo and Higginson, 1988).

Though disposal of waste on land can not be avoided and would continue to be the most predominant form of final waste disposal, the trend in solid waste management from global perspective is one characterized by a shift from waste disposal in waste dumps to disposal in sanitary landfills. Because the initial capital investment necessary for landfill development is quite considerable, there is the temptation to single out lack of capital as the reason for the continuous disposal of waste in waste dumps in the developing countries. Phnom Penh, the capital of Cambodia with a population of about one million has no sanitary landfill. Waste collected is transported to a dump site called Stung Mean Chey (SMC) located about five kilometres (5km) from the city centre (Sharp et al., 2005). Nigeria with a population of over 100 million has only two sanitary landfills with the majority of the waste going into waste dumps (Agunwamba, 1998). In July, 2000, more than 200 people were killed in Manila, Philippines, by an avalanche of waste from a waste dump (MB, 2000). The reality is that disposal of waste in waste dumps presents the lowest economic cost to present generation among available options and hence the preference for this option. It therefore requires policy change (development) which considers other factors other than economics for example environmental concerns and intergenerational impacts to move waste disposal in waste dumps to disposal in sanitary landfills.

Even though Israel could be compared in terms of economic development with other parts of the developed world, it was not until the beginning of the 1990s when a major policy change precipitated a shift from waste disposal in some 500 unregulated garbage dumps to disposal in sanitary landfills (Nissim et al. 2005). In the United States, the passage of Solid Waste Disposal Act, 1965 was directed towards curtailing disposal of waste in waste dumps. The major provisions of this act were as follows:

1. Promulgation of guidelines for solid waste collection, transport, separation, recovery, and disposal systems.
2. Provision of training grants for occupations involved the design, operation, and maintenance of solid waste disposal systems
3. Provision of technical and financial assistance to states and local governments and interstate agencies in the planning and development of resource recovery and solid waste disposal programmes

4. Promotion of demonstration, construction, and application of solid waste management and resource recovery system that preserve and enhance the quality of air, water, and land resources.
5. Promotion of national research and development programme for improved management techniques; more effective organizational arrangements; new and improved methods of collection, separation, recovery, and recycling of solid wastes; and the environmentally safe disposal of non-recoverable residues (Tchobanoglous et al., 1993).

In spite of the fact that the Solid Waste Disposal Act of 1965 prohibited disposal of waste in waste dumps, one EPA survey pointed out that as many as 14,000 communities were still using open dumps in 1972 (EPA, 1973). According to Blumberg and Gottlieb, 1989, a combination of different factors was instrumental in finally putting pressure on the open dump system. These factors include; increasing scarcity of urban landfill space and sites, growing public sentiment against contamination of the land and water, and the passage of a new legislation in 1976. Congress passed its most far reaching legislation on solid waste management, the Resource Conservation and Recovery Act (RCRA) in 1976 (EPA, 1979). RCRA spelled out in its provision the involvement of the federal government in permitting and regulation of waste facilities, specifically open dumps. EPA was required to set standards for landfills, while the states were obliged to inventory their open dumps and either bring them up to the stipulated standards or shut them down. EPA was also directed by the provisions of RCRA to establish criteria to distinguish between an acceptable “sanitary” landfill and an unacceptable dumps site by reference to any adverse effects on health or the environment from the disposal of solid waste at such a facility. Once the guidelines and criteria were established and the state and local government plans were developed, a time limit of five years was set to phase out all unacceptable dumps within a given area. The broad interpretation of what constitute an open dump (estimated to be as high as 94% of all existing land disposal sites) and the widespread use of land disposal methods (handling up to 90 % of the waste stream) set in motion a crucial chain of events that changed the character of the waste issue (Blumberg and Gottlieb, 1989).

In Germany, the Waste Disposal Act of 1972 marked the transition from disposal of solid waste in open dumps to disposal in sanitary landfills. Prior to this, there were about 50,000 unauthorized waste dumps (Fischer and Petschow, 2000). The first federal report on waste

disposal in 1963 documented the extent of problem to be solved and made the public aware of this. The parties involved announced their general willingness to cooperate and establish a body to work out general principles and directives. When in 1965 the central office for waste disposal, under the directive of the federal health agency, was established to negotiate with municipalities regarding scientific and or organizational questions, the cost of implementation had to be shared equally by the Länder (the states) and the federal government. The resistance of industries and municipalities to contribute to this institution was documented in the second federal report on the problem of waste disposal in 1966. The Länder formed a special Co-Länder working group on waste management (Länderarbeitsgemeinschaft Abfall LAGA) in order to confer with each other (and the federal government). In 1969 the publication of an action programme to protect nature, including the first proposal for a Federal Waste Act was published. Following this, responsibility for the environment was shifted from the Ministry of Health to the Ministry of Interior. The passage of the 1972 Waste Disposal Act was preceded by an Environmental Programme Concerning Waste. The highlights of the 1972 Waste Disposal Act were as follows:

1. Re-introduction of waste into the economic cycle
2. Creation of adequate capacity for disposal of hazardous wastes
3. Developing waste disposal plans in accordance with regional planning
4. Financing research and development of alternative waste treatment facilities
5. Application of polluter pays principle by means of an appropriate fee structure
6. Directives focusing on agricultural recovery of sewage sludge and on throw-away packaging
7. Shifting waste disposal authority to a higher level of administration to facilitate efficiency and harmless land filling (ecology through economy) (Fischer and Petschow, 2000)

The instances cited are not unique in policy intervention in solid waste management. Individual and group endeavours are often driven by short term considerations and so long as there are no policy measures that prescribe the methods of waste disposal, individuals or groups engaged to carry out waste collection, transport and final disposal would choose the method that involves the least financial expenditure and hence **waste dumps** instead of **sanitary land fills**. Even with waste dumps at different locations, there would be preference for waste dump involving the **least haulage distance**. The fact that there is often a considerable time lag between waste disposal and

any associated adverse effect exacerbates this situation. Government policy development makes both short term and long term considerations involving intergenerational, social, environmental and economic dimensions. Because this process is normally a cyclical activity, any factor(s) or issues not considered at any particular point in time can be considered in the future.

2.1.2 Waste Disposal in Water

The development of human settlements started along major surface water bodies; oceans, rivers, lakes and streams. Wastes were initially disposed of in oceans or rivers and streams until downstream communities discovered that they had become recipient of pollutants. Initial policy development to streamline public attitude with respect to solid waste management therefore were directed towards prohibition of disposal of waste in surface water bodies. Cognizance should be taken of the fact that initial policy interventions in solid waste management were limited to individual and group disposal attitudes and that final waste disposal options were not considered. In this respect, reference can be made to the River and Harbours Act of 1899 passed in the US to prohibit indiscriminate disposal of waste into ditches, drains and rivers (Tchobanoglous et al., 1993). Another example was in Germany where the enactment of the Federal Epidemic Act in 1900 was in response to pollution by private waste disposal activities (Fischer and Petschow, 2000).

Some municipal authorities in Western Europe including the United Kingdom permitted the dumping of household waste in the seas around their coast right up to the 1950's (Millard, 1981). The coming into effect of some international environmental conventions such as the United Nations Convention on the Law of the Sea (UNCLOS), however, has helped in stopping disposal of waste into the sea and ensured the protection of the marine environment (Knopp et al., 2000). In most developing countries where waste disposal in open dumps form the predominant form of waste disposal, there is a very high tendency for part of the waste disposed of in open dumps to ultimately end up in surface water bodies.

2.1.3 Ploughing Waste into the Soil (Waste for Land Application)

The use of biodegradable components of solid waste for agriculture purposes has been practised since time immemorial. Desrochers, 2002 quoting Carey (1883) wrote “manure annually applied to the soil of Great Britain, at its market prices, was estimated in 1850 at £ 103,369,139, a sum much exceeding the entire value of its foreign trade”. The extensive use of the organic components of solid waste from large urban areas however, has been limited by the presence of heavy metals such as lead and cadmium which have adverse health impacts Tchobanoglous et al., 1993).

2.1.4 Feeding Waste to Animals (Hogs)

Feeding of organic components of waste to animal was a very common practise in the past and still practised in some rural communities in the developing countries as in Fegge in Onitsha, Nigeria (Agunwamba, 1998). Sharp et al., 2005, also reported instances where scavenging animals feed on waste left at curb or roadside for subsequent collection and disposal in Phnom Penh, Cambodia. This situation is typical of some urban areas of most developing countries where domestic animals are often not confined and are left to roam the streets and waste dumps in search for feed. Swine feeding, that is directing the garbage component of waste to feed hogs and other animal was very popular in the US in smaller towns and other medium-sized cities but not in the larger cities during World War I. Swine feeding was actively encouraged during World War I as a means of increasing food production. By 1917, 35% of all cities monitored in one survey actively utilized this method. That figure increased to 44% in 1925 and then levelled off at 39% by 1930. When a series of swine epidemic occurred in the 1950s, public health regulations were issued to prevent the feeding of raw garbage to pigs, and several operations including one involving the US Army were shut down (Blumberg and Gottlieb, 1989). While cooking the garbage solved this particular set of problems, the additional cost proved to be too much as a result feeding raw or processed garbage to animals has ceased in most modern solid waste management practises.

2.1.5 Waste Incineration

Incineration of combustible waste sterilizes the residue and reduces the bulk. The volume is reduced by about 90% and the weight by about 60% (Millard, 1981). Incineration of waste in

waste dumps has been a common practise in the history of solid waste management, and this continues to be practised in many developing countries. Uncontrolled incineration of waste, however, is accompanied by environmental pollution. Pollutants associated with uncontrolled incineration of waste include Oxides of Nitrogen (NO_x); Ozone (O₃), which is formed from a combination of NO_x and Hydrocarbons (HC); particulate matter; Carbon Monoxide (CO); Lead (Pb); and Oxides of Sulphur (SO_x). Each of these pollutants can contribute to a range of health problems. Ozone, a colourless gas, results in eye irritation and damage to lung tissues. It reduces resistance to cold and pneumonia, contributes to asthma, bronchitis, and emphysema, and aggravates chronic heart diseases as well. It can also damage crops and forest, and corrode materials such as rubber and paints (Blumberg and Gottlieb, 1989). Other pollutants also have health related problem and contribute to the formation of acid rain. Incineration of waste in controlled facilities is also saddled with the production of dioxins. Dioxins are a variety of chlorinated organic compounds known collectively as polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), or dioxins and furans. Dioxin is of primary concern because of its carcinogenic effect. Dioxin and its related compounds have been conclusively proven to cause cancer in animals and are suspected of causing cancer and birth defects in humans (Blumberg and Gottlieb, 1989). Some toxicologists contend that these compounds also damage the genetic, neurological, and immunological systems. In the US, dioxin has been discovered in varying levels in the emissions of every single incinerator (EPA, 1987).

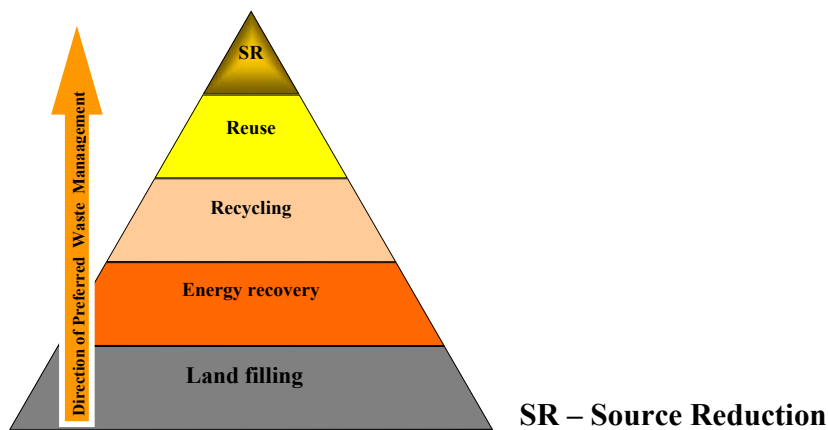
Waste incineration with energy generation promises a bright future for waste management until consideration is given to the pollutants accompanying the incineration process. Installation of electrostatic precipitators to extract the dust and grit from the gases arising from incineration plants is very costly and so is the installation of gas scrubbers to remove dangerous gases. Another problem with incineration is the need to finally dispose of the incineration ash which in most cases can not be disposed of in normal landfills as result of the concentration of pollutants. As a result of the additional cost involved in handling incineration ash, some incineration operators in the past resorted to unethical methods of disposing of incineration ash. In January 1988, ash from Philadelphia was dumped on a small island called Kassa, four miles from the main land capital of Guinea-Bissau. The ash immediately damage plant life and posed health risk problem to the residents of the island (Blumberg and Gottlieb, 1989).

2.2 Modern Perspective of Solid Waste Management

As a residual component of the production and consumption processes, waste can not be completely avoided. There are problems associated with all forms of waste disposal. This situation has been instrumental in redefining contemporary solid waste management practices. Modern solid waste management is oriented towards emphasizing management options that have the least negative impact on the environment. This involves categorizing waste management options into different levels. The categorization can vary from one country to another. For example in Europe, four waste management hierarchies are prescribed in European Council Framework Directive on waste management (75/442/EEC). The options from the most preferred to the least preferred level are: 1st source reduction, 2nd material recycling, 3rd energy recovery, and 4th final disposal (Geigrich, 2004).

A conceptual waste management hierarchy consisting of five levels is as presented in fig.2.2.1 with the most preferred management option at the top.

Fig. 2.2.1 Hierarchy of Waste Management Options



2.2.1 Source Reduction

Source Reduction is defined by the California Integrated Waste Management Board as the design, manufacture, purchase, or use of materials or products/packages to curtail their amount or toxicity before they enter the waste stream (Tellus Institute, 1992). Source reduction synonymous with waste minimisation comprises activities to prevent the generation of waste or limit the volume and or environmental impact of waste that is generated, treated, stored or disposed of.

This is the highest ranked waste management strategy because it simply involves self-evaluation accompanied by change of the waste generation options available to the waste generator with no or minimal input from the waste management institution. In an editorial marking the Seventh Meeting of the Conference of the Parties to the Basel Convention in Geneva, Switzerland, with the theme 'Partnership for meeting the global waste challenge', the former United Nations Under-Secretary-General and Executive Director of UNEP, Klaus Toepfer, emphasized the need for waste management to focus attention on the three Rs – Reduce, Reuse and Recycle (OP, 2004).

Source reduction, reuse and recycling should be approach in an integrated framework as was demonstrated by McDonald in response to "McToxics", (a public campaign against the use of hazardous materials in the production of its food packaging industry). The McDonald's foamed polystyrene container, the famous clamshell package surrounding the variety of McBurgers consumed daily, is a highly recognizable and familiar disposable item. McDonald was the single largest consumer of foamed polystyrene containers in the United States, responsible for use and subsequent discard of about 0.04 million tonnes a year of foam packaging wastes (Blumberg and Gottlieb, 1989). These containers posed a range of hazards from the wide variety of toxic chemicals used in their production, including chlorofluorocarbons (CFC), which was used to puff up or to create the foam effect. As a result of public campaign against waste generation by McDonald, (McToxics) by Citizens Clearinghouse for Hazardous Waste and Friends of the Earth, the company changed its food packaging policy. Plastic foam containers without CFC have been introduced, and the used CFC free plastic foam is recycled into insulation panel.

With per capita waste generation in the developing world a third that of the developed world (Cointreau et al., 2000), there is the temptation to deemphasize source reduction as a waste management option in the developing world. This, however, should not be the case. Rapid population growth and increasing standards of living (the source of high per capita waste generation) make relevant the development of policies and strategies to promote source reduction as a waste management option in the developing countries as well. South Africa for example, has provided a detailed waste minimisation programme in its national waste management strategy (NWMS, 1999). The goal of the South African waste minimisation programme is to ensure that waste minimisation procedures and practices are adopted by all sectors of the society. This goal is to be achieved through the creation of incentives for waste generators in both the public and

private sectors to adopt waste minimisation practices, provision of information on the benefits and techniques of waste minimisation, and building of the capacity of waste generators to implement waste minimisation initiatives. Specific policy instruments for waste minimisation in the South African national waste management strategy include the following:

- ◆ Development of a list of priority pollutants and waste streams.
- ◆ Drawing up a schedule for various waste minimisation initiatives.
- ◆ Initiation of incentives such as tax rebates and high profile national and provincial waste minimisation awards.
- ◆ Incorporation of waste minimisation considerations in environmental impact assessments as well as a requirement of waste minimisation assessment as part of license approval procedures.
- ◆ Development of sector specific guidelines for waste minimisation and promotion of management tools such as total cost accounting, environmental performance indicators, environmental auditing and life cycle assessment (NWMS, 1999).

Source reduction regarded as the most preferred waste management option should be promoted through public campaigns to constantly equip individuals of its benefits. The strategies of attaining individual as well as household source reduction targets within a broader waste management framework should be freely accessible to all categories of waste producers. With respect to promoting source reduction among industries and enterprises, policy development should provide incentives in the form of tax relief for attainment of specified source reduction goals.

2.2.2 Waste Reuse

The use of returnable beverage containers represents the best example of reuse strategy in waste management. This strategy is usually operated through a Deposit-Refund System. Deposit-Refund System is an economic instrument in waste management that obliges the purchaser of a product to pay a certain amount of money included in the price of the commodity to cover waste recovery and or treatment of the waste. The main limitation to waste reuse is the inherent properties of some materials that do not allow for their reuse without compromising the health of the user. Plastics including some polyethylene terephthalate (PET) bottles for example degrade when reheated and hence eliminating any potential reuse strategy for food, drug, and cosmetics

containers. Temperatures high enough to sterilize the container to meet government regulations will lead to melting and deformation of such plastic products.

Scavenging the term used for describing operations of groups or individuals involved in search, collection for direct use or sale of items salvaged from waste dumps is a characteristic of many developing countries where there is a high economic disparity among the populace. Although not substantial, quite a number of the populace in the developing world survive through these informal waste recovery activities (Medina, 1997). Nas and Jaffe, 2004 after studying the operations of scavengers in a couple of countries concluded that recognition of their activities for governmental support and incorporation into the formal waste management system can play important role in sustainable urban development. However, as a result of the fact that most of the items recovered are not directly used but rather sold to recycling companies, it could be said that apart from the reuse of returnable beverage containers, waste reuse although very high in the waste hierarchy has very limited practical implications and applications.

2.2.3 Recycling and Composting

2.2.3.1 Recycling

Recycling involves collection and preparation of waste materials for processing and re-manufacturing and or the return of manufactured products into the economic cycle. This process is hereby differentiated from waste reuse and occupies a lower level in the waste management hierarchy than reuse because unlike direct waste reuse energy is involved in processing and in the re-manufacturing processes of recycling. There is also emission of pollutants associated with the recycling process. Recycling, however, is very important process in helping to reduce demand for virgin materials and thereby reduce the pressure on natural resources. In most cases, the energy requirement of recycling processes is less than that required for processing virgin materials into finished products. Recycling also reduces the amount of waste going into landfills and in the process help increase the life span of landfills.

Recycling of the nutrients in organic waste has a very old tradition in agriculture and agriculture related industries. Miller, 1998 stated that in the early nineteenth century, most of New York City's milk was produced in 260 urban stables by cows living on the swill of local distilleries.

Recycling of waste in the manufacturing sector also has a long history. One example of recycling often cited is the development of recycling linkages among four large industrial plants, the municipality, and a few smaller businesses in the Danish industrial town of Kalundborg. In this recycling set up, Desrochers, 2002, quoting Ehrenfeld and Gertler, 1997, pointed out that about 2.9 Mt of waste materials/substances are recycled annually and water consumption is reduced by 25%.

It should , however, be noted that the development of the recycling linkages among the industries and the municipality of Kalundborg has been driven more by economic consideration than by environmental concerns. The supply of waste as a raw material to other industries always brings additional revenue through this transaction and/or avoidance of waste disposal costs or taxes on the side of the company producing the waste. At the same time, the use of waste as raw material saves cost of acquiring primary materials from the perspective of the company receiving the waste. Therefore, although the need to meet environmental standards can provide catalyst for an industry to consider establishing recycling as an option of managing its waste, economic considerations are always more important as industries themselves are established with the objectives of making profit. Recycling of materials contained in domestic or municipal waste however, is more cumbersome from organizational point of views. Wastes from diffuse sources (different households) are of diverse composition and handled with divergent degrees of contamination. The main problems associated with recycling municipal waste are collection and sorting the waste into various components that have similar recycling properties. Table 2.2.3 below shows a comparison between recycling properties of industrial and municipal waste.

Management of municipal (domestic) waste is always community centred and the collection cost usually forms a greater percentage of the total waste management cost. Government intervention is therefore very important in developing policies that encourage the participation and compliance of the populace in especially handling and storage of waste until the waste is collected. Government needs to promulgate regulations that clearly define the ownership of materials regarded as waste and how these should be handled.

Table 2.2.3 Comparison of Recycling Properties of Municipal and Industrial Waste

	Recycling Property	Industrial Waste	Municipal Waste
1	Material Purity	High.	Low. Waste often contaminated
2	Composition of Waste	Waste usually of single material type	Composed of different material types even in source separated waste
3	Stability of Waste Composition	Stable composition over a long period	Unstable composition. Waste composition can change with seasons of the year
4	Sorting	Usually not required	Sorting required in most cases.
5	Source of Waste	Usually from a single or few related Industries	From numerous and diffuse sources
6	Collection and Transport Cost	Usually low	Usually very High
7	Initiation	In most cases initiated and sustained by industries	Usually initiated and sustained by government through subsidies and or regulations

Regulations and standards that support source separation of waste should be established to improve the quality of recyclable materials. The support of all parties is very important for the success of municipal waste recycling. The support of companies and industries connected to the production of goods is as important as the companies involved in the recycling itself. In Jamaica, “Recycling for Life” is an industry-sponsored recycling programme. A group of several beverage companies work together with community based partners (Schools, NGOs, Community Based Organization (CBOs), and churches) to collect polyethylene terephthalate (PET) bottles for recycling. Recycling for life pays its community partners for bottles collected and the programme is accompanied by education campaign (Jaffe, 2001). Another example of community involvement for the success of recycling is seen in Belo Horizonte, Brazil. In this project, the local Roman Catholic Church formed the “The Street Pastoral” an association of scavengers which was later supported in their operations logistically by the municipal government. The Street Pastoral developed into the lead agents in the collection of recyclable materials

2.2.3.2 Composting

The biological decomposition of organic constituent in the waste stream and the subsequent return of nutrient to the soil is the oldest waste recycling strategy. One of the first organized composting operations to be reported in the literature was carried out in India in the early 1930s under the direction of Haward and associates (Gotaas, 1956). Materials included in compostable waste are; food and other putrescible waste; wood, grass clippings, leaves, garden waste and bushes from households and parks as well as paper and paperboard, and some textiles. The composition of compostable waste varies from community to community and from region to region. Compost has a number of existing and possible applications such as; topsoil, mulch, and soil nutrient.

Composting can be done mechanically or non-mechanically. Although the capital and operating cost of mechanical composting are relatively high compared with other composting methods, it has the advantage of producing the least odour and aesthetically the least offensive. The environmental concerns of composting are related to the significant amount of land needed for composting, depending on the technology. A windrow compost system typically requires about 118 acres of land for every 7,650 cubic meters of compost processed each year. A fully enclosed mechanical plant, on the other hand, can process as much as 1,000 tones per day on about 20 to 25 acres (Blumberg and Gottlieb, 1989).

The usefulness of compost is reduced through inorganic materials in waste which often become part of the compost. These unwanted materials include; plastics, metal, glass, large stones, and wires. Trace amounts of various kinds of toxic gases might also be released as a by-product, particularly due to the presence of various chlorinated compounds among the inorganic components. To increase the usefulness of compost, source separation measures are often implemented. In rural areas in Japan, households separate their waste into compostable and non-compostable. These bags are collected by crew members on collection day. Bags are examined and those that are mixed are simple not picked up (Blumberg and Gottlieb, 1989).

2.2.4 Energy Recovery

Of all the various technologies and methods of waste processing for energy recovery; Gasification, Pyrolysis, Anaerobic Digestion, Refuse-Derived Fuel (RDF), Waste Incineration is the most popular and the most widely used.

2.2.4.1 Gasification

This process involves incomplete combustion of a carbonaceous fuel. The process produces a combustible fuel gas rich in carbon monoxide, hydrogen, and some saturated hydrocarbons, principally methane. The combustible fuel gas can then be combusted in an internal combustion engine or boiler. The products obtained in a gasifier operating at atmospheric pressure with air as the oxidant are as follows:

1. Condensable liquid
2. A char containing carbon and the inert materials originally in the fuel
3. A low-energy content gas typically containing Carbon Dioxide (CO₂), Carbon Monoxide (CO), Hydrogen (H₂), Methane (CH₄), and Nitrogen (N₂)

2.2.4.2 Pyrolysis

Most organic substances are thermally unstable. They can be separated through a combination of thermal cracking and condensation reactions in oxygen-free atmosphere into, gaseous, liquid, and solid fractions. Pyrolysis is the term used to describe this process. As a result of this property, solid waste can be processed in the absence or near absence of oxygen to convert the organic component to useful substances. In contrast with the combustion process which is highly exothermic, pyrolytic process is highly endothermic. For this reason, it is sometimes referred to as destructive distillation. The characteristic of the three major component fractions resulting from the pyrolysis of the organic portion of municipal solid waste are:

1. A gas stream containing primarily Hydrogen (H₂), Methane (CH₄), Carbon Monoxide (CO), Carbon Dioxide (CO₂), and various other gases, depending on the organic characteristics of the waste material being pyrolyzed.
2. A tar and /or oil stream that is liquid at room temperature and contains chemicals such as acetic acid, acetone, and methanol and.

3. A char consisting of almost pure carbon plus any inert material that may have entered the process.

2.2.4.3 Anaerobic Digestion

The organic component of municipal solid waste can be biologically transformed in the absence of oxygen to gaseous substances and a resistant organic matter. The principal organisms involved in the transformation of organic waste are; bacteria, fungi, yeast, and actinomycetes. The principal gases are; carbon dioxide, methane, ammonia and hydrogen sulphide. The carbon dioxide and methane constitute over 99 percent of the total gas produced. The resistant organic matter usually contains a high percentage of lignin, which is difficult to convert biologically in a relatively short time. The resistant organic matter (digested sludge) is usually dewatered before it is disposed of by land spreading or land filling. Dewatered sludge is often composted aerobically to stabilize it further before application.

2.2.4.4 Refuse-Derived Fuel (RDF)

RDF systems involved a shredding of waste followed by separation to remove the non-combustible components such as ferrous metals. The particle sized combustible part of the waste is then ground down into dense, pellet-like units suitable as fuel in a stoker-fired fuel-burning system such as those using coal. The RDF technology could thus be effective both as a waste disposal option and as a fuel supplement for other electricity-generating systems.

2.2.4.5 Waste Incineration

Even when energy generation is not the objective, incineration of solid waste sterilizes the waste and reduces the bulk. The volume is reduced by about 90% and the weight reduced up to 60% (Millard, 1981). However, it was the prospect of deriving energy from waste by incineration that provided the impetus for exploiting incineration as a waste disposal option. Public outcry against land fill in most countries and the general lack of land for developing land fills gave additional boost to waste incineration. Although waste incineration plants have their own associated environmental emissions and are both expensive to build and operate than landfills they seem to

offer more environmental benefits than landfills (IDB, 2003). The possibilities of utilising the energy they produce also make them more politically less risky to defend than landfills.

On a global scale waste incineration has become very popular and has become the principal means for processing municipal solid waste in many countries. In Japan for example about 80% of the municipal solid waste generated is incinerated (Mutsuto et al., 2004) amounting to 314 kg per capita of waste to energy. Although in the past, lack of expertise and high initial capital investment needed for the establishment of such waste incineration facilities have combined to limit this option of waste processing or disposal to the developed countries, developing countries have also now developed interest in waste to energy facilities. Blumberg and Gottlieb, 1989, estimated the initial capital requirement for waste incineration facilities to range between \$1.2 and \$350 million for 50-ton-per-day (tpd) and 3,000-tpd facilities respectively. Notwithstanding the cost factor, there are waste to energy (WTE) facilities in 35 nations, including large countries such as China and small ones such as Bermuda. From global perspective, about 130 million tonnes of municipal solid waste are combusted annually in over 600 waste-to-energy (WTE) facilities that produce electricity and steam for district heating and recovered metals for recycling (Themelis, 2003).

2.2.5 Land Filling

Source reduction can only help limit the volume and toxicity of waste so much; Waste reuse cannot continue indefinitely; both recycling and energy recovery processes generate residues that have to be disposed of, and there are only two options;

1. Disposal on or in the earth's mantle, and
2. Disposal at the bottom of surface water bodies

Disposal at the bottom of surface water bodies is no longer acceptable in modern waste management and the practise is banned by various national regulations and international conventions and agreements. The indispensability of **Landfills** in modern waste management therefore can not be overemphasized. Landfill is the cheapest and the most widely used method of final waste disposal that is environmentally acceptable. In terms of cost and with particular reference to the developing countries, sanitary landfill is about 3-8 times more expensive than **Open Dumping** with some grading to maintain truck access to the working face. It is 5-10 times less expensive than Incineration which is capital and energy intensive, and it is 2-3 less expensive

than composting (IDB, 2003). Modern waste management therefore is oriented towards **limiting** the amount of waste going into landfills and making landfills **safe**.

2.2.5.1 Limiting the Amount of Waste Going into Landfills

Limiting the amount of waste for land filling is achieved through policies that encourage waste generators to; reduce, reuse, recycle and recover conversion products from waste. In the European Union for example the Council Directive 1999/31/EC, stipulated that land filling of biodegradable waste was to be reduced by 25% in the year 2004, 50% in 2007, and 75% in 2014 relative to a 1995 baseline (Geigrich, 2004; OJEC,1999).

2.2.5.2 Making Landfills Safe

Limiting the health and ecological impact of landfills is achieved through; **site selection, design of the landfill**, and its **operation**. These considerations and operational procedures are geared towards eliminating or at least minimising the following concerns:

1. Uncontrolled release of landfill gases that might migrate off-site and cause odour and other potential dangerous conditions.
2. Impact of uncontrolled discharge of landfill gases on greenhouse effect in the atmosphere.
3. Uncontrolled release of leachate that might migrate down to underlying groundwater or to surface water.
4. Breeding and harbouring of disease vectors, and
5. Health and environmental impacts associated with the release of trace gases arising from hazardous materials that are sometimes deposited in landfills.

2.2.5.2.1 Landfill Site Selection

The whole world has become engulfed in “Not in my Backyard” popularly known as NIMBY syndrome with conflicts between residents and social/environmental movements on one side and government authorities on the other side in connection with the siting of solid waste management facilities leading to the closure of some facilities (Vittes et al., 1994). There is therefore the need to involve communities in the siting of landfills. Siting of landfills is influenced by a number of

physical and environmental factors and considerations. Table 2.2.5.2.1 presents a summary of physical and environmental factors and how these influence site selection in the siting of landfills.

2.2.5.2.2 Landfill Design Consideration

Once constructed, landfills represent a permanent feature of the landscape. The planning and construction of landfills therefore require a lot of care in consideration of alternatives sites and synthesis of ideas and opinions from different disciplines in the design process. Usually the landfill type influences the design type and the site selection consideration. Table 2.2.5.2.2 shows landfill classification based on the type of waste to be disposed of in the landfill and table B1 (Appendix B) is a summary of landfill design consideration.

Table 2.2.5.2.1 Influence of Physical and Environmental Factors on Siting of Landfills

Factors	Impact on Landfill Site Selection
Haul Distance	From economic perspective, this is about the most important factor in site selection
Location Restriction	All legal and non-legal restrictions must be reviewed eg. permissible distance of landfill from Airports and flood plains
Available Land Area	Available land should permit at least 5 years of operation and incorporation of buffer zones
Site Access	Selected site may involve construction of new access roads as suitable suits are usually outside developed zones
Soil Conditions	Information on geologic and hydro-geologic characteristics of local soil type is important as soil is needed for covering waste in daily operations
Topography	This determines equipment requirement and the amount of work necessary to make site suitable
Climatologic Conditions	Data on rainfall is important for design and type of access road and information on wind strength determines the need to make provision for wind break
Surface Water Hydrology	Important for defining existing and intermittent flow channels and natural drainage and run-off characteristics of site
Geologic and Hydro-geologic Conditions	Most important factor in determining environmental suitability of site. Data on these factors are important for assessing pollution potential of site
Local Environmental Conditions	Operating environmental conditions such as traffic, noise, odour, dust, airborne debris, visual impact, vector control, hazards to health, and property values should be considered and managed appropriately
Ultimate Use of Completed Landfills	The ultimate use of land after decommissioning of landfill should be considered during design stage.

Table 2.2.5.2.2 Landfill Classification Based on Waste Type

Classification	Type of Waste	Remark
I	Hazardous waste	They pose the greatest health risk to human and require expert knowledge in handling
II	Designated waste	Although non-hazardous contain substances in concentrations that can be harmful to human health and require expert handling
III	Municipal solid waste (MSW)	Usually not harmful unless not disposed of in time or mishandled and does not require expert handling

2.2.5.2.3 Operation of Landfill

A solid waste landfill can be conceptualized as a biochemical reactor. Solid waste and water can be regarded as the major inputs, and landfill gas and leachate as the principal outputs. A tragic landfill accident occurred in 1993 near Istanbul, Turkey, when an explosion of methane and other gases caused decomposed waste to flow out of the landfill, covering part of a nearby settlement and killing 39 people (UNEP, 2004). Health and environmental concerns associated with landfills therefore are managed through control of leachate and landfill gases and the institution of measures to exclude materials regarded as hazardous from the landfill.

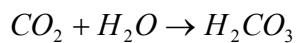
2.2.5.2.3.1 Leachate Control and Management

Leachate is the liquid that has percolated through solid waste and has extracted dissolved or suspended materials. In most landfills leachate, is composed of the liquid that has entered from external sources, such as surface drainage, rainfall, groundwater, and water from underground springs and the liquid produced from the decomposition of the waste, if any. According to Millard, 1981, research has indicated that once there is an unsaturated zone of sufficient depth beneath landfill, without significant fissures giving direct hydraulic continuity to aquifers, the degree of pollution should not reach unacceptable limits. Measures to prevent leachate from percolating into the underground water include lining the landfill at the construction stage. Liners could be of natural materials such as clay or puddle chalk, or synthetic material such as membranes of plastic. Landfills should be designed to allow accumulation of leachate. The leachate so accumulated is collected periodically for treatment or recirculation through the landfill.

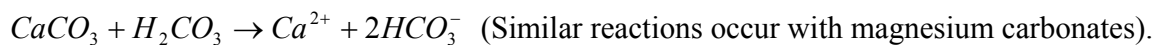
2.2.5.2.3.2 Landfill Gas Control and Management

Landfill biogas generally contains about 54% methane and 46% carbon dioxide (Themelis, 2003). Other gases found in various proportion include; Ammonia (NH_3), Carbon Monoxide (CO), Hydrogen (H_2), Hydrogen Sulphide (H_2S), Nitrogen (N_2), and Oxygen (O_2). The practise of covering and compacting waste at the end of each day's operation can prevent landfill gases from otherwise venting harmlessly into the atmosphere. Under such conditions, some landfill gases can migrate literally and allow potential dangerous pockets of gases to accumulate.

Methane can be explosive at concentrations between 5 and 15% (Tchobanoglous et al. 1993). The presence of limited amount of oxygen in landfill reduces the chances of explosion in landfill when methane concentration exceeds the critical level. However, methane mixtures in the explosive range can form if landfill gas migrates off-site and mixes with air. The fact that the specific gravity of methane is less than that of air, facilitates the process of gas migration and makes it possible for methane to accumulate below buildings or other enclosed spaces at or close to a landfill. This is the problem that happens when venting is not done properly. On the other hand, Carbon dioxide is 1.5 times as dense as air and 2.8 times as dense as methane and hence has the tendency of moving towards the bottom of the landfill. Carbon dioxide that accumulates at the bottom of a landfill can move downward by diffusive. When carbon dioxide comes into contact with water, it readily reacts with it to form carbonic acid as represented by the equation below.



This reaction lowers the pH, which in turn can increase the hardness and mineral content of groundwater through solubilization. For example if solid calcium is present in the soil structure, carbonic acid will react with it to form soluble calcium bicarbonate, according to the following reaction;



Control and management of landfill gases to reduce atmospheric emissions, to minimize the release of odorous emissions, and to minimize subsurface gas migration involve active or passive extraction of gases for thermal destruction or recovery of energy from the methane. In passive gas control the pressure of the gas that is generated within the landfill serves as the driving force for the movement of the gas. In active gas control system, energy in the form of an induced vacuum is used to control the flow of gas. Because of concerns over air pollution, modern landfill gas flaring facilities are designed to meet rigorous operating specifications to ensure effective destruction of volatile organic compounds (VOCs) and other similar compounds that may be present in the landfill gas.

2.2.5.2.3.3 Exclusion of Hazardous Materials from Landfill

The best way to exclude hazardous materials from entering the waste stream and ultimately ending up in landfills is to separate them at source. Source separation should be accompanied by clearly defined procedures for collection, treatment and or final disposal in special or designated landfills. Various countries have devised different procedures to prevent the entry of hazardous waste into landfills designated for municipal waste. In Denmark, industries, generating oil and chemical waste (hazardous waste) must notify the local authority and deliver the waste through a municipal collection system consisting of 21 transfer stations to a central treatment plant “Kommunekemi” at Nyborg. In the United Kingdom, generation and disposal of hazardous waste is controlled through a consignment note system. A consignment notes must be completed by the producer, transporter and disposer of special (hazardous) wastes. The consignment note provides such information as; description of the materials, the form in which they are transported and place of disposal etc (Bonomo and Higginson, 1988).

Normally, entrance to a landfill is provided through a gatehouse to monitor vehicular traffic to and from the landfill and to record the weight of waste entering the landfill. Random sampling of vehicle at the gatehouse to determine content of waste although can be very tedious is recommended for waste from single sources such as industries and large institutions. In the case of municipal waste, it is impossible for transporters to know the content of the waste they are transporting in most cases.

2.3 Global Overview of Solid Waste Management

The volume of global solid waste generation is expected to increase with increasing global population. Improvement in standard of living across the global is expected to contribute its quota not only to the global waste volume but also its complexity. Globalization of the world economy is expected to have the same effect on solid waste as improvements in standards of living across the globe. According to Cointreau et al. 2000, high-income countries produce about three times more municipal waste per capita than the developing countries. The same applies to generation of hazardous waste. Table 2.3 provides an overview of municipal waste generation per capita from global perspective.

Table 2.3 Waste Generation Per Capita from Global Perspective

Per Capita Waste Generation	Low Income Country	Middle Income Country	High Income Country
Mixed urban waste – large city (kg/capita/day)	0.50 to 0.75	0.55 to 1.1	0.75 to 2.2
Mixed urban waste – medium-sized city(kg/capita/day)	0.35 to 0.65	0.45 to 0.75	0.65 to 1.5
Residential waste only (kg/capita/day)	0.25 to 0.45	0.35 to 0.65	0.55 to 1.0

Table adopted from Cointreau et al. 2000

Notes to table 2.3

1. Country categorization by income is based on 1992 Gross National Product (GNP) data from the 1994 World Development Report published by the World Bank. Waste data based on a wet, “as received” condition (i.e., not oven dried).
2. For purposes of this table, a medium-sized city has 100,000 to 500,000 residents, and a large city has above 500,000 residents.
3. Urban waste includes residential, commercial, industrial and institutional waste, as well as street sweepings and yard waste. Construction/demolition debris is not included.
4. Recycling rates can effect a reduction of as much as 50% in the amount of waste requiring disposal. In the U.S. in 1995, recycling recovered 27% of all wastes generated, with paper recycling reaching 41% and yard waste composting reaching 38%.

The increased volume and complexity of waste generation in the developed countries, however, is matched with adequate management capacity developed through dynamic policy development. For example the Commission of the European Communities in 1992 formulated a series of concrete waste management objectives for member states for the period 1992-2000. These objectives include; stabilizing waste production at the 1985 level by the year 2000, banning export of certain categories of waste, and recycling and reusing at least 50% of paper, glass, and plastic by the year 2000 (Karl and Ranné, 1999). These objectives were to be achieved through a range of economic instruments as well as command and control instruments.

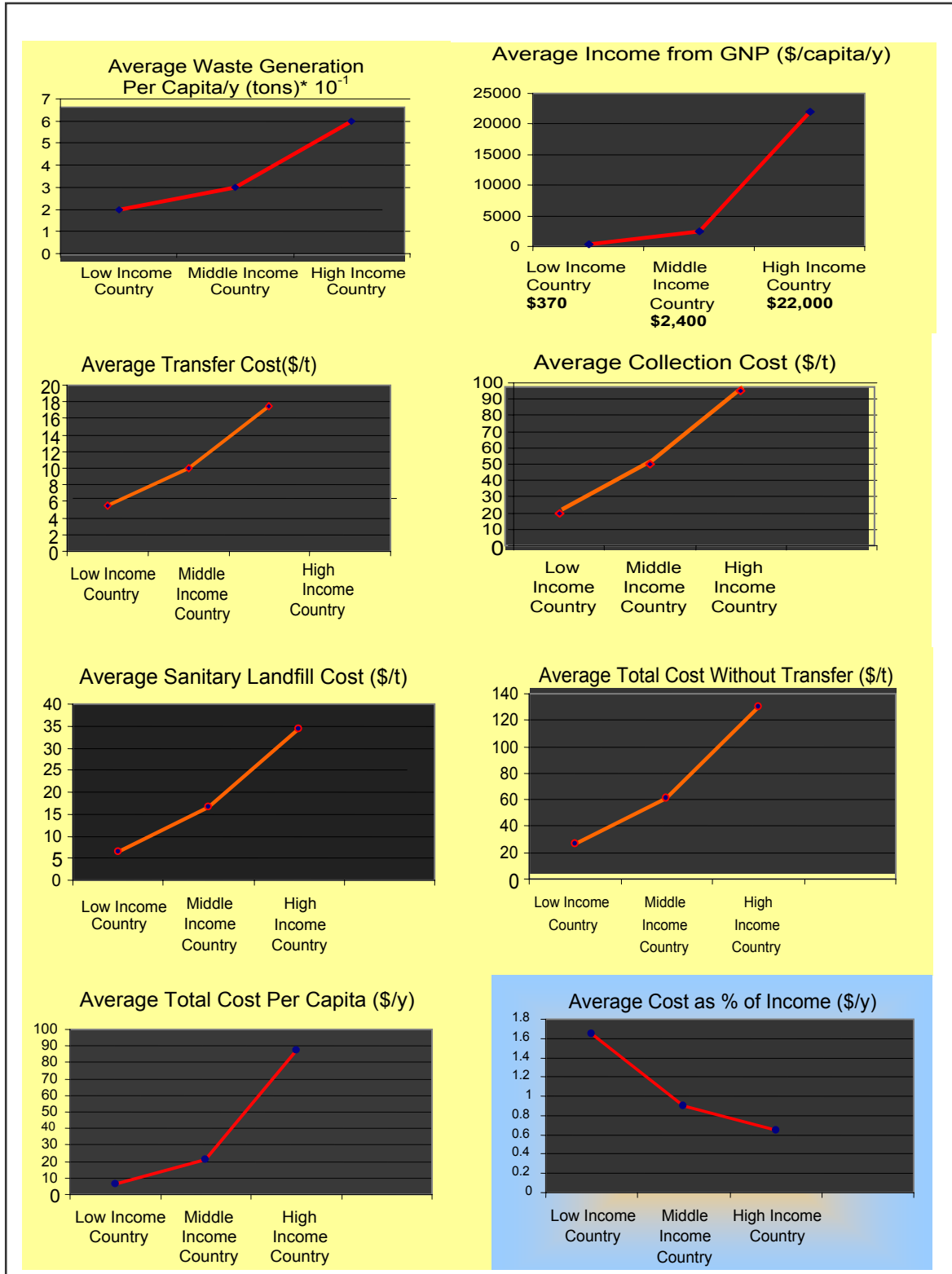
In the developing countries, different factors combine to stifle the development of adequate capacity for solid waste management. Equipment and machinery and their spare parts for solid

waste management often need to be imported. The relatively high prices of these items often result in their undersupply. Irrational service routes and traffic conditions in most cities of the developing world result in inefficient collection services. Public indiscriminate waste disposal habits leads to littering of streets and open spaces and creation of unauthorized waste dumps. The hot climate of most of the developing world as well as compact development necessitates more frequent waste collection than is the case in the developed countries. The main constraints to any rational waste management in the developing countries, however has been limitations to cost recovery of the provision of waste management services attributable to the high proportion of income individuals in the developing world have to spend on payment for waste management services. Fig. 2.3 graphically presents a picture of different average costs related to solid waste management for different parts of the world.

Notes to Fig. 2.3

1. Income based on 1992 Gross National Product (GNP) data from the World Development Report published by the World Bank in 1994.
2. Costs are for owning, operation, maintenance, and debt service in 1995, assuming no equipment provision through grants.
3. If sanitary landfill can be located within an economic hauling distance that allows direct haul, the cost of transfer can be avoided. An economic hauling time for a small truck carrying 2 to 6 tons commonly is within 30 minutes one way from the collection area to the unloading point. Depending on traffic conditions, 30 minutes one-way would be 15 to 30 kilometres one-way.
4. \$/t means US Dollar per metric ton, and \$/capita/y means US Dollars per capita per year.

Fig. 2.3 Comparison of Various SWM Cost for Different Parts of the World



Data for Fig.2.3 derived from Cointreau et al. 2000.

The approach to building the necessary capacity for sustainable solid waste management in the developing countries therefore is to engage dynamic policy development processes that involve an appropriate mix of command and control instruments as well as economic instruments to meet the changing demands of solid waste management. Waste collection cost often constitutes about 60-80% of total management cost (IDB, 2003; UNEP, 2005). Since solid waste generation in the developing countries is about a third of that of the developed world (Cointreau et al., 2000), improving the efficiency of the functional element of waste collection in the developing world can greatly reduce total cost of waste management.

Although not considerable, the quest by some individuals and development partners to bridge the digital divide between the developed and the developing world by exporting used computers and accessories to the developing world as well as the changing life styles in the developing world for example the growing use of mobile telephones can pose special waste problems. In an editorial to the Seventh Meeting of the Conference of the Parties to the Basel Convention in Geneva, Switzerland, which has as its theme 'Partnership for meeting the global waste challenge' Klaus Toepfer, the former United Nations Under-Secretary-General and Executive Director of UNEP lamented;

“Is a vessel en route from Europe or North America to a breaker’s yard half way across the world a ship heading for dismantling? Or is it hazardous waste, since it is likely to be filled with asbestos, toxic metal sludges and other health-threatening substances? Similarly, shipping huge numbers of computers – outdated by the latest model in a developed country – to a developing one may offer poorer people there a chance to step onto the information technology ladder. Or maybe this is just a clever way of passing on the economic, social and environmental costs of disposal from the consumers and companies of the rich” (OP, 2004).

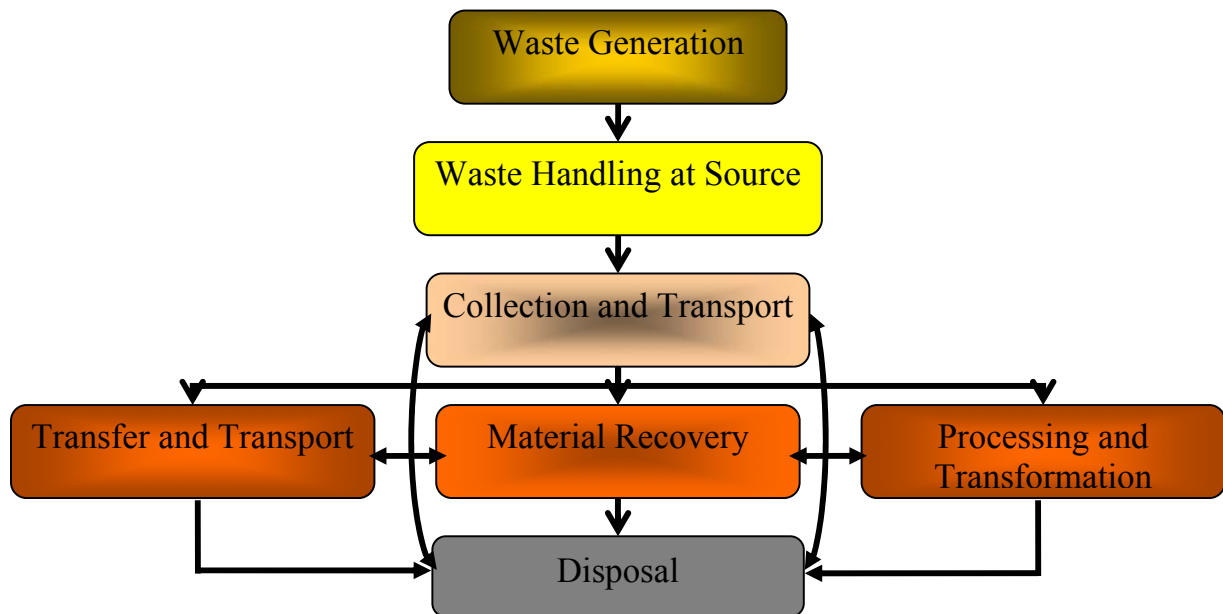
Policy development therefore needs to take cognizance of trends in the generation of special and hazardous waste in the developing countries and factor these into solid waste management goals.

2.4 Functional Elements of Solid Waste Management

The whole complex of solid waste management can be divided into phases which can be influenced by management activities and policy interventions. These phases of solid waste management that offer opportunities for policy interventions are the functional elements.

Although there can be further sub-divisions, this dissertation recognized seven (7) functional elements consisting of; i. Waste Generation, ii. Waste Handling at Source (storage and processing), iii. Collection and Transport, iv. Transfer and Transport, v. Processing and Transformation, vi. Material Recovery, and vii. Disposal. Fig.2.4 shows how these functional elements are connected and interrelated. The functional activities at each stage are influenced by all of the preceding functional elements and their associated activities.

Fig.2.4 Functional Elements of Solid Waste Management



2.4.1 Waste Generation

Waste generation involves creation and recognition of materials and substances as no longer having any value and the designation of these for disposal. Consumption and production processes represent the two major sources of waste although natural ecological cycles also generate some waste. With the modern concept of “material loop closing” where the waste (by-product) of one consumption and or production process becomes the input material of another process, there is the need to redefine what constitutes waste and subsequently the understanding

of waste generation. Clearly, definition and designation of what constitutes waste need to be activity and process specific.

Waste generation is greatly influenced by geographic and physical factors. These factors include; geographic location, season of the year, the use of kitchen waste food grinders, waste collection frequency, and the characteristics of the service area. Table 2.4.1 summarized the impact of these factors on waste generation

Table 2.4.1 Impact of Geographic and Physical Factors on Waste Generation

Geographic and Physical Factors	Impact on Waste Generation
Geographic Location	This is important when different climatic regions and their impact on generation of yard and garden waste are considered.
Season of the Season of the Year	The quantities of certain types of solid waste vary with seasons of the year. For example organic waste composition can increase considerable during fruit harvesting season.
Use of Kitchen Food Waste Grinders	The use of Kitchen food grinders normally reduces the amount of organic components of waste
Frequency of Collection	When there is inadequate collection service in material recovery programmes, some materials that otherwise would have been diverted, end up in materials disposed of as waste.
Characteristics of Service Area	Within the same municipality, the amount of materials designated as waste is higher in wealthy neighbourhoods than in poor neighbourhoods.

A very important development that has had considerable impact on both composition and volume of waste generation is the development of the Packaging Industry. In the US, EPA estimated the composition of packaging materials in the waste stream in the eighties to be about a third (EPA, 1986). Closely associated with the rise of the packaging industry was the boom in petrochemical industry in general and plastics in particular which were transformed from nearly nonexistent industry in the 1920s to multi-billion-dollar operations by the 1970s (Blumberg and Gottlieb, 1989). Blumberg and Gottlieb, 1989, observed “While people can not be forced to eat more they can be made to pay more through processing and packaging gimmicks. Farmers receive a small percentage of the retail price spent by consumers for food products; the money goes for

packaging and processing. Today farmers are paid less for the food they produce than is spent on the package it is sold in. The food is eaten, the package is dumped”.

The use of plastics in both packaging and a variety of consumer products is particularly attractive because of its versatility and price. Today, plastics related waste is a major problem in both the developed and the developing countries. The problems of plastic waste, however, is particularly serious in the developing countries where indiscriminate waste disposal habits leave streets, drains and open spaces strewn with plastics (UNEP, 2005). Plastic wastes constitute a major component of solid waste from the major sources of solid waste in any community as depicted in table B2 (Appendix B)

2.4.2 Waste Handling at Source (Storage and Processing)

These include all the activities associated with holding and manipulating waste until they are placed in storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection. Waste handling at source is an important step in the entire waste management structure and performance, and presents a very important intervention point for policy and management decisions. For example source separation of waste into various components which is part of waste handling at source is very important for minimizing contamination of materials from the standpoint of material recovery. On-site storage is of primary importance because of public health concerns and aesthetic considerations.

Public health and aesthetic are influenced by the following factors; biological decomposition of waste, absorption of fluids by waste constituents, contamination of waste components, type of containers used for waste storage, and the location of the container. Table 2.4.2 summarizes how these factors influence public health and aesthetic.

Table 2.4.2 Impact of On-site Storage Factors on Public Health and Aesthetic

On-site Factors	Impact on Public Health and Aesthetic
Biological decomposition of waste	Fungi and Bacteria start growing immediately on food and other organic components of waste leading to production of odour. Depending on the extent of storage time, flies, rats and other pathogens can develop and multiply. Both containers and storage sites should be kept clean and container should be provided with lid. Biodegradable materials should be removed within 8 days
Absorption of fluids by waste constitutes	Redistribution of moisture takes place when mixed wastes are stored together and in instances where water tight containers are not used or where waste containers are left in the open, infiltration of rain water can occur. Where water-tight containers are not used discharge of liquid waste associated with on-site storage has both health and aesthetic implications.
Contamination of waste components	<p>Contamination with mixed waste storage has serious health implications and when materials are to be recovered for recycling, contamination reduces the value of recovered materials. Even when there is no source separation programme, attempts should be made to exclude hazardous materials from commingled waste.</p> <ul style="list-style-type: none"> ◆ Contamination on the other hand could have beneficial effect of reducing the concentration of individual pollutants when the contaminated components are spread out and compacted in land fill operations.
Type of containers used for waste storage	<p>The type and capacity of containers used depend on the characteristics and types of solid waste to be collected, the type of collection system in use, the collection frequency, and the space available for the placement of the containers. On-site storage container could be temporal or permanent.</p> <ul style="list-style-type: none"> ◆ Temporal :(paper bags, plastic containers and bags, cardboard boxes, wooden boxes. Temporary waste containers could disintegrate easily causing injury to waste collectors) ◆ Permanent: (modern waste collection requires the use of permanent on-site waste storage containers that are adapted to the loading and unloading mechanism of collecting vehicle and the capacity of permanent waste container depends on the volume of waste anticipated)
Location of waste container	Container storage locations depend on the type of residence or commercial or industrial facility, and the available space. Access to storage location by waste collecting crew or vehicle is a very important consideration.

Sustainable solid waste management should constantly look for interventions that focus on waste handling at source in addressing public health and aesthetic concerns. Policy development for solid waste management needs to factor economic, environmental and social considerations into decision making processes in prescribing interventions that influence waste handling at source. For example while source separation of waste into various components leads to better material recovery with minimum environmental impact, it is more expensive and more inconvenient to households (Tjell et al.,1981). A very important policy and management issue related to waste handling at source is ownership of waste. Since people are at liberty to do whatever they want with what they own, there is the need to assign ownership right of waste to the institution that is charged to collect the waste. In this way, the waste generator will be legally required to comply with appropriate disposal procedures prescribed by the waste collecting authority. For example the Waste Act of August 27, 1986 of the Federal Republic of Germany, clearly stipulated the ownership of waste and states “Those in possession of household waste or similar type of waste are obliged by law to place it at the disposal of the bodies responsible for its disposal or third parties appointed by them” (Bonomo and Higginson, 1988). Proper disposal is therefore intrinsically implied by this legislative provision and probably explains why Germany has very little problem with indiscriminate waste disposal.

2.4.3 Collection and Transport

This functional element involves not only the gathering of solid waste and recyclable materials, but also includes the transport of these materials, after collection, to the location where the collection vehicle is emptied. This location may be a material processing facility, a transfer station, or landfill sites (for disposal). This functional element is very important for two reasons

- i. In terms of total waste management cost, collection and transport constitute about 60-80% (IDB, 2003; UNEP, 2005).
- ii. Collection and transport are the most visible components of the array of operations involved in waste management.

The effectiveness and efficiency of this functional element therefore is pivotal to the efficiency of the whole solid waste management set up because a small percentage improvement in the collection operation can cause a significant savings in the overall cost. This functional element

has been targeted with various management and policy interventions in different countries in efforts aimed at improving the efficiency of waste management as well as meeting changing trends and demands in waste management. In Germany an industry financed take-back system (Duales System Deutschland) was initiated to collect and recycle packaging waste from households as prescribed under German packaging regulations (Verpackungsverordnung) (Vollny et al., 2002). Under this system, producers are required to take back specified proportion of their packaging for recycling and submit audited report to the effect that their target has been attained. Package Producer take-back responsibility could be avoided if the package producer engages the services of licensed recycler to collect and recycle the packaging waste. The package producer shows this delegation of responsibility by placing a “Green Dot” trademark on his product. This policy has a lot of benefits especially from environmental perspectives. Most packaging materials are plastic and it serves more energy to recycle plastics compared with production from virgin materials. In another take-back system, Kodak has been able to achieve 85% reuse of its single-used cameras through film developers (EPA, 1999).

2.4.4 Transfer and Transport

Transfer involves the use of relatively small collection vehicles to convey waste materials to a central location for onward transport over extended distances either to material recovery facilities (MRF) or to disposal points by larger vehicles. Transfer and transport operations become necessary when;

1. Haul distances to available processing centres or disposal sites increase so that direct hauling is no longer economically feasible. For example, wastes from the city of Portland, Oregon in the US are hauled to a disposal site 150 miles away (Tchobanoglous et al., 1993).
2. Processing centres or disposal sites are in remote locations and cannot be reached directly by highway.
3. Poor spatial planning in urban centres do not allow access for large vehicles for direct waste collection as is the case of the slum areas of the urban centres of many developing countries.

Transfer stations are classified depending on the method used to load the vehicle for final transport, and three basic classifications are;

1. Direct-load: At direct-load transfer stations, the wastes in the collection vehicle are emptied directly into the vehicle to be used for further transport.
2. Storage load: At storage-load transfer station, waste is emptied directly into a storage pit. The waste is later loaded into transport vehicle by various types of auxiliary equipment. The main difference between a direct-load and a storage-load transfer station is that there is no waste storage in the case of direct-load transfer station, where as in the case of storage load transfer, waste can be stored for one to three days.
3. Combined direct-load and discharge load: In this transfer station both direct-loading and storage loading take place.

Although solid waste can be transported by railways and ocean-going vessels, motor-vehicle transport represent the most wide-spread means of transporting solid waste. Transport of solid waste on highways should satisfy the following requirements:

1. Wastes must be transported at minimum cost.
2. Vehicles must be designed for highway traffic.
3. Wastes must be covered during haul operation.
4. Method used for unloading must be simple and dependable.
5. Vehicle must be designed such that the allowable weight limit is not easily exceeded (Tchobanoglous et al., 1993).

2.4.5 Material Recovery

Modern solid waste management is oriented essentially towards salvaging materials from the waste stream, and subsequently returning these recovered materials into the economic cycle in one form or the other. This perspective of modern waste management is being driven by various national policies and legislations. In the United States, The passage of the Resource Recovery Act of 1976 was directed towards recovery materials from waste. This act directed that the emphasis of the national solid waste management programme be shifted from disposal as its primary objective to recycling and reuse of recoverable materials in solid wastes or to the conversion of waste to energy (Tchobanoglous et al., 1993). Legislative provisions similar to the

Resource Recovery Act were passed in many countries. In the UK, material recovery was the focus of “Making Waste Work”, a government white paper on waste (Read, 1999). Material recovery from waste was captured in the Swedish Environmental Policy of 1986/87 (SAPCSWM, 1988).

The orientation of solid waste management towards resource recovery stems from the fact that it offers both economic and ecological advantages. Recovery of materials from waste reduces pressure on natural resources and the cumulative environmental pollution/degradation associated with the processes of putting back recovered materials into the economic cycle is often less than that associated with manufacturing products from virgin materials (Craighill and Powell, 1996). Material recovery reduces demand on landfill space and the pollution associated with landfills. The fundamental principle underlying the success of any material recovery programme in solid waste management is that **the cost of collecting waste and the cost of subsequently processing the waste into useful product must not be more than the cost of useful products that can be made out of them.** In practice, however, the cost of collecting waste is often so high that without government subsidies, material recovery although a laudable concept remains to be fully utilized in solid waste management. The draw back has always been that, the environmental benefits of material recovery can not be easily integrated into production cost accounting. For example even though environmental degradation and pollution associated with the production of goods from virgin materials are often more than that associated with the production of similar product from recovered materials, the cost of environmental degradation/pollution is often not completely incorporated into the prices of the final goods. As a result goods produced from recovered materials become more expensive than those produced from virgin materials because of the high waste collection cost component.

The approach to realizing the full benefits of material recovery is to reduce the collection cost component of the whole process of putting back waste materials into the economic cycle. Various management and policy instruments have been used to reduce the cost of recovery materials for processing. These include deposit-refund and product take-back. Deposit-refund policy strategies pass on to consumers the cost of collecting waste materials which the consumer foregoes when the waste is not disposed of at designated places. In Sweden when parliament made decision in 1982 with respect to recovering aluminium cans used for beverages, a special company was

formed to run a deposit refund system. The deposit-refund system was introduced in 1984. In 1985, 66% of the cans were recovered. The amount recovered in 1986 was the same. To achieve a higher recovery rate, the economic incentive was doubled during 1987, to SEK 0.50 per can. This increased recovery rate to 85% (SAPCSWM, 1988). In a deposit-refund system the cost of collecting the waste materials is charged to the consumer of product at the time of purchasing the product and the consumer loses this cost component if the waste so generated after product consumption is not returned for reprocessing. On the contrary, a product take-back policy instrument does not impose any financial penalty on consumers when waste material(s) generated after product consumption is not returned. Product take-back, however, encompasses strategies to entice and or compel consumers to return their waste materials for recycling. In one product take-back system, Mexico does not allow the sales of a car battery replacement unless the old one is returned (Huber et al. 1997). A product take-back system in British Columbia, Canada, involves a legislative requirement that all sellers of oil take back used oil at no cost to the consumer (BC, 2001). Unless consumers have no option but to return product to sellers as in the case of car batteries in Mexico, the success of product take back will be dependent largely on environmental consciousness of consumers.

The functional element of material recovery can play a very important role in sustainable solid waste management, however, this recognition has to be made at the policy development level for the establishment of the necessary institutional and infrastructural requirements. Decisions as to the various components into which waste should be separated need to be made and whether separation of components should be made at the household level or at a central location also need to be considered. If waste separation for material recovery is to be carried out at the household level, the functional element of material recovery needs to develop the modalities for collecting the separated components for processing. If material recovery is to be achieved at a material recovery facility, then the number and types of components into which the commingled waste is to be separated and the standards of the separated materials should be in conformity with the waste diversion goals of the entire waste management system.

The whole concept of material recovery has no meaning if materials so separated from waste can not be put back into the economic cycle. Apart from developing the engineering requirements for reprocessing waste materials into products, there is the urgent need to develop the market for

goods that can be made from waste materials. This involves education and public campaigns to keep society abreast with the environmental benefits of recovering materials from waste and hence the development and sustenance of market for goods recycled from waste. Materials such as paper, cardboard, plastic, garden trimmings, glass, ferrous metal, aluminium, and other nonferrous metals have successfully been recovered from waste in many countries because both the technology for their reprocessing and the market for goods produced from these waste materials have been developed.

2.4.6 Waste Processing and Transformation

Solid waste can be transformed by physical, chemical and biological processes. These processes offer waste management the opportunity to;

- i. Recover conversion products and energy,
- ii. Recover materials for reuse and recycling,
- iii. Improve the efficiency of waste disposal management, and
- iv. Reduce the volume and weight of waste requiring disposal.

Transformation of municipal solid waste is influenced by the physical, chemical and the biological properties of waste. Table 2.4.6 summarizes the properties of municipal solid waste and the importance of these properties for waste transformation processes.

Table 2.4.6 Implications of Physical, Chemical and Biological Properties of Solid Waste for Waste Transformation

Property Of Waste	Characteristics	Implications /Applications In Waste Management
Physical	<p>Specific Weight This is the weight of a material per unit volume and depends on the degree of compaction. It varies with geographic location, season of the year, and length of storage.</p>	Determines the amount of material to be processed.
	<p>Moisture Content Can be expressed as wet weight (the % of moisture of the wet weight) or (% of moisture amount of dry weight of waste). Depends on composition, season of the year and weather</p>	Important for waste transformation by combustion.
	<p>Particle Size and Size Distribution Considers the length, width, and height of particles.</p>	Important for separation into components eg. mechanical separation such as trammel screens and magnetic separators.
	<p>Field Capacity This is the total amount of moisture that can be retained in a waste sample under downward gravitational pull. It varies with the degree of applied pressure and the state of decomposition of the waste. (50 to 60 % for MSW).</p>	Important for leachate formation in landfill and also has application in aerobic and anaerobic digestion of waste.
	<p>Permeability of Compacted Waste This depends solely on the properties of the solid material, including pore size distribution, tortuosity, specific surface, and porosity.</p>	The hydraulic conductivity of compacted waste is an important physical property for the determination of movement of liquid and gases in landfills.
Chemical	<p>Proximate analysis</p> <ul style="list-style-type: none"> ◆ Loss of moisture when waste is heated to 105°C for 1hour. ◆ Volatile combustible matter (additional loss of weight on ignition at 950°C in a covered crucible. ◆ Fixed carbon (combustible residue left after volatile matter is removed). ◆ Ash (weight of residue after combustion in an open crucible). 	Important for use of waste as fuel
	<p>Fusing Point of Ash The temperature at which the ash resulting from the burning of waste will form a solid (clinker) by fusing and agglomeration. Typical fusing temperatures for the formation of clinker from solid waste range from 2000 to 2200°F (1100 to 1200°C).</p>	Important for use of waste as fuel.
	<p>Ultimate Analysis of Solid Waste Components This involves the determination of the percent C (Carbon), H (Hydrogen), O (Oxygen), N (Nitrogen), S (Sulphur), and ash</p>	Important for use of waste as fuel and for biological convention.
Biological	<p>Essential Nutrients and other Elements These are the major elements found in the organic components of MSW and include; NH_4-N, NO_3-N, P, PO_4-P, K, SO_4-S, Ca, Mg, Na, B, Se, Zn, Mn, Fe, Cu, Co, Mo, Ni.</p>	Important for use of waste as feedstock for the production of biological conversion products such as compost, methane, and ethanol.
	<p>Biodegradability of Organic Waste Components Volatile solids (VS) content, determined by ignition at 550 °C.</p>	Important for biological waste transformation.
	<p>Production of Odours Usually formed during anaerobic decomposition of organic waste.</p>	Important for landfill management and the siting of waste facilities.
	<p>Breeding of Flies Flies can develop in less than 2 weeks after the eggs are laid.</p>	Important for on-site storage of waste.

2.4.6.1 Physical Processes of Waste Transformation

The physical processes involved in waste transformation include; component separation, mechanical volume reduction and mechanical size reduction. Unlike biological and or chemical transformation processes, physical waste transformation processes do not result in change of phase of the waste for example change of waste from solid to gas or solid to liquid. Component separation can be accomplished manually or mechanically. This is very important for the recovery of materials for both direct use and for reprocessing into other products, For example separation of hazardous materials from food and other organic waste is important for the biological transformation of these waste products into other useful products.

Volume reduction involves the use of pressure to reduce the initial volume occupied by any waste material. In modern waste management, collection vehicles are equipped with compaction mechanisms to increase the amount of waste collected per trip. Size reduction is applied to waste materials to obtain a final product that is reasonably uniform and considerably reduced in size.

2.4.6.2 Chemical Transformation

Chemical transformation of solid waste materials usually involves a change of phase (eg. solid to liquid, solid to gas etc). The main chemical transformation processes are; Combustion (chemical oxidation), Pyrolysis and Gasification¹

2.4.6.3 Biological Transformation

Biological transformation processes are used in processing the organic fraction of municipal solid waste. The main biological transformation processes in use include; aerobic composting anaerobic digestion, and high-solid anaerobic digestion²

¹ Chemical transformation processes related to waste have been briefly covered under review of waste hierarchy, section 2.2.4.

² Refer to section 2.2.3 for review of composting under waste hierarchy.

2.4.7 Disposal

Landfills have become the only acceptable means of disposing of waste materials that cannot be reused, recycled and or converted to other useable products. The objective of modern waste management is to reduce by various programmes and policy instruments, the amount of waste going into landfills and also make landfills safe through their design and operations¹. Landfills represent a major alteration of the landscape that influence land use patterns even after closure and decommissioning of the facilities. There should therefore be involvement of city, district, and regional planning agencies, health sector agencies and any other such agencies associated with environment, public health and development. This will ensure that environmental and public health concerns as well as aesthetic considerations are not compromised in any way in design, siting, construction and operation of landfills.

2.5 Integrated Solid Waste Management

This involves the evaluation and integration of all the functional elements of waste management for effectiveness and economic efficiency. Because waste management objectives and goals vary from one municipality to another the assessment of various options to integrate the functional elements of solid waste management should be driven by stated goals and objectives. A community or a municipality is said to have developed an Integrated Waste Management System (IWMS) when all of the functional elements of waste management have been evaluated for use, and all of the interfaces and connections between elements have been matched for effectiveness and economy to meet community waste management goals and objectives. In this respect, Tchobanoglous et al., 1993 defined an Integrated Solid Waste Management (ISWM) as the selection and application of suitable techniques, technologies, and management programmes to achieve specific waste management objectives and goals.

¹ Refer to section 2.2.5 for more information on landfill design and operation.

2.6 Policy Instruments and Solid Waste Management

“Public policy is a course of government action or inaction in response to social problems. It is expressed in goals articulated by political leaders; in formal statutes, rules, and regulations; and in the practices of administrative agencies and courts charged with implementing or overseeing programmes. Policy states intent to achieve certain goals and objectives through a conscious choice of means, usually within a specified period of time” (Kraft and Vig, 2003, p.4).

Policy options for solid waste management can be broadly classified into Economic Instruments (EIs) and Command and Control Instruments (CCIs). Sustainable solid waste management recognizes an appropriate mix of both types of instrument directed at both the general public and industries for the attainment of management goals and objectives.

2.6.1 Command and Control Policy Instruments for Solid Waste Management

Solid waste related problems have presented one of the serious social problems and challenges associated with world development. Public policy development in the field of solid waste management hitherto had focused on the use of standards, laws and regulations referred to as “command and control instruments” (CCIs) in mitigating social problems associated with solid waste management¹. Such CCIs varies from one country to another, however, they can all be identified by obligations for all parties; the public, organizations (industries and companies), waste collectors (private or public), and government, to act in ways that facilitate waste management. The public is usually requested to act in conformity with standards in connection with waste generation and handling. Industries and business establishments are expected by CCIs to act in conformity with standards related to pollution control, design of goods and services etc. Waste collection companies are directed by CCIs in connection with waste collection frequencies, methods of transport and disposal of the waste collected, and government are required by such laws and regulations to facilitate the whole operation of solid waste management through provision of sites for waste disposal in addition to monitoring to ensure that all other parties are functioning well and in compliance with the provisions of the CCIs.

¹ Instances of use of command and control instruments in solid waste management have been cited under section 2.1.2 and in other sections.

The effectiveness of CCIs depend to a large extent on the efficiency of the monitoring and enforcement role of government. Any compromise in the roles of government will manifest itself in lack of motivation on the part of all other parties to comply because non-compliance can not be adequately monitored and penalized in monetary terms or otherwise. Fines and penalties serve as disincentive and help to compel solid waste generators to reduce level of generation and or handle waste in ways prescribed by law to facilitate management. Where these can not be adequately monitored and enforced, there will surely be problem with both waste generation and handling. The same applies to waste collection, where lack of adequate monitoring and enforcement of CCIs can result in non-compliance with regulatory provisions and hence distortion and inefficiency in waste collection systems characterized by irregular collection services as well as low collection coverage.

While provision of effective monitoring, enforcement and penalization of non-compliance is very central to the functioning of CCIs, it is fundamentally flawed because there is often no mechanism to monitor, enforce and or penalize governmental agencies that are supposed to be monitoring, enforcing and penalizing non-compliance of all the other parties for effective functioning of CCIs. Some check and balances is supposed to be provided in constitutional democracy where lack of effective monitoring, enforcement and penalization of CCIs could be interpreted by electorates as lack of effectiveness of government machinery and hence a rejection of the government in question in an election. However, this is often not the case when there is absence of democracy. Even in democratic dispensations, the check and balances that is supposed to be provided by the electoral system could be seriously compromised with special reference to monitoring, enforcement and penalization of non-compliance of CCIs of solid waste management if issues connected with solid waste management are not politically sensitive as is often the case in many developing countries. Other factors responsible for the general lack of effectiveness in the enforcement and penalization of non-compliance of environmental regulatory standards in developing countries were provided by the IDB, 2003 in justifying the basis for proposing economic instruments (EIs) as complimentary tools to CCIs in solid waste management. These factors include the following;

1. Political interventions after ticketing.
2. Disinterest within the court system for minor offences.
3. Fines and penalties that are too small to be significantly deterring.
4. Lack of inspection staff and transport for them to make their rounds.

5. Lack of court for minor offences (a municipal court or sanitation magistrate).
6. Inadequate detail in the law regarding what is acceptable versus unacceptable behaviour.
7. Inadequate police coverage to make arrests and follow-up of arrests in the court system.
8. Inadequate empowerment of inspectors to follow through on ticketing when offenders are identified.

The inadequacy of CCIs in meeting the demands and complexities of modern environmental management in general has been instrumental in the introduction and use of economic instruments as complimentary policy instruments to CCIs. The effectiveness of economic instruments, however, depends on adequate functioning of the same institutional structures (judiciary and the regulatory system) required by CCIs. Economic instruments for solid waste management can be successfully applied in both developed and developing countries to meet various management objectives.

2.6.2 Economic Instruments for Solid Waste Management

The economics proposition that when the price of a good increases, other things being equal, the quantity of that good demanded will decrease has provided the basis for interest in market instruments as a means of not only mitigating pollution and resource degradation but also raising tax revenue. In solid waste management, the quantity of waste generation increases with increasing household income. This perspective presents an opportunity to ascertain the appropriateness of such economic instruments as unit pricing, deposit-refunds, product charges, recycling permits, taxes on primary product inputs etc for the attainment of management goals and objectives. Whether the choice of policy instrument is economic or command and control, the aim of government is to increase the costs of those activities they wish to discourage and reduce the costs of those they favour.

The effectiveness of any economic instrument in solid waste management will depend on the degree of “linkage” between the economic instrument and the desired behavioural change. For example if the policy goal is to increase the return of plastic bottles for recycling through the use of a deposit-refund, the effectiveness of this instrument will depend on the strength of the linkage between deposit-refund and the plastic disposal habit of consumers. If the linkage is weak the

deposit-refund will not provide the necessary behaviour change of **return** of plastic bottle¹. The introduction of any economic instrument however, is influenced by other factors other than economic consideration. Efav and Lanen, 1979 in a study involving 5 cities in the United States concerning the introduction of user charges in solid waste management, discovered that managerial decisions to institute or modify user charges take place in social-political and technological contexts which may influence decisions more strongly than narrowly conceived economic considerations. As a result of socio-political and the technological matrices into which economic instruments are introduced, economic instruments should be in conformity with some principles for their effectiveness and ease of implementation. Six principles that determine the effectiveness of economic instruments in addressing environmental problems were mentioned by Russel and Powell, 1996. These principles and their requirements are summarized in table 2.8.2. Turner et al. 1998 observed that compliance with all the six principles simultaneously and in getting the appropriate mix of regulatory and economic instrument constitute a formidable task especially when some of the principles conflict under certain circumstances.

Table 2.6.2 Criteria for Assessing Economic Instrument for Environmental Management

Criteria	Requirement
Economic Efficiency	The instrument should interfere as little as possible with well informed private resource allocation decisions in competitive markets, and should provide a continuous incentive for seeking least cost solutions.
Environmental Effectiveness	The instrument should be appropriately linked to the pollution and resource usage for effective mitigation and in particular in minimization of health impacts and risks.
Fairness	The instrument should be significantly regressive ie. should not impose a disproportionate cost burden on the least well-off in society.
Administration Cost-effectiveness	The instrument should involve low administrative and compliance cost
Institutional Concordance	The instrument should be compatible with existing national regulations/legislations.
Revenue Raising	The Instrument should be able to raise appropriate amounts of finance for given expenditures.

Table adapted from Russel and Powell, 1996

¹ Reference to Deposit-Refund in solid waste management has been made under section 2.4.5.

Although a functional command and control regulatory system is required for effective functioning of economic instruments, they seem to have some advantages over CCIs (UNEP, 2005). These advantages include among others; flexibility in the overall cost of emission reduction, cost-recovery of public service provision, etc. The use of economic instruments in solid waste management, however, is constrained by some pre-conditions for their application. First is the need for the presence of a reasonably functioning market with well defined property rights and related institutions. The second is political will. The implementation of economic instruments has implications for enterprises and can affect their competitiveness from global perspective. In solid waste management economic instruments have been specifically used in different parts of the world to:

- ◆ Reduce waste generation.
- ◆ Generate revenue to cover cost.
- ◆ Reduce the toxicity of waste content.
- ◆ Optimize recovery, reuse and recycling of waste.
- ◆ Segregate hazardous waste for special handling and disposal.
- ◆ Support cost-effective solid waste collection, transport, treatment and disposal operations.
- ◆ Minimize adverse environmental impact associated with solid waste collection, transport, treatment and disposal systems (IDB, 2003).

2.6.2.1 Classification of Economic Instruments

IDB, 2003 classified economic instruments for environmental management into three categories; Revenue generating instruments, Revenue providing instruments and Non-revenue Instruments as shown in table B3 (Appendix B). The selection of which instrument to implement depends on specific solid waste management situation in any given country.

2.7 Sustainable Development and Solid Waste Management

The concept of **sustainable development** became popular following the publication of “Our Common Future” by the World Commission on Environment and Development in 1987. In this

publication (also often referred to as the Brundtland Report), sustainable development is defined as;

“a process of change in which the exploitation of resources, the direction of investment, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations” (WCED, 1987, p. 46).

Lumley and Armstrong, 2004, pointed out that the concept of sustainability/sustainable development has been variously interpreted and diversely applied in efforts to put into practice sustainability principles (Agenda 21) developed in Rio at the Earth Summit in 1992. Central to contemporary interpretations of sustainability (following the World Summit on Sustainable Development in Johannesburg, 2002) is the need to orient as well as integrate current social, economic and technological development in a way that enhances or at least maintains the environment in order not to compromise the ability and developmental opportunities available for future generations.

In the field of solid waste management, various authors have used the term “Sustainable Solid Waste Management” (Kijak and Moy, 2004; Read, 1999; Boyle, 2000; Karl and Ranné 1999). Although, not explicitly defined by these authors, policy strategies mentioned for the attainment of Sustainable Solid Waste Management (SSWM), clearly took cognizance of social, economic, and technologic factors. These strategies which include among others; waste reduction, waste reuse, waste recycling, waste transformation, are common waste management strategies in the developed countries where economic and technological standards are more or less comparable and waste generation is high. Any differences observed in efforts at attaining sustainable waste management among the developed countries could be associated with the implementation of these strategies which could be attributed to the differences in the social settings of these countries. In the developing countries where the problem with solid waste management is not necessarily high volume of waste production per capita but rather unconcerned waste disposal attitude of individuals and the general public in addition to difficulties with recovery cost of solid waste management services, policies and strategies for the attainment of sustainable solid waste management should focus on efforts at streamlining public attitude towards proper waste disposal, and in raising public consciousness about the needs and benefits of doing so.

In response to United Nations General Assembly resolution 44/228, section I, paragraph 3, chapter 21 on environmentally sound management of solid waste and sewage-related issues was added to Agenda 21 (UN, 1992). Essentially this document tasked the Commission on Sustainable Development to elaborate strategies and measures to halt and reverse the effects of environmental degradation in the context of increased national and international efforts to promote sustainable and environmentally sound development in all countries. The General Assembly also affirmed in section I, paragraph 12 of the same resolution that environmentally sound management of wastes was among the environmental issues of major concern in maintaining the quality of the earth's environment and especially in achieving environmentally sound and sustainable development in all countries.

The resolution called for the use of integrated life cycle management concept to address the root cause of solid waste related problem by attempting to change unsustainable patterns of production and consumption in a way that reconciles development with environmental protection. National programmes for the attainment of Sustainable Solid Waste Management should be driven by hierarchical objectives taking cognizance of the following hierarchy:

1. Minimizing wastes
2. Extending waste service coverage
3. Maximizing environmentally sound waste reuse and recycling, and
4. Promoting environmentally sound waste disposal and treatment.

Sustainable Solid Waste Management in any one country should take recognize of the interrelatedness and the mutual supportiveness of these four programme areas and the need to integrate them in order to provide a comprehensive and environmentally responsive framework for managing municipal solid wastes. “The mix and emphasis given to each of the four programme areas will vary according to the local socio-economic and physical conditions, rates of waste generation and waste composition. All sectors of society should participate in all programme areas” (UN, 1992). Table B4 to B7, appendix B presents a summary of the objectives, activities and implementation programmes related to each of these programme areas.

2.8 Policy Analysis, Design and Implementation

Since the middle of the 20th century when Harold Lasswell and others helped institutionalized Policy Science as a formal discipline, policy scientists have been engaged in methodological debates, especially on what epistemology scientists should buy for policy analysis (Wagle, 2000). Although, there are various perspectives, the methodological debate seems to have polarized into positivist and post-positivist approaches.

Positivism, a strong form of empiricism that rejects metaphysics and theology as seeking knowledge beyond the scope of experience, holds that experimental investigation and observation are the only sources of substantial knowledge. This is related to the belief that every intelligible proposition can be scientifically verified or falsified and that philosophy can only be concerned with the analysis of the language used to express such propositions (NSOED, 1993). It follows that in the positivist approach to policy science study (Policy Analysis) such techniques as modelling, statistical inference, operations research, cost-benefit analysis, and risk-benefit analysis are used to analyze policy problems. Development of more sophisticated statistical and analytical techniques, therefore, become crucial to policy analysis. Positivist policy scientists believe that the more rigorous the techniques used, the more they are likely to get precise outcomes (Wagle, 2000). Cost-benefit analysis a widely used empirical technique of policy analysis, for example involves assignment of monetary values to all seemingly measurable elements that play roles in particular policy problems (Meier, 1982; Wildavsky, 1979).

Post-positivist approach on the other hand, tends to base policy analysis on subjective understanding of the value systems that are important in any society. Under this approach, policy scientists seek inputs from the general public regarding how a particular problem is understood, how it can be unravelled, and what effects different policy alternatives will have in society. Various authors; DeLeon, 1997; Dryzek and Tongerson, 1993; Fischer, 1993 and 1998, have criticize positivist approach to policy analysis and label it as “unrealistic”. These authors pointed out that the use of such tools as cost-benefit analysis, risk-benefit analysis, and other empirical models in policy analyses simplifies policy problems and prescribes inaccurate solutions. The method of cost-benefit analysis, for example, will be inapplicable especially when one tries to measure public goods and “incommensurables”

Societal values can be variously categorized, (use values, non-use values and optional values) All these categories of values are involved in the way any society defines its problems and for that matter play important roles in finding solutions to them. Linder and Peters, 1984, asserted that evaluation is not the comparison of outcomes with objectives, but rather, ways of specifying values attached to particular policy instruments. The role of value system of any society therefore goes beyond definition of problems. Policy science is about analysis of fundamental social problems in order to provide policy makers with pragmatic action-oriented recommendations for alleviating the problems. Since experimental investigation and observation are the only sources of substantial knowledge from the positivist approach to policy studies, values other than use values may be eclipsed in this sort of policy analysis. Post-positivist policy research on the other hand is likely to capture subjective values such as non-use and optional values which form an integral part of the value system of any society and subsequently help in proper definition of societal problems and hence their policy solutions.

What is perhaps most important in policy analysis is not the debate over positivist and post-positivist methodological approaches because a synthesis of the two perspectives may help policy makers in making better informed decisions. This position was rightly echoed by (Majchrzak, 1984 p.12) “because there is no method specific to policy research, and because technical analysis contains arguments and scrutiny of information, researchers must be prepared to use whatever methodology is appropriate to the problem at hand” and one definition of public policy analysis that highlighted the perspective of Majchrzak is one provided by Nagel, 2001. Nagel defined public policy analysis as “determining which of various alternative public or governmental policies will most achieve a given set of goals in light of the relations between the policies and the goals”. This definition identified five key elements of policy evaluation. These are as follows:

1. Definition of goals, including normative constraints and relative weights for goals,
2. Determining what it would take to bring a second place or other placed alternative up to first place,
3. Determination of policies, programmes, projects, decisions, options, means, and other alternatives available for achieving goals,
4. Drawing a tentative conclusion as to which policy or combination of policies is best to adopt in light of the goals, policies, and relations, and

5. Establishing relations between policies and goals, including relations that are established by intuition, authority, statistics, observation, deduction, guesses, or by other means (Nagel, 2001).

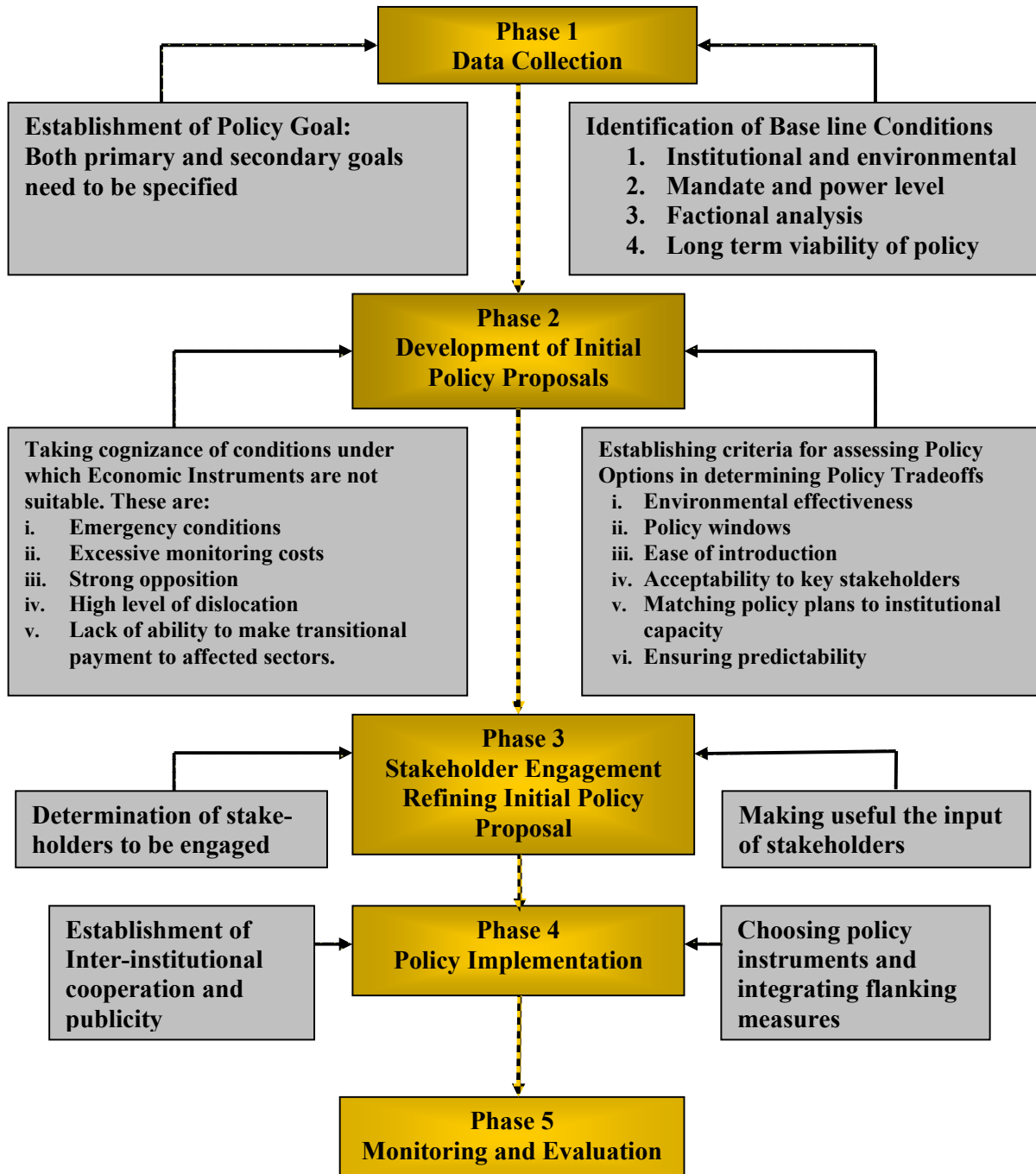
Nagel's perspective on policy analysis which was more or less a concept was captured in a policy process model developed by UNEP to provide a practical guide for policy makers and managers in developing an environmental policy package. The Functional elements of the UNEP policy process model represented diagrammatically in fig. 2.8, was used in developing a policy package to address plastic bag waste in Nairobi, Kenya. The model can be categorized into five phases which are as follow:

- i. Data assembly
- ii. Development of initial policy proposal
- iii. Stake holder consultation
- iv. Policy implementation
- v. Monitoring and Evaluation

Data Assembly

The data assembly phase involves definition of policy goals, identification of baseline conditions and taking cognizance of the need to incorporate measures that will ensure the long-term viability of policy package. Identification of baseline conditions is important for the development of realistic policy instruments and consequently for their successful implementation. Issues considered during identification of baseline conditions include institutional capacities, political realities and the power structure of various stakeholders and their interrelatedness.

Fig. 2.8 Environmental Policy Design, Selection and Implementation Model



Information for Diagram was taken from UNEP, 2005

Development of Initial Policy Proposal

With the definition of goals and identification of problems and baseline conditions, phase two of the policy development process essentially involves prescription of policy options to link the current state of affairs (Baseline Conditions) through the problems to desired state of affairs (Policy Goals). Prescription of policy options takes place within the confines of recognizing policy trade-offs and assessment of policy limitations. All policies involve trade-offs. While some policy instruments may appear from theoretical perspective to be most effective in achieving policy goals and objectives, they may be most difficult to implement in the light of existing political and institutional arrangements. Some times, there may be the need to incorporate subsidies into some policy packages to ease their implementation if it is realized that such policies although can be effective in attaining policy goals and objectives will be difficult to implement. The criteria for assessing different policy instruments in determining policy trade-offs include; environmental effectiveness, policy windows, ease of introduction, and acceptability to key stakeholders. In assessing policy limitations, there is the need to match institutional capabilities to policy plans. Policy options that involve extensive changes to existing institutional structures although theoretically may create the environment for realizing the best policy goals and objectives may not be practicable. There is the need to give priority to simpler solutions where these can achieve results. That is local solutions where problems are local. Another consideration in assessing policy limitation is the need for policy options under consideration to have clear operational rules to ensure predictability. Cognizance should be taken of the conditions under which economic instruments are less effective in achieving policy goals. Such conditions include; emergency situations, strong opposition, high level of dislocation, excessive monitoring cost, fragmented oversight authority, social stigma, lack of ability to make transitional payment to affected sectors etc.

Stake holder Consultation

Phase three of the policy development process involves engagement of stakeholders identified in phase one in refining initial policy proposal developed in phase two. Here, careful consideration is made to ensure that all categories of stakeholders are represented; Groups responsible for problem; Groups affected by problems and Groups that will be affected by one or more of the solutions. The identification of all stakeholders and the incorporation of inputs from all stakeholders ensure that the socially, politically, and the economically powerful individuals in the

society do not hijack the policy development process and succeed in orienting final policy prescription in their favor. There are various means to facilitate stakeholder input into the policy process and these include the following: early solicitation of input, usage of a variety of outreach programmes, clarifying to stakeholders the use to which information gathered will be put, publication of list of all stakeholders, explanation of decision taken, establishment of data provision window, and provision of policy comment window.

Policy Implementation

Phase **four** of the policy development process is concerned with the choice of final policy options and their implementation. The choice of final policy options is influenced and conditioned by baseline conditions identified in **phase one**, consideration of the output of integrating inputs solicited from stakeholder in **phase three** with provisional policy options outlined in **phase two**.

Policy implementation takes cognizance of flanking measures to mitigate adverse impact of policy implementation. Such impacts may include lose of employment resulting from placing ban on the production of certain items or dislocation. Flanking measures include among others subsidies and gradual phasing out instead of outright banning of product. Other issues of concern at this stage are establishment of inter-institutional cooperation and publicity. There is the need to establish inter-institutional networks needed for implementing policy options. In this respect, policy options that seek to solve problems of other sectors (ministries) are more likely to receive support from these other sectors. Publicity involves providing public information about policy package, steps involve and why a particular policy package is chosen among other options. The message should be simple and easy to understand. Consideration should be given the fact that the final policy package selected for implementation should meet established and acceptable criteria for environmental policy analysis. IDB, 2003 presented some criteria for assessing environmental policy instruments and these have been subjectively used in assessing the optimum policy choice for plastic bag waste management in Kenya, UNEP 2005. These criteria are presented in table 2.8

Table 2.8 Principles for Evaluating Environmental Policy Package

Evaluating Principle	Policy Implication
Environmental Effectiveness	Does the instrument lead to the desired environmental improvements, such as reduction in waste generation, increased waste recycling, reduced emissions from transport and disposal?
Economic Efficiency	Does the instrument create incentives for investment and innovation toward reduction of pollution control costs?-
Administrative Cost Effectiveness	Does the instrument require affordable and available levels of skill and effort to implement and monitor?
Revenue Usefulness	Are revenues generated able to be applied to address the environmental objectives of the instrument and adequate to create measurable improvement?
Ease of Implementation and Replicability	Are the relative costs and benefits relatively easy to assess and the legal requirements for introducing the new instrument reasonable?
Acceptance	Does the general public and the affected industries accept the instrument as a viable means of cost-effectively achieving environmental improvement without adversely affecting competitiveness, employment, income distribution, and trade
Distributional Effects	Is there distributional disparity or inequity in the application or impact of the instrument, particularly regarding effects on lower income households, small businesses, and disadvantaged parties?
Short-term Results	Does the instrument have the potential to result in sufficient short-term improvement to motivate political administrators to undertake commitment to the costs associated with the instrument during their political term?
Economic Development Enhancement	Does the instrument provide an environment that maintains trade competitiveness and encourages industrial development and employment generation?
Waste Type Applicability	Does the instrument address a wide range of waste types and have significant impact on overall urban waste quantities, or does the instrument address only a limited number of unique and important waste types?

Adapted from IDB, 2003

Monitoring and Evaluation

No policy decision is final because changing conditions, new information, and shifting opinions will require policy re-evaluation and revision. Other short-term forces and events, such as presidential or parliamentary election or environmental accidents can also profoundly affect the course of policy over its life-cycle. Thus policy at any time is shaped by the interaction of long-term social, economic, technological, and political forces and short-term fluctuations in the political climate. All of these factors manifest themselves in the implementation of policy options. There is therefore the need to monitor the policy progress to see if baseline conditions are changing in direction of policy goals over time. Monitoring and Evaluation should be included in the policy package from the onset. Monitoring generate new data that can be recycled through the policy process. Monitoring and evaluation should set up measurable parameter against which policy progress should by measured from the onset of policy development and since value system that determine what is progress or otherwise vary across different stakeholders, the opinion of all stake holders should be sought in defining parameters of policy progress.

3.0 Ghana and Solid Waste Management

3.1 Back Ground and Country Information

Ghana is located in West Africa along the Gulf of Guinea as shown in fig. 3.1.1 and covers an area of about 23.9 million hectares. The country extends between latitudes 4.5 degrees north on its southern coast to 11 degrees north inland. Ghana is divided into ten(10) administrative regions and each region is sub-divided into districts, municipality and or metropolis. Within each district, municipality or metropolis is an Assembly, a body consisting of elected individuals from local government electoral areas with authority to promulgate bye-laws.



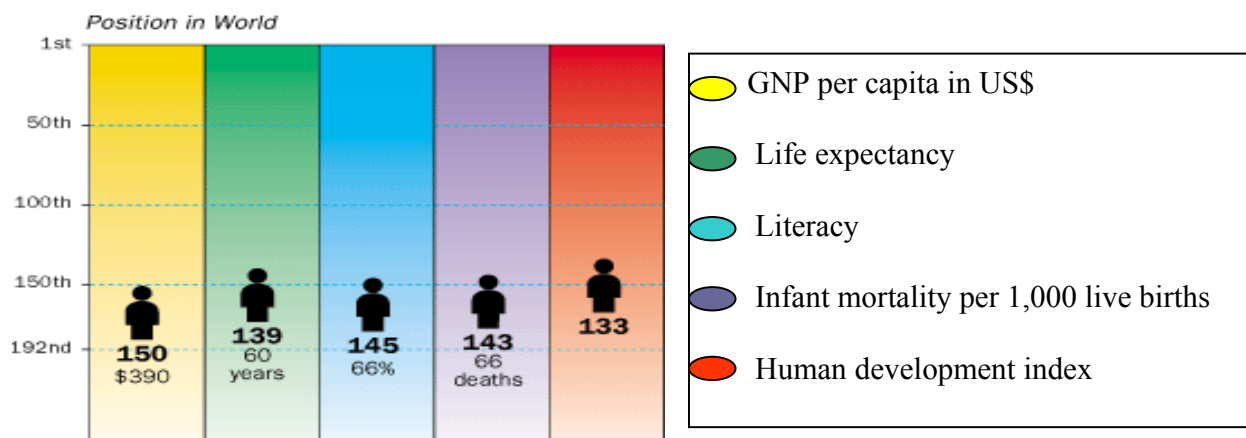
Fig.3.1.1 Map of Ghana

The District Assembly therefore constitute the ultimate political unit for the translation and implementation of national government policies and programmes. Ghanaians live in more than 47,800 towns and villages (Hens and Boon 1999). A national census in 2000 put Ghana's population at 18.8 million. The estimated population in 2005 was 21 million with a growth rate of 1.25% (Ghanaweb, 2005). The 2000 census put the population density of Ghana at about 78.9 persons/sq. km, however, the coastal districts representing approximately 6% of the country, are home to 25% of the nation's population. Like most developing countries the urban centres of Ghana are characterized by high population growth resulting from rapid rural-urban migration and unplanned infrastructural development.

At independence from the United Kingdom in 1957, Ghana was among the richest of tropical African countries. Political instability precipitated by military takeover of the first elected government headed by Kwame Nkrumah in 1966 and bad economic policies, however, have resulted in poor economic development for about 25 years (Gillis, 1988). A return to constitutional democracy in 1969 and 1979 did not last for more three years. Ghana finally returned to constitutional democracy in 1992 and has since enjoyed political stability with successive change of governments through the electoral system. Both presidential and parliamentary elections are held every 4 years, and the system of government is multiparty. The

domestic economy of Ghana is still pivoting on subsistence agriculture which employs about 60% of the work force and accounts for about 36% of the GDP with industry and services sectors contributing 25% and 39% respectively (Ghanaweb, 2005). Tourism is the third largest foreign exchange earner for Ghana. Export of Cocoa is the first followed by export of mineral resources such as gold diamond and manganese. Other economic and development indices relative to the rest of the world are as shown in fig. 3.1.2.

Fig.3.1.2 Position of Ghana in Comparison to Other Countries with Respect to Major Development Indices



(Source; Ghanaweb, 2005)

Although English is the official language, more than 75 other languages and dialects are spoken in Ghana (CCGG, 2000). The percentages of the major ethnic groups in Ghana are as follows: Akan 49.1%, Mole-Dagomba 16.5%, Ewe 12.7%, Ga-Dangme 8% (2000 Census). The trend in religious affiliation depicts a move from traditional African religion to either Islam or Christianity. In 1960, 45.14% of Ghanaians had no religion or were adherents of Traditional African religion. 12% were Muslims and 42.81% were Christians. In 1993, the proportion of the population that had no religion or were following traditional African religion dropped to 21.71%. Both Christianity and Islam, however, registered increases in the number of followers (NCSU, 1993). The proportions of the various religious representations captured in the 2000 national census were as follows: Christian 69%, Traditionalists 8.5%, Muslim 15.6%, others 6.9%.

3.2 Overview of Solid Waste Management in Ghana

Every human activity generates waste solid or liquid and sometimes in gaseous forms. The impacts of waste in the gaseous and liquid phase may persist long after they have been integrated into the natural environment and are no longer visible. Solid wastes on the other hand have an additional undesirable characteristic of “**visual persistency**”. In short, solid wastes persist in the physical environment as an eyesore apart from their interference with the functional elements of the ecosystem. Solid wastes usually remain where they are discarded. The adverse impact of waste and of solid waste in particular calls for institution of management measures to limit these impacts. Various authors have associated poor solid waste management to poverty in the developing countries. The connection, however, ramifies beyond just poverty to include public health and reconnects poverty through the economy. Ashton John, 2000, described Henry Duncan of Liverpool, the world’s first medical officer of health in 1847, as an environmentalist because of his concern for sanitation and water systems. Rhyner et al. 1995, pointed out that about 80% of all diseases in developing countries are related to unsafe drinking water, and there is a strong correlation between solid waste management and water pollution.

In Ghana, a study made by Attipoe, 1996, estimated environmental related diseases reported in the capital Accra to be between 60-80%. This finding is in fact a reflection of sanitation and in particular solid waste management situation in Accra and the country as a whole. Though policy makers and political leaders are aware of the deplorable state of solid waste management in Ghana, efforts to address the situation has so far remain at the level of political rhetoric. Although there is inadequate capacity to collect the waste generated in most of the urban centres, the main problems confronting solid waste management in Ghana are indiscriminate waste disposal habits of the populace and cost recovery of solid waste management services. As a result of indiscriminate waste disposal habits, open spaces and drains are laden with waste. There is also creation of unauthorized waste dumps as shown in fig.3.2. Waste collected by agencies responsible for waste collection and final disposal is also not disposed of in environmentally friendly manner. The following presents an overview of the solid waste management situation in Ghana based on the author’s field observation, interview with members of the general public and solid waste management officials in three cities in Ghana. The cities are; Accra, Kumasi and

Takoradi. Although there is a general paucity of information on solid waste management in Ghana, available literatures are appropriately referenced in this description.

Fig.3.2 Example of Unauthorized Waste Dump in the Outskirt of Accra



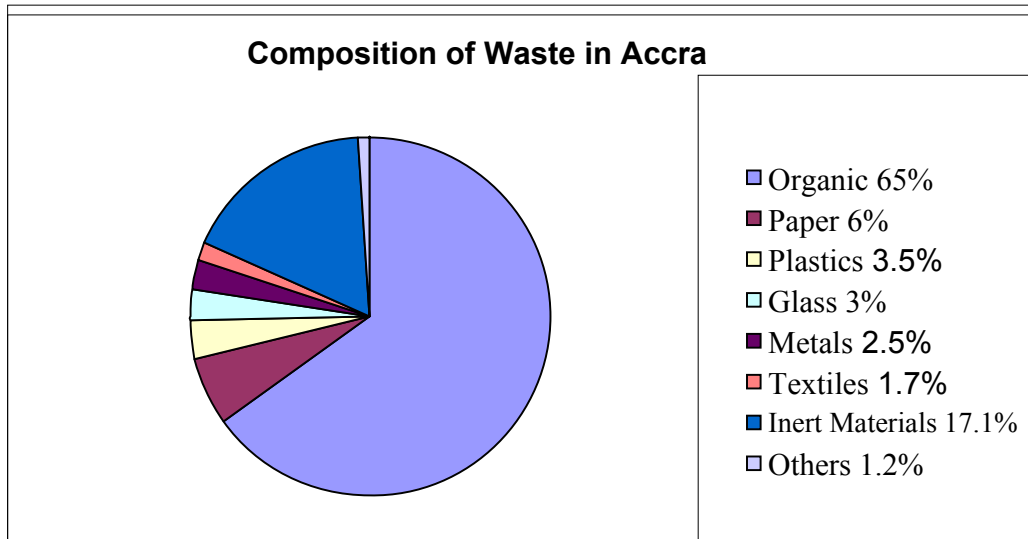
Source: GC, 2003

3.2.1 Waste Generation and Handling at Source

Based on a population estimate of about 20 million and an estimated daily per capita waste generation of 0.45kg, GEPA, 2002, put Ghana's annual solid waste production at about 3.3 million tons. The main problem confronting waste handling at source is the general unconcerned public attitude in connection with proper waste storage and disposal. This has resulted in indiscriminate waste disposal (littering) and the creation of unauthorized waste dumps. This situation should be visualized against the background that various district and metropolitan by-laws make illegal indiscriminate waste disposal (littering). The legal provisions on waste handling at source assign ownership of waste to the responsible governmental agency only after the waste has been deposited "All waste deposited in the public domain shall be the property of the District Assembly" (MLGRD, 1999). In this respect, the generator of waste can chose to do whatever he deems necessary with the waste he generates prior to its deposition in the public domain. The main causes of public indiscriminate waste habits, however, can be ascribed to lack of awareness, absence of proper waste disposal culture, and lack of institutional structures that facilitate proper waste disposal. A review of the legal provisions in connection with ownership of waste is necessary. There is the need to assign ownership right of waste prior to its disposal to the agency responsible for waste collection. The agency will then be able to dictate to waste

generators how the waste to be generated should be handled at source prior to collection for disposal.

Fig. 3.2.1 Composition of Waste Generated in Accra



Density = 470Kg/m³

Moisture Content = 40%

Data for Diagram was obtained from Accra Metropolitan Assembly (AMA) Waste Management Department

Composition analysis of waste generated within Accra metropolitan area shows that almost two third of the waste generated is organic or biodegradable as represented in fig.3.2.1 above. Although there is no formal programme of waste separation at source, most materials remain in the waste stream only when no use can be found for them. Informal waste separation occurs at two main levels. At the household level in rich neighbourhoods and at waste dumps. Domestic servants working in rich neighbourhoods pick items that can be used directly or recycled by a second or third party. At waste dumps scavengers are constantly searching through freshly tipped waste for items of economic value. Items recovered from waste include; plastic bags, bottles, paper, cardboard, and cans. Non ferrous metals such as tin and aluminium have high demand. These items are sold to small scale smelting and moulding industries where they are recycled into cooking utensils. Recovery of ferrous metals is also very high because these metals can be sold through middlemen or directly to large scale smelting industries. This informal waste recovery system is characteristic more of the large cities and towns than of the rural areas. In rural areas,

waste recycling takes place principally at the household level where food waste is recovered as animal feed.

In both rural and urban areas, a modified deposit-refund system exists for the recovery and reuse of bottles for alcoholic and non-alcoholic beverages. When beverages are sold in a crate (a pack of 24 bottles), the price of the bottles is included in the sales price. The value of single bottles is not high enough to serve as incentive for consumers to return bottles. Recovery of single bottles therefore is achieved in two ways. In one approach, retailers retain some money (usually the change of the purchaser) in excess of the value of the bottles. The money is returned once the consumer returns the bottles intact. In the situation where a bottle is broken, the actual price of the bottle is deducted from the purchaser's money that is being retained by the retailer. In a second approach the consumer/purchaser brings his own empty bottles in exchange for finished products. Almost all retail outlets operate the two systems simultaneously so that consumers are not deprived of products by reason of not having empty bottles of their own. This modified deposit-refund system has one main drawback. Because there is no bottle recycling programme, deformed bottles (broken bottles even slightly broken ones) are rejected and end up in the waste stream.

Storage of commingled waste at source is achieved through the use of different containers. In high income and middle income areas of the urban centres where house to house waste collection is carried out, modern two-wheeled 70 litre plastic containers are used. These containers are adapted to fit into the lifting device of the collecting vehicles. In low income areas where central containers are used to receive waste from surrounding community, containers are often metal with capacity of 20m³. In low income areas and in rural areas, all types of containers are used for storage of waste at the household level prior to disposal in the central containers. This waste storage containers include; baskets, plastic bags, cardboard boxes, wooden boxes, etc. These types of household waste storage containers are sometimes used in areas served by house to house waste collection services when the modern two-wheeled containers are not available as shown in fig.3.2.2. Considering the fact that organic waste constitutes in most cases more than 60% of the waste generated in the urban centres in Ghana, composting to produce manure or processing waste to produce biogas can be a viable economic venture. This would have the added advantage of considerably reducing the amount of waste destined for final disposal. The amount of

the organic component of waste produced in the rural areas could be lower or higher than that produced in the urban centres. In rural areas where there is recycling of food waste as feed for domestic animal, the component organic waste of the total waste produced would be expected to be lower than that produced in the urban areas and vice versa when there is no or little processing of food waste as animal feed.

Fig.3.2.2 Waste Collection in Accra and Types of Waste Storage Containers at Source



Source: BFT, 2003

3.2.2 Waste Collection and Transport

In line with the prescriptions of a new government policy on waste management in 1999, the solid waste management sector in Ghana was reformed to allow private sector participation in solid waste collection transport and disposal in the major cities. Prior to this reform, collection, transport and disposal of solid waste was carried out **free of charge** by the waste management departments of the various municipal or metropolitan authorities. With the reform, major cities

and towns were zoned into solid waste management units, and private companies granted the right of collection, transport and disposal of solid waste within the various zones. Accra the capital for example was zoned into 15 solid waste management units, and Kumasi, the second largest city was divided into seven (7). Each waste management zone is classified into high income, medium income and low income residential areas.

Private sector participation in solid waste management is limited to waste collection, transport and disposal. Each waste management zone is assigned to only one private waste collection company. House to house waste collection is carried out within **high income** and **medium income** residential areas at rates agreed on with the District/Municipal or Metropolitan Assembly, the residents and the private waste collecting firm. On the other hand, the Assembly pays the private company for waste collected from low income residential areas where waste from homes is brought to **communal waste containers** situated at vantage positions. The rate agreed on with the Assembly and collected by private waste collection company from residents in house to house operations depends on:

- i. The waste management zone
- ii. The traffic situation within the city
- iii. Distance to waste disposal facility, and
- iv. Classification within zone (high or medium) residential area

Fees charged to residents by private companies involved in house to house waste collection therefore varies from urban area to urban area and within an urban area from waste management zone to waste management zone. Table 3.2.2 shows comparison of rates charged to residents in 3 urban areas and the percentage of the populace covered by house to house waste collection. The municipal assembly pays private waste collecting firm per ton of waste collected from communal waste containers and the private waste collecting firm pays a tipping fee for disposal of waste collected in waste dumps controlled by the municipal assembly. The main problem facing private sector participation in waste management in the urban centres in Ghana is the inability of the various assemblies to pay private waste collecting companies in time, for waste collected from communal waste containers which form more than 70% of the total waste stream in most urban areas (BFT, 2003; ADM, 2002; GNA, 2003). There is also a high incidence of default in payment of monthly rates for house to house waste collection. In most urban areas where private sector participation has been introduced into waste collection and disposal, the waste

management department of the municipality retains and maintains the capacity to carry out about 20% of waste collection and disposal in selected areas.

In middle income areas with poor access roads and poorly designed alleys waste is collected with push carts by people engaged by the private company within whose waste management zone the area is located. Even in low income areas, there are some households who prefer to engage the services of others to collect and dispose of their waste especially in instances where the communal containers are located at some distance from these households. Pre-collection services in such situations are provided by local youths (or some unemployed individuals) who charge some minimal amount for their service. The waste collected is finally discharged into communal containers or disposed of at an unauthorized waste dump. There are no organized waste collection services in small towns and rural communities. Such rural communities usually identify natural depressions or abandoned sand or clay pits to serve as their waste dumps, and in coastal communities, disposal of waste on the beach is a common practice.

Table 3.2.2 Types of Waste Collection Operation and the Average Rates Charged to Residents in Three Cities in Ghana as of June 2005

Urban Area	Waste Collection Operation Type	Rate Charged to Residents/month	Percentage of total Population
Accra	House to House (High Income)	\$ 10	20-25 %
	House to House (Medium Income)	\$ 6	
	Communal Containers (Low Income)	Free	75-80%
Kumasi	House to House (High Income)	\$ 2.5-3	20%
	House to House (Medium Income)	\$ 2	
	Communal Containers (Low Income)	Free	80%
Takoradi	House to House (High Income)	\$ 2-2.5	15%
	House to House (Medium Income)	\$ 2	
	Communal Containers (Low Income)	Free	85%

3.2.3 Processing and Treatment of Waste

In most cases municipal solid waste is disposed of without any processing and or treatment. Given the composition of waste analysis for Accra¹ which could be taken to represent waste composition for the whole country, and with the high initial capital requirement for the establishment of incineration plants, the most viable waste treatment options that could be adopted in Ghana are; composting and or biogas production. However, the current system of waste handling at source with no waste separation could be a serious draw back to any biological treatment of waste. Because there is no formal programme of waste separation at source, potentially hazardous waste such as household cadmium batteries, insecticide containers, paint containers etc are included in municipal waste. Although there is currently a small scale waste composting facility in Accra which involves co-composting of treated human waste sludge and solid waste, the plant is inefficient and often not operational. In most cases medical and clinical waste are treated by incineration in open pits with no environmental control.

3.2.4 Waste Disposal

All over the country waste collected is disposed of in waste dumps. Though there are such daily operations as vector and rodent control and covering of waste with soil at authorized waste dumps, these waste disposal facilities in most urban areas are not properly designed and engineered facilities. They are either natural depressions or old quarries which have been adopted for waste disposal. In the rural areas and smaller towns, communities dispose of their waste in natural depressions or in abandoned sand or clay pits, and in coastal communities, disposal of waste on the beaches is a common practise. All over the country solid waste is ultimately disposed of in both authorised and unauthorised waste dumps. “ All kinds of wastes, regardless of their nature, are being dumped indiscriminately into depressions, sand pits, old quarries, beaches, drains and even in certain areas, along streets, without due regards to the nuisance and harm caused to the environment”(GEPA, 2002).

Although there is a new policy to construct sanitary landfills in most of the major cities, only one is completed and operational in Kumasi at the time of this research. There is however, no plan to recover biogas for use in any of these projects. Two other sanitary landfill projects are under

¹ Refer to fig.3.2.1 for details

construction, one in Accra and the other in Tamale. The project in Accra has been interrupted on many occasions as a result of opposition by residents of Kwabenya, the community close to (within) where the project has been sited (GC, 2001; GNAA, 2004). There have been community opposition to other sites that have been adopted for waste disposal by Accra Metropolitan Assembly (AMA), and there had been community opposition to the development of the current waste disposal site at Oglogbo (GC, 2001). JO, 2001 also reported opposition by residents of Mallam to the continued disposal of waste at a waste disposal site located close to this community. The instances cited, although are related to Accra is typical of the siting and operation of solid waste disposal facilities in the urban centres of Ghana. The point is, because every human activity generates waste, there is the need to integrate waste management including waste disposal options in all regional development planning. This will lead to designation and demarcation of land exclusively for the siting of solid waste management facilities and consequently avoid encroachment on land designated for other community projects which often leads to community opposition to the siting of waste management facilities.

4.0 Research Design and Methodology

The design of a research is literally the plan with respect to how a research should be conducted (Leedy, 2001). Issues of major concern include: The type of information or data to be gathered and the data collection technologies to be used, area (location) where the research will be undertaken, form and nature of data to be collected, organization and analysis of data etc. These considerations, however, are driven by the goal of the research and the resources available for carrying out the processes (Berg, 2004; Henry 1998).

The goal of this survey is to gather information related to constraints to sustainable solid waste management in Ghana, and essentially, to sample the views of the populace on solid waste management policy and to synthesise the results into a policy package design for addressing the situation. It is not the goal of this survey to investigate how socio-economic or socio-cultural variables and constructs of respondents are related to waste management issues. Information and data gathering were also directed towards acquiring inputs from respondents for the development of a conceptual policy implementation model for implementing policy proposals.

Data collection was carried out in three cities; Accra, Kumasi and Sekondi-Takoradi in Ghana between March and June 2004. Interviews were held with solid waste management officials in both the public and private sectors, and with members of the general public. Questionnaires were administered to all members of parliament and to a cross section of the general public. Data collection also involved personal observation and desk review of national and municipal environmental related publications and records.

4.1 Design of Questionnaire

A variable is something that can take more than one value and the value could be a number or word. Whether the instrument of data collection is interview with semi-structured questionnaires or administration of questionnaires, the basic element in most social researches is about asking questions. Questions are about variables which are measured by their indicators. In a question such as “What is your age?” the variable “age” can take a number of values representing the number of years (indicator) that different individuals have lived since their birth. While some variables and their indicators are easily observed and measured, others are more conceptual, lack

concrete indicators, and are difficult to measure. For example a concept such as “environmental consciousness” of individuals is a complex concept with no clear indicators. Complex concepts are often referred to as constructs. The difficulty associated with the measurements of such complex concepts as a result of lack of concrete indicators is further exacerbated by lack of specificity in their definitions. Complex concept can, however, be measured by operationally defining them. Operationally defining a concept concretizes the intended meaning of the concept in relation to a particular study and provides some criteria for measuring the empirical existence of that concept (Frankfort-Nachmias and Nachmias, 1996; Leedy 2001). This involves reducing a complex concept into simpler variables and hence asking and consequently, obtaining answers to many questions in order to be able to measure a complex concept. This research which is related to sustainable solid waste management in Ghana clearly defined what is meant by sustainable solid waste management. This is followed by a series of questions that cumulatively provide assessment of the current waste management system. The questions also elicited information from the general public with respect to their perceptions of approaching the problems of the solid waste management system from three broad policy perspectives; the use of appropriate taxes, regulatory measures and public education to change undesirable behaviours associated with waste management¹.

In composing questions to give a researcher an indication about concept(s), the researcher is requesting respondent(s) to make decision in connection with measuring variable(s). Variables can be measured at four levels depending on the nature of the variable and the way questions about variables are asked. The four levels of measuring a variable in ascending order of “concreteness” are: Nominal, Ordinal, Interval, and Ration. The general principle underlying measurement of variables is that, **measurements should always be done at the highest level possible**. Table 4.1 below summarizes the attributes of these levels of measurement

¹ Samples of questionnaires for both groups of respondents are included in appendix A1 and A2

Table 4.1 Characteristics of the different Levels of Measuring Variables

Level of Measurement	Measurement	Attributes
Low	Nominal	The values of a nominal variable comprise a list of names and this is a qualitative measurement. This gives no information regarding degree or amount. For example what is your name? or are you a male?
High	Ordinal	The values of ordinal variables can be rank-ordered. The scales of opinion, the familiar strongly agree, agree, neither agree or disagree, disagree and strongly disagree are ordinal measures.
Higher	Interval	Like values of ordinal variables, those of interval variables have rank-order structure. In addition to this, the distances between the rank orders are meaningful. They represent true quantitative measurements as in the difference between series of consecutive temperature scales for example 30°C-40°C, 40°C-50°C etc.
Highest	Ratio	Ratios are interval variables that have a true zero point. The measurement includes a level of the absence of the phenomenon being measured. Because of a true zero point, the measurements exhibit ration properties.

Other considerations of survey instruments are the need for such instruments to be **valid, reliable and precise, and accurate**. Tyson et al. 1998, pointed out that in order for surveys to be useful, the survey instrument should meet special requirements. The most outstanding of these requirements are validity, reliability, and objectivity. Reliability indicates how well or badly a specific parameter is measured by the test applied or the questions asked. Objectivity on the other hand indicates the extent to which the results are independent of the researcher. Validity which refers to the accuracy and trustworthiness of instruments, data, and findings in research can further be categorized into: face validity, content validity, construct validity, and criterion validity. Face validity involves simply, looking at the operational indicators of a concept and deciding whether or not on the face of it, the indicators make sense. Face validity is based on consensus among researchers. Content validity is related to whether an instrument (questionnaire) has the appropriate content (contain relevant questions) for measuring a complex concept, or construct. An instrument has high construct validity if there is a close fit between the construct it

supposedly measured and actual observations made with the instrument. Criterion validity is related to the closeness of fit of the measurements produced by the instrument and those produced by some other instruments that is known to be valid.

In designing the questionnaires for this research, a great deal of caution was taken to ensure validity, reliability and objectivity of the measuring instruments. Measures taken in the design of questionnaire include expert rating of the various questions included in the questionnaire. There was also pre-testing of questionnaires. This involves sending questionnaire to individuals who have insight into the issue under study. These people were asked to criticize the questions and give suggestions as well. Minor problems identified including seemingly ambiguous questions were addressed before the questionnaires were sent to the actual respondents.

4.2 Administration of Questionnaires to Members of the General Public

Selection of respondents was achieved through clustered random sampling of religious groups in three cities located in three different regions of the country. Ghana is divided into 10 administrative regions and the cities studied are all regional capitals. Accra apart from being the capital of Ghana is also the capital of Greater Accra region, Kumasi is the capital of Ashanti region, and Sekondi-Takoradi is the capital of Western region¹. Selection of respondents within a cluster (a church or mosque) was adopted because of the limited resources available to the researcher and religious groups were chosen because the researcher is interested in evaluating the roles of leaders of such organized groups in a conceptual policy implementation model. As pointed out by UNEP 2005, policy failure in the developing countries is more related to the implementation phase than to any other phase in the policy development cycle. This research therefore intends to propose a new model for the implementation of the policy package that will be put forward.

Although Henry, 1998 pointed out that labelling a sample as representative reflects nothing more than the subjective judgement of the writer, there are criteria that determine how sampling contribute to the total error associated with any research. The concern of any researcher is to limit

¹ The respective locations of the three cities surveyed can be found on a map of Ghana fig.3.1.1 under section 3

total error associated with research findings. In connection with sampling, the issues that need to be taken cognizance of so as to reduce error are related to the following questions:

1. Have the methods for selecting subjects or units biased the sample?
2. Are the estimates or sample statistics sufficiently precise for the study purpose?
3. Is the population from which the sample is drawn consistent with the population of interest for the study? (Henry, 1998).

Taking measures to address these three questions is important to reducing total error in design of sampling. Total error of sampling which is connected to the three questions above can be categorized into; non-sampling bias, sampling bias and sampling variability.

The selection of sampling units and respondents in each of the three cities studied was carried out taking cognizance of the three questions above in order to reduce total error of sampling. This research targeted religious groups in three cities in Ghana. A national census in 2000 identified the following religious representations: Christian 69%, Traditionalists 8.5%, Muslim 15.6%, others 6.9%. Ideally data collection should have been carried out on individuals at the household level in randomly selected cities and villages across the entire nation. Resources and time, however, would not allow the researcher to adopt this approach. The choice of religious groups as a cluster for the selection of respondents is based on the assumption that religious affiliation has no influence on the perception of individuals with respect to the assessment of the problems of solid waste management situation in the country and on the introduction of policies to address the situation. It should, however, be noted that religious affiliation could have influence on the waste disposal habit of individual. The research therefore did not ask respondents to report on activities related to their own waste disposal habits¹. Some element of non-sampling bias is expected to be included in the findings of this research because non-response associated with this research is not randomly distributed. This, however, is more related to lack of seriousness and concern of some of the contact persons engaged and trained for the administration and retrieval of completed questionnaires. Some religious groups, have also been left out in the sampling process (in particular groups associated with traditional African religion). This is because these groups are not represented by identified central organisations.

¹ Reference can be made to a sample of the questionnaire used for members of the general public selected from religious units (churches and mosques)

In this research respondents were randomly chosen once a religious unit a church or a mosque has been chosen. In each city selection of Christian religious units (church) was based on a list of churches provided in a 1993 national church survey (NCSU, 1993). Although this document listed the churches located in the various regions rather than in the cities studied it was realized that the churches listed in each of the three regions related to this research are present in the regional capitals of the cities that were studied. The listings of churches in the regions therefore were used as the listing of the churches in the capitals. There was no such information on the number of mosques in each city. Selection of a mosque in each city therefore was approach as follows. In each city, an Islamic institution was identified to provide a list of 10 mosques in the city out of which two were chosen as sampling units.

After a religious unit (a church or a mosque) is selected, the selection of a respondent was carried out as follows. The religious leader of a selected unit was contacted and the goal of the research and some background information were explained. The leader was made to understand that the choice of his/her unit was by chance. The consent of the leader was then sought with respect to the use of the unit for the research exercise. The opinion of the leader was then asked in connection with a member of his congregation who would be willing to help in administration of the questionnaire to other members of the congregation. This contact person was then given some orientation with respect to the administration of the questionnaire. The contact person was also asked to give explanation to some questions to respondents who would have difficulty understanding these questions. In order to simulate a random selection process, assistants were instructed to administer questionnaires to every other second member of their congregation starting from the first person as members enter the religious unit (church or mosque). In instances where congregations were small, the distribution frequency was to be every other person.

Follow ups were done through research assistants/contact persons within each sampling unit. After a period of two months, completed questions were collected from assistants. In spite of the fact that some monetary incentive was provided to assistants, there were instances where no completed questionnaires were retrieved. In Accra 10, religious units consisting of two mosques and 8 churches were selected and 40 questionnaires were administered within each religious unit. The number and composition of sampling units selected in Kumasi and Takoradi were the same as those of Accra, however, the number of questionnaires in both cases were reduced to 30. The

number of questionnaire administered and the response rate recorded in each city is as presented in Table 5.3.1.

4.3 Administration of Questionnaires to Members of Parliament

The administration of questionnaires to members of parliament was carried out in April and May, 2004 and all 200 members of parliament were served. The questionnaires with covering letters explaining the purpose and background of research were distributed in the letter boxes of the parliamentarians after obtaining permission for doing so. Each questionnaire was accompanied with an addressed and stamped envelope for the return of the completed questionnaire. Each questionnaire had two parts. In the first part, questions were structures to elicit the views of parliamentarians with respect to:

- i. The level of importance of identified constraints to sustainable solid waste management in the country, and the difficulty or otherwise with which the constraints can be mitigated.
- ii. The support for three main policy instruments; regulatory measures, education and public awareness creation, and appropriate taxes to influence public indiscriminate waste disposal habits.
- iii. The level of impact of the three main policy instruments mentioned and the difficulty with which these can be implemented.

The questions in this category were closed-ended and the options were arranged in a Likert scale, other types of ordinal scale, and in nominal choices. The second part of the questionnaires solicited information with respect to the background of respondents¹.

Two weeks after respondents were served with the questionnaires, they were sent reminder letters to prompt those of them who had not returned the questionnaires to complete and return them. The response rate with respect to political party recorded in this exercise is reported in fig. 5.4.1

¹ A sample of question for members of parliament is included in appendix A2

4.4 Interviews

Apart from the administration of the two sets of questionnaires, interviews were conducted using semi-structured questionnaire¹ with government officials involved directly and indirectly with solid waste management, management and employees of private companies involved in waste collection and disposal, and with members of the general public.

¹ Refer to appendix A3 for a sample of semi-structured questionnaire used for all interview sections

5.0 Results, Analysis and Discussions

5.1 Interviews

Interview with members of the general public and with solid waste management officials provided information with respect to the status of waste management in the country as presented in part under chapter 3. This exercise also provided input for the development of questionnaires used in the data collection exercise. Interview results also helped in the development of the policy package for the attainment of sustainable solid waste management in Ghana

5.2 Analysis of Responses to Similar Questions

In order to compare the perspectives of members of the public and those of parliament on policy issues related to solid waste management, similar questions were included in the questionnaire for the two categories of respondents. The following presents a comparison of responses to these similar question types. Analysis of the responses was carried out using Statistical Package for the Social Sciences (SPSS).

5.2.1 Assessment of Current Solid Waste Management (SWM) System

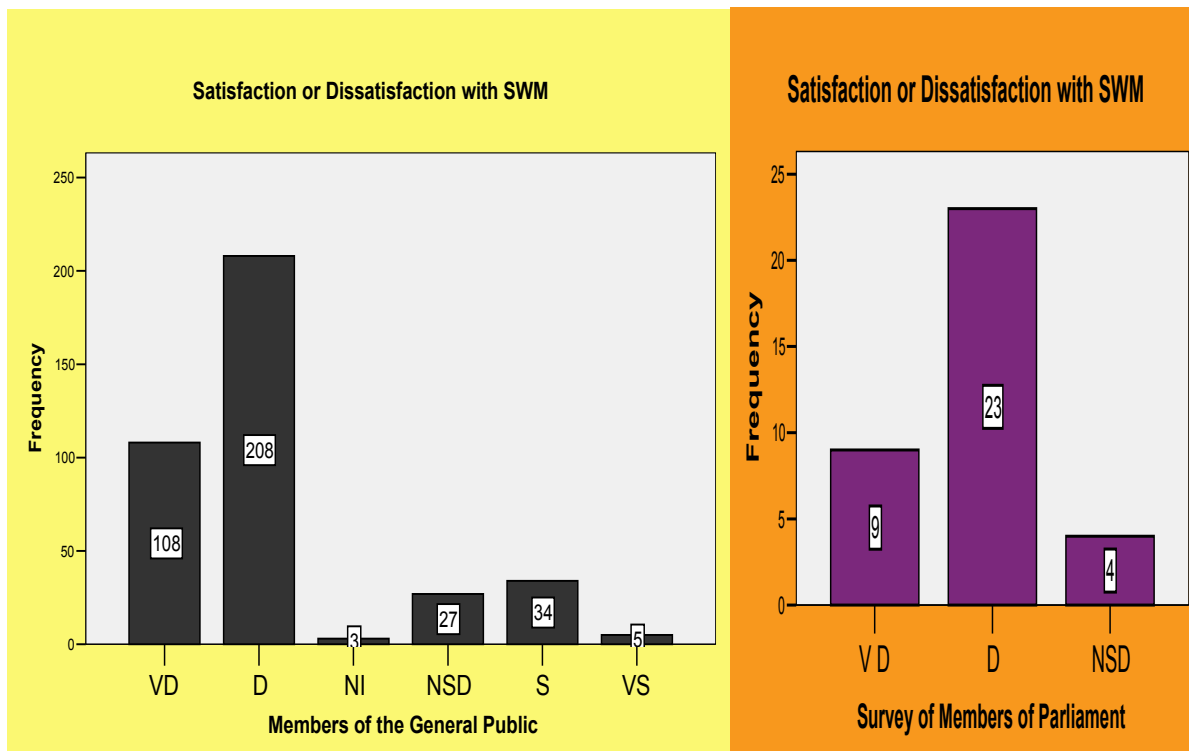
The demand for more quality environment in terms of more effective solid waste management services resulting in proper sanitation normally increases with increase in the socio-economic status of individuals (Inglehart, 1997). In the developing countries with a wide disparity between the rich and the poor, it is the poor neighbourhoods in the urban areas especial that have serious problem with solid waste management and sanitation. One approach to solving societal problems is to change the way society thinks about itself. In trying to change the way society thinks about itself, it is first of all necessary to take into consideration the way the society of interest has generated it own values, as a result of interacting flux of events and ideas unfolding through time (Checkland, 1994). It was therefore necessary to assess the current solid waste management system in Ghana from the perspective of respondents. If society by its own standards does not recognize the existing deficiencies, when in fact there are (at least from the perspective of policy makers or analysts), then policy intervention in this case would better be directed towards facilitating learning within the system, by enhancing opportunities for dialogue (between policy implementers, and subjects) over desired values and stimulating reflection by subjects on their

own reactions to change as was advanced by Schön and Rein 1994. This survey therefore included an instrument (a question) to measure the current solid waste management system in Ghana from the perspective of respondents. Fig.5.2.1 is the result of processing responses to a question¹ which asked respondents to express their level of satisfaction or otherwise with the solid waste management system in the country.

The solid waste management situation in Ghana was one characterized with open spaces strewn and open drains laden with all types of waste especially plastic waste. In general, both categories of respondents were dissatisfied with the existing waste management system. The proportion of members of the general public that was dissatisfied with the existing solid waste management system was 82.1% (54% Dissatisfied + 28.1% Very Dissatisfied) and that of members of the parliament was 88.9% (63.9% Dissatisfied + 25.0% Very Dissatisfied)

¹ Refer to question 1, appendix A1 for members of the general public and question 1, A2 for members of parliament

Fig.5.2.1 Satisfaction or Dissatisfaction with SWM



Members of the General Public					
Legend	Response Categories	Frequency	Percent	Valid Percent	Cumulative Percent
D	Dissatisfied	208	53.5	54.0	54.0
NI	No Idea	3	.8	.8	54.8
NSD	Neither Satisfied nor Dissatisfied	27	6.9	7.0	61.8
S	Satisfied	34	8.7	8.8	70.6
VD	Very Dissatisfied	108	27.8	28.1	98.7
VS	Very Satisfied	5	1.3	1.3	100.0
	Total	385	99.0	100.0	
Missing	No Response	4	1.0		
Total		389	100.0		

Members of Parliament					
	Dissatisfied	23	63.9	63.9	63.9
	Neither Satisfied nor Dissatisfied	4	11.1	11.1	75.0
	Very Dissatisfied	9	25.0	25.0	100.0
	Total	36	100.0	100.0	

In the three cities surveyed, about 30% of the populace in high income areas of these cities enjoy house to house waste collection services. The proportion of respondents among members of the general public who indicated satisfaction with the existing solid waste management system was 10.1% (1.3 Very Satisfied + 8.8 Satisfied). Members of this group who perceived the waste management system to be satisfied might be residing in one of those high income residential areas where house to house waste collection services are provided. With members of parliament no respondent indicated dissatisfaction with the existing waste management system although 7% were non-judgemental. It is not clear why some members of this group (the legislature) who should be very explicit on such issues of social importance as solid waste management would be indecisive with respect to the state of solid waste management in the country.

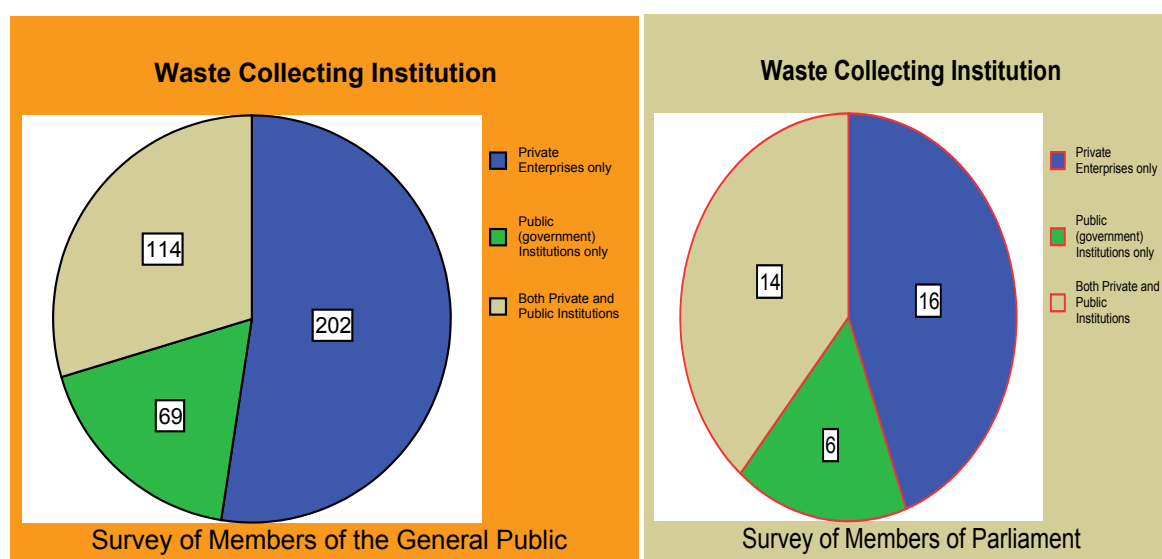
5.2.2 Waste Collection and Disposal Authority

Based on a mixed feelings expressed by members of the public during the interview phase of this research in connection with the efficiency of waste collection by both the private companies engaged in waste collection and disposal and by the waste management department of the metropolitan authority/assembly of the cities studies, it was decided to ascertain which of the two groups was better perceived by the public as well as members of parliament to carry out the function of waste collection and disposal. Fig.5.2.2 is analysis of a question that asked respondents to indicate their preferred agency that should be tasked with waste collection and disposal¹. In both cases majority of respondents indicated that the function of waste collection and disposal should be carried out by private enterprises. A combination of both public and private companies was recognized by the second largest proportion of respondents to be most suitable for waste collection and disposal in both cases with government institutions coming last. The management of most of the private companies involved in waste collection and disposal have indicated that the main hindrance to their operations is the delay by city authorities to pay them on time for waste collected from low income areas which constitute about 70 percent of their operational areas. Resolving issues related to payment for services rendered by private companies on behalf of city officials for waste collection and disposal from low income areas therefore can enhance the operations of these private companies and subsequently further increase the trust of

¹ The related questions are; question 4 appendix A1 for members of the general public and question 3 appendix A2 for members of parliament

the public in private waste collection firms. It seems difficult to have some sections of the populace pay for the disposal of the waste they generate for which reason government pays private companies to carry out waste collection and disposal in these low income areas. Active participation of members of such low income areas should necessarily be secured in a way that impact efficiency and effectiveness to service delivery.

Fig. 5.2.2 Preferred Waste Collection and Disposal Authority/Agency



Members of the General Public					
	Response Categories	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Private Enterprises only	202	51.9	52.5	52.5
	Public (Government) Institutions only	69	17.7	17.9	70.4
	Both Private and Public Institutions	114	29.3	29.6	100.0
	Total	385	99.0	100.0	
Missing	No Response	4	1.0		
Total		389	100.0		
Members of Parliament					
Valid	Private Enterprises only	16	44.4	44.4	44.4
	Public (Government) Institutions only	6	16.7	16.7	61.1
	Both Private and Public Institutions	14	38.9	38.9	100.0
	Total	36	100.0	100.0	

5.2.3 Most Problematic Waste

The goal of this research, of mitigating policy constraints to sustainable solid waste management in Ghana, involves defining solutions within the constraints of local, social and economic conditions. By ascertaining the most problematic waste from the perspective of respondents (the public) policy measures aimed at addressing the solid waste management problems can focus more on this type waste. It was identified during the interview section which provided inputs for designing the questionnaires that, three waste types; bio-waste, plastics, and scrap metals were regarded as most problematic. Fig.5.2.3 is an output of analysis of responses to a question¹ that asked respondents to identify among three options the waste type they consider to be most problematic. The identification of plastic waste as most problematic by respondents stems from the fact that it is the most visible indicator of the problems confronting the solid waste management sector in Ghana. Plastic waste forms only about 3.5% of the waste stream of the urban centres in Ghana², however, unconcern and indiscriminate waste disposal habit of the populace has resulted in serious littering with plastics.

The identification of plastics as the most problematic waste type by most respondents clearly underscores the need for policy measures to address it. With the survey involving members of parliament, all respondents identified plastics as the most problematic waste. The underlying factors which have projected plastic waste to be perceived by majority of respondents as the most problematic waste in the county are indiscriminate waste disposal habits of majority of the populace and creation of unauthorized waste dumps. These have very little connection with lack of finance which is perceived as the most important constraints to sustainable management of solid waste in Ghana³. Resolving issues related to indiscriminate disposal of waste and creation of waste dumps therefore can have considerable impact on waste management in Ghana. The waste management sector can focus all its energy and resources into waste collection and subsequent waste disposal in an environmentally friendly manner if they do not have to deal with unnecessary street sweeping and cleaning of public places.

¹ The related questions are; question 6, appendix A1 for members of the general public and 4, appendix A2 for members of parliament

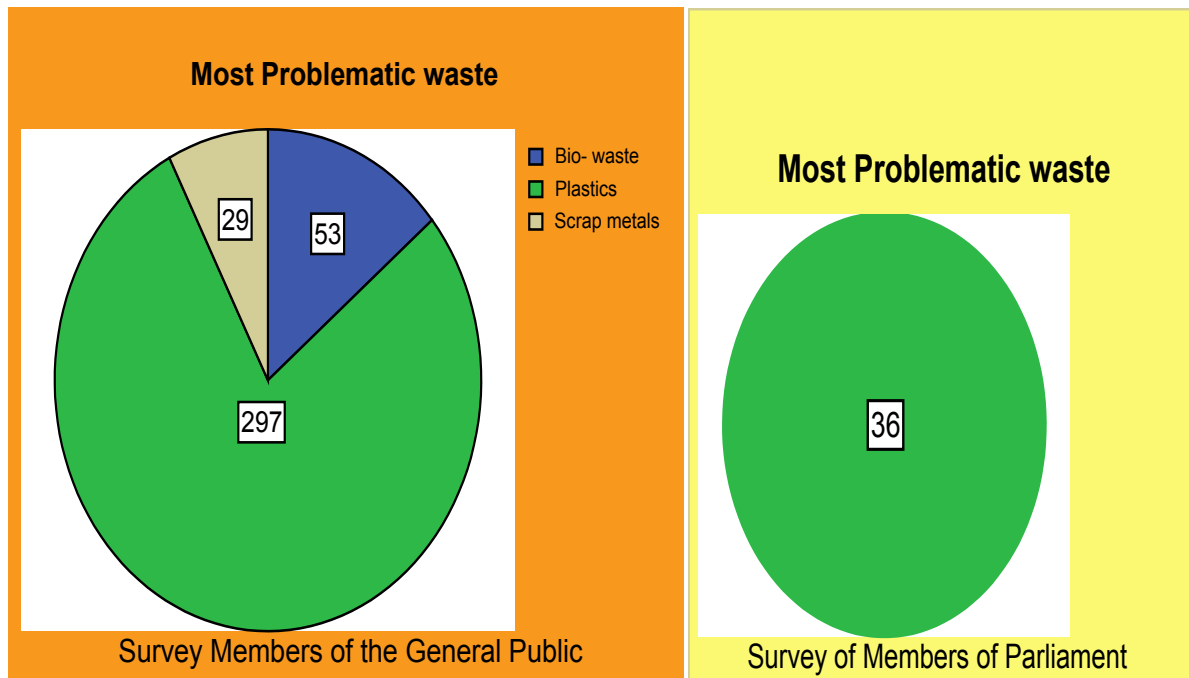
² Refer to fig 3.2.1 chapter 3 for composition of waste in Accra

³ Analysis of relative importance of constraints to SSWM in Ghana by members of parliament identified lack of finance as most important. Refer to fig.5.4.2.1 for details

In the survey with member of the general public, 13.6% of respondents identified bio-waste as the most problematic waste. Waste composition analysis revealed that about 65% of waste generated is biodegradable. Under the hot climate of the tropics which accelerates microbial activities, production of odour resulting from the decomposing bio-waste can present serious social nuisance. Decomposition of bio-waste encourages production of disease vectors and pathogens. In such situations where waste collection is not regular, waste storage sites (as in the case of central containers used in low income areas of urban centres in Ghana) can have serious health implications for the general public.

With no national policy on the disposal of old vehicles, the metal remains of unserviceable vehicles are found littering many open spaces, especially places in the vicinity of car repair shops. There has been a new development of retrieving such old metals for sale to metal smelting industries. This, however, was being organized by the informal sector which lack organizational and managerial efficiencies. There should be a national policy on the disposal of old cars and white goods destined for disposal. Part of the tax levied on the importation of cars for example could be channelled into the solid waste sector to organize the disposal of old vehicles.

Fig.5.2.3 Public Perception of Most Problematic Waste



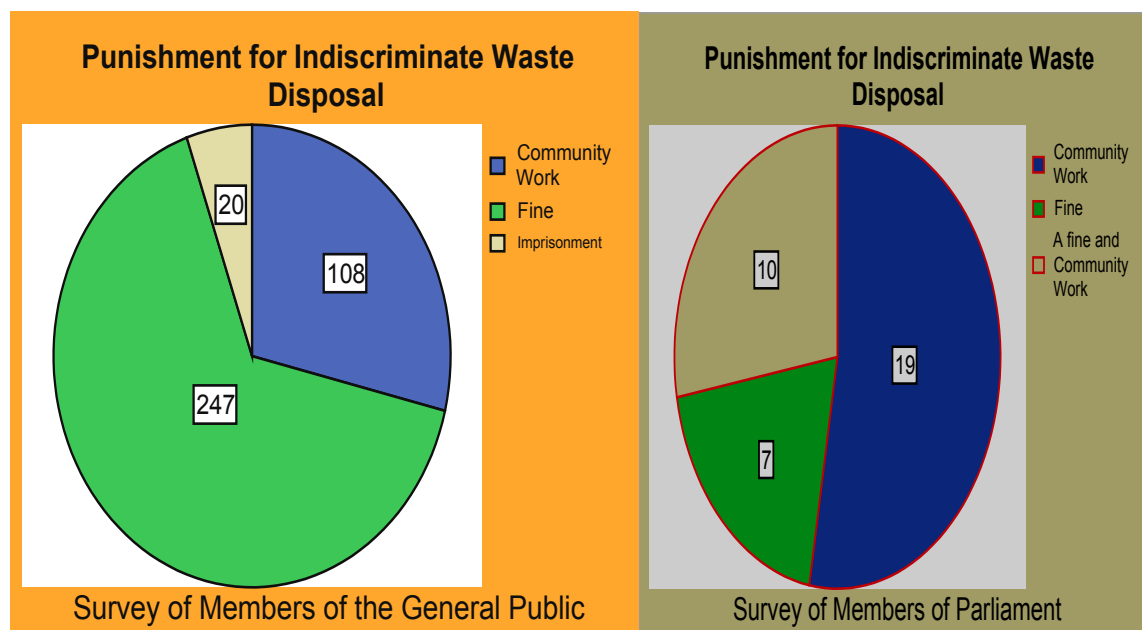
Members of the General Public					
	Response Categories	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bio- waste	53	13.6	14.0	14.0
	Plastics	297	76.3	78.4	92.3
	Scrap metals	29	7.5	7.7	100.0
	Total	379	97.4	100.0	
Missing	No Response	10	2.6		
Total		389	100.0		
Members of Parliament					
	Plastics	36	100.0	100.0	100.0

5.2.4 Penalty for Indiscriminate Waste Disposal

Essentially, government policy intervention in public life aims at achieving desirable goals and objectives through two principal means. Penalizing those actions that are reversal or detrimental to policy goal and rewarding actions that are favourable to the attainment of policy goals. Regulatory measures, used in solid waste management in Ghana would need to be monitored and enforced to provide the necessary deterrent effect. In connection with penalizing indiscriminate

waste disposal habit, respondents were asked to indicate the penalty they considered appropriate¹. Fig.5.2.4 presents analysis of responses in connection with penalties respondents considered appropriate for penalizing indiscriminate waste disposal.

Fig.5.2.4 Public Prescription of Penalties for Indiscriminate Waste Disposal



Members of the General Public					
	Response Categories	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Community Work	108	27.8	28.8	28.8
	Fine	247	63.5	65.9	94.7
	Imprisonment	20	5.1	5.3	100.0
	Total	375	96.4	100.0	
Missing	No Response	14	3.6		
Total		389	100.0		
Members of Parliament					
Valid	Community Work	19	52.8	52.8	52.8
	Fine	7	19.4	19.4	72.2
	A fine and Community Work	10	27.8	27.8	100.0
	Total	36	100.0	100.0	

¹ The related questions are question 13, appendix A1 for members of the general public (MGP) and question (Q) 11 appendix A2 for members of parliament (MP).

The two categories of respondents seemed to be divergent on what should constitute an appropriate penalty for indiscriminate waste disposal. While majority of members of the general public indicated a fine for indiscriminate waste disposal habits, the prescription that majority of members of parliament considered appropriate for indiscriminate waste disposal was community work. Fines like taxes are politically sensitive and perhaps the reason why most members of parliament were reluctant to prescribe this as a penalty. Imposition of a fine although has been on paper as a policy instrument for addressing indiscriminate waste disposal habits in most municipalities, it has hardly been used because of lack of personnel for monitoring and enforcement. Community work which was recognized by the second largest number of members of the general public as the most appropriate penalty was also recognized by majority of members of parliament as the most appropriate penalty for indiscriminate waste disposal. Considering the fact that this approach has never been exploited, it could offer an effective solution to public indiscriminate waste disposal habit if this is appropriately designed, in terms of monitoring and how the community work should be carried out etc. While some members of the general public would recommend imprisonment as a penalty for indiscriminate waste disposal, this option has not been selected by any member of parliament.

5.2.5 Policy Instruments for Sustainable Solid Waste Management

Public education is always necessary whenever an existing public policy is changed or a new policy is introduced. In solid waste management, policy strategies for the attainment of policy goals and objectives can be broadly classified into economic and regulatory. It was necessary to find out the extent to which the public is already informed with respect to general policy issues as well as ascertain public support for some of these policy perspectives. Table 5.2.5.1 is a frequency distribution of responses on general policy issues connected to solid waste management. Essentially Table 5.2.5.1 combines responses to 7 policy related questions¹ in the case of the questionnaire for members of the general public, and responses to 6 policy related question in the case of the questionnaire for members of parliament. There was almost an even distribution of the proportion of respondents who were aware and those who were not aware about taxes and laws related to solid waste management among members of the general public.

¹ The related questions (Qs) are (Qs: 9, 12, 14, 15, 17, 18 and 23, A1 for MGP) (Qs: 9, 10, 5, 12, 13, and 20, A2 for MP)

Even among law makers the proportion of respondents who were unaware about the existence of laws that punish littering was quite high (36.1%). In terms of awareness of taxes for keeping cities clean, the proportion of members of parliament who indicated that they were not aware of any tax were more than those who were aware of taxes and this percentage was even more than that of the general public.

Table 5.2.5.1 Public Awareness and Support for Some Selected SWM Policy Instruments

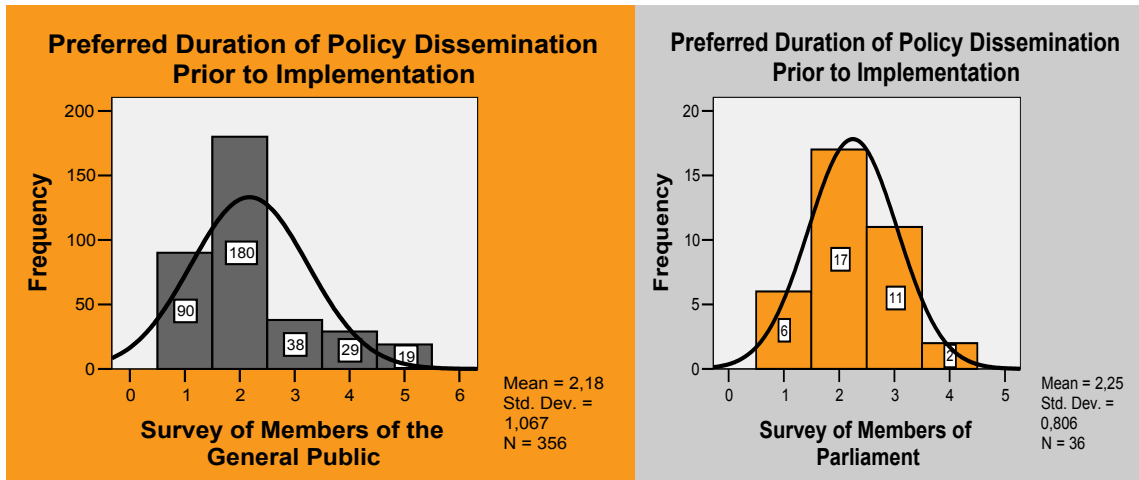
	Awareness of Laws/ Regulations that punish Littering		Support for SWM Laws/ Regulations		Support for Waste Separation at Source		Awareness of tax for keeping the city/ Country clean		Necessity to Know Reasons for Paying a Particular Tax		Support for SWM Tax		Advance Notice on Policy Change	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Members of the General Public														
Yes	197	50.9	375	97.7	293	79	198	52	365	96.1	342	91.4	352	91.9
No	190	49.1	9	2.3	78	21	183	48	15	3.9	32	8.6	31	8.1
Total	387	100	384	100	371	100	381	100	380	100	374	100	383	100
Members of Parliament														
Yes	23	63.9	36	100	36	100	14	38.9			36	100	36	100
No.	13	36.1	0	0	0	0	22	61.1			0	0	0	0
Total	36	100	36	100	36	100	36	100			36	100	36	100

In terms of support for the introduction of both taxes and regulations, the proportions of respondents who were in support of these policy instruments were quite high, 97.7% in support of regulatory measures and 91.4% in support of tax instruments among members of the general public and 100% for both regulatory and tax measures in the case of members of parliament. The high support for the introduction of these policy instruments, however, is not unexpected. As pointed out by Stern, 1992, most people would report environmentally friendly behaviour than actually practice it. These figures, however, provide some indication with respect to the concern of respondents and their willingness to contribute their quota in finding solutions to the solid

waste management problems if the right atmosphere is created. With the selection of the right strategies, both regulatory and economic instruments can make the needed impact. Although the proportion of respondents who were in support of waste separation at source into bio-waste and non-biowaste was not as high as the proportion recorded for support for introduction of regulatory and tax measures, 79% among members of the general populace and 100% among members of parliament are indicative enough for source separation of waste to be considered in any policy package to address the solid waste management situation in Ghana. Two other issues worth mentioning in these results were the indication by respondents to be informed in advance prior to the introduction of any policy and the need for information to be provided in connection with the reasons why a particular tax is collected or introduced. The solid waste management system existing in most urban areas in Ghana was financed through property rates and market tolls with user charges operational only in a small proportion, about 30% among urban dwellers. The public however was not adequately informed with respect to how their money (property rate and tolls) were used. As a result, most people were resultant to pay such rates and would do everything to evade them. Inadequate tax collection by the authorities of most cities and town resulted in reliance on central government for budgetary allocations to carry out management functions related to solid waste management. In respect of length of time required for providing information on a new policy prior to its introduction, respondents were asked to choose various durations that they considered ideal¹. Fig.5.2.5.2 represents various length of time indicated by respondents as ideal for the dissemination of information on a new policy prior to its introduction. For both categories of respondents, the mean duration was within the interval 3-6 months.

¹ The related questions are Q24,A1 for MGP and Q21,A2 for MPs

Fig.5.2.5.2 Preferred Duration of Policy Dissemination Prior to Implementation



Members of the General Public							
	Response Categories	Midpoint (Months) (<i>x</i>)	Frequency (<i>f</i>)	<i>fx</i>	%	Valid %	Cumulative Percent
Valid	Less than 3 months	1.5	90	135	23.1	25.3	25.3
	3 - 6 months	4.5	180	810	46.3	50.6	75.8
	6 - 9 months	7.5	38	285	9.8	10.7	86.5
	9 - 12 months	10.5	29	304.5	7.5	8.1	94.7
	More than 1 Year	13.5	19	256.5	4.9	5.3	100.0
	Total			356	1791	91.5	100.0
Missing	No Response		33		8.5		
	Total		389		100.0		
Members of Parliament							
Valid	Less than 3 months	1.5	6	9	16.7	16.7	16.7
	3 - 6 months	4.5	17	76.5	47.2	47.2	63.9
	6 - 9 months	7.5	11	82.5	30.6	30.6	94.4
	9 - 12 months	10.5	2	21	5.6	5.6	100.0
	More than 1 Year	13.5	0	0			
	Total			36	189	100.0	100.0
Members of the General Public				Members of Parliament			
The mean $\bar{x} = \frac{\sum fx}{N}$ where ,N = The sample size $\bar{x} = 5.00$ The standard deviation given by $SD = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}} = 0.59$ The Standard error of the mean $SED = \frac{SD}{\sqrt{N}} = 0.31$ VC = 5.03 ± 0.61 (95%)				The mean $\bar{x} = \frac{\sum fx}{N}$ where ,N = The sample size $\bar{x} = 5.25$ The standard deviation given by $SD = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}} = 1.82$			

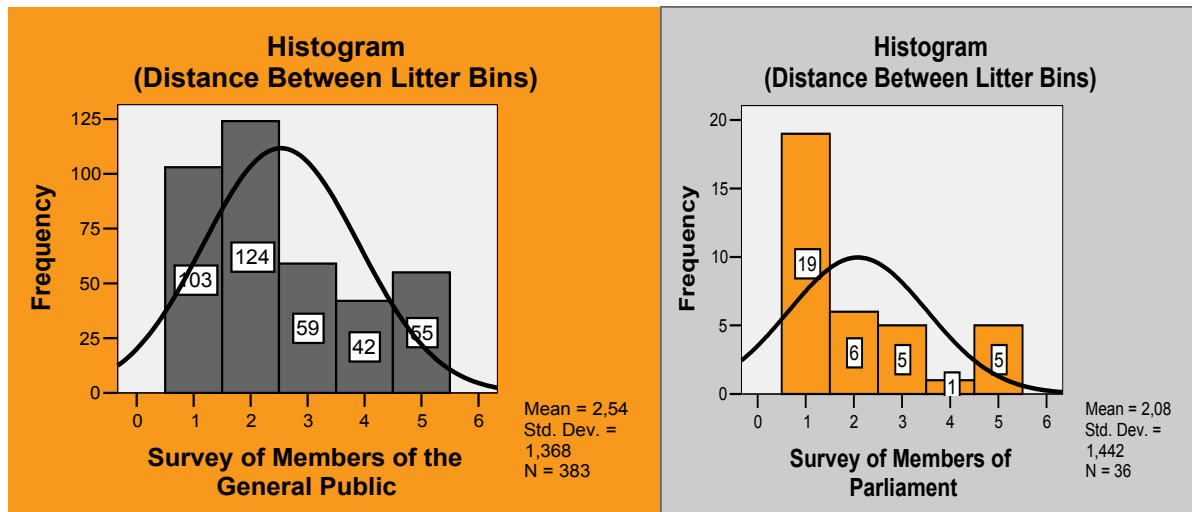
5.2.6 Preferred Distance between Litter Bins

Although the distance between litter bins at public places should be based on the density of people and the intensity of activities at such places, littering could be reduced if the public is aware that litter bins are located at some regular intervals at public places. Sibley and Liu, 2003, differentiated indiscriminate waste disposal (Littering) into Passive and Active Littering. According to Sibley and Liu, active littering involves conscious disposal of waste in unconcerned manner (as in somebody dropping waste on the street and continuing walking) is less resistant to change than passive littering (as in somebody dropping a litter on the bench while seated and failing to remove it when leaving). It was noticed during field observation in this research that the predominant form of littering (indiscriminate waste disposal) in Ghana was active littering, and hence there could be considerable improvement in public indiscriminate waste disposal with the implementation of the right policies. A policy of regular spacing of litter bins at public places should be accompanied by other complementary policies.

In connection with regular spacing of litter bins at public places, respondents were asked to indicate the preferred distance that should separate litter bins at public places¹. The result as represented in fig.5.2.6 depicts various preferred range of distances. As indicated, the mean of preferred distance for members of the general public was 151.76m and this lies within the preferred interval 150-200m. The mean of the preferred distance between litter bins from the perspective of members of parliament was 129.17m and this is located within the intervals 100 - 150m as shown fig.5.2.6.

¹ The related questions are Q8, A1 for MGP and Q7, A2 for MPs

Fig.5.2.6 Preferred Distance between Waste Bins



Members of the General Public							
	Response Categories	Midpoint (x)m	Frequency (f)	fx	%	Valid %	Cumulative Percent
Valid	Less than 100m	75	103	7725	26.5	26.9	26.9
	100 - 150m	125	124	15500	31.9	32.4	59.3
	150 - 200m	175	59	10325	15.2	15.4	74.7
	200 - 250m	225	42	9450	10.8	11.0	85.6
	More than 250m	275	55	15125	14.1	14.4	100.0
	Total		383	58125	98.5	100.0	
Missing	No Response		6		1.5		
	Total		389		100.0		

Members of Parliament							
	Response Categories	Midpoint (x)m	Frequency (f)	fx	%	Valid %	Cumulative Percent
Valid	Less than 100m	75	19	1425	52.8	52.8	52.8
	100 - 150m	125	6	750	16.7	16.7	16.7
	150 - 200m	175	5	875	13.9	13.9	13.9
	200 - 250m	225	1	225	2.8	2.8	2.8
	More than 250m	275	5	1375	13.9	13.9	13.9
	Total		36	4650	100.0	100.0	

Members of the General Public	Members of Parliament
<p>The mean $\bar{x} = \frac{\sum fx}{N}$ where ,N = The sample size</p> <p>$\bar{x} = 151.76$ The standard deviation given</p> <p>by $SD = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}} = 8.52$</p> <p>The Standard error of the mean</p> <p>$SED = \frac{SD}{\sqrt{N}} = 0.44$ VC = 151.76 ± 0.86 (95%)</p>	<p>The mean $\bar{x} = \frac{\sum fx}{N}$</p> <p>where ,N = The sample size</p> <p>$\bar{x} = 129.17$</p> <p>The standard deviation given by</p> <p>$SD = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}} = 31.85$</p>

5.3. Results of Survey of Members of the General Public

5.3.1. Rate of Survey Response

Results in this category focused on questions that were exclusive to members of the general public. These results were coded and analysed using Statistical Package for the Social Sciences (SPSS). Table 5.3.1 is a summary of the survey results. Out of 1000 questionnaires administered in the three cities studied, a total of 389 valid responses were received. This represented a return ratio of 38.9%. The response rate varied from as low as 0% to as high as 90%. This variation can be ascribed to lack of commitment and unconcerned attitude of some research assistants engaged within each sampling unit to help with administration and retrieval of completed questionnaires.

Table 5. 3.1 Summary of Survey of Members of the General Public

Town/ Region	Religious Units Sampled	No. of Quests. Administered	No. of Valid Responses	% of Valid Response
Accra/ Greater Accra	Action Faith	40	5	12.5
	Catholic (Christ the King)	40	4	10.0
	Evangelical Church	40	34	85.0
	Methodist	40	0	0.0
	Seventh Day Adventist (SDA)	40	6	15.0
	Africana Mission	40	0	0
	Central Mosque, Nima	40	23	57.5
	Pentecost	40	10	25.0
	Central Mosque Newtown	40	6	15.0
	Word Miracle Church	40	15	35.5
Sekondi- Takoradi /Western	Action Faith	30	10	33.3
	Assemblies of God	30	5	16.6
	Anglican	30	24	80.0
	Catholic	30	23	76.6
	Central Mosque Sekondi	30	19	63.3
	Faith Alive Chapel	30	12	40.0
	Methodist	30	16	53.3
	Presby	30	20	66.6
	Word Miracle Church	30	11	36.6
	Central Mosque Takoradi	30	0	0
Kumasi/ Ashanti	Bethel Methodist	30	12	40.0
	Church of Christ	30	13	43.3
	Musama Disco Christo Church	30	0	0
	Camp. Christian Family(CCF)	30	27	90
	Mosque Ayigya	30	24	80
	Central Mosque Kejetia	30	26	86.6
	Pentecost	30	13	43.3
	Presby	30	10	33.3
	Seventh Day Adventist (SDA)	30	9	30.0
	Deeper Life Bible Church	30	0	0
Total		1000	389	38.9

5.3.2 Public Awareness and Waste Disposal Habits

Indiscriminate public waste disposal habit has considerable negative influence on solid waste management in Ghana. Granted that the public at the individual level had cultivated proper solid waste disposal habit such that waste from households was properly disposed of at designated waste disposal points and that there were sufficient waste bins at public places, the main concern of waste management would have been how to dispose of the waste collected in an environmentally friendly way. This however, was not the case. A large proportion of the populace has not cultivated proper waste disposal habits. This situation was exacerbated by the fact that waste collected by waste collecting authorities was not disposed of in an environmentally friendly manner. Central to efficient solid waste management, is the sufficiency or otherwise of public information on proper waste disposal. Table 5.3.2 is a summary of responses on two items on the questionnaire¹ related to public waste disposal habit.

With respect to influence of knowledge about proper disposal of waste collected by institutions (public or private) authorized to collect and dispose of waste on the waste disposal habit of the individual, majority of respondents (80.9%) agreed (44.8% strong agreement + 36.1 % agreement) that this would have influence on the way they also dispose of their way. The proportion of respondents who indicated that this knowledge would not have any effect on their individual waste disposal habits was 16.4% (11.2% disagreement + 5.2 %strong disagreement) with 2.7% in between. This knowledge is very important for the development of public campaigns on proper waste disposal and also a signal for waste management authorities to move away from the existing environmentally unfriendly waste disposal practices. In connection with sufficiency of public awareness of proper waste disposal habits, 30.6% agreed (14.9% strong agreement + 15.7% agreement) that there was sufficient information and 66% disagree (20.8% strong disagreement + 45.2% disagreement). Against the background of the prevalence of indiscriminate waste disposal habits among the general populace, there is the need to intensify public campaigns on proper waste disposal habit. This, however, need to accompanied by the setting up of institutional structures that facilitate proper waste disposal. The assertion made by Hungerford and Volk, 1990 that giving individuals more environmental information can change their environmental behaviour, although important, is of little relevance to solid waste

¹ The related questions are Q5 and Q19, A1

management which constitutes some sort of “institutionalized behaviour”. Changing improper waste disposal habit needs to be approached from institutional perspective with programmes and policies put in place to inculcate in the general public, proper waste disposal habit. This will involve incorporation of pragmatic programmes in the educational system accompanied by active public campaign. As pointed out by Pooley and O’Connor 2000, such awareness creation with respect to solid waste management could make considerable impact by appealing more to the emotions and beliefs of the populace.

Table 5.3.2 Waste Disposal and Public Awareness of Proper Waste Disposal

Response Category	Knowledge about Proper WD by Waste Collectors on Personal WDH		Sufficient Public Awareness on Proper Waste Disposal	
	No.	%	No.	%
Strongly Agree	164	44.8	53	14.9
Agree	132	36.1	56	15.7
Neither Agree nor Disagree	10	2.7	12	3.4
Disagree	41	11.2	161	45.2
Strongly Disagree	19	5.2	74	20.8
Total	366	100	356	100.0

WD= Waste Disposal
WDH= Waste Disposal Habit

5.3.3 Prioritization of options “The Differentiated Perception Ranking Method”

Though a combination of policy instruments or options are needed to achieve desired policy goals, there is always the need to prioritize or put emphasis on some particular policy options at a particular phase of policy implementation and hence policy development is characterized by various processes of ascertaining the most appropriate policy options among others. The method used in prioritizing policy options and issues is unique to this research. This method is demonstrated with a hypothetical example presented in fig.5.3.3.1.

Fig.5.3.3.1 Hypothetical Example of Prioritizing Policy Options

A hypothetical situation is considered where 5 respondents A, B, C, D, and E were asked to rank three issues; Lack of Finance, Lack of Personnel, and Lack of Equipments considered as constraints to solid waste management in order of most important to least important using a scale 1-3, where 3 = Most Important; 2 = Moderately Important, and 1 = Least Important. Table 5.3.3.1 is the result of ranking the three constraints by the five respondents above (A, B, C, D, and E)

Table 5.3.3.1 Ranking of Three Hypothetical Constraints to Solid Waste Management

Constraints	Respondents				
	A	B	C	D	E
Lack of Personnel (Lp)	1	2	1	3	2
Lack of Finance (Lf)	2	3	3	2	3
Lack of Equipments (Le)	3	1	2	1	1

NB Scale

3 = Most Important; 2 = Moderately Important, and 1 = Least Important

The ranking of the hypothetical constraints to solid waste management represented in table 5.3.3.1 above is interpreted as follows: Respondent “A” considered lack of equipment to be most important constraint to solid waste management, lack of finance to be moderately important, and lack of personnel to be least important. Respondent “B” considered lack of finance to be most important constraint, lack of personnel to be moderately important and lack of equipment to be least important. Respondent “C” considered lack of finance to be most important constraint, lack of equipment to be moderately important and lack of personnel to be least important. Respondent “D” considered lack of personnel to be most important constraint, lack of finance to be moderately important and lack of equipment to be least important, and respondent “E” considered lack of finance to be most important constraint, lack of personnel to be moderately important and lack of equipment to be least important.

The task is to establish which of the constraints is most important and which is least important to solid waste management from the perspective of all respondent considered as a group. This is achieved as follows:

- i. The rankings various respondents have assigned to each of the three constraints are classified based on **level** of importance by replacing the numerical scales used in the ranking with the constraint that has been ranked at that level as presented in table 5.3.3.2.
- ii. A frequency table is constructed to depict the number of times each constraint has been ranked at the various levels of importance as shown in table 5.3.3.3. Although by constructing a frequency table to show the constraints at the different levels of importance the individual rankings can no longer be shown, this is however, not important as the goal is to determine the most important constraints from group perspective (represented by frequencies) rather than from the perspective of individuals.
- iii. The frequency distribution of the various constraints (number of times each constraint has been chosen at a particular level of importance by respondents) is plotted as shown in fig.5.3.3. Because the various level of importance (most, moderate, and least) as used in this example can be regarded as **discrete variables**, emphasis is placed on the association between constraints at the level of importance during interpretation and not on any linear association between constraints in-between levels of importance.

Because this approach of ranking constraints (or any option of issues) differentiates various levels of importance (in general, levels of perception) it is here referred to as “**Differentiated Perception Ranking Method**”.

Table 5.3.3.2 Ranking of Hypothetical Constraints to Solid Waste Management Based on Level of Importance

Level of Ranking	Respondents				
	A	B	C	D	E
Most Important	Le	Lf	Lf	Lp	Lf
Moderately Important	Lf	Lp	Le	Lf	Lp
Least Important	Lp	Le	Lp	Le	Le

NB Le = Lack of equipment

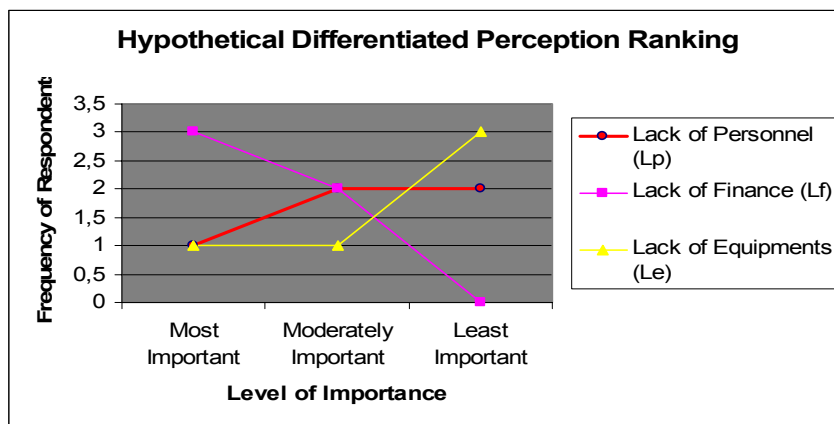
Lf = Lack of finance

Lp = Lack of personnel

Table 5.3.3.3 Frequency Distribution of Ranked Hypothetical Constraints to SWM

Constraints	Level of Ranking		
	Most Important	Moderately Important	Least Important
Lack of Personnel (Lp)	1	2	2
Lack of Finance (Lf)	3	2	0
Lack of Equipments (Le)	1	1	3

Fig.5.3.3 Graphical Presentation of Ranked Hypothetical Constraints to Solid Waste Management Using Differentiated Perception Ranking Approach

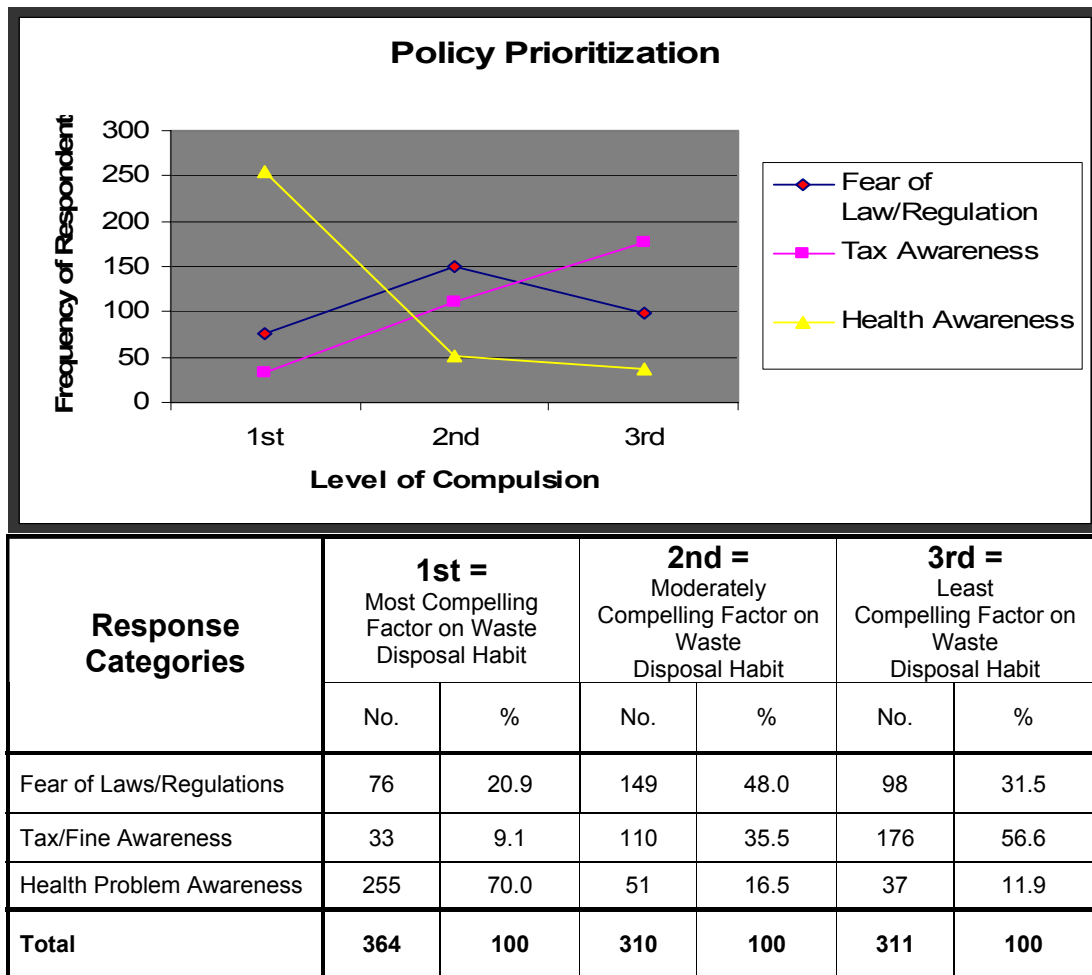


In policy development the emphasis is often on finding the **most** or **least** preferred option from the perspective of the majority. The “Differentiated Perception Ranking” method which presents the frequency distribution of respondents at various levels of perception (in this case most, moderately, and least) is very important approach in prioritizing policy options. **This is the approach that has been used in prioritizing issues and policy options in this research.** The inspiration for the search for an appropriate method(s) to prioritise issues and in the process, provide analytical basis for obtaining results needed in accomplishing the goal and objectives of this research was provided by Majchrzak, 1984. Majchrzak asserted that there is no method specific to policy research. Scientific standards, however, require that any method used or developed be objective, logical and systematic. The approach developed here is objective, logical and systematic and takes its root from the framing of questions associated with issues (options) to be ranked.

5.3.4 Prioritization of Policy Options

Public policy attains its goal by influencing indirectly the behaviour of the general public. It follows therefore that members of the general public should be in a better position to indicate among others which policy options have or will have various degrees of impact on their lives with reference to specific issues. This research considered priority policy option from the perspective of the general public rather than from that of policy experts. Respondents were asked to rank three policy options using numbers with respect to the impacts these options will have on their waste disposal habits¹.

Fig.5.3.4 Prioritization of Policy Options



¹ The related question is Q22,A1

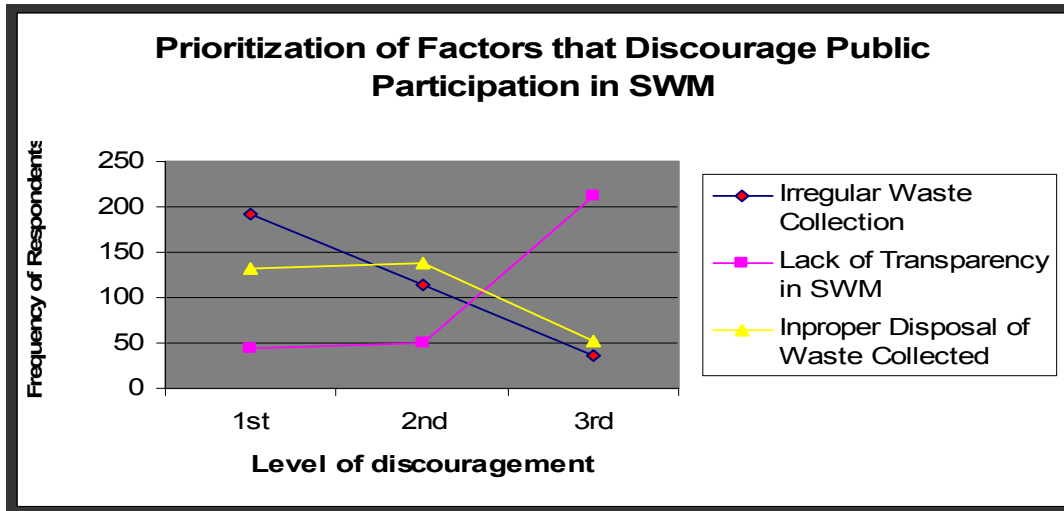
Responses were analysed using the Differentiated Perception Ranking Method. As indicated in fig. 5.3.4, majority of respondents (70%) have ranked awareness of association of health problems with indiscriminate waste disposal as the most compelling factor in influencing their waste disposal habits. This is very important in defining the direction of awareness creation with respect to solid waste management. At the level of moderately compelling, fear of laws and regulations has the largest representation of 48% followed by awareness that more tax is associated with indiscriminate waste disposal with a representation of 35.5%. Majority of respondents have indicated that awareness of more tax associated with indiscriminate waste disposal will have the least impact on their waste disposal habits. Ranking of these policy options with respect to their impact on the waste disposal habit of individuals is very important in designing a policy package that aims at reducing indiscriminate waste disposal habit among the populace.

5.3.5 Public Participation in Solid Waste Management Activities

The success of any solid waste management scheme depends to a large extent on the active participation of the general public in management programmes as well as public compliance with management directives. Solid waste management in particular is influenced by what Steel, 1996 referred to as “institutionalized behaviour”. The inclination of the public towards placing litter in litter bins would largely be influenced by such factors as how clean the public place is in the first place and the availability of waste receptacles. It is therefore important in policy development to identify factors that encourage public participation in waste management schemes. Conversely, finding factors that discourage public participation and taking steps to limit these can promote public participation. Three factors¹ that were identified as having potential discouraging effect on the participation of the public in solid waste management activities therefore were ranked by respondents. Fig. 5.3.5 shows how the public prioritize the three factors with respect to how these factors can discourage their participation in solid waste management activities.

¹ The related question is Q7,A1

Fig. 5.3.5 Public Participation in Solid Waste Management



Response Categories	1st = Most Important Discouraging Factor to Participating in SSWM		2nd = Moderately Important Discouraging Factor to Participating in SSWM		3rd = Least Important Discouraging Factor to Participating in SSWM	
	No.	%	No.	%	No.	%
Irregular Waste Collection	192	52	115	38	37	12.2
Lack of Transparency in SWM	44	12	50	16.5	213	70.3
Improper Disposal of Waste Collected	133	36	138	45.5	53	17.5
Total	369	100	303	100	303	100

This result indicated that all other things being equal, the public would be most discouraged by irregular collection of waste. Unfortunately, provision of waste collection services has been characterized by irregular waste collection in all the cities surveyed. Private waste collection firms attribute this to inability of city authorities to pay them on time. City authorities on the other hand attribute lack of finance to poor tax payment and tax evasion by residents. As indicated by the results of this analysis, irregular waste collection could precipitate non-participation in waste management activities and reluctance to pay taxes could be interpreted as non-participation in management activities. Indiscriminate waste disposal can also be described as non-participation in solid waste management system by the public. The existing waste management system which excluded majority of residents from any payment for waste

management services needs to be reviewed to make all residents pay directly or otherwise for the waste they generate. Beyond the effect of irregular waste collection as a discouraging factor for public participation in waste management, improper disposal of the waste collected becomes the dominating element in discouraging the public from active participation in waste management activities. Majority of respondents have identified this factor as moderately important in discouraging them from participating in solid waste management activities. Although there were such daily operations as covering of waste with soil, waste compaction and some vector control programmes at the disposal sites in Accra and Takoradi, these sites lacked proper environmental control. These sites can best be classified as improved dumps. Kumasi was the only city operating sanitary landfill in Ghana at the time of this research and as indicated by the analysis of results, knowledge about improper disposal of the waste collected by agencies tasked to do so can discourage the public from contributing their quota to solid waste management. The authorities/agencies responsible for waste collection need to have waste disposed of properly in an environmentally friendly manner. There is the need for national or at least regional approach to waste management, with the incorporation of sanitary landfill development in regional development planning. This will eliminate the problem of lack of land for the development of solid waste management facilities. Lack of transparency or corruption in waste management was ranked by majority of respondents as the least factor in discouraging them from participation in solid waste management activities. People usually show a lot of enthusiasm in and concern for issues that affect their well being when there is transparency and accountability. There is the need therefore to have a transparent solid waste management scheme that is accountable to the public and all stake holders. A public constituted audit unit for example could be tasked to periodically review the transactions of public solid waste management to ensure that all budgetary allocations are accounted for.

5.3.6 Prioritizing Information with Respect to Sources

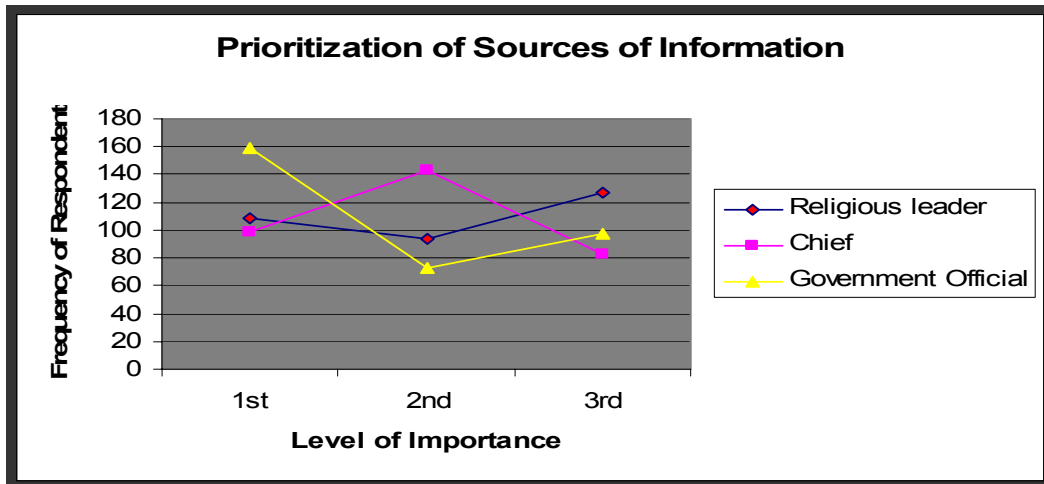
Indirect colonial rule in Africa employed by the British involved the use of indigenous African power structures, including local institutions, kings, chiefs, etc., as an instrument for the implementation of their colonial policies (Njoh, 2000). Although this has helped prepared the grounds for self-governance after independence, it has the disadvantage of reinforcing ethnic consciousness which has the potential of compromising efforts at attaining national unity in post-

colonial Anglophone African countries (Mazrui, 1983). In post independent Ghana, chiefs are still very important part of the cultural and social system. Although chiefs are constitutionally prohibited from taking part in politics, they wield a lot of “social power” as they are highly respected to the extent that they can have considerable influence on the implementation of national policies. Another group of people that can polarize social power is religious leaders. The two dominant religions in Ghana; Christianity and Islam are growing very fast. In 1960, 42.81% of Ghanaians were Christians and 12.05% were Muslims (NCSU, 1993). The proportions of the various religious representations captured in the 2000 national census were as follows: Christian 69%, Traditionalists 8.5%, Muslim 15.6%, others 6.9% (Ghanaweb, 2005). Religious leaders are highly respected and can influence the decision making process of their members as individuals and as a group.

Government officials by virtue of constitutional power conferred on them as implementers of government policy, have power to penalize non-conformity. Under normal circumstances, government officials should be the sole source of authority on matters related to the implementation of government policies. However, within a social system polarized by other power actors, the authority of government officials can be augmented or weakened by the interplay of such power sources. For example even though chiefs are not supposed to take part in politics, a government policy that is in conflict with the beliefs and or perspectives of a traditional leader can have implementation failure within the jurisdiction of the chief concerned if he or she opposes it (even if secretly). The same can be said about religious leaders. Some members of a particular denomination can reject some government policy if the leadership of the religious group opposes it. An example of this phenomenon is the scepticism about the use of condoms by members of Roman Catholic churches. The people who control power in the society therefore have implications for policy implementation. In order to ascertain the extent to which policy implementation can be influenced by the various entities (government officials, chief and religious leaders) who command respect in the social set up and for that matter can influence the decision making processes of others, respondents were asked to rate the same piece of information originating from these three sources¹. Fig.5.3.6 is the result obtained in connection with rating the same piece of information from different sources by respondents. As in other cases responses that indicated no differential rating of variable were excluded from analysis.

¹ The related question is Q20,A1

Fig. 5. 3.6 Prioritizing Information Based on Source



Response Categories	1st = Most Important Source of Information		2nd = Moderately Important Source of Information		3rd = Least Important Source of Information	
	No.	%	No.	%	No.	%
Religious Leader	109	29.7	94	30.3	127	41.2
Chief	99	27	143	46.2	83	27.0
Government Official	159	43.3	73	23.5	98	31.8
Total	367	100	310	100	308	100

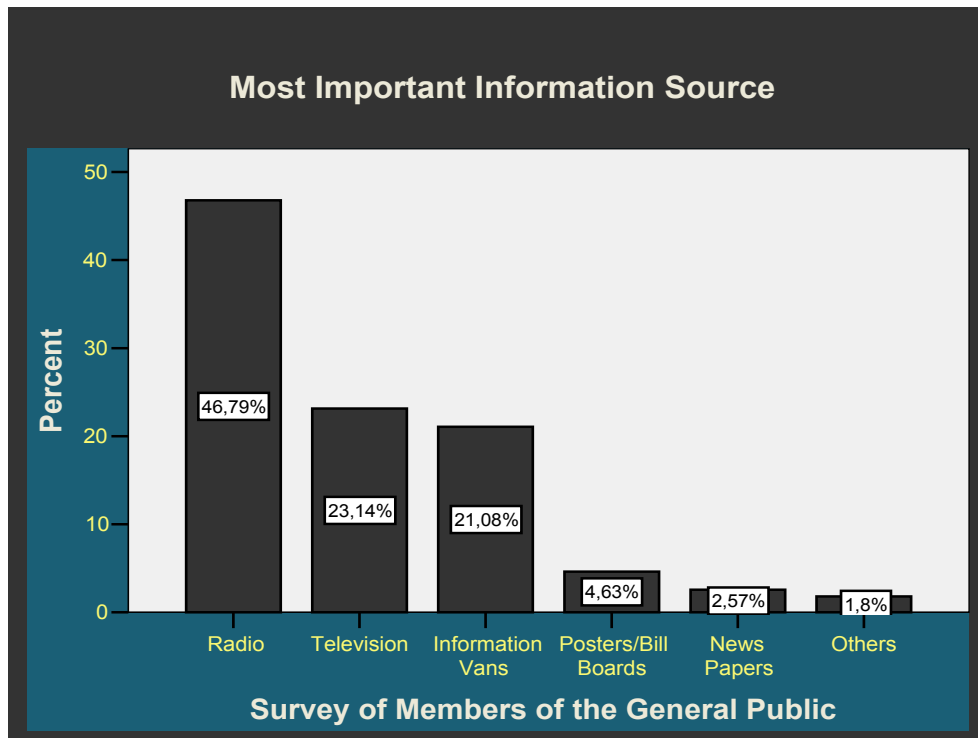
The graph above clearly shows polarization of “social power”. Although majority of respondents ranked government officials as the most important source of information, the proportions of respondents who considered chiefs and religious leaders as the most important sources of information are equally high. It can not be established how government officials are related to religious leaders as sources of information in terms of the importance attached to pieces of information by respondents. However, when government officials were selected by the least number of respondents as information source of moderate importance, the number of respondents that selected religious leaders in this ranking also fell and when the number of respondents that selected government officials as least important source of information increased that of religious leaders also increased. These pieces of information are very important for policy implementation. That individuals attach various degrees of importance to the same piece of information originating from different power actors is indicative of the impact these sources can have on policy dissemination and implementation.

5.3.7 Prioritization of Media for Policy Dissemination

Dissemination of information on public policy prior to its implementation is very important to the policy development process. Identification of the medium that serves as the most important source for the public for receipt of its information is relevant for both cost effective and efficient information dissemination in policy implementation and for keeping the public abreast with policy changes. In identifying the most important channel by which the public receives information, respondents were asked to choose only one among different sources of disseminating public information¹. The result of the analysis of this question as presented in fig.5.3.7 provides indications with respect to the channels on which to put emphasis in providing the public with policy information. The identification of radio by most respondents as their most important source for receiving public information requires that both public and private radio stations be involved in any effort at creating awareness among the populace in connection with policy development.

¹ The related question is Q21,A1

Fig.5.3.7 Prioritizing Media for Public Information Dissemination



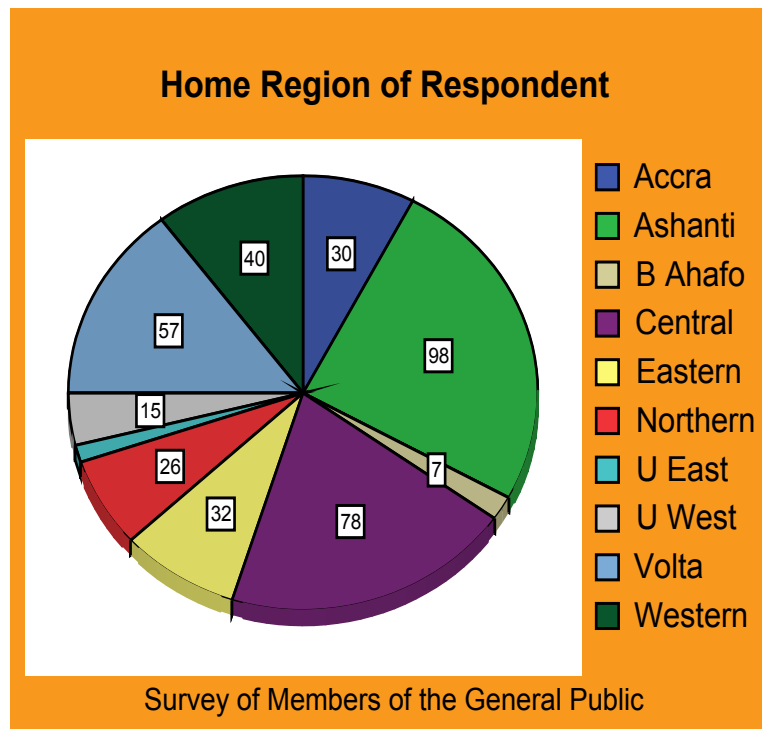
5.3.8 Representativeness of Data

Even though researchers in the social and policy sciences would like to relate their finding to an entire population they are constrained by time and resources. Research design considers how data collected from only a limited number of members of a population can be extrapolated unto an entire population. The bridge between research goals and the limitations imposed by time and cost of studying a whole population is provided by sampling methods.

5.3.8.1 Home Region of Respondents

Although data was collected from the capitals of only three regions, the survey captured respondents from all the 10 regions of Ghana as shown in fig. 5.3.8.1. The home region of respondents was requested among other background information to enable the researcher determine the extent to which the sampled population is consistent with the population of interest in this study. As it was to be expected the regions were disproportionately represented, the central issue, however, is that solid waste management is a serious problems in all the towns and cities in Ghana and hence the need for a nationally driven policy to address the situation.

Fig.5.3.8.1 Home Regions of Respondents

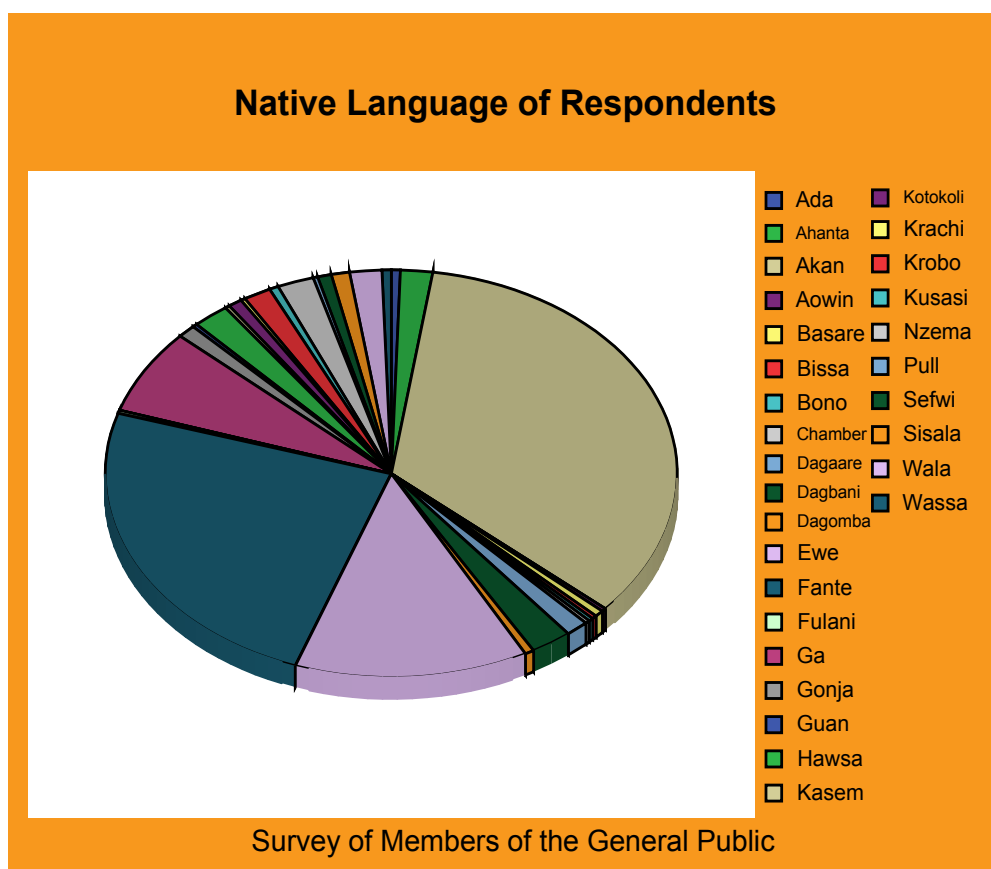


5.3.8.2 Native Language of Respondents

The results also showed the multi-ethnic characteristic of most of the towns and cities in Ghana represented by the native language of the respondent. Fig.5.3.8.2 shows that as many as 30 languages (dialects) of respondents are represented. The proportion of people of Akan speaking origin represented in this data was 34%. In the national census of 2000, Akan speaking people were in majority with a percentage of 49.1%. In the 2000 national census, Fante which was

captured in this survey as the second most spoken language of respondents was counted under the domain Akan. The percentage of Fante speaking people captured in this survey was 24.2 %. Classifying Fante under the native language domain Akan would have give people of Akan speaking origin a representation of 58.2% which is not too different from the percentage of Akan speaking people recorded in the 2000 national census. Cognizance should be taken of the fact that two of the three cities surveyed are capitals of predominantly Akan speaking regions.

Fig.5.3.8.2 Native Language (Dialect) of Respondent



5.3.8.3 Precision of Sample Estimates

Making inference from sampled data is related to the Central Limit Theory which states that

If all possible random samples of N observations are drawn from a population with mean μ_Y and variance σ_Y^2 , then as N grows larger, the sample means $\mu_{\bar{Y}}$ will be approximately normally distributed, with the population mean μ_Y and variance σ_Y^2/N .

Expressed mathematically; $\mu_{\bar{Y}} = \mu_Y$ and $\sigma_{\bar{Y}}^2 = \sigma_Y^2/N$

It follows from the central limit theory that for a randomly selected sample from a given population, the sample mean approximates the population mean as the sample size increases. Using statistical principles derivatives of the central limit theory, it is possible to accurately estimate population parameter of such very large population as that of the United States (over 250 million) with a sample as small as 1,416 (Bohrstedt and Knoke, 1988).

The practise therefore is to construct an interval (Confidence Interval) around a sample statistic within which a population parameter lies. The confidence Interval as pointed by Henry, 1998 is the most popular direct measure of the precision of the estimate. Most of the variables measured in this survey are qualitative and do not present themselves for any meaningful statistical manipulations. The confidence intervals for the two quantitative variables (“preferred duration for policy information dissemination prior to its dissemination” and “preferred distance between litter bins at public places”) measured in this survey were computed using the t distribution scores first introduced by W.S. Gossett (Bohrstedt and Knoke, 1988).

The t distribution is one of a family of test statistics used with small samples selected from a normally distributed population or for a large sample drawn from a population with any shape. The standard error of t distribution approaches that of a normal distribution as N becomes larger (Bohrstedt and Knoke, 1988). The formula for constructing confidence interval around a sample mean with t distribution is

$$\text{Confidence Interval (CV)} = \bar{Y} \pm t\alpha/2(S_Y / \sqrt{N})$$

Where \bar{Y} = Sample Mean

$t\alpha/2$ = The value of t variable in the student’s t distribution table

S_Y = Sample Standard Deviation and

N = Sample Size

In construction a Confidence Interval there is the need to specify the level of significance called alpha (α). This is normally set at 0.05. This gives a confidence interval of 95%.

For (α) = 0.05 and $t = 1.960$ the confidence intervals (cv) for preferred duration for policy information dissemination prior to its implementation (PDI) and preferred distance between litter bins at public places (PDL) are:

VC of PDI = 5.03 ± 0.61 (95%)

VC of PDL = 151.76 ± 0.86 (95%)¹

¹ Details of computing the PDI and PDI can be referenced from fig.5.2.5.2 and fig.5.2.6 respectively

5.4 Results of Members of Parliament

The results in this category are analysis of questions that are exclusive to members of parliament. In this survey, questionnaires were administered to all 200 members of parliament to ascertain the political support for implementing policies necessary to mitigate issues identified as constraints to solid waste management, and to move the sector towards sustainable management goals and objectives. After two month, 36 completed questionnaires representing a response rate of 18% was recorded. This was very low considering the seriousness of the solid waste management situation in Ghana. This low response rate, however, could be explained from the perspective that the year of the survey was an election year as a result, most of the members of parliament were concerned and busy campaigning for their re-election. The findings, however, are relevant and important for redefining policy options and programmes necessary for moving the solid waste management sector forward.

5.4.1 Perception of Members of Parliament of the Waste Disposal Habit of Citizens and Public Awareness of Proper Waste Disposal

The perception of the legislature with respect to the attitude of the general public on solid waste related issues will determine whether any policy proposal to legislate laws to regulate unconcerned public attitude and behaviour will receive support or not. It was therefore pertinent for this research to ascertain how members of parliament classify public waste disposal habit according to graded agreement-disagreement scales. Table 5.4.1 is a summary of responses to a question that asked members of parliament to indicate their perception of the citizenry in connection with their waste disposal habit¹. All respondents have disagreed (14 Disagreement + 22 Strong Disagreements) that citizens have cultivated proper waste disposal habits. All things being equal, based on this analysis, parliament will be supportive of any policy package that proposes programmes to instil in the general public, proper waste disposal habits. Table 5.4.1 also summarizes the perception of members of parliament on the sufficiency or otherwise of public information on proper waste disposal².

¹ The related question is Q8,A2

² The question related to sufficiency of public information on proper waste disposal is Q14,A2

Table 5.4.1 Perceptions of Members of Parliament of Waste Disposal Habits of the Citizenry and Sufficiency of Public Awareness of Proper Waste Disposal

Response categories	Citizens in General have Cultivated Proper Waste Disposal Habits		There is Sufficient Public Awareness on Proper Waste Disposal	
	No.	%	No.	%
Strongly Agree	0	0	0	0
Agree	0	0	11	30.6
Neither Agree nor Disagree	0	0	5	13.9
Disagree	14	38.9	6	16.7
Strongly Disagree	22	61.1	14	38.9
Total	36	100	36	100

The result related to sufficiency of public information on proper waste disposal is a mix with 13.9% indicating neither agreement nor disagreement. 55.6% of respondents have acknowledged that there is insufficient public awareness on proper waste disposal while 30.6% have indicated agreement with the statement that there is sufficient public awareness on proper waste disposal. It could be interpreted that even though respondents unanimously agree that the citizenry has not cultivated proper waste disposal habits, there is no unanimous agreement among respondents as to whether this perception could be ascribed to lack or otherwise of public awareness on proper waste disposal.

5.4.2 Agenda Setting and Development of Sustainable Solid Waste Management (SSWM) in Ghana

According to Kraft and Vig 2003, agenda setting that is the rise of an issue to prominence for the development of the necessary policy to address it, is influenced by three factors. These are:

- i. Evidence of the existence of problems
- ii. Available policies to deal with them, and
- iii. The political climate or willingness to act

Since every government policy has as its goal to indirectly influence the behaviour of the general populace in ways that make possible the attainment of policy goals and objects, policy

development will better serve its purpose if factors responsible for problems “constraints” are defined from the perspectives of the targets (the public and administrators of policy) through which public policy achieve it goals and objectives. The approach adopted in this research in identifying and defining constraints to sustainable solid waste management in Ghana was to ascertain, during the interview section with stakeholders in the solid waste management sector, factors that constitute constraints to the sector. Five main factors (issues) were identified as constraints to sustainable solid waste management in Ghana and these are as follow:

- i. Lack of finance
- ii. Lack of personnel
- iii. Technical Constraints
- iv. Unconcerned attitude of the general public, and
- v. Lack of transparency in solid waste management

Should all three conditions of agenda setting be met, the direction of policy development and in this particular case for the attainment of sustainable solid waste management in Ghana will be influenced by the following factors:

- a. The relative importance of the identified constraints (from the perspective of policy makers) to management efforts at solving the problem,
- b. The relative difficulty (from the perspective of policy makers) with which the constraints can be mitigated,
- c. The relative impact (from the perspective of policy makers) of policy options on efforts at mitigating identified constraints, and
- d. The relative difficulty (from the perspective of policy makers) with which policy options for mitigating constraints can be implemented.

5.4.2.1 Relative Importance of Constraints to SSWM in Ghana

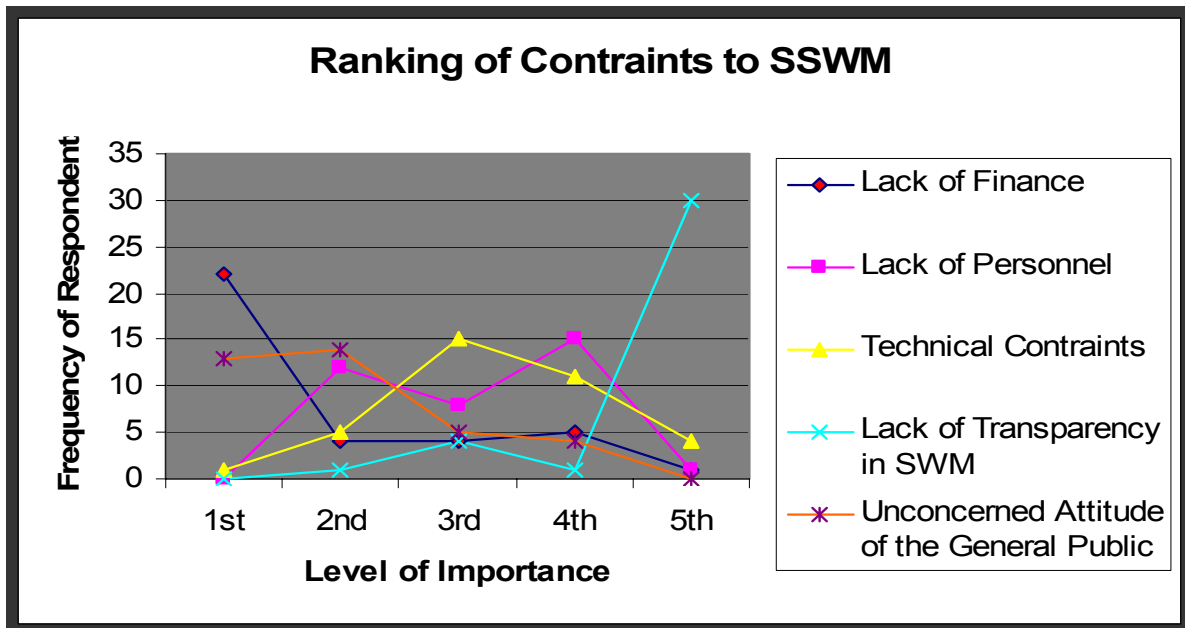
The relative importance of identified constraints to sustainable solid waste management in Ghana was ascertained by asking respondents (members of parliament) to rank in order of importance the issues identified as constraints to sustainable solid waste management in Ghana using a scale 1-5 (where 1 = Very Important, 2 = Important, 3 = Moderately Important, 4 = Little Important, 5

= Least Important) The result obtained from the analysis of the related question¹ using differentiated perception ranking method is as presented in fig. 5.4.2.1.

As indicated in fig.5.4.2.1, lack of finance was ranked by majority of respondents as most important for the attainment of sustainable solid waste management in Ghana. The proportion of respondents who identified lack of finance as very important for the attainment of sustainable solid waste management in Ghana was 61%. Other identified constraints that made this category of ranking were unconcerned attitude of the general public and technical constraints with proportions of respondents of 36.1% and 2.8% respectively.

¹ The related question is Q16,A2

Fig.5.4.2.1 Relative importance of Constraints to SSWM in Ghana



Response Categories	1st = Most Important Constraints to SSWM		2nd = Important Constraints to SSWM		3rd = Moderately Important Constraints to SSWM		4th = Little Important Constraints to SSWM		5th = Least Important Constraints to SSWM	
	No.	%	No.	%	No.	%	No.	%	No.	%
Lack of Finance	22	61.1	4	11.1	4	11.1	5	13.9	1	2.8
Lack of Personnel	0	0	12	33.3	8	22.2	15	41.7	1	2.8
Technical Constraints	1	2.8	5	13.9	15	41.7	11	30.6	4	11.1
Lack of Transparency in SWM	0	0	1	2.8	4	11.1	1	2.8	30	83.3
Unconcerned Attitude of the General Public	13	36.1	14	38.9	5	13.9	4	11.1		0
Total	36	100	36	100	36	100	36	100	36	100

At the level of importance, all categories of constraints were recognized by various proportions of respondents as important with unconcerned attitude of the general public having the highest representation of 38.9% followed closely by lack of personnel with a percentage representation of 33.3%. Lack of transparency in solid waste management was identified by the least number of respondents as an important constraint. Technical constraint was identified by majority of

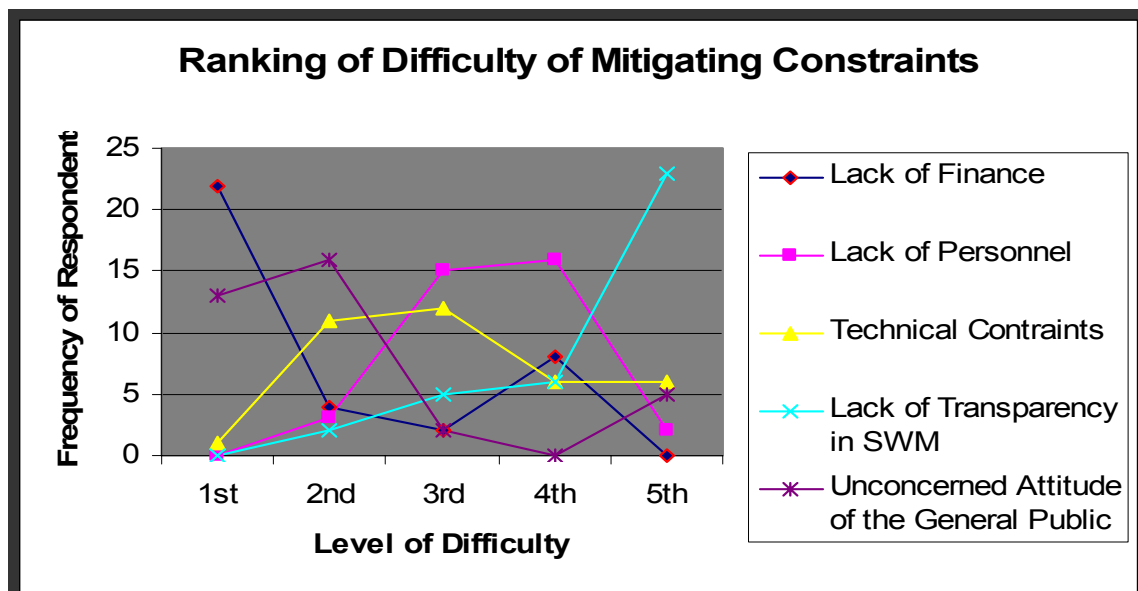
respondents at the level of moderately importance. Lack of personnel was selected by majority of respondents as a constraint of little important and lack of transparency in management was identified by rather a very high proportion of the respondents as the least important constraint for the attainment of sustainable solid waste management in Ghana.

5.4.2.2 Relative Difficulty of Mitigating Constraints to SSWM in Ghana

The determination of the relative difficulty with which identified constraints can be mitigated was accomplished by asking respondents to rank the listed constraints using a scale 1-5 (where 1 = Most difficult to mitigate, 2 = Difficult to mitigate, 3 = Moderately difficult to mitigate, 4 = Little difficult to mitigate, 5 = Least difficult to mitigate). Fig. 5.4.2.2 is obtained from the analysis of the related question¹. In this analysis, lack of finance and unconcerned attitude of the general public which were identified as most important constraints to sustainable solid waste management in Ghana have again been classified by respondents as factors that are very difficult to mitigate. Unconcerned attitude of the general populace as constraints to sustainable solid waste management retained its relative position as being selected by majority of respondents in the second category of ordered-ranking. Lack of personnel exhibited a unique ranking among respondents in this analysis. It was recognized by majority of respondents as both the third and fourth most difficult constraints to mitigate. In other words, lack of personnel was ranked by majority of respondents as a factor that is both moderately difficult and little difficult to mitigate. Lack of transparency in management is again ranked by majority of respondents in the last category of ordered ranking. In other words, lack of transparency is recognized by respondents among the constraints as least important as well as least difficult to mitigate.

¹ The related question is Q17,A2

Fig. 5.4.2.2 Relative Difficulty of Mitigating Constraints to SSWM in Ghana



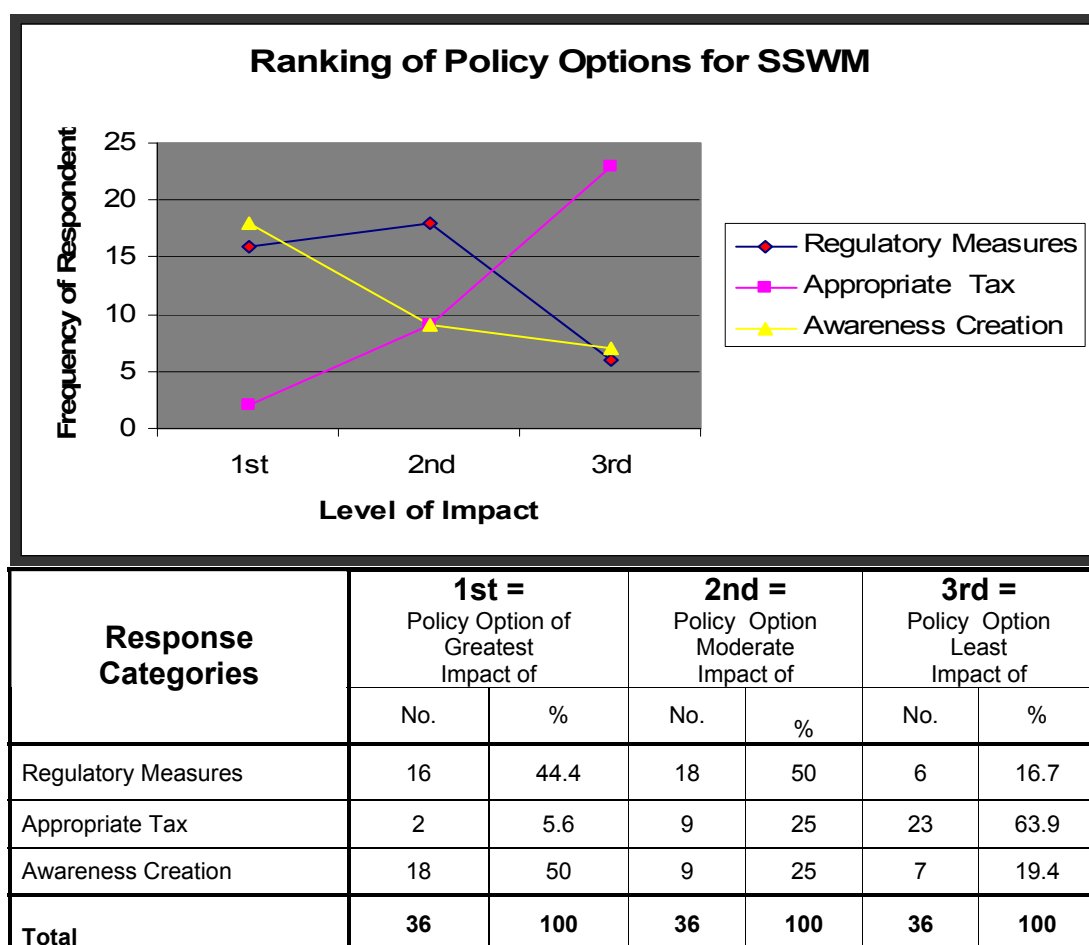
Response Categories	1st = Very Difficult Factor to Mitigate		2nd = Difficult Factor to Mitigate		3rd = Moderately Difficult Factor to Mitigate		4th = Little Difficult Factor to Mitigate		5th = Least Difficult Factor to Mitigate	
	No.	%	No.	%	No.	%	No.	%	No.	%
Lack of Finance	22	61.1	4	11.1	2	5.6	8	22.2	0	0
Lack of Personnel	0	0	3	8.3	15	41.7	16	44.4	2	5.6
Technical Constraints	1	2.8	11	30.6	12	33.3	6	16.7	6	16.7
Lack of Transparency in SWM	0	0	2	5.6	5	13.9	6	16.7	21	58.3
Unconcerned Attitude of the General Public	13	36.1	16	44.4	2	5.6	0	0	7	19.4
Total	36	100	36	100	36	100	36	100	36	100

5.4.2.3 Relative Impact of Policy Option for Mitigating Constraints

The determination of the relative impact of three main policy options that could help mitigate the constraints to solid waste management was achieved through a question that asked respondents to rank the three policy options using a scale 1-3 (where 1 = Greatest Impact, 2 = Moderate Impact,

3 = Least Impact). Fig.5.4.2.3 is a representation of analysis of the related question¹. This analysis reveals almost a split between awareness creation (50%) and regulatory measures (44.4%) in terms of their impact on efforts at mitigating constraints to sustainable solid waste management in Ghana from the perspective of policy makers.

Fig.5.4.2.3 Relative Impact of Policy Option on Efforts at Mitigating Constraints



This contrasts to some extent with the perspectives of the general public on the same issue. When members of the general public were asked to rank these three policy options in terms of the impact these can have on their waste disposal habits, there was a clear majority that indicated awareness creation as the option that can have the most compelling impact². Respondents in this

¹ The related question is Q18,A2

² Refer to fig.5.3.4 for details

category were aware of the fact that existing regulatory measures have so far proved to be ineffective as result of poor monitoring and enforcement of non-compliance. This probably explained why respondents anticipated that increased public awareness about the benefits of proper waste disposal could increase public participation and concern for solid waste management related issues and hence the choice of awareness creation by majority of them as the option that can have the greatest impact. Appropriate taxes even though can bring in the needed financial resources for the payment of the cost of solid waste management has always been politically sensitive issue. This probably explained why it was the policy option ranked by most respondents as that which can have the least impact on efforts at attaining sustainable solid waste management in Ghana. This should especially be considered against the background that lack of finance was recognized by majority of respondents as the most important constraints and also by majority of respondents as the most difficult constraint to mitigate in efforts aimed at attaining sustainability in management.

5.4.2.4 Relative Difficulty of Implementing Policy Option

The relative difficult of implementing policy options was assessed by asking respondents to rank the three policy options using a scale 1-3 (where 1 = Most Difficult to Implement, 2 = Moderately Difficult to Implement, 3 = Least Difficult to Implement). Fig. 5.3.2.4 was obtained by processing responses to the question related¹. Issues related to finance seem to ramify as usual beyond the boundaries of solid waste management thereby presenting a unique and complex matrix within the solid waste management system. Lack of finance was identified by most respondents as the most important constraint to sustainable solid waste management in Ghana², it was also the factor identified by majority of respondents as the most difficult to mitigate³. One should expect that any policy option that aims at generating financial resources such as appropriate taxes should be considered to have the greatest impact. This, however, was not the case as was depicted in fig. 5.4.2.3. In this analysis, imposition of appropriate tax has been ranked by majority of respondents as the policy option that can be most difficulty to implement as presented in fig.5.4.2.4.

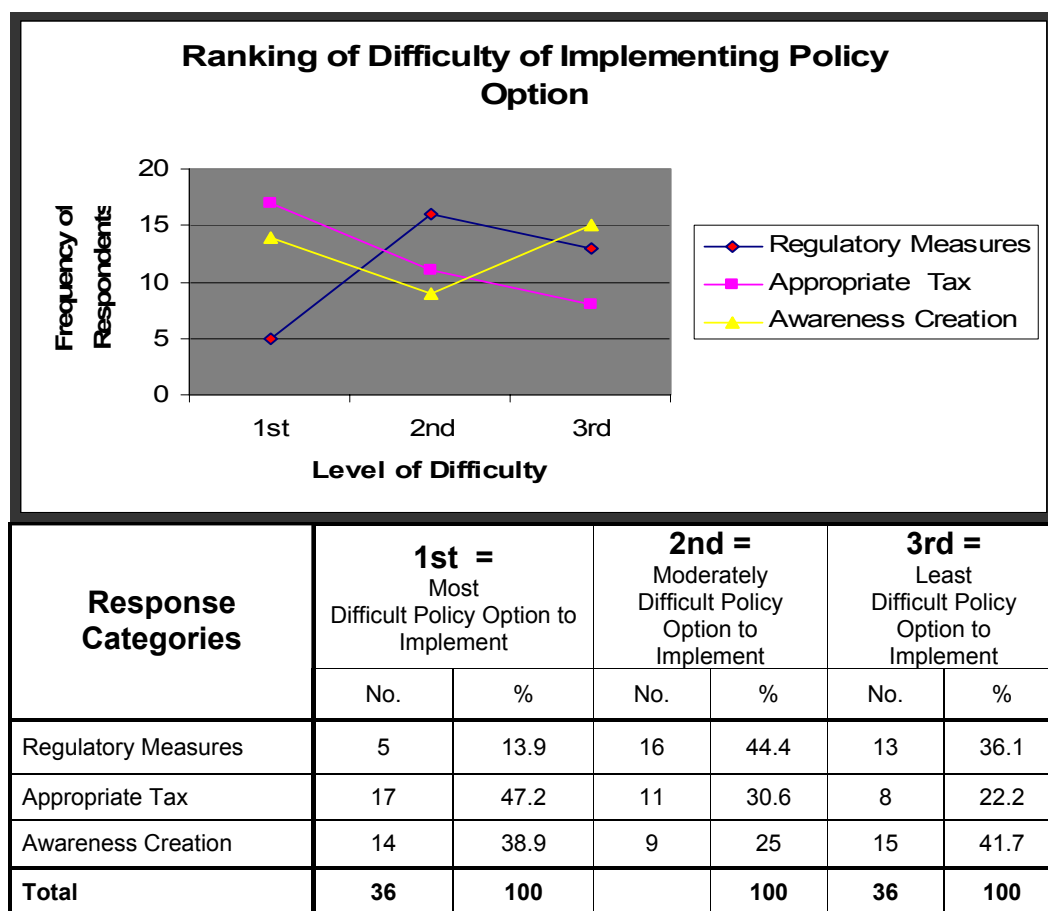
¹ The related question is Q19,A2

² Refer to fig.5.4.2.1 for details

³ Refer to fig.5.4.2.2 for details

Awareness creation seems to offer some window of opportunity for policy entry. It edged out regulatory measures as the option that will present the least implementation difficulty as shown in fig.5.4.2.4 below. It was also identified by majority of respondents as the option that can have the greatest impact with respect to efforts at attaining sustainable goals in solid waste management from the perspective of both policy makers¹ and the general public as the policy option that can have the most impact in on their waste disposal habits².

Fig. 5.4.2.4 Relative Difficulty of Implementing Policy Options



It follows from these analyses that awareness with respect to the needs and benefits of proper solid waste management can prepare the grounds for the introduction of other complementary policies.

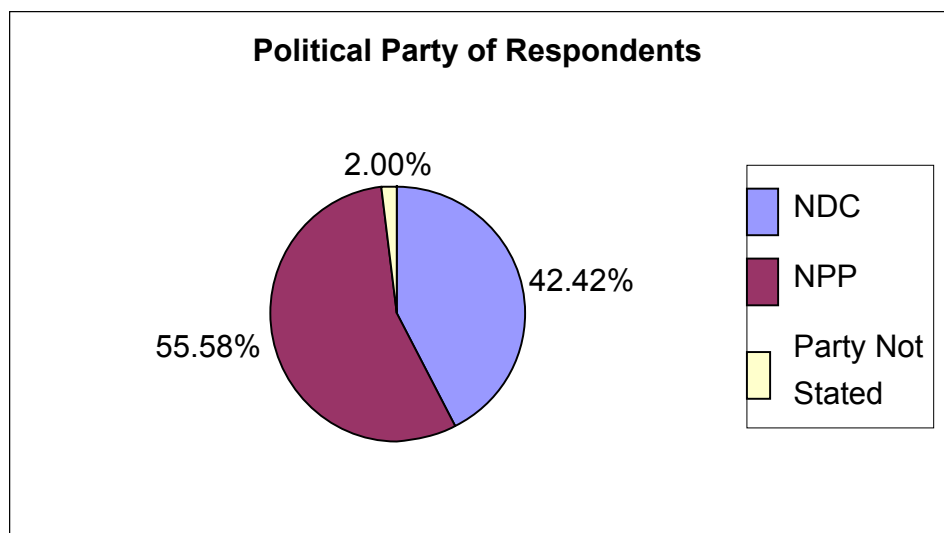
¹ Refer to fig.5.4.2.3

² Refer to fig.5.3.4

5.4.3 Representativeness of Data

In this exercise, self-addressed envelopes and questionnaires were distributed in the letter boxes (pigeon holes) of all members of parliament. Two months after the start of the exercise, 36 completed questionnaires representing a response rate of 18% was recorded. Though this response rate is very low and can not be judge to be representative, the distribution of respondents with respect to political parties, is a reflection of the proportion of the two main parties in parliament. Fig.5.4.3.1 shows the political parties of respondents, and Table 5.4.3.1 shows the proportion of the various political parties in parliament as of 2004. The findings therefore are quite relevant for the advancement solid waste management sector in Ghana

Fig.5.4.3.1 Distribution of Political Party of Respondents



NPP = New Patriotic Party

NDC = National Democratic Congress

Table 5.4.3.1 Representation of Political Parties in Parliament in Ghana, 2004

Party	No. of Seats	% of total
NDC	92	46
NPP	100	50
Other Parties	4	2
Non-Partisan	4	2
Total	200	100%

NPP = New Patriotic Party
NDC = National Democratic
Congress

5.4.3.1 Precision of Survey Data

Since survey was carried out on all 200 members of parliament, any reported statistical value represents that of the whole group (population) and not for a sample. The means and standard deviations for the two quantitative variables measured in this survey for members of parliament are as follows:

1. Preferred Duration (PDI) for Policy Information Dissemination Prior to its Dissemination;
 - i. Mean (PDI) = 5.25
 - ii. Standard Deviation (PDI) = 1.82

2. Preferred Distance (PDL) Between Litter Bins at Public Places;
 - i. Mean (PDL) = 129.17
 - ii. Standard Deviation (PDL) = 31.85

6.0 Development of Policy Proposal for Sustainable Solid Waste

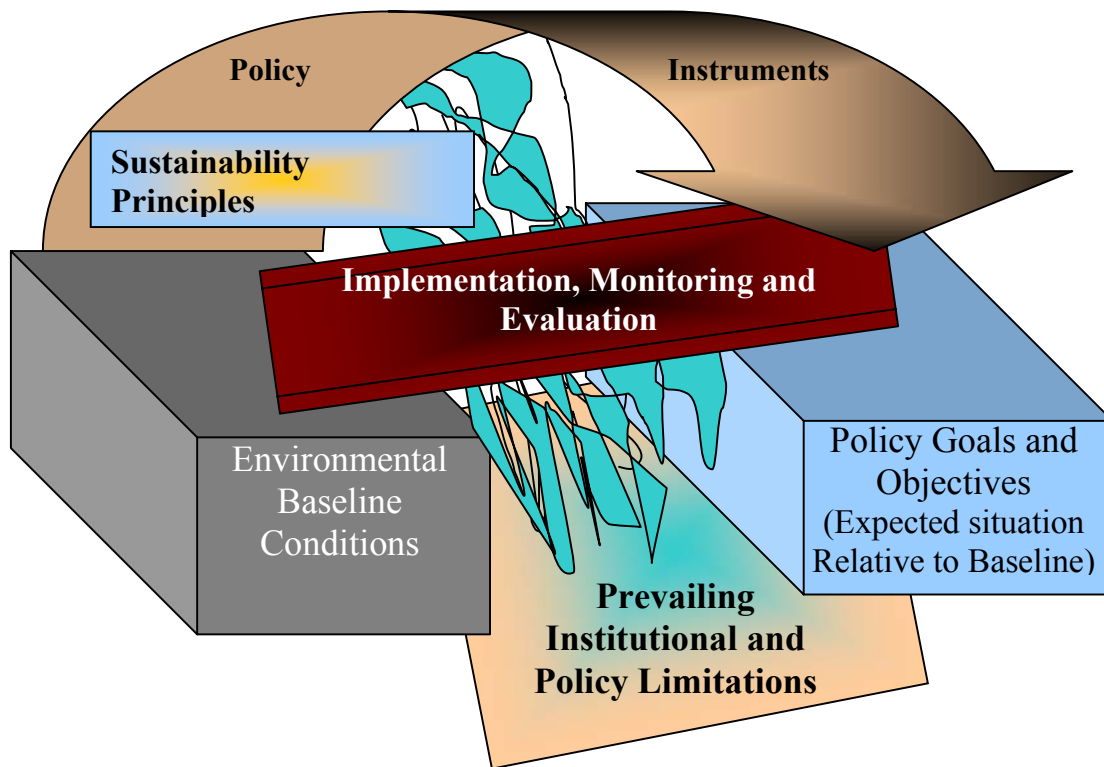
Management in Ghana (The Bridge Model of Policy Development)

A conceptual model of policy development similar to the UNEP¹ process of environmental policy development is proposed for developing a policy package for sustainable solid waste management in Ghana. This model here referred to as “The Bridge Model” of policy development conceptualizes policy development as a bridge building process. The model considers baseline environmental conditions as one bank of a river and the opposite bank as the policy goal(s). The task is to bridge baseline environmental conditions with intended policy goals using various policy instruments with the river in between as constraints. The river represents the institutional and policy limitations that exist in reality to the attainment of policy goals. The approach to bridging the two banks of a river is to first undertake field investigation in order to ascertain information relative to the river environment (depth of river soil type etc). Field investigation can be likened in the bridge model of policy development to the survey and information gathering on the society within which the policy to be designed will be implemented. In the Bridge Model of policy development therefore, field investigation, is tantamount to survey of respondents (administration of questionnaires, interviews and other data gathering exercises).

With the results of field investigation a bridge is then designed. In the same vane the bridge model of policy development proceeds with design of policy package after analysis of research result and processing of related research data. In this particular situation, however, the intention is to design a policy that is sustainable and hence the need to incorporate principles of sustainability into policy design. This can be interpreted from the Bridge Model perspective as designing a bridge that will be durable. This concept is as represented diagrammatically in fig.6.1

¹ A summary of the UNEP process of environmental policy development can be referenced from fig.2.8

Fig.6.1 Conceptual Bridge Model of Policy Development



The construction of a bridge after the design stage can be likened to policy implementation, monitoring and evaluation. As in the case of constructing a bridge, the two banks of the river become connected, the same applies to policy implementation which connects policy goals with baseline condition for monitoring and assessment and this is a cyclical process.

Apart from conceptual differences, the main differences between the Bridge and the UNEP model of environmental policy development are related to the mode and methods of ascertaining prevailing institutional and policy limitations and in the mode of implementation. The Bridge Model used the “differentiated perception ranking” analysis approach¹ which is unique to this model. The mode and method of information gathering in this Bridge Model is also based on the central assumption that “since government policies have as their goal to indirectly influence the behaviour of the general populace in ways that make possible the attainment of policy goals and

¹ Refer to section 5.3.3 for details

objectives, policy development will better serve its purpose if policy shortcomings (prevailing institutional and policy limitations) are defined from the perspectives of the targets (the public and administrators of policy) through which public policy achieve it goals and objectives”. The implementation of some policy instruments that are envisaged to encounter implementation difficulty is accomplished in the Bridge Model through “The Rotational Model”¹ of policy implementation which is also unique to the Bridge Model.

The approach to developing a policy package for sustainable solid waste management in Ghana therefore proceeded by bridging base baseline conditions and policy goals (research goal) identified in the introductory section of this thesis² with policy design taking cognizance of the following:

- i. Research Results
- ii. Principles of Sustainability
- iii. Prevailing Institutional and Policy Limitations, and
- iv. Relevant Solid Waste Management Policies in other Countries

6.1 Definition of Policy Goal

The goal of this policy proposal synchronizes with the goal of this research of mitigating policy constraints to sustainable solid waste management in Ghana leading to enhanced solid waste management system. Other derivatives of the primary goal are improvements in public health and economic development.

6.2 Institutional Baseline Conditions

Policy implementation takes place within institutional framework. Institutional structures available for policy implementation therefore, play very important roles and contribute to the attainment of policy goals and objectives. Implementation of the existing solid waste management policy in Ghana falls within the purview of the various district assemblies and their associated waste management departments. The local authorities tasked with the administration of cities, towns and villages in Ghana are functionally weak and lack capacity especially in the

¹ The rotational model is covered under section 6.8

² Refer to table 1.1 for baseline environmental solid waste management conditions in Ghana

area of tax collection. Dependence on central government for budgetary allocation for payment of solid waste management related cost has created a cycle of “delayed payment” of solid waste management services which is affecting the efficiency of private sector performance in service delivery. The Ministry of Local Government and Rural Development (MLGRD), responsible for solid waste management from national perspective lack capacity in terms of personnel and expertise at the district and local level for the implementation of solid waste management related policies. The National Environmental Sanitation Policy Co-ordination Council (NESPCC) is responsible for coordinating policy and ensuring effective communication and cooperation between the various public and private sector agencies involved in environmental sanitation (MLGRD, 1999). This institution is functionally weak and lack capacity evidenced in the poor state of solid waste management in the country.

6.3 Institutional Modifications

Institutional capacity available for policy implementation is very important in the prescription of a policy package for the attainment of stated goals. A new policy package no matter how plausible it may look from theoretical perspectives in attaining policy goals may fail in practise if its implementation requires the establishment of completely new institutional structures. The development of this policy package therefore does not propose the setting up of new institutions for the attainment of sustainable solid waste management in Ghana. There is however, the need to modify existing institutional structures in order to bring about functional changes that will facilitate policy implementation. The policy package to be proposed recognizes the NESPCC within the Ministry of Local Government and Rural Development (MLGRD) as the focal national institution. Table 6.1 presents the expected ministerial composition of NESPCC that will facilitate the realisation of sustainable solid waste management in Ghana.

The mandate and power level of the lead institution responsible for coordinating policy implementation is very important and contributes considerably to successful policy implementation. To be able to push sustainable solid waste management policy through to implementation, NESPCC must have the necessary power and mandate within all of its constituent ministries. As a result, representatives of all ministries should be directly answerable to their respective sector ministers.

Table 6.1 Expected Organizational Composition of NESPCC Necessary to Facilitate Successful Implementation of Sustainable Solid Waste Management in Ghana

	NESPCC Composition	Function
1	Ministry of Education and Sports	<ul style="list-style-type: none"> ◆ Capacity building through introduction of programmes at tertiary level to train qualified SWM personnel ◆ Incorporation of a programme into the educational system that inculcates in pupils and students the habit of proper waste management.
2	Ministry of Health	<ul style="list-style-type: none"> ◆ To put in place programmes for augmenting awareness creation against littering focusing on littering and public health. ◆ To be involved in programmes for managing medical waste
3	Ministry of Trade and Industry	<ul style="list-style-type: none"> ◆ To institute programmes to promote the use of locally produced cotton shopping bags ◆ To negotiate for imposition of tax on sources of plastic related waste ◆ To be Involved in collection of the necessary tax on import of vehicles ◆ To be Involved in developing details of the deposit-refund programme for household batteries and hazardous household waste
4	Ministry of Finance and Economic Planning	<ul style="list-style-type: none"> ◆ To be involved in deciding initial budgetary allocation necessary for the implementation of programmes and in cost estimation of policy implementation
5	Ministry of Lands, Forestry and Mines	<ul style="list-style-type: none"> ◆ To be involved in incorporating solid waste management into regional development planning and in acquiring sites for solid waste management facilities
6	Ministry of Environment and Science	<ul style="list-style-type: none"> ◆ To be involved through the Council for Scientific and Industrial Research in setting up pilot projects related to processing of bio-waste and plastic recycling ◆ To be involved through the EPA in developing sector specific guidelines for waste minimisation, training of district assemblies in waste management related programmes, monitoring of landfill and in developing guidelines for community waste disposal points
7	Ministry of Local Government and Rural Development	<ul style="list-style-type: none"> ◆ To be involved in developing capacity for the functions that the districts assemblies are to play in this policy and in serving as the focal ministry of NESPCC
8	Ministry of Energy	<ul style="list-style-type: none"> ◆ To be involved in facilitating the roles that the Electricity Corporation of Ghana is suppose to play in this policy

6.4 Political Support and Policy Windows

Political support for public policy overrides all other consideration for policy adoption and implementation. There has been a lot of political rhetoric over the years in connection with the need for solid waste in Ghana to be managed sustainably. Although until now no pragmatic efforts have been made to address the situation, there appears to be a conducive political environment for the adoption and implementation of a sustainable solid waste management policy if the policy windows through which policy instruments can be pushed and the benefits that will accrue to society at large from the adoption of policy package are well presented. Both the president and vice president in addition to many ministers of state have made several pronouncements on the need for proper solid waste management in Ghana. The president was quoted to have stated in early 2004 that a new policy on sanitation would be operational that year (GNA, 2004), and the vice president was quoted in January, 2002 to have called on the EPA to give technical support to district assemblies on solid waste management (GNA, 2002). Responses received from members of parliament during the survey section of this research also provide some evidence in support of the need for a sustainable solution to solid waste management in Ghana. In this survey, 82.1% (28.1% Very Dissatisfied + 54.0% Dissatisfied)¹ of respondents indicated dissatisfaction with the current solid waste management in the country. This demonstrated dissatisfaction by members of parliament is tantamount to political support for any pragmatic policy that can address the situation.

The policy of incorporating private sector into solid waste collection and disposal which has been on going for some years now makes easy the implementation of the policy package to be proposed. It has already been ascertained that majority of the populace will be more satisfied with the functions of waste collection and disposal in the hands of private enterprises². What is necessary therefore, is the creation of the policy environment that can increase the efficiency as well as the scope of private sector participation in solid waste management in Ghana.

¹ Details of the perception of members of parliament on the current solid waste management situation can be referenced from fig.5.2.1

² On the agency most appropriately disposed to carry out the function of waste collection and disposal, majority of both categories of respondents indicated private enterprises. This can be referenced from fig.5.2.2

The authorities of almost every town and municipality have made attempts to address the problem of unconcerned attitude and indiscriminate waste disposal habits of the general public. However, these attempts have only been fragmented and ineffective as a result of which open drains continue to be laden and open spaces continued to be strewn with all sorts of waste. For example, clean up exercises have been organized in almost every town only for waste to reappear in the drains and open spaces. Public awareness campaigns have been organized every now and then although without pragmatic programmes and efforts to instil in the general public the habits of proper waste disposal. Attempts have also been made to compel agents and agencies responsible for generating waste, contribute financially for the disposal of the waste they produce. However, these attempts have so far remained unfocused and un-compelling.

In developing a policy package to address the problems of waste management in Ghana, it was necessary to prioritize the sources of the problems and policy options to address them. Plastic related waste form only about 4% of the total waste stream¹ in Ghana. Plastic waste, however, was recognized by majority of both groups of respondents² as the most problematic waste. This is evidential in labelling indiscriminate waste disposal by the public as one issue which when addressed can have considerable impact on solid waste management in Ghana. With the knowledge that proper waste disposal constitutes an institutional behaviour, this research concludes that a policy package consisting of command-and-control and Economic Instruments in addition to other policy programmes and strategies will be required to address the solid waste management situation in Ghana. Taking cognizance of the results obtained in this research, prevailing institutional and policy limitations, principles of sustainability and relevant experiences of solid waste management in other countries the following policy instruments as presented in fig.6.4 are proposed as a package for the attainment of sustainable solid waste management in Ghana.

¹ Fig.3.2.1 presented the composition of waste in Accra which could be taken to represent the rest of the country because of the absence of waste composition data of other cities.

² Fig.5.2.3 depicted the most problematic waste from the perspective of both categories of respondents.

Fig.6.4 Policy Package for Sustainable Solid Waste Management in Ghana

1. Provision of litter bins at all public places.
2. Introduction of Waste Separation at source.
3. Estimation of associated Implementation cost.
4. Provision of guidelines for medical waste management.
5. Provision of sector specific waste minimisation guidelines.
6. Support for the development of plastic recycling industries.
7. Promotion of the use of locally produced cotton shopping bags.
8. Specification of time for policy dissemination and policy review.
9. Development of sanitary landfills and material recovery facilities.
10. Support for the development of systems for processing bio-waste.
11. Promulgation of national laws and regulations related to sanitation.
12. Institution of a programme to streamline the operations of waste scavengers.
13. Institution of a programme for the disposal of old and unserviceable vehicles.
14. Institution of a programme for waste management officials to meet periodically.
15. Incorporation of solid waste management into regional development planning.
16. Support for the development of waste related Information Management System.
17. Promotion of active anti-littering campaign and awareness on proper waste disposal.
18. Institution of levy on sources of plastic related waste (plastic bags and sachets for water).
19. Incorporation of graduate programmes related to waste management into the education system.
20. Capacity building and re-defining the responsibilities of some solid waste related agencies.
21. Institution of deposit-refund system for household batteries and other household hazardous waste.
22. Institution of programmes for cost recovery for waste collection and disposal in low income communities.
23. Incorporation of programmes into the educational system that inculcates proper waste disposal habits in pupils and students.

6.5 Explanation of Policy Package

6.5.1 Provision of Litter Bins at all Public Places

The pursuit by government to transform indiscriminate waste disposal habit of the public through various policy instruments and programmes should take cognizance of the fact that litter reduction interventions usually functions through two behavioural principles. First, by changing the antecedent conditions of littering using interventions such as prompts or the presence or absence of prior litter and second, by changing the consequence of littering behaviour through interventions such as rewards or penalties (Geller et al., 1982). What this means is that enforcement of laws to transform public indiscriminate waste disposal habits should be accompanied by increased efforts by government to keep streets and public spaces clean because the presence of litter encourages more littering. Although the distance between litter bins at public places should be based on the density of people and the intensity of activities at such places, littering could be reduced if the public is aware that litter bins are located at some regular intervals at public places. This research ascertained the optimum distance for spacing litter bins at public places to be between 150-200m from the perspective of the general public, although majority of members of parliament would prefer the spacing to be between 100-150m¹.

6.5.2 Introduction of Waste Separation at Source

Sustainable solid waste management aims at reducing the environmental impact of waste through return of useful materials in waste streams into the economic cycle. Waste separation at source provides the basis for subsequent processes involved in transforming waste into resources. With organic composition of the waste stream in Ghana as high as 65%², there is the need to lay down structures to reduce the environmental impacts associated with waste disposal through recovery of material in the form of compost and or energy in the form of biogas. Source separation of waste into bio and non-bio waste will provide the basis for the development of waste recycling. The main draw backs to waste separation at source are the expected increase in collection cost and the reliance on the cooperation of the general public for the integrity of the source separated components. The increase in collection cost is not expected to be any appreciable. Source separated organic components will continue to be collected once or twice a week as usual.

¹ Details of optimum distance between litter bins at public places from the perspectives of both the general public and members of parliament can be referenced from fig.5.2.6.

² Refer to fig.3.2.1 for composition of waste.

Because the non-organic components form about 35% of the total waste stream these can be stored on site and collected once a month. The integrity of source separated components will be checked and further separation carried out in material recovery facilities to be linked with recycling facilities.

NESPCC will be expected under this package to involve the Council for Scientific and Industrial Research (CSIR) in developing pilot projects to determine the viability or otherwise of both compost production and biogas generation as well as recycling of plastic. Such a pilot project will need to take cognizance of operational limitations, local and plant specific requirements and needs. The pilot project will also need to consider the availability or otherwise of market of products to be recovered. In this research the proportion of respondents who indicated that they will practise source separation of waste was quite high¹, however, source separation of waste need to be accomplished through the conceptual rotational policy implementation model developed by this research.

6.5.3 Estimation of Associated Implementation Cost

The final cost of policy implementation should be determined as follows; NESPCC will determine the number of personnel and logistic requirement of each participating institution (ministry). After this, three different groups, each consisting of individuals who are well versed with cost estimations related to policy implementation will be constituted. Each group will be required to make independent cost assessment of implementing the policy package. The final estimate to be adopted should be the average of any of two estimates that are not too different or in the case of three completely different estimates the average of all the three.

6.5.4 Provision of Guidelines for Medical Waste Management

Under this policy, the EPA will be required to develop guidelines for the management of medical waste. Cognizance should be taken here of the fact that not all the waste generated within a hospital are infectious. As a result, guideline for medical waste management should make provision for source separation into infectious and non-infectious waste, and the later disposed of in the municipal solid waste management system. The guideline should provide specific directions for disposing of infectious waste.

¹ The proportion of respondents who indicated that they will participate in waste separation at source can be referenced from table 5.2.5.1.

6.5.5 Provision of Sector Specific Waste Minimisation Guidelines

Waste minimisation or source reduction is the most preferred waste management strategy. For sustainable solid waste management to be able to reduce environmental impact of solid waste management, there will be the need for the EPA under this policy to list all industries in a process of producing separate guidelines for those industries that produce **high volume** of waste (by-products) and those that produce waste types that have **considerable impact** on the environment even in small amounts (hazardous waste). The waste minimisation guidelines will be developed in conjunction with various categories of industries. Industries will be made to understand that they will be the main beneficiaries if guidelines are observed. Industries under the waste information management provisions of this policy package will be required to periodically equip the EPA with information in connection with their waste management in terms of quantity produced, treatment if any, and mode of disposal.

6.5.6 Support for the Development of Plastic Recycling Industries

Plastic bags are non biodegradable (with the exception of specially made biodegradable plastic) and pose a lot of problem to the environment and contribute in many ways in influencing public health negatively. In terms of environmental consequences, plastic wastes once disposed of interfere with ecosystem processes as a result of their non-biodegradability attribute. The production processes associated with plastic are also highly energy demanding. For every 1 kg of plastic produced, 2 kg of oil are required (IDB, 2003). Land filling of plastics eliminates any chances of recovering any of the energy equivalents. Incineration of plastic recovers about 0.5 to 1.0 kg of the energy value. Recycling of plastics, however, recuperates almost all of the energy value and in the process save the oil that would have been used in producing new plastic materials. Recycling of plastics need to be encouraged through tax relieves on the importation of equipment and parts for industries involved in plastic recycling. Though there is domestic market for locally produced and imported plastic shopping bag, recycling of plastic first need to identify products which can be made for which there are markets.

Like other waste processing projects, the viability of recycling plastics needs to be established through a pilot project. The CSIR can be engaged to undertake this pilot project. Plastic recycling is very important since the use of plastics can not be completely eliminated. Drinking water, bread

and other food items will continue to be packaged in plastics. This offers the most cost effective means of preventing contamination. This perspective is supported by the assertion made by Blumberg and Gottlieb, 1989, that plastics have overtaken all other materials for packaging food and cosmetic products. The irony is that while plastic contributes positively to public health directly by the role it plays as packaging material which is effective in preventing contamination and hence the outbreak and spread of diseases in the dusty environment of the tropics, indirectly, plastic has adverse impact on public health through creation of the environment that encourages the breeding of germs and pathogens if they are not disposed of properly. The public therefore stands to gain considerably if plastic waste can be managed effectively.

Industrial development is always driven by economic considerations. As a result, if government can create the policy environment that ensures availability of plastic waste as source of raw material (through implementation of source separation of waste) and market for products that can be made from plastic waste, the interest of the private sector will be precipitated in plastic recycling. There have been many debates at governmental level in connection with recycling of plastics. From the positive impacts that plastic recycling can have on both the health and economic sectors not to mention the gains from environmental perspectives, it can be said that the policy window exist for political support for private sector initiatives aimed at establishing plastic recycling plants.

6.5.7 Promotion of the Use of Locally Produced Cotton Shopping Bags

The use of cotton carrier bags provides a very good alternative to plastic bags and they are more economical in the long term since they have a longer life span. Although periodic washing of such bags consumes resources in terms of detergents, water and energy, they still offer better alternatives to plastic bags from economic perspective. Cotton shopping bags also have less impact on the environment from the perspectives of their production as well as disposal. Locally manufactured textile and wax-prints and numerous dressmakers and tailors are available in almost every town and village to facilitate the production of cotton shopping bag once the market has been created. Because shopping with cotton bags is foreign to most Ghanaians, this idea has to be promoted through television and radio adverts.

6.5.8 Specification of Time for Policy Dissemination and Policy Change

The implementation of this policy package is designed to proceed through three phases¹ with the incorporation of a conceptual rotational policy implementation model to address policy instruments that are envisaged to have implementation difficulty. The duration of each phase of the policy implementation is to be determined by policy implementers. However, each of the three phases should necessarily be preceded by a period of information dissemination on the set of policy instruments to be implemented. This research ascertained the preferred duration of policy dissemination from the perspectives of both categories of respondents to be between three to six (3-6) months². It is, however, recommended to set the period of review of the whole policy package to four years.

6.5.9 Development of Sanitary Landfills and Material Recovery Facilities

Every solid waste management strategy apart from source reduction leaves residues that need to be disposed of. Landfills present the ultimate option for waste disposal since the banning of disposal in surface water bodies by international conventions such as UNCLOS (Knopp et al., 2000) and many national regulations. Sustainable development takes into consideration local socio-economic factors. At this stage of its socio-culture and economic development, Ghana cannot afford sanitary landfill for every town and village. The EPA, however, will be required under this policy to specify a **population density threshold** of towns and cities beyond which waste generated should necessarily be disposed of in sanitary landfills. The development of Landfills should be accompanied by Material Recovery Facilities. For towns and villages below the stipulated threshold, waste disposal should be at designated Community Waste Disposal Points (CWDP). The requirements of Community Waste Disposal Points should be clearly stated in a national guide of waste management. This will prevent the practise where a couple of households in any small village or town create their own final waste disposal points.

This policy does not recommend separate disposal of industrial and municipal waste at the initial phase of this policy cycle because of socio-economic reasons. This, however, should be a future

¹ Simultaneous implementation of all instruments of this package will result in policy implementation failure. A three phase implementation schedule has been devised based on research result and this can be referenced from table 6.7.

² Details of preferred duration of dissemination of information on policy instruments can be referenced from fig.5.2.5.2.

consideration and be included in policy review as and when it becomes necessary based on data supply by industries to NESPCC under the Waste Information Management System provision of this package.

6.5.10 Support for the Development of Systems for Processing Bio-waste

Incorporation of waste separation at source in this policy package is to prepare the ground for processing the organic component of the waste which is about 65%. The two options are production of biogas and compost. If availability of market for recovered products from waste is taken into consideration, production of biogas appears a more viable option. Initial capital investment for plant establishment for biogas production is expected to be higher than that for compost production, the option to be chosen should be based on careful analysis that integrates socio-economic with environmental considerations and this should be assessed through a pilot project.

A policy window exists for the implementation of this policy through the additional income this can bring to the solid waste management sector and its positive effect in reducing environmental impact of organic waste decomposition in landfills. The option also offers additional advantage of extending the life span of landfills. At the moment almost all municipalities in Ghana are faced with the problem of land acquisition in the proximity of cities for the development of landfills. Any management option which can extend the life span of existing and future landfills should be accepted especially that this option can provide some revenue to management.

6.5.11 Promulgation of National Laws and Regulations Related to Sanitation

Historically, development of solid waste management has been characterized by the use of regulatory measures to mitigate indiscriminate waste disposal. In response to indiscriminate public disposal of solid waste, the urban sanitary act was passed in the United Kingdom in 1888 to prohibit the throwing of solid waste into ditches, rivers, and lakes. About a decade later, in 1899, the River and Harbours Act was passed in the US for the same reason (Tchobanoglous et al., 1993). In Germany the enactment of the Federal Epidemic Act in Germany in 1900 was in response to pollution by private waste disposal activities (Fischer and Petschow 2000). In Ghana

the development of sanitation related laws and regulation have so far been devolved to the district assembly level. Not only is this approach ineffective, it is fragmented and lack focus. Sanitation laws and regulations will need to be nationally driven and locally enforced. For example law obliging all households to have waste receptacles should be promulgated and passed on a national basis and so should be laws banning indiscriminate disposal of waste. A provision within a national sanitation policy should make people who own shops along road sides to be custodians of the space and areas around their shops. The provision should clearly specify the marginal space around shops that owners should be responsible for keeping clean and the penalty for non-compliance should be clearly defined. When this policy is nationally driven people in any part of the country will be reminded of the same thing wherever they go and this is easier to follow. A fine will be appropriate as a penalty for non-compliance in this case. Shop owners will be vigilant to prevent other people from littering within the area they have custody over and institute measures to avoid penalty if this law is enforced. The fine however should not be too high as this can encourage bribery and corruption. Offending shop owners may prefer to pay a willing law enforcement agent fraction of the penalty that will not be recorded and fraction of a high fine may be tempting to a law enforcement agent. On the other hand a fine which is too low may not be deterrent enough and people will prefer to pay a low fine than institute measures to ensure compliance.

One penalty for non-compliance that has not been used in solid waste management at least in Ghana is **community work**. Sanitation policy prescribing community work as a penalty for indiscriminate waste disposal will need to be nationally driven because national laws carry more weight than local bye-laws. However, local authorities can be given the prerogative to define what constitutes community work. Under the condition where the judiciary system is overburden with cases authorities consider at the moment to be more demanding than non-compliance of solid waste management regulatory provisions, a nationally prescribed penalty of community work to be administered instantly by law enforcement agent can provide some level of deterrence. For example, 30 minutes or an hour of street sweeping can be prescribed as a penalty for indiscriminate waste disposal. The law enforcement agent under this condition will need to identify himself by uniform and identity card. This will provide the mechanism for people who feel they have been unjustly treated to lodge complains. Although most people will escape this

penalty initially, the more people are apprehended and penalized, the more the public will be deterred from indulging in indiscriminate waste disposal practices.

6.5.12 Institution of a Programme to Streamline the Operations of Waste Scavengers

In line with the recommendation made by Nas and Jaffe, 2004¹ who studied the operations of scavengers in a couple of countries, this policy recognizes the need for waste scavengers operating at the waste disposal sites in the urban centres of Ghana to be formalized into the waste management system for sustainable management. Opportunities exist for them to be engaged in material recovery facilities that this policy proposes and or to be involved in the deposit-refund system for the retrieval of household batteries and household hazardous waste materials.

6.5.13 Institution of a Programme for the Disposal of Old and Unserviceable Vehicles

Although it was recognized by a small percentage of respondents, the identification of scrap metals as one of the problematic waste² is a reflection of the extent to which old and unserviceable vehicles have been left littering parts of the urban centres of Ghana especially around the premises of vehicle repair shops constituting “visual obtrusions”. There is a new development in the informal sector where some unemployed youths retrieve old metals and metal components of old vehicles for sale to metal smelting industries. This policy proposes a system to centralize the disposal of old vehicles in each municipality. The disposed vehicles can then be subsequently dismantled and the metal part sold to metal smelting industries. Financial resources for this operation should be part of the import tax imposed on vehicles. This tax should be proportional to the age of vehicle with older vehicle attracting higher tax.

6.5.14 Institution of a Programme for Waste Management Officials to Meet Periodically

The current waste management system in Ghana where no forum exists for officials of solid waste management to meet and exchange ideas is unproductive. This policy therefore proposes an annual or biannual meeting for officials of solid waste management at the district level to meet once a year to take stock of their operations, present their difficulties, exchange ideas and strategize towards the achievement of goals and objectives within the national sustainable solid

¹ Reference has been made to Nas and Jaffe under waste reuse in the literature review in section 2.2.2.

² A section of members of the general public identified scrap metals as most problematic. Refer to fig.5.2.3 for details.

waste management goals. NESPCC could ask officials who are doing exceptionally well to be seconded to districts that are struggling for a limited period of time so that experiences and expertise could be transferred and impacted across.

6.5.15 Incorporation of Solid Waste Management into Regional Development Planning

Almost every human activity generates solid wastes that require management. Unfortunately, the engineering structures associated with solid waste management are designed to be huge for cost effectiveness and these require large capital investment and large tracks of land. These engineering structures either occupy the landscape permanently or leave permanent features on the landscapes for years even after they have been decommissioned. There is the need therefore to incorporate solid waste management into regional development plans. It will be necessary to legally acquire sites (land) for the development of solid waste management facilities with title deeds to forestall future litigations. The current problem of land acquisition for the development of sanitary landfills is expected to deteriorate without planning from regional perspective in connection with solid waste management. Increasing community protest against the siting of solid waste related facility¹ (Not in my backyard) provides the policy window necessary for the implementation of this policy strategy.

6.5.16 Support for the Development of Waste Related Information Management System

Policy development thrives on information and data. Every functional element of solid waste management in Ghana should be accompanied with gathering of data to be specified by the policy coordination centre, NESPCC. The obligation of data submission or acquisition should be clearly specified in the responsibilities of all agencies/agents connected with solid waste management in Ghana. For example private companies involved in solid waste collection and disposal should be made aware in their contract agreement of their obligation to submit data to the waste management department of the municipality in terms of amount of waste collected and disposed of, number of fleets and other equipment holdings, frequency of data submission as well

¹ There have already been several community protests especially in Accra against the siting of sanitary landfills. This is expected to extend to other municipalities with increasing population. Instances of community protest against siting of landfill have been cited under section 3.2.4.

as the mode of submission (either electronic or paper) should be clearly specified. Solid Waste Information Management System (SWIMS) will make it possible for NESPPCC to assess the extent of accomplishment with respect to policy goals and objectives and make the necessary policy changes when the period for policy review is due.

6.5.17 Promotion of Active Anti-littering Campaign and Awareness on Proper Waste Disposal

Indiscriminate waste disposal by the public (littering) is a serious problem in solid waste management in Ghana. It is not enough to institute programmes in school and colleges to instil in pupils and students the habits of proper waste disposal. The generally populace need to be made aware of the implications of littering. This study ascertained that awareness of association of health problems¹ and improper solid waste disposal can have more compulsive effect on the waste disposal habit of the public than any other association or measure. Anti-littering campaigns therefore should emphasize the relatedness of proper waste management with avoidance of diseases. There is the need therefore to involve the health sector in anti-littering campaigns. If the message of the impact of improper waste disposal on deterioration of public health comes from health sector workers, this is likely to carry more weight and be compelling than if it originates from some other sources.

This study identified that chiefs and religious leaders can play a very important role in policy dissemination by the relative importance people attach to messages originating from these groups of leaders². Anti-littering campaign programmes should incorporate the findings of this study by involving chiefs and religious leaders in both policy dissemination and implementation especially when the issue is politically and religiously neutral like solid waste management. Anti-littering campaigns should also take cognizance of another finding in this research which identified the most preferred media through which majority of the populace receive public information³. This should make it possible to ascertain the relative emphasis to be put on the various media in disseminating public information.

¹ The relative impact of various policy instruments in compelling individuals to practice proper waste disposal was determined among members of the general public. The result can be referenced from fig.5.3.4.

² Refer to fig.5.3.6 for the relative importance people attach to the same piece of information originating from different sources.

³ Radio was identified by majority of members of the general public as the media through which they receive public information. This can be referenced from fig.5.3.7.

Promotion of anti-littering campaign need to incorporate a programme directed towards the public transport system. Such a programme should oblige all drivers of privately owned and those of publicly owned vehicles in the public transport system to inform passengers about the need to avoid littering and the penalty of throwing waste from their vehicle any time they are about to start a journey. The verbal information should be accompanied by obligations for such vehicles to carry an inscription against littering. When vehicle operators are allowed to write their own message the message could be trivialised as a result the inscription for all vehicles should be standard. A sticker with the message and the fine for contravention would be appropriate. The standard fine to be determined by NESPCC and this in case of contravention should be collected by the driver as a motivation for his role in this exercise. The driver however does not have to apply force in situation when an offender refuses to pay a fine. The offender should simply be reported to law enforcement agents where appropriate.

The encouragement for pushing for the right policies to change littering is provided by Sibley and Liu, 2003, who differentiated indiscriminate waste disposal (Littering) into Passive and Active Littering. According to Sibley and Liu, active littering is less resistant to change than passive littering. This study observed that active littering is the predominant form of littering (indiscriminate waste disposal) in Ghana, and hence there could be considerable improvement in public indiscriminate waste disposal with the implementation of the right policies and programmes. There is already active participation of some chiefs and some religious organization in sanitation related programmes. The strong public sentiment about the need for pragmatic solutions to the waste problem in Ghana provides the necessary policy window for the success of anti-littering campaigns if coordinated properly.

6.5.18 Imposition of a Levy on Sources of Plastic Related Waste (Plastic Bags and Sachets for Water)

The use of plastic in both packaging and a wide range of consumer products is particularly attractive because of its versatility and price. Plastics, however, create a lot of problems for solid waste management systems through out the world and various policy instruments including outright ban have been used to control it in some countries UNEP, 2005. Plastic bags however is playing a very important role in the socio-economic development drive of Ghana as a result, this

policy package would not recommend banning of plastics shopping bags and water sachets. Not considered a hazardous waste, plastics in the total waste stream constitute about 4%¹. This proportion is so relatively small that if properly handled at source can be recycled into useful products. The approach therefore is to incorporate policy measures that can lead to elimination of unnecessary use of plastic bags by the general public and also direct the public towards cultivation of proper waste disposal habits and hence proper disposal of plastic bags that people find necessary to use.

Once a levy is imposed on plastic bags, it will ultimately be transferred to the final consumer. If this levy is high enough consumers of plastic shopping bags will be compelled to adopt other alternatives to plastic bags in addition to reuse (multiple uses) of plastic bags where possible. This will eliminate indiscriminate use of plastic bags and their subsequent indiscriminate disposal. A fall in demand for plastic bags will definitely lead to loss of some employments in industries related to manufacturing of plastics and plastic shopping bags. However, adoption and demand for alternatives of plastic bags and hence the creation of new jobs is expected to grow. As a result, the cumulative economic implications of a levy on plastic bags is expected to be zero or at least minimal. The gain is expected to be in two folds. In the first place money from the levy will become available for managing the plastic bags and other plastic related products (sachet) water that people find necessary to use. In the second place reduction in indiscriminate use of plastic will manifest itself in reduced indiscriminate disposal of plastics. Reduced indiscriminate disposal of plastics has positive implications for public health which can be considerable. Cognizance should be taken of the fact that about 80% of diseases in the developing countries are environmentally related (Rhyner et al. 1995).

Imposition of levy on plastic shopping and other such products should target supplies or manufacturers depending on which group is more appropriately disposed to identification and hence less susceptible to tax evasion. What is important in national development is the pursuit of policies that translate into gains in societal well being. Imposition of a levy on plastic bags should be interpreted in terms of the positive impact this can make in the socio-economic well being of the populace taking everything into consideration with the involvement of all stakeholders and

¹ Composition analysis of waste in Accra revealed the proportion of waste that is plastic. This can be referenced from fig. fig.3.2.1.

based on principles of societal well being without and selfish interests. This research recognized the political sensitiveness of imposition of taxes¹. However, if majority of respondents and the legislature aggress on a particular waste type as most problematic² as in the case of plastics then that waste type can be targeted by an appropriate levy.

6.5.19 Incorporation of Graduate Programs Related to Waste Management into the Educational System

The trend in economic development is one associated with increased quantity and complexity of waste generation. Human resources both in number and expertise is needed to lead the way forward in managing the already complex solid waste management terrain in Ghana. Every year billions of cedis are spent at various municipal and district levels on solid waste management. Without the human resources, municipalities and district assemblies will continue to squander resources without getting any desirable results. This policy therefore proposes the introduction of graduate programmes at university and poly-technique levels to train the needed man power for the task at hand and for the future. The current state of solid waste management in the country and the public demand for improved services³ coupled with the amount of money spent on solid waste management nation wide provides the justification and policy windows.

6.5.20 Capacity Building and Re-Orientation of Some Related SWM Agencies

Policy requires the establishment or the presence of functional and appropriate institutions for its implementation. This policy package does not propose any major changes in the existing institutional set ups apart from those recommended. There will be the need for capacity building within the various implementing agencies to be determined by NESPCC. EPA will need to increase capacity in terms of personnel and expertise in order to be able to reach out to district assemblies in the construction and operation of sanitary landfills. One finding made in this research is the preference by majority of the populace for private companies to be engaged for the

¹ On policy instrument that is most difficult to implement, majority of members of parliament indicated imposition of appropriate tax. This can be referenced from fig.5.4.2.4.

² Refer to fig.5.2.3 for details on most problematic waste.

³ Dissatisfaction with the current system of solid waste management in Ghana demonstrated by both categories of respondents as depicted in fig.5.2.1 is tantamount to public demand for improvements.

services of waste collection and disposal¹. The department of solid waste management of the district/metropolitan assemblies will need to completely privatise waste collection and disposal in all districts and municipalities. The current arrangement where municipalities retain capacity to carry out 20% of waste collection and disposal services is counter-productive. So long as the waste management department of the district/municipal/metropolitan assemblies retains some capacity to collect and dispose of waste which government officials can direct to serve themselves and important government institutions, efforts at governmental level to improve the efficiency and capacity of private waste collection companies will remain noncommittal. Complete privatization of waste collection and disposal will orient the department of solid waste of the district/municipal/metropolitan assemblies towards focusing more on the monitoring and supervisory roles they exercise over the private companies engaged to carry out waste collection and disposal services. They will also be able to redirect capacity towards the enforcement of some of the provisions in this policy package. To increase the efficiency and commitment of the private firms engaged, the department should open them up for competition by granting them short duration contract for example five to eight (5-8) year-contracts subject to re-bidding. In this way, inefficient companies will be replaced by efficient ones. This arrangement will make room for one company to operate within more than one waste management zone.

6.5.21 Institution of Deposit-Refund System for Household Batteries and Other Household Hazardous Waste

The policy objective of processing waste to derive some conversion products could be compromised by the presence of household batteries and other household hazardous waste materials in the waste stream. This policy therefore proposes a deposit-refund system for the retrieval of such household hazardous materials. This will involve identification of the sources of these products and some tax imposed on their production and or distribution cost (money added to their prices). This will ultimately reflect in the final prices of these items. The distributors of these products will then need to set up collection points within communities where people could return used batteries for refunds. This exercise will need to be accompanied by extensive public education. Anticipated implementation difficulties can be minimized especially that this policy

¹ Details of public preference of private companies to perform the services of waste collection and disposal can be referenced from fig.5.2.2.

instrument is labelled to be implemented through the rotational policy implementation model¹. The experience with both public and private lottery operations will be useful here. Manufacturers or distributors of household hazardous products can even engage the services of private lottery sellers within the various communities to act as return-refund points. There are a number of unemployed individuals including people who search solid waste disposal site (scavengers) who will be eager to retrieve used household batteries and other such specified items for their refund value. The policy window therefore exists for the implementation of this policy strategy.

6.5.22 Institution of Programs for Cost Recovery of Waste Collection and Disposal in Low Income Communities

The principles of sustainable solid waste management recognize that people pay for the disposal of the waste they produce. Although there are genuine cases in the developing countries where some members (emphasis on some members and not the whole low income community) of low income urban areas can not afford the cost of collection, treatment and disposal of the waste they generate, such low income urban areas in the developing countries including Ghana have physical characteristics that can enable solid waste management to benefit from economy of scale using the **central container system** instead of house to house waste collection. The full cost of waste collection (treatment where applicable) and disposal can then be achieved at very low rates per household. The characteristics of low income urban areas that make viable waste management based on the **central container system** in the low income communities of the urban centres in the developing countries and which **render house to house** waste collection unsuitable are as follow:

- i. Alleys inaccessible to motorized vehicles: Houses are built with no alleys between them. The very few roads within built up areas are either unpaved with badly eroded shoulders and surfaces or roads are paved but with many potholes
- ii. Complex household structures: Households differ considerable with reference to number and income level. There are households with single families and there are households with multiple families. In terms of income the disparity among households is quite considerable. There are households that have income well below the community average and there are others with income considerably above the community average.

¹ Refer to chapter 6.8 for details of the rotational policy implementation model

The challenges these pose to cost recovery in solid waste management in the urban areas of developing countries with such low income communities is considerable. Even in the developed countries with sufficient information on household income, flat rates rather than user charges based on volume or weight of waste is the approach normally adopted in cost recovery in solid waste management. This is because of the tediousness of operations associated with volume or weight based user charge option. In the developed countries, however, the number of persons per households is more or less uniform and differences in household income are not too appreciable. The amount of solid waste generation per household which varies proportionately with income level and also depends on number of person in a household therefore is almost uniform across households in the developed countries. The foregoing is true for high income residential areas in the developing countries and almost true for the middle income areas as well. This however can not be said about the low income communities of the urban areas in the developing world.

The approach to cost recovery which is one of the main drawbacks to sustainable solid waste management in the urban centres in Ghana¹ should proceed taking cognizance of the following:

- i. Solid waste generation is closely associated with household income levels or number of person within households (IDB, 2003).
- ii. Household structure and income become more and more complex as one moves from high income residential areas to low income residential areas.
- iii. The household structure in low income residential areas can be further divided into sub-groups using number of persons per household or income level per household.

Since waste generation per capita is closely related to household income, the total amount of waste production among poor communities is expected to be low compared to high income areas. Within low income communities, high income households are also likely to produce more waste per capita than low income households. It follows therefore that the amount of waste generation per household will be dependent on either income of household and or number of persons per household.

Since the consumption of other utilities such as electricity and water is normally proportional to the number of persons per household or the income level of individuals within a household, the

¹ Lack of finance was rated by members of parliament as the most important constraint to sustainable solid waste management in Ghana. Details can be referenced from fig.5.4.2.1.

amount of electricity or water consumed could be an approximate index of the amount of waste generation per household within the community. This policy therefore proposes addition of proportionate rates to either water or electricity bills and this is to proceed as follows:

The electricity bills of households within the low income community over the past six months should be studied and classified into three categories (High, Medium, and Low). Household with utility bills falling within the same category will pay the same amount and in the order of high to low. Because this study observed that some households sell water to other household within such poor communities, the use of water bills as an index for determining amount of waste generated could be misleading. The most appropriate candidate for this exercise therefore is electricity bills. This policy could be implemented as a pilot project using the conceptual rotational policy implementation model developed.

Cost recover in solid waste management in the urban centres in Ghana covers only about 30% of the population in most towns and cities with free waste collection services for 70% and beyond. The fact that city authorities have been looking for avenues to make low income urban communities also contribute some money towards the management of solid waste provides the policy window for the adoption of this policy. The main draw back to this policy could be if Electricity Company of Ghana (ECG) is unwilling to cooperate with city authorities. Under the situation where ECG officials are unwilling to have solid waste management bills added to electricity bills, the electricity bills could still be used to classify the households into the three categories mentioned and another avenue exploited for collecting waste management bills. In looking for another alternative for cost recovery from low income communities in the urban centres of Ghana, cognizance should be taken of the observation made by Post in 1999. In his study “The Problems and Potentials of Privatising Solid Waste Management in Kumasi, Ghana”, Post, 1999 observed that high rate of civil disobedience in property rate payment and the limited success in sanctioning defaulters does not make the option of adding fees for solid waste management to property rate attractive. Unfortunately, Post’s observation is true for almost the whole country.

6.5.23 Incorporation of Programs into the Educational System that Inculcates Proper Waste Disposal Habits in Pupils and Students

Proper waste disposal is a habit that ought to be cultivated. In societies where proper waste disposal is part of the social setting, children grow up unconsciously picking up the culture of proper waste disposal. Institutional set ups such as the presence of litter bins at schools and public places reinforce proper waste disposal habits even if these are learnt unconsciously. Institution of programmes to develop proper waste disposal habits in pupils and students will mean more than just a curriculum modification which is an academic exercise. This will need to proceed with setting up of litter bins in every classroom for use and demonstration exercises. The idea of “litter bins” here should not be construed as a specially made box or manufactured receptacle for which reason lack of funds will be cited as an implementation constraint. Any locally made container (baskets with lid, wooden boxes with lid, old paint containers) can all serve this purpose. In the rural areas where any depression or open space serve as final waste disposal point the process of instilling proper waste disposal habits in pupils and students should go beyond the classroom to designating and fencing an area where waste collected should always be sent. Teachers can show pupils how useful products such as compost can be made out of waste. Orienting the future generation of Ghana towards proper waste disposal habits can make a lot of difference. They will surely transfer this habit to their respective homes and finally succeed in transforming their parents and others. The idea of clean up exercises although can provide some temporary relief is a useless approach to orienting any community towards proper waste disposal. This can give the impression to some people that others will always be organized to gather and dispose of the waste they refuse to put away properly. The policy window exists for implementing this policy as this should be seen as an extension of environmental science that is supposed to be taught in every school.

6.6 Evaluation of Policy Package

Looking at policy development from the “Bridge Model” perspective, the construction of a bridge is followed by a series of test to determine if the bridge so constructed is safe and sound before it can be opened to traffic. In this Bridge Model of policy development, the policy package developed need to be evaluated to determine its appropriateness in achieving desirable policy goals. Various societies have standards and codes with which engineering constructions must comply. The standards and codes here can be likened to existing principles for evaluating environmental policy instruments and packages. The IDB, 2003 recommended a package consisting of 10 principles (parameters) for evaluating solid waste management policy¹. This dissertation is of the view that the evaluation principles presented by IDB lack two important parameters for the evaluation of the policy package developed for sustainable solid waste management in Ghana. From the Bridge Model perspective, it can be said that some shortcomings have been identified with the existing construction standards and codes for use in evaluating a new bridge that has been constructed (referred in this policy as “sustainable”). The principles for evaluating solid waste management policy as presented by IDB therefore have been modified with the inclusion of two important parameters for use in evaluating the policy package developed. The two parameters are; **Polluter Pays Principle** and **“Waste Hierarchy Orientation”**. Waste hierarchy orientation here refers to the extent to which the policy package promotes attainment of preferred waste hierarchy levels in preventing waste from going into landfills. Since it may not be possible for a single policy instrument to meet all the parameters presented for policy evaluation, the questions relating to the various principles for policy evaluation have been modified to reflect the perspective that the evaluation principles are being considered as a unit for measuring a policy package instead of a single instrument as was presented by IDB and this is presented in table 6.5.1

In evaluating the policy package for sustainable solid waste management in Ghana, each instruments of the policy package is evaluated and labelled with respect to the parameter(s) that it is in compliance with. The evaluation principles are presented as abbreviations, and the result of evaluation is as presented in table 6.5.2.

¹ The 10 principles recommended by IDB have been included in the literature review section in table 2.8.

Table 6.5.1 Parameters for Evaluating Policy Package for Sustainable Solid Waste Management in Ghana

Evaluating Principle	Abbreviation	Policy Implication
Environmental Effectiveness	EnvE	Does the policy lead to the desired environmental improvements, such as reduction in waste generation, increased waste recycling, reduced emissions from transport and disposal?
Economic Efficiency	EcoE	Does the policy create incentives for investment and innovation toward reduction of pollution control costs?-
Administrative Cost Effectiveness	AdCE	Does the policy require affordable and available levels of skill and effort to implement and monitor?
Revenue Usefulness	ReU	Are revenues generated able to be applied to address the environmental objectives of the instrument and adequate to create measurable improvement?
Ease of implementation and replicability	EaIR	Are the relative costs and benefits relatively easy to assess and the legal requirements for introducing the new instrument reasonable?
Acceptance	Acc	Does the general public and the affected industries accept the instrument as a viable means of cost-effectively achieving environmental improvement without adversely affecting competitiveness, employment, income distribution, and trade?
Distributional Effects	DisE	Is there distributional disparity or inequity in the application or impact of the instrument, particularly regarding effects on lower income households, small businesses, and disadvantaged parties?
Short-Term Results	ShoTR	Does the policy have the potential to result in sufficient short-term improvement to motivate political administrators to undertake commitment to the costs associated with the instrument during their political term?
Economic Development Enhancement	EcoDE	Does the policy provide an environment that maintains trade competitiveness and encourages industrial development and employment generation?
Waste Type Applicability	WasTA	Does the instrument address a wide range of waste types and have significant impact on overall urban waste quantities, or does the instrument address only a limited number of unique and important waste types?
Polluter Pays Principle*	PPP	Does the policy package address the issue of polluter pays principle?
Waste Hierarchy Orientation*	WasHO	Does the policy package promote attainment of preferred waste hierarchy levels and results in reduction of waste going into landfills?

Table Modified from IDB, 2003 * New parameters added

Table 6.5.2 Evaluation of Sustainable Solid Waste Management Policy for Ghana

	Policy Instruments	Evaluating Principles (Abbreviation)											
		W a s h O	P P T A	W a s T A	E c o D E	S h o T R	D i s E	A c c I R	E a I R	R e U	A d C E	E c o E	E n v E
1	Provision of litter bins at all public places			√	√		√	√		√		√	
2	Introduction of waste separation at source	√ R					√	√		√		√	
3	Estimation of associated implementation cost			√			√					√	
4	Provision of guidelines for medical waste management	√		√			√	√				√	
5	Provision of sector specific waste minimisation guidelines	√ S R			√		√			√		√	
6	Support for the development of plastic recycling industries	√ R		√	√	√						√	√
7	Specification of time for policy dissemination and policy review			√			√	√		√		√	
8	Development of sanitary landfills and material recovery facilities			√			√					√	
9	Support for the development of systems for processing bio-waste	√ E R		√	√	√	√	√	√		√	√	
10	Promulgation of national laws and regulations related to sanitation			√	√	√				√		√	
11	Institution of a programme to streamline the operations of waste scavengers				√	√	√	√		√		√	
12	Institution of a programme to for the disposal of old and unserviceable vehicles	√	√	√		√	√		√	√		√	
13	Promotion of production and use of locally produced cotton shopping bags	√ S R			√	√		√		√	√	√	
14	Institution of a programme for waste management officials to meet periodically			√				√		√		√	
15	Incorporation of solid waste management into regional development planning			√	√		√	√		√		√	
16	Support for the development of waste related information management system	√		√			√				√	√	
17	Promotion of active anti-littering campaign and awareness on proper waste disposal			√	√	√	√			√		√	
18	Institution of levy on sources of plastic related waste (plastic bags and sachets for water)	√ S R	√	√					√	√	√	√	
19	Incorporation of graduate programmes related to waste management into the educational system			√			√	√		√		√	
20	Capacity building and re-defining the responsibilities of some SW related agencies			√			√					√	
21	Institution of deposit-refund for household batteries and other household hazardous waste	√	√	√	√					√		√	
22	Institution of programmes for cost recovery of waste collection and disposal in low income communities			√	√	√	√	√		√		√	
23	Incorporation of programmes into the educational system that inculcates proper waste disposal habits into pupils and students			√	√	√	√	√		√		√	

√SR – promotes Source Reduction; √R – promotes Recycling; √ER – promotes Energy Recovery

6.7 Policy Implementation (Policy Phase-in)

From the Bridge Model perspective, policy implementation (policy phase in) can be likened to the phases in the construction of a bridge after design stage. The construction of a bridge proceeds through:

- i. Excavation and Construction of Foundation,
- ii. Construction of walls and piers (vertical structural components), and
- iii. Construction of Deck (horizontal structural components).

In as much as the implementation of all instruments of the policy package designed is essential for the attainment of sustainable solid waste management in Ghana, simultaneous implementation of all instruments has the highest possibility of policy failure. A phase in approach based on the phases of constructing a bridge is therefore devised for the implementation of the policy package designed. The policy package therefore is categorized based on the extent to which associated instruments and programmes prepare the grounds for the introduction of other instruments, programmes and strategies, and on the relative ease of implementing associated instruments. On the basis of the foregoing the three categories devised are:

- i. Instruments Least Difficult to Implement and Necessary for the Introduction of Subsequent Instruments (*Excavation and Construction of Foundation*),
- ii. Instruments Moderately Difficult to Implement, and Necessary for the Introduction of final Instruments (*Construction of walls and piers; vertical structural components*), and
- iii. Instruments Most Difficult to Implement (*Construction of Deck; horizontal structural components*).

Determination of the relative difficulty of implementing policy instruments is based on the results of the analysis of the relative difficulty of implementing three policy options¹ and the results of the analysis of the relative difficulty of mitigating constraints to sustainable solid waste management in Ghana². All instruments related to Awareness Creation and Capacity Building related to awareness creation are classified as Least Difficult to Implement; All policy instruments related to Regulatory Measures and Capacity Building related to regulatory measures are classified as Moderately Difficult to Implement and all instruments related to Appropriate Tax and strategies related to finance are classified as Most Difficult to Implement. All instruments of the policy package designed were then classified into the three categories above and the outcome is as presented in table 6.7.

¹ The relative difficulty with which three policy instruments can be implemented was determined from the perspective of policy makers. This can be referenced from fig.5.4.2.4.

² The relative difficulty of mitigating identified constraints to SSWM in Ghana was evaluated from the perspective of policy makers and this can be referenced from fig.5.4.2.2

Table 6.7 Evaluation of Policy Implementation Phase-in

Implementation Category	Policy Instruments	Implementation Phases		
		Phase 1	Phase 2	Phase 3
Least Difficult to Implement and Necessary for Introducing Subsequent Instruments	Estimation of associated Implementation cost	√		
	Specification of time for policy dissemination and policy review	√		
	Promotion of active anti-littering campaigns and awareness on proper waste disposal	√		
	Provision of litter bins at public places*	√		
	Institution of programmes for waste management officials to meet periodically		√	
	Promotion of production and use of locally produced cotton shopping bags	√		
	Incorporation of programmes into the education system that inculcates proper waste disposal habits in pupils and students	√		
Moderately Difficult to Implement and Necessary for Introducing Final Instruments	Capacity building and re-defining the responsibilities of some solid waste related agencies		√	
	Promotion of national laws and regulations related to sanitation		√	
	Provision of sector specific waste minimisation guidelines		√	
	Support for the development of waste related information management system			√
	Provision of guidelines for medical waste management		√	
	Incorporation of graduate programmes related to waste management into the educational system		√	
	Incorporation of solid waste management into regional development planning		√	
	Institution of programmes to streamline the operations of waste scavengers			√
Most Difficult to Implement	Institution of programmes for cost recovery for waste collection and disposal in low income communities®			√
	Introduction of waste separation at source®			√
	Institution of levy on sources of plastic related waste (plastic shopping bags and water sachets)			√
	Institution of deposit-refund system for household batteries and other hazardous household wastes®			√
	Support for the development of plastic recycling industries			√
	Support for the development of systems for processing organic waste			√
	Institution of a programme for the disposal of old and unserviceable vehicles			√
	Development of sanitary landfills and material recovery facilities			√

*- Based on theory of solid waste disposal habit as an institutionalized behaviour, provision of litter bins at public places has been included in phase 1 although this is related to finance. ®- This label, depicts Policy instrument that require implementation through the conceptual Rotational Policy implementation model explained on the next page

6.8 Policy Implementation (The Rotational Policy Implementation Model)

The rotational model of policy implementation borrows from the agricultural method of crop rotation where a piece of land is divided into a number of management units with different crop types cultivated on different management units. On a single management unit, however, only one crop type is cultivated, and units are arranged such that adjacent management units have different crop types. Crop types are seasonally rotated from one management unit to another to facilitate nutrient utilisation from the soil as well as pest and disease control. In this method crops which use similar nutrients and are susceptible to the same diseases and pests do not follow each other in the sequence of rotation.

As in crop rotation, rotational policy implementation conceptualises a town or a municipality as a piece of land available to the farmer in this case the policy implementation team. The municipality is then divided into segments to be decided by the implementation team as represented in fig.6.8. In this conceptual model the municipality is divided into 4 implementation zones. The rotational model of policy implementation deviates from the agricultural method of crop rotation by limiting initial policy implementation to only a segment at a time. In this conceptual model, implementation is limited to segment 2. This segment of the town or municipality is sub-divided into sections in this model, segment 2 of the municipality is sub-divided into 6 sections labelled as A, B, C, D, E and F. Where applicable a digital map could be used to facilitate management through storage and retrieval of implementation data.

The next step in this conceptual policy implementation model is related to field work involving a visit to the rotational area. The objective of visiting the rotation area is to identify for each section (here labelled as A, B, C, D, E and F) individuals within the section that can help with policy dissemination and where applicable monitor. This research ascertained that religious leaders and chiefs have the potential of polarizing government policy¹. Every implementation section therefore should be searched for the identification of such people as religious leaders and or chiefs or any other influential individuals who could help in policy implementation through dissemination of policy information and monitoring. This model of policy implementation integrates the advantages of both the top-down and bottom-up approaches of policy

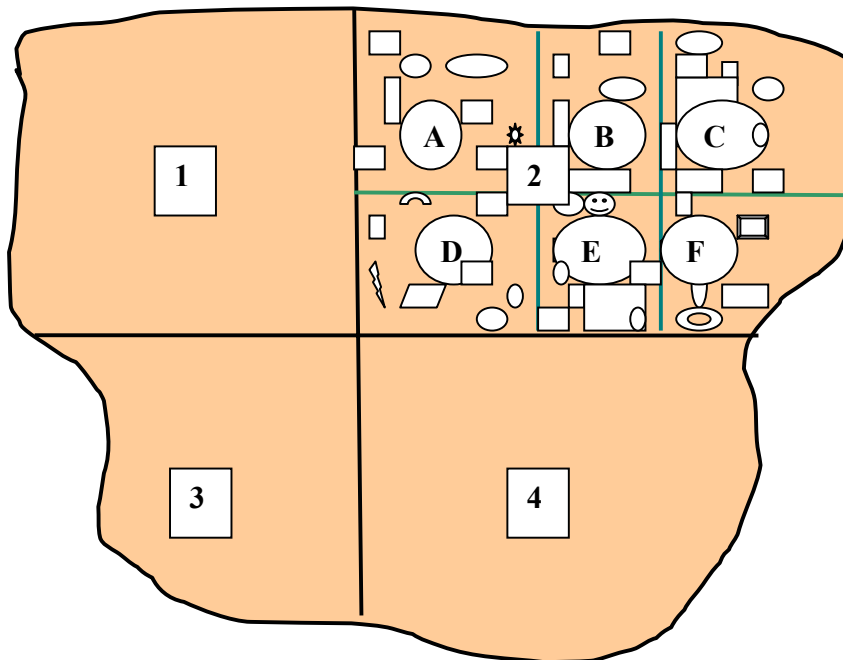
¹ By determining the importance people attach to the same piece of information coming from different source (government officials, chiefs and religious leaders) it was possible to determine the extent to which these sources can affect policy implementation. The details are as presented in fig,5.3.6.

implementation through identification of influential individual within the local community that can help with both policy information dissemination and implementation.

Based on field investigation, implementation sections can then be categorized into three groups based on level of external monitoring requirement as follows:

- i. Sections that need high external monitoring because of lack of any identified individual who can influence policy implementation or because of the seriousness of the baseline conditions that policy aspires to change. Here referred to as the **High External Monitoring Requirement Group**
- ii. Sections that require moderate external monitoring. Here referred to as **Moderate External Monitoring Requirement Group**, and
- iii. Sections that require low external monitoring. Here referred to as **Low External Monitoring Requirement Group**

Fig. 6.8 The Rotational Model of Policy Implementation



For policy instruments that require implementation through the rotational model (labelled in table 6.7 with the symbol “®”), a two stage phase in approach should be adopted in their introduction. These are:

vi. **Voluntary Compliance Stage.**

The voluntary compliance stage starts with dissemination of information on policy instrument. At the policy dissemination stage which should accompany every phase of policy implementation, compliance with policy instrument should be voluntary and this should be promoted. This research identified the preferred duration for policy dissemination from the perspective of both members of parliament and from that of the general public to be between 3-6 months¹. Structures should be put in place to encourage and accommodate those who will start complying with directives of policy instrument at this stage.

vii. **Obliged Compliance Stage**

This phase starts after the period required for dissemination of information on the introduction of policy. Even though information dissemination on policy should be a continuous process, at the obliged compliance phase every member of the community is expected to comply with policy directives and non-compliance is monitored penalized at this stage. At this stage such activities as awards and competitions can be introduced among sections to promote compliance and hence implementation.

At the end of a rotation period to be decided by policy implementation team, implementation is extended to other segments with incorporation of lessons learnt in initial policy implementation stage. The optimum size of a rotational unit or section (number of houses that should constitute a section can not be determined at this stage. These among others are lessons that should be learnt during implementation.

Ghana is divided into ten administrative regions and each region is sub-divided into districts, municipality and/or metropolis. Within each district, municipality or metropolis is an Assembly, a body consisting of elected individuals from local government electoral area with authority to promulgate bye-laws. The District Assembly therefore constitute the ultimate political unit for

¹ Details of preferred duration of policy dissemination can be referenced from fig.5.2.5.2

the translation and implementation of national government policies and programmes. The local government electoral area under the supervision of an assembly man is in most cases too large to be considered an implantation section. On the other hand, the local government electoral area is too small to constitute a rotational unit. The assembly men within rotational units or segment could help in identifying influential individuals that can facilitate policy implantation within implementation sections.

The knowledge that policy development especially solid waste management policy in the developing world is characterized by implementation failure has been instrumental in devising this new approach to policy implementation. In this research, financial constraints identified by majority of the legislature as the most important constraint¹ to sustainable solid waste management in Ghana, was classified by majority of them as the most difficult to mitigate. Imposition of levy on sources of plastic waste which was included in this policy package requires political will, an issue which is beyond the scope of this research. Already cost recovery is in place for waste collection and disposal in about 30% of most of the urban centres of Ghana. The concern of this research is how cost recovery can be extended to cover all urban residential areas. The principle of sustainable solid waste management recognizes that individuals contribute towards the disposal of the waste they generate. In taking into consideration the existing socio-economic conditions of the proportion of urban dwellers that currently do not pay anything for the disposal of their waste, implementation of the policy instrument proposed for cost recovery within low income communities through the rotational model can bring considerable improvement in the socio-economic lives of this people. About 80% (Attipoe, 1996) of the diseases reported in the urban areas in Ghana are environmentally related. It is logical to conclude that majority of these cases applies to people who reside within the low income residential areas where sanitation conditions are lower than middle and high income areas. The gain therefore to dwellers of low income residential areas in implementing this policy is related to cost savings in medical expenses as well as increased productivity resulting from low illness rates as a result of improved collection and disposal of solid waste leading to improved sanitation and hence improved public health conditions.

¹ Details of this classification can be referenced from fig.5.4.2.1

7.0 Summary and Conclusion

The absence of a sustainable solid waste management policy in Ghana or its implementation failure resulting in poor solid waste management conditions provided the basis for formulating the goal and objectives of this research. This research converges on its goal of mitigating policy constraints to sustainable solid waste management in Ghana from three main directions. Interviews were first conducted with some members of the general public and with solid waste management officials as well as private companies involved in waste collection and disposal in three main cities. Two sets of questionnaires were then developed and administered to all members of parliament and to a cross section of the general populace. The questionnaire to members of parliament focused on determining the relative importance of issues identified during the interview section as constraints to sustainable solid waste management in Ghana by solid waste management officials and by members of the general public. The questionnaire to members of parliament also elicited their views on the relative impact as well as the relative difficulty of implementing three categories of policy instruments.

The approach to determining the relative importance of constraints to solid waste management in Ghana, the relative difficulty of mitigating identified constraints, the relative impact of policy options and the relative difficulty of implementing policy options is unique to this research which conceptualised policy development as a bridge building exercise. In terms of constraints, lack of finance was identified by majority of respondents among four other issues (lack of personnel, lack of transparency in solid waste management, technical constraints, and unconcerned attitude of the general public) as the most important. This presupposes that addressing the financial constraints should provide a very important platform for solving the problems of solid waste management in Ghana. The question on relative difficulty of mitigating constraints, however, revealed that lack of finance was the most difficult of the constraints to mitigate. The results of the relative impact of policy options on efforts aimed at mitigating identified constraints and the relative difficulty of implementing policy options revealed the complexity involved and the caution needed in addressing the financial constraints.

The questionnaire to members of the general public focused on determining the relative impact of policy options on their waste disposal habits. Other issues addressed were the relative importance of factors that could discourage the public from participating in solid waste management

activities and the relative importance of three sources of information. Analysis of responses revealed the policy window through which to approach the solid waste management problems in Ghana. Awareness creation which was identified by members of the general as the policy options that can have most compelling effect on their waste disposal habit was identified by members of parliament as the policy option with least implementation difficulty.

Needless to reiterate that social problem can not be eradicated and that they can only be mitigated. With its origin as the by-products of production and consumption processes, two important attributes of any society which can not be avoided, the problems of solid waste can not be eradicated but they can considerably be reduced with the adoption of the right policies.

By identifying the constraints to sustainable solid waste management from the perspective of the general public and officials related to solid waste management in Ghana and subsequently determining the relative difficulties with which these problems can be addressed with different policy instruments from the perspective of policy makers, this research accomplished its **first objective** of *assessing obstacles to the implementation of sustainable solid waste management policies in Ghana* and in the process prepared the basis for attaining its goal of mitigating policy constraints to sustainable solid waste management in Ghana.

The second objective of this research of *proposing a policy package for the attainment of sustainable solid waste management in Ghana* was achieved by devising a new approach to environmental policy development “The Bridge Model of Policy Development”. This model integrated research findings on prevailing institutional and policy limitations with the principles of sustainability and relevant lessons on solid waste management in other countries into building a policy package for the attainment of sustainable solid waste management in Ghana.

The third objective of this dissertation of *proposing a new policy implementation framework for sustainable solid waste management in Ghana* was realized by borrowing from agriculture, the concept of crop rotation. With research findings providing the needed bearings, the agriculture concept of crop rotation was modified into a new model, the rotational model of policy implementation and subsequently accomplishing the goal as well as the objectives of this research.

The disparity in solid waste management between the developed and the developing countries is often explained from the perspective of differences in income between the developed and the developing countries. The proportion of income that residents in the developing countries have to spend on solid waste management services is considerably higher than those of the developed countries. While this plays some important roles in connection with cost recovery, efforts at finding solutions to the solid waste management problems of developing countries including Ghana are often misguided. With everything pointing to the fact that solid waste management is related to poverty, policy makers in the developing countries often complicate the problem of proper solid waste management with their struggle with economic development. There is however no logic in the perspective that one needs to be “rich” in order to maintain a clean environment. This is particularly true against the background that the real problem with solid waste management in the developing world is indiscriminate waste disposal habits of the general populace. The approaches adopted so far in solving the solid waste management problems in Ghana (also true for other developing countries) have been misguided and fragmented because cognizance is not taken of the institutional settings that affect waste disposal habits of the public.

While availability or otherwise of financial resources influence the institutional settings that influence solid waste management in Ghana and in fact other developing countries, the solution to the problems of solid waste management in Ghana is imbedded within the societal structure and within the nature of the waste generated. The following are central to finding solutions to the problems of solid waste management in Ghana:

- i. The relatedness of per capita waste generation with household income and the conspicuous disparity between the rich and the poor within major urban centres in Ghana necessitate categorising these towns into high income, middle income and low income for different rates of cost recovery for the provision of solid waste management services. (fortunately this is already in place in solid waste management in Ghana)
- ii. Low income residential areas which form a greater percentage of the urban centres in Ghana and are currently served with **free waste** collection services need to be further categorised into different household income classes (details are covered within policy package) and different rates charged. Cognizance should be taken of the fact that the cost of **house to house** waste collection services can not be

afforded by residents of low income residential areas of the urban centres in Ghana. Besides, the spatial layouts of these poor communities do not lend themselves to any effective house to house waste collection services.

- iii. Proper waste disposal is an institutionalized behaviour and hence influenced by institutional settings. There is the need to put in place the necessary institutional structures and the details of these have been covered in policy package.

While initial investment (especially those related to the provision of litter bins, monitoring and enforcement of the necessary regulations in addition to the implementation of other related instruments proposed in the policy package of this dissertation to influence individual waste disposal habits) can be high, the economic and social gains ultimately far outweigh the cost. Proper solid waste disposal leading to improved sanitation should lead to considerable improvement in public health and hence reductions in public expenditure on health service provision. Reduction in rates of infection among the populace is in itself a recipe for individual as well as collective economic productivity. The level of solid waste management has long been accepted in the developed world as an index of good governance. Proper waste management will be interpreted as the presence of a functional government in Ghana and good governance is a prerequisite not only for investment in tourism related industries but also in other sectors of the economy as well. There is no easy way to changing the way any society is used to doing things. Policy development (policy development here refers to implementation of policy package, review and subsequent implementation of policy changes) for sustainable solid waste management in Ghana or in any developing country is not expected to be without difficulties. The gains, not to mention environmental and hence intergenerational ones are considerable and hence the need for the political will and commitment required for the implementation of this policy package for sustainable solid waste management in Ghana.

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9.0 Appendices

9.1 Appendix A1. Sample of Questionnaire for Members of the General Public



Friends of the Nation



**Brandenburg University of Technology, Cottbus, Germany
Faculty of Environmental Sciences and Process Engineering**

Dear respondent,

Improper Solid Waste Disposal and Management are issues of great concern in this country. These have considerable impact on our lives; health, economy and the environment. The origin of the problems associated with the waste management situation in this country, however, is more related to Public Attitude and Consciousness (classified here as Socio-Cultural and Economic Constraints) towards Waste Disposal and Management than technical. Any approach to finding a sustainable solution to the Solid Waste Management problem in this country should therefore be aimed at addressing the Socio-Cultural and Economic Constraints.

In a joint cooperation between the Department of Environment and Resource Management of the Brandenburg Technical University, Cottbus, Germany and Friends of the Nation, a non-governmental Organization with headquarters in Takoradi, Ghana, a Ghanaian student is undertaking this research with the objective of addressing the Socio-Cultural and Economic Constraints to Sustainable Solid Waste Management in this Country.

This questionnaire seeks to solicit your view on policy issues that pertain to Sustainable Solid Waste Management. This survey is anonymous. Any response you give can not be traced to you. Your selection for participation in this research is by chance. While participation in this research is voluntary, we would urge you to provide sincere responses to the questions to enable a lasting solution to a problem that is of great concern in this country to be found.

Our contact information is provided below. If you have any need to contact us, please do not hesitate to do so.

Your input is very much appreciated and we thank you very much for spending your time to answer these few questions.

Please put the questionnaire in the envelope provided and remember to **SEAL (CLOSE)** the envelope after you complete the questionnaire before you return it.

NB: For the purpose of this research, Sustainable Solid Waste Management is defined as

“A management option that attains social and economically desirable goals without compromising the integrity of the environment”

- a. An indicator of socially desirable goal is complete and effective removal of all waste generated from the human settlement
- b. An indicator of economically desirable goal is the ability of such a management option to generate at least sufficient income to sustain itself without external capital injection.

CONTACT

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BACK GROUND INFORMATION:

1. Please indicate your sex
 - Male**
 - Female**

2. Please indicate your native language
.....

3. In which region of the country is your home town located?
.....

4. a. Please indicate your profession.
.....

- b. If you are a student, please indicate the name of your School.
.....

5. What is your highest level of education attained? Please choose only one answer.
 - Tertiary**
 - Secondary**
 - Elementary**
 - No education**
 - Others; Please specify**.....

QUESTION:

1. Of the following which would you say is your level of **Satisfaction** or **Dissatisfaction** about Waste Management in this country? Please choose one answer only.
 - Very Satisfied**
 - Satisfied**
 - Neither Satisfied nor Dissatisfied**
 - Dissatisfied**
 - Very Dissatisfied**
 - No idea**
 - Others; Please specify**.....

2. Please mark the appropriate boxes to indicate your knowledge/awareness about the effect of unconcerned/indiscriminate waste disposal on the following issues.
 - Effect of unconcerned waste disposal on your personal health**
 - Effect of unconcerned waste disposal on public health**
 - Effect of unconcerned waste disposal on the economy**
 - Effect of unconcerned waste disposal on environmental pollution**
 - Others, please specify**.....

3. Of the following options, which is your **Knowledge** about waste collected by waste collecting authorities? You can choose more than one correct answer
- Waste is treated and disposed of in landfills**
 - Waste is disposed of without treatment in landfills**
 - Waste is dumped at sea after treatment**
 - Waste is dumped at sea without treatment**
 - Waste is incinerated in controlled facility**
 - Waste is incinerated in the open**
 - No idea**
 - Others; Please specify.....**
4. Which of the following groups will you be more satisfied with, to carry out the functions of waste collection and disposal? You can choose more than one option.
- Private Enterprises**
 - Public (government) Institution**
 - Others; Please specify.....**
5. Using a scale, **1 to 5**
- 1= Strongly Agree**
 - 2 = Agree**
 - 3 = Neither Agree nor Disagree**
 - 4 = Disagree,**
 - 5 = Strongly Disagree**
- Indicate your level of **Agreement** or **Disagreement** with the following statement. Please put the number indicating your level of agreement or disagreement in the box provided
- Knowledge about proper disposal of waste collected by authorities will compel me to also dispose of waste properly.**
6. Which of the following waste type according to your understanding do you consider to be **most problematic waste**? Please choose only one option.
- Bio-waste**
 - Plastics**
 - Scrap metals**

NB

- i. **Bio-waste** here refers to food leftover, plant and animal parts and any other such waste materials that will decay/get rotten easily when left in the environment.*
- ii. **Plastics** here refer to polythene bags and any other such waste materials.*

7. Using a scale 1 to 3

1 = Most important

2 = Moderately important

3 = Least important

Arrange in order of level of importance the impact of the following factors in **Discouraging** you from participating in a Solid Waste Management scheme to keep the city clean. Please put the numbers indicating the level of importance in the boxes before the options.

- Irregular Waste Collection**
- Lack of Transparency in waste management**
- Improper disposal of waste collected by waste collecting authorities**
- Others, please specify.....**

8. In your opinion what should be the distance between waste bins (receptacles) located in the city centre and other public places? Please choose only one.

- Less than 100m**
- 100- 150m**
- 150- 200m**
- 200- 250**
- More than 250m**

9. Are you aware of any laws/regulations that punish people who make the city dirty by throwing waste in open drains/gutters, on the streets and open spaces?

- Yes**
- No**

If answer to question 9 above is **Yes**, answer 10 and continue with question 12, if answer is **No**, please leave question 10 and continue with question 11.

10. Awareness of a law/regulation that punishes people who dispose of waste in unconcerned manner/indiscriminately has the following effect on my waste disposal habit. Please choose only one answer.

- Has no effect on my waste disposal habit**
- Has contributed to compel me to dispose of my waste properly**

11. Awareness of a law/regulation that punishes people who dispose of waste in unconcerned manner/indiscriminately will have the following effect on my waste disposal habit. Please choose only one answer.

- Will have no effect on my waste disposal habit**
- Will contribute to compel me to dispose of my waste properly**

12. Do you support any law/regulation that prescribes appropriate penalty for people who make the city dirty through unconcerned/indiscriminate waste disposal?

- Yes**
- No**

If answer to question 12 above is **No**, please leave out question 13 and continue with Question 14, if answer is **Yes** continue with question 13.

13. Of the following, which do you prescribe as punishment for people who throw waste indiscriminately on the street and in open drains/gutters? Please select only one option.

- Community work**
- Fine**
- Imprisonment**
- Others; Please specify.....**

14. Will you observe any regulation/law that call for waste separation at source into **Bio-waste** and Non **bio-waste**?

- Yes**
- No**

15. Are you aware of any tax (money contribution) that you pay purposely for keeping the city clean?

- Yes**
- No**

If answer to question 15 above is **Yes**, please continue with question 16, if answer is **No**, leave out Question 16 and continue with Question 17.

16. Of the following, which is the effect/impact of your awareness that you pay tax to help keep the city clean? Please select only one answer.

- It has caused me to be more unconcerned/indiscriminate about the way I dispose of waste**
- It has caused me to be more concerned/careful about the way I dispose of waste**
- It has no effect/impact on the way I dispose of my waste**

17. Do you support any tax (money contribution) that helps keep the city clean?

- Yes**
- No**

18. Do you consider it necessary to know the reason for paying a particular tax?

- Yes**
- No**

19. Using a scale **1** to **5**

- 1 = Strongly Agree
- 2 = Agree
- 3 = Neither Agree nor Disagree
- 4 = Disagree
- 5 = Strongly Disagree.

Indicate your level of **Agreement** or **Disagreement** with the following statement.

Please put the number indicating your level of agreement or disagreement in the box before the statement.

- There is sufficient public awareness on proper waste disposal.**

20. Using a scale **1** to **3**

- 1 = Most important
- 2 = Moderately important
- 3 = Least important

Arrange in order of **Priority** the importance you will attach to **the same piece of information** coming from the following sources. Please put the numbers indicating your level of importance in the boxes before the options.

- Religious leader**
- Chief**
- Government Official**

21. Of the following, which is the most important to **You** for receiving public information?
Please choose only one option.

- Radio**
- Television**
- Information Vans**
- Posters/Bill Boards**
- News papers**
- Others, please specify.....**

22. Using a scale **1** to **3**

- 1 = Most compelling
- 2 = Moderately compelling
- 3 = Least compelling

Arrange in order of **most compelling** to **least compelling** the impact, the following options will have on **your waste disposal habit**. Please put the numbers in the boxes before the options

- Fear of laws/regulations pertaining to waste disposal**
- Awareness that more tax is associated with indiscriminate waste disposal**
- Awareness of health problems associated with indiscriminate waste disposal**

23. Would you like to be informed in advance or made aware before a new policy is introduced by government? Please choose only one option.

Yes

No

24. If answer to question **23** above is **Yes**, please indicate the time you would like to know/be made aware about a new policy prior to its implementation. Please choose only one.

Less than 3 months

3- 6 months

6-9 months

9- 13 months

More than 1 year

9.2 Appendix A2. Sample of Questionnaire for Members of Parliament



Friends of the Nation



**Brandenburg University of Technology, Cottbus, Germany
Faculty of Environmental Sciences and Process Engineering**

Dear Honourable Member of Parliament,

Improper Solid Waste Disposal and Management are issues of great concern in this country. These have considerable impact on our lives; health, economy and the environment. The origin of the problems associated with the waste management situation in this country, however, is more related to Public Attitude and Consciousness (classified here as Socio-Cultural and Economic Constraints) towards Waste Disposal and Management than technical. Any approach to finding a sustainable solution to the Solid Waste Management problem in this country should therefore be aimed at addressing the Socio-Cultural and Economic Constraints.

In a joint cooperation between the Department of Environment and Resource Management of the Brandenburg Technical University, Cottbus, Germany and Friends of the Nation, a non-governmental Organization with headquarters in Takoradi, Ghana, a Ghanaian student is undertaking this research with the objective of addressing the Socio-Cultural and Economic Constraints to Sustainable Solid Waste Management in this Country.

This questionnaire seeks to solicit your views on policy issues that pertain to Sustainable Solid Waste Management. This survey is anonymous. Any response you give can not be traced to you. While participation in this survey is voluntary, we would urge you to provide sincere responses to the questions to enable a lasting solution to a problem that is of great concern in this country to be found.

Our contact information is provided below. If you have any need to contact us please do not hesitate to do so.

Your input is very much appreciated and we thank you very much for spending your time to answer these few questions.

Please note that Envelope is already addressed and **POSTAGE IS PREPAID**. All you need to do is to complete the questionnaire and drop it in the post box.

NB: For the purpose of this research, Sustainable Solid Waste Management is defined as

“A management option that attains social and economically desirable goals without compromising the integrity of the environment”

- a. An indicator of socially desirable goal is complete and effective removal of all waste generated from the human settlement
- b. An indicator of economically desirable goal is the ability of such a management option to generate at least sufficient income to sustain itself without external capital injection.

CONTACT:

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QUESTION:

1. Of the following options, which would you say is your level of **Satisfaction** or **Dissatisfaction** about solid waste management in this country? Please choose one answer only.

- Very Satisfied**
- Satisfied**
- Neither Satisfied nor Dissatisfied**
- Dissatisfied**
- Very Dissatisfied**
- No idea**
- Others, please specify.....**

2. Of the following options, which is your knowledge about waste collected by waste collecting authorities? You can choose more than one option.

- Waste is treated and disposed of in landfills**
- Waste is disposed of without treatment in landfills**
- Waste is dumped at sea after treatment**
- Waste is dumped at sea without treatment**
- Waste is incinerated in controlled facility**
- Waste is incinerated in the open**
- No idea**
- Others, please specify.....**

3. Which of the following groups would you be more satisfied with, to carry out the functions of waste collection and disposal. You can choose more than one option

- Private Enterprises**
- Public (government) Institutions**
- Others, please specify.....**

4. Which of the following waste type according to your understanding do you consider to be **most problematic waste**? Please choose only one option.

- Bio-waste**
- Plastics**
- Scrap metals**

NB

iii. *Bio-waste here refers to food leftover, plant and animal parts and any other such waste materials that will decay/get rotten easily when left in the environment.*

iv. *Plastics here refer to polythene bags and any other such waste materials.*

5. Would you support a policy that obliges households and individuals to practice waste separation (separation into **bio-waste** and **non bio-waste**) at source in the future?

- Yes**
- No**

6. Government will equip all municipalities to process bio waste prior to disposal by the year.

- 2006**
- 2008**
- 2010**
- Others, please specify.....**

7. In your opinion, what should be the distance between waste bins (receptacles) located in the city centre and other public places? Please choose only one.

- Less than 100m**
- 100- 150m**
- 150- 200m**
- 200- 250**
- More than 250m**

8. Using a scale **1 to 5**

- 1= Strongly Agree
- 2 = Agree
- 3 = Neither Agree nor Disagree
- 4 = Disagree
- 5 = Strongly Disagree

Indicate your level of **Agreement** or **Disagreement** with the following statement.
Please put the number indicating your level of agreement or disagreement in the box before the statement.

- The citizens in general have cultivated proper waste disposal habit**

9. Are you aware of any laws/regulations that punish people who make the city dirty by throwing waste in open drains/gutters, on the streets and open spaces?

- Yes**
- No**

10. Would you support a policy that prescribes appropriate punishment for people who indiscriminately dispose of waste on the street, open places and into the open drains?

- Yes**
- No**

If answer to question **10** above is **No**, please leave out question **11** and continue with Question **12**, if answer is **Yes**, please continue with question **11**.

11. Of the following options, which do you prescribe as punishment for people who throw waste indiscriminately on the street? You can choose more than one correct answer.

- Community work**
- Fine**
- Imprisonment**
- Others, please specify.....**

12. Are you aware of any tax (money contribution) imposed purposely for keeping our country clean? Please choose only one.

- Yes**
- No**

13. Would you support a policy that imposes appropriate environmental tax to generate income for sustainable waste management in this country?

- Yes**
- No**

14. Using a scale **1 to 5**

- 1= Strongly Agree
- 2 = Agree
- 3 = Neither Agree nor Disagree
- 4 = Disagree
- 5 = Strongly Disagree

Indicate your level of **Agreement** or **Disagreement** with the following statement.
Please put the number indicating your level of agreement or disagreement in the box before the statement.

- There is sufficient public awareness on proper waste disposal.**

15. Would you favour the introduction of a programme in our educational system that aims at inculcating in students/pupils proper waste disposal habits?

- Yes**
- No**

16. Using a scale 1 to 5

- 1 = Very Important
- 2 = Important
- 3 = Moderately Important
- 4 = Little Important
- 5 = Least Important

Arrange the following options in order of level of importance, in your opinion, as constraints to sustainable Solid Waste Management in this country.

Please put the numbers in the boxes before the constraints.

- Lack of Finance**
- Lack of personnel**
- Technical constraints**
- Lack of transparency in Solid Waste Management**
- Unconcerned attitude of the general public**
- Others, please indicate.....**

17. Using a scale 1 to 5

- 1 = Very difficult to Mitigate
- 2 = Difficult to Mitigate
- 3 = Moderately Difficult to Mitigate
- 4 = Little Difficult to Mitigate
- 5 = Least Difficult to Mitigate

Arrange the following constraints to sustainable solid waste management in your opinion, with respect to the **difficulty** with which they can be **mitigated**.

Please put the numbers in the boxes before the constraints.

- Lack of Finance**
- Lack of personnel**
- Technical constraints**
- Lack of transparency in Solid Waste Management**
- Unconcerned attitude of the general public**
- Others, please specify.....**

18. Using a scale 1 to 3

- 1 = Greatest Impact
- 2 = Moderate Impact
- 3 = Least Impact

Arrange the following policy options, in your opinion, with respect to their impact on efforts at achieving sustainable solid waste management goals. Please put numbers in the boxes before the policy options

- Regulatory measures that compel people to behave in prescribed ways**
- Application of appropriate tax instruments to generate income needed for Solid Waste Management**
- Awareness creation to raise the consciousness of the general public about the benefits and need for proper waste disposal**

19. Using a scale **1 to 3**

1 = Most Difficult to Implement

2 = Moderately Difficult to Implement

3 = Least Difficult to Implement

Arrange the following policy options as they pertain to Sustainable Solid Waste Management, in your opinion, with respect to the difficulty with which they can be **implemented**. Please put the numbers in the boxes before the policy options

- Regulatory measures that compel people to behave in prescribed ways**
- Imposition of appropriate tax instruments to generate income needed for Solid Waste Management**
- Awareness creation to raise the consciousness of the general public about the benefits and need for proper waste disposal.**

20. Do you think the public should be informed in advance or made aware before a new policy is introduced by government? Please choose one answer

- Yes**
- No**

21. If answer to question **20** above is Yes, please indicate the time you think appropriate for the populace to be informed/made aware about a new policy prior to its implementation. Please choose one answer.

- Less than 3 months**
- 3- 6 months**
- 6-9 months**
- 9- 13 months**
- More than 1 year**

BACK GROUND INFORMATION:

1. Please indicate the political party you belong to
Political party:.....

2. Please mark the appropriate box

- Male**
- Female**

3. Please indicate your profession prior to your entry into Parliament

.....

9.3 Appendix A3. Sample of Semi-Structured Questionnaire for Interview Sections Questionnaire

Type: *Semi-Structured*

Respondent:

We are all concerned about the impact improper Solid Waste Disposal and Management is having on our lives; health, economy (tourism) and the environment. The origin of the problems associated with the waste management situation in this country, however, is more related to Public Attitude and Consciousness (classified here as Socio-Cultural and Economic Constraints) towards Waste Disposal and Management than technical. Any approach to finding a sustainable solution to the Solid Waste Management problem in this country therefore should aim at addressing the Socio-Cultural and Economic Constraints.

In a joint cooperation between the Department of Environment and Resource Management of the Brandenburg Technical University, Cottbus, Germany and Friends of the Nation a non-governmental organization based in Takoradi, a Ghanaian student is undertaking this research with the objective of addressing the Socio-Cultural and Economic Constraints to Sustainable Solid Waste Management in this Country.

This questionnaire seeks to solicit your view on policy issues that pertain to Sustainable Solid Waste Management.

This research pledges the confidentiality of your responses. While participation in this research is voluntary, I would be very grateful if you would be willing to answer these few questions.

For the purpose of this research, Sustainable Solid Waste Management is defined as

“A management option that attains social and economically desirable goals without compromising the integrity of the environment”

- a. An indicator of socially desirable goal is complete and effective removal of all waste generated from the human settlement
- b. An indicator of economically desirable goal is the ability of such a management option to generate at least sufficient income to sustain itself without external capital injection.

BACK GROUND INFORMATION

Name of Department/Organization:.....

Name Personnel:.....

Position:.....

QUESTIONS

1. Does the Environmental Protection Agency (EPA) play any role with respect to solid waste management in the country?
 - Monitory of Waste Disposal sites**
 - Policy Formulation**
 - Advisory**
 - Others**
 - Comments**

2. Do you have any constraints with respect to playing this role(s)?
 - Yes**
 - No**

3. What Constraints do you face with respect to this role
 - Finance**
 - Personnel**
 - Equipment**
 - Lack of Cooperation**
 - Others**
 - Comments**

4. Do you know how waste collected is finally disposed of by the waste collecting authorities?
 - Sea dumping**
 - Dumping in isolated area**
 - Waste dump**
 - Land fills**
 - Others**
 - Comment**

5. Do you know the number of final waste disposal facilities in the metropolis?
 - Yes**
 - No**
 - Comment**

6. Do you do any monitoring of these facilities?

Yes

No

7. How often do you do this monitoring?

Comment

8. What parameters are monitored and measured?

Leachate

Release of land fill gases

Odour

Eye sore

Comment

In your opinion, is it possible for private enterprises to develop sanitary landfills and charge waste collectors per number of tips?

Yes

No

Comment

9. Are you aware of any waste treatment prior to disposal?

Yes

No

Comment

10. What type of waste processing are you aware of?

Incineration

Composting

Biological digestion

Chemical Digestion

Others

Comment

11. Are you aware of any waste recovery programme?

Yes,

No

Comment

12. How does it work?

Comment

13. What materials are recovered?

- Paper**
- Plastic**
- Metal**
- Aluminium**
- Glass/Bottle**

14. Do you know of any waste recycling programme?

- Yes**
- No**
- Comment**

15. Do you know any waste to energy programme?

- Yes,**
- No**
- Comment**

16. What type?

- Biogas generation,**
- Waste fuel**
- Comment**

17. In your understanding of problematic waste, which waste type would you consider as the most problematic in this metropolis

- Bio-waste**
- Plastics**
- Scrap metals**
- Comment**

18. If there should be a policy that advocate for waste processing prior to final disposal, what processing facilities would you recommend for the metropolis

- Incineration**
- Composting**
- Biological digestion**
- Chemical Digestion**
- Others**
- Comment**

19. In your estimation what should be the ownership of such waste processing facilities

- Government**
- Private**
- Both private and government**
- Comment**

20. Landfill as means of ultimate disposal cannot be avoided, would you support a policy that require the establishment of sanitary landfill in all metropolis
- Yes**
 - No**
 - Comments**
21. What should be the ownership of such a facility?
- Government**
 - Private**
 - Both government and private**
22. Are you aware of any environmental tax currently in place in this country?
- Yes**
 - No**
 - Type**
 - Comment**
23. Would you recommend the imposition of appropriate tax to generate income towards sustainable solid waste management in this country?
- Yes**
 - No**
 - Comments**
24. Do you see any obstacle to the implementation of such a measure?
- Yes**
 - No**
 - Comment**
25. Are you aware of any regulation/laws that punish indiscriminate waste disposal habit?
- Yes**
 - No**
 - Comment**
26. Would you recommend the imposition of more stringent regulation?
- Yes**
 - No**
 - Comments**

27. In the implementation of a more stringent regulation that punishes people who indiscriminately dispose off waste, what would you recommend as penalty for indiscriminate waste disposal?
- Fine**
 - Community work**
 - Imprisonment**
 - Other comments**
28. What constraints do you envisage to the imposition of stringent laws with respect to waste management.
- Monitoring**
 - Personnel**
 - Comment**
29. How will you rate the level of public awareness of proper waste disposal in this country
- Very Satisfied**
 - Satisfied**
 - Neither Satisfied nor Dissatisfied**
 - Dissatisfied**
 - Very Dissatisfied**
 - No idea**
 - Others; Please specify**
30. Do you know of any awareness creation programme with respect to proper waste disposal?
- Yes**
 - No**
 - Comment**
31. Would you support the introduction of a programme that aims at building proper waste management habit in our students and pupils in schools?
- Yes**
 - No**
 - Comment**
32. Does your outfit play any role in formulating SWM policy in this country
- Yes**
 - No**
 - Comments**

33. When was the SWM policy last reviewed

Comment

When will the policy be reviewed again

Comments

34. Would you recommend any waste separation at source into bio waste and non bio waste

Yes

No

Comment

35. What constraints do you envisage to such a scheme

Lack of Finance

Lack of personnel

Technical constraints

Unconcerned attitude of the general public

Comment

36. In order of impact how would you arrange the following as a means of streamlining public attitude to proper waste disposal

Appropriate tax

Stringent regulatory control

Education/awareness creation on the impact of improper waste disposal on the

Economy, health and the environment

37. In terms of the feasibility of implementation how would you arrange these policy options as means of achieving sustainable solid waste management goals.

Tax

Stringent regulatory control

Education/Awareness creation

38. The infrastructure layout plays a very important role in waste collection and disposal, is your outfit involved in the planning of new residential areas?

Yes

No

Comments

39. Do you think your outfit can play more role in achieving sustainable solid waste management in this country?

Yes

No

Roles

Comment

40. What constraints do you envisage to the roles your outfit can play in achieving sustainable solid waste management in this country?

Comments

41. In your official capacity what do you consider as constraints to implementing policies aimed at achieving sustainable management in the solid waste sector?

Comment

42. In your personal opinion, do you think it is possible to implement any sustainable solid waste management scheme?

Comments

9.4 Appendix B

Table B1. Important Considerations in landfill Design

Factors	Remarks
Access	Paved all-weather access roads to landfill site; temporary roads to unloading areas
Land area	Area should be large enough to hold all community wastes for a minimum of 5 yrs but preferably 10 to 25 yrs; area for buffer strips or zones must also be included
Landfilling method	Landfilling method will vary with terrain and available cover; most common methods are excavated cell/trench, area, canyon
Completed landfill characteristics	Finished slopes of landfill, 3 to 1; height to bench, if used, 50 to 75ft; slope of final landfill cover, 3 to 6%
Surface drainage	Install drainage ditches to divert surface water runoff; maintain 3 to 6% grade on finished landfill cover to prevent ponding; develop plan to divert storm water from lined but unused portions of landfill
Intermediate cover material	Maximize use of onsite soil materials; other materials such as compost produced from yard waste and MSW can also be used to maximize the landfill capacity; typical waste to cover ratios vary from 5 to 1 to 10 to 1
Final Cover	Use multilayer design; slope of final landfill cover, 3-6%
Landfill liner	Single clay layer (2to 4ft) or multilayer design incorporating the use of a geomembrane. Cross slope for terrace type leachate collection systems, 1 to 5%; maximum flow distance over terrace, 100ft; slope of drainage channels, 0.5 to 1.0%. Slope for piped type leachate collection system, 1 to 2%; size of perforated pipe 4in; pipe spacing, 20 ft.
Cell design and construction	Each day's waste should form one cell; cover at end of day with 6 in of earth or other suitable material; typical cell width, 10 to 30 ft; typical lift height including intermediate cover, 10 to 14 ft; slope of working faces 2:1 to 3:1
Groundwater protection	Divert any underground springs; if required, install perimeter drains, well point system, or other control measures
Landfill gas management	Develop landfill gas management plan including extraction wells manifold collection system, condensate collection facilities, the vacuum blower facilities, and flaring facilities and or energy production facilities. Operating vacuum at well head, 10in of water
Leachate Collection	Determine maximum leachate flow rates and size leachate collection pipe and/or trenches; size leachate pumping facilities; select collection pipe materials to withstand static pressures corresponding to the maximum height of the landfill
Leachate treatment	Based on expected quantities of leachate and local environmental conditions, select appropriate treatment process
Environmental requirements	Install vadose zone gas and liquid monitoring facilities; install up- and downgradient groundwater monitoring facilities; locate ambient air monitoring stations
Equipment requirement	Number and type of equipment will vary with the type of landfill and the capacity of the landfill
Fire prevention	Water onsite; if non-potable, outlets must be marked clearly; proper cell separation prevents continuous burn-through if combustion occurs

Table adopted from Tchobanoglous et al. 1993.

9.5 Table B2 Sources of Solid Waste within a Community

Source	Typical facility, activities Or locations where waste Are generated	Types of Solid Waste
Residential	Single family and multifamily detached dwellings, low-, medium, and high-rise apartments, etc	Food waste, paper, cardboard, * plastic , textiles, leather, yard waste, wood, glass, tin cans, aluminium, other metals, ashes, street leaves, special wastes (including bulky items, consumer electronics, white goods, yard wastes collected separately, batteries, oil, and tires), household hazardous waste
Commercial	Stores, restaurants, markets, office buildings, hotels, motels, print shops, service stations, auto repair shops, etc	Paper, cardboard, * plastics , wood, food waste, glass, metals, special wastes (see above), hazardous wastes etc.
Institutional	Schools, hospitals, prisons, governmental centers	As above in commercial
Construction and demolition	New construction sites, road Repair/renovation sites razing of buildings, broken pavement	Wood, steel, concrete, dirt, * plastic , etc.
Municipal services (excluding treatment facilities)	Street cleaning, landscaping, catch basin cleaning, parks and beaches, other recreational areas	Special wastes, rubbish, street sweepings * (plastics) landscape and tree trimmings, catch basin debris general wastes from parks, beaches, and recreational areas
Treatment plants sites; Municipal incinerators	Water, wastewater, and industrial treatment processes, etc	Treatment plants wastes, principally composed of residual sludges
Municipal solid waste	All of the above	All of the above
Industrial	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, power plants, demolition, etc	Industrial process waste, scrap materials, * plastics , etc. Non-industrial waste including food wastes, rubbish, ashes, demolition and construction wastes, special wastes, hazardous wastes
Agricultural	Field and row crops, orchards, vineyards, dairies, feedlots, farms, etc.	Spoiled food wastes, agricultural wastes, rubbish, hazardous wastes

Table adapted from Tchobanoglous et al. 1993.

* Note presence of plastic in almost all sources

9.6 Table B3 Typology of Economic Instruments Adapted from IDB, 2003

Revenue Generating Instruments	Revenue Providing Instrument	Non-revenue instruments
<p style="text-align: center;">Charges</p> <p>Pollution charge Based on pollutant loading</p> <p>Generation charges Based on quantity and degree of hazard</p> <p>User Charges Based on collection and user services received</p> <p>Tipping charges For unloading at transfer or disposal facilities</p> <p>Product charges Fees to handle disposal of problem products eg. batteries, tyres etc</p> <p style="text-align: center;">Taxes</p> <p>Disposal taxes Added to disposal charges to influence disposal options</p> <p>Pollution taxes Added to user charges to influence choice of manufacturing feedstock, fuels etc. for pollution reduction</p> <p>Eco-taxes Added to non-renewable energy production or fuels to influence energy demand and fuel choices</p>	<p>Tax credits and Tax relief Allowances on property taxes, custom duties, or sales taxes to motivate investment in waste management improvement</p> <p>Charge reduction Based on proof of recycling or reuse in reducing waste requiring collection or disposal</p> <p>Environmental improvement funds Established to support pollution reduction, resource protection and energy efficiency</p> <p>Research Grants To stimulate technology development</p> <p>Tax rebates For pollution saving or energy efficiencies</p> <p>Carbon Sequestration funds To encourage purchasing lands that rejuvenate the air quality sometimes as a trade-off by polluters</p>	<p>Product life cycle assessment Predicts overall environmental burden of products and can be used in certification programmes</p> <p>Performance-Based Management Contracting Oversight contractors commit to overall service improvement</p> <p>Deposit-Refund Deposit paid and refund given upon product return for reuse</p> <p>Managed Competition Imposed to enables equitable competition b/n public and private sector</p> <p>Take-Back Systems Manufacturers take back products or packaging</p> <p>Tradable Permits Allow trading of emissions among various polluters</p> <p>Bans Imposed on materials or waste causing disposal problems such as mercury batteries</p> <p>Procurement Preferences Evaluation criteria adding points for products with recycled content or reduced resource demand</p> <p>Recycled Content Requirement Laws and procurement specifications noting the precise recycled content</p> <p>Insurance Pools Restructuring of insured parties to enable pollution risks to be covered</p> <p>Product Stewardship Encourages product designs that reduce pollution, include the full cost of the solid waste recycling and disposal, reduce waste and encourage recycling</p> <p>Disclosure Requirement Waste generators are required to disclose their pollution</p>
<p>Presumptive taxes Based on presumed level of pollution</p> <p>Renewable resource taxes Imposed on virgin materials to influence their demand and motivate recycling of secondary materials</p> <p style="text-align: center;">Subsidy</p> <p>Subsidy reductions Removal of subsidies that encourage use of virgin and non renewable resources</p>	<p>Host Community Compensation Incentives given to host communities to allow waste management facilities to be situated there</p> <p>Development Rights Long-term leases of land and development rights provided to private companies building waste treatment and disposal facilities, or to those remediating and reclaiming old disposal sites</p>	<p>Manifest System Precise cradle-to-grave tracking of hazardous waste</p> <p>Blacklist of Polluters Published list enable consumers to consider boycott of products</p> <p>Liability Insurance Liability assurances by contractors and private operators</p> <p>Bonds and Sureties Guarantee for performance by contractors and private operators</p> <p>Liability Legislation Laws defining environmental restoration settlements</p> <p>Clean City Competition Reward neighbourhoods and cities that have improved cleanliness</p>

9.7.1 Table B4 Summary of Waste Minimization in Sustainable Solid Waste Management

Objectives	Activities	Implementation
<p>1.To stabilize or reduce the production of wastes destined for final disposal with respect to time</p> <p>2.To strengthen procedures for assessing waste quantity and composition changes for the purpose of policy formulation</p> <p>Governments, according to their capacities and available resources and with the cooperation of the United Nations and other relevant organizations, as appropriate, should:</p> <p>i. By the year 2000, ensure sufficient national, regional and international capacity to access, process and monitor waste trend information and implement waste minimization policies</p> <p>ii. By the year 2000, have in place in all industrialized countries programmes to stabilize or reduce, wastes destined for final disposal; Developing countries as well should work towards that goal without jeopardizing their development prospects</p> <p>iii. By the year 2000, in all countries, in particular in industrialized countries, programmes to reduce the production of agrochemical wastes, containers and packaging materials, which do not meet hazardous characteristics</p>	<p>1.Development and strengthening of national capacities in research and design of environmentally sound technologies, as well as adopt measures to reduce wastes to a minimum.</p> <p>2.Provision of incentive to reduce unsustainable consumption and production</p> <p>3.Development of national waste minimization plans Emphasizing waste minimization in procurement within the United Nations system.</p> <p>4.Monitoring and gathering relevant information for country waste minimization programmes Coordination of regional and national cooperation in waste minimization</p> <p>5. Collaboration with UN and Intergovernmental agencies on:</p> <p>i. Identifying, developing and harmonizing methodologies for waste monitoring and transferring such methodologies to countries;</p> <p>ii. Identifying and further developing the activities of existing information networks on clean technologies and waste minimization</p> <p>iii. Undertaking periodic assessment, collating and analysing country data and reporting systematically, in an appropriate United Nations forum, to the countries concerned</p> <p>iv. Reviewing the effectiveness of all waste minimization instruments and identifying potential new instruments that could be used</p> <p>v. Undertaking research on the social and economic impacts of waste minimization at the consumer level.</p>	<p>Industrialized countries should consider investing in waste minimization the equivalent of about 1 per cent of the expenditures on solid wastes and sewage disposal.</p> <p>Identification and dissemination of waste minimisation technologies and procedures</p> <p>Undertaking a continuous review of the effectiveness of all waste minimization instruments and identifying potential new instruments that could be used Promoting waste prevention and minimization as the principal objective of national waste management programmemes</p> <p>Promoting public education and a range of regulatory and non-regulatory incentives to encourage industries to change product design and reduce industrial process wastes through cleaner production technologies and good housekeeping practices</p> <p>Demonstration and pilot programmemes to optimize waste minimization instruments Establishing procedures for adequate transport, storage, conservation and management of agricultural products, foodstuffs and other perishable goods in order to reduce the loss of those products</p> <p>Establishment of concrete national standards for effluents and solid waste, taking into account, inter alia, raw material use and energy consumption</p> <p>Human resource development for waste minimization not only should be targeted at professionals in the waste management sector but also should seek to obtain the support of citizens and industry. Education and public campaigns to raise consciousness of the general public</p>

Drawn with information from UN, 1992

9.7.2 Table B 5 Summary of Maximizing Environmentally Sound Waste Reuse and Recycling in Sustainable Solid Waste Management

Objectives	Activities	Implementation
<p>1. To strengthen and increase national waste reuse and recycling systems</p> <p>2. To create a model internal waste reuse and recycling programme for waste streams, within the UN system</p> <p>3. To make available information, techniques and appropriate policy instruments to encourage and make operational waste reuse and recycling schemes</p> <p>Governments, according to their capacities and available resources and with the cooperation of the UN and other relevant organizations should:</p> <p>i. By the year 2000, promote sufficient financial and technological capacities at the regional, national and local levels, to implement waste reuse and recycling policies</p> <p>ii. By the year 2000, in all industrialized countries, and by the year 2010, in all developing countries, have a national programme, including, to the extent possible, targets for efficient waste reuse and recycling</p>	<p>1. Developing and strengthening of national capacity to reuse and recycle an increasing proportion of wastes;</p> <p>2. Review and reform national waste policies to provide incentives for waste reuse and recycling;</p> <p>3. Develop and implement national plans for waste management that take advantage of, and give priority to, waste reuse and recycling. Modify existing standards or purchase specifications to avoid discrimination against recycled materials</p> <p>4. Develop public education and awareness programmes to promote the use of recycled products. Information and research is required to identify promising socially acceptable and cost-effective forms of waste reuse and recycling relevant to each country. Collaboration with the UN and other international organizations in:</p> <p>i. Reviewing of options and techniques for reuse and recycling all forms of municipal solid wastes. Making reuse and recycling policies an integral component of national and local waste management programmes.</p> <p>ii. Assessing existing waste reuse and recycling operations and practices and identifying ways by which these could be increased and supported.</p> <p>iii. Increasing funding for pilot research programmes to test various options and scales of reuse and recycling operations.</p> <p>iv. Producing guidelines and best practices for waste reuse and recycling.</p> <p>v. Intensifying efforts at collecting, analysing and disseminating relevant information to key target groups.</p> <p>vi. Identifying potential markets for recycled products.</p> <p>vii. Periodic review waste reuse and recycle programmes</p> <p>viii. Review and update international guidelines for the safe reuse of wastes</p> <p>ix. Establish appropriate programmes to support small communities' waste reuse and recycling industries in developing countries</p>	<p>It was estimated that if the equivalent of 1 per cent of waste-related municipal expenditures was devoted to safe waste reuse schemes, worldwide expenditures for this purpose would amount to \$8 billion.</p> <p>Transfer of recycling technologies within bilateral and multilateral technical cooperation and aid programmes</p> <p>Developing and improving existing technologies, especially indigenous technologies, and facilitating their transfer</p> <p>Offer of incentives to local and municipal authorities to recycle their wastes</p> <p>Providing technical assistance to informal waste reuse and recycling operations</p> <p>Applying regulatory and economic principles to support polluter pays principles</p> <p>Providing legal and economic conditions conducive for investments in waste reuse and recycling</p> <p>Promoting separate collection of recyclable parts of household wastes</p> <p>Improving the marketability of technically recyclable waste</p> <p>Encouraging the use of recyclable materials, particularly in packaging</p> <p>Governments, in collaboration with United Nations international and regional organizations should include</p> <p>i. the advantages and civic obligations associated with waste reuse and recycling in school curricula and relevant general educational courses</p> <p>ii. Encourage participation of NGOs, CBOs and all other interest groups mobilizing support for waste reuse and recycling programmes and campaigns</p> <p>iii. Capacity-building to support increased waste reuse and recycling should focus on making operational national waste management policies and enabling local and municipal authorities to mobilize community support for waste reuse and recycling by involving the informal sector in waste reuse and recycling operations</p>

Drawn with information from UN, 1992

9.7.3 Table B6 Summary of Promoting Environmentally Sound Waste Disposal and Treatment; in Sustainable Solid Waste Management

Objectives	Activities	Implementation
<p>1. To treat and safely dispose of a progressively increasing proportion of the generated wastes.</p> <p>Governments, according to their capacities and available resources and with the cooperation of the UN and other relevant organizations should</p> <p>i. By the year 2000, establish waste treatment and disposal quality criteria, objectives and standards based on the nature and assimilative capacity of the receiving environment</p> <p>ii. By the year 2000, establish sufficient capacity to undertake waste-related pollution impact monitoring and conduct regular surveillance, including epidemiological surveillance</p> <p>iii. By the year 1995, in industrialized countries, and by the year 2005, in developing countries, ensure that at least 50 per cent of all sewage, waste waters and solid wastes are treated or disposed of in conformity with national or international environmental and health quality guidelines</p> <p>iv. By the year 2025, dispose of all sewage, waste waters and solid wastes in conformity with national or international environmental quality guidelines</p>	<p>Governments, institutions and NGOs together with industries, in collaboration with appropriate organizations of the United Nations system, should launch programmes to improve the control and management of waste-related pollution in</p> <p>i. Developing and strengthening national capacity to treat and dispose of wastes safely</p> <p>ii. Reviewing and reforming national waste management policies</p> <p>iii. Encouraging countries to seek waste disposal solutions within their sovereign territory and as close as possible to the sources of origin that are compatible with environmentally sound and efficient management</p> <p>iv. Develop human wastes management plans, giving due attention to the development and application of appropriate technologies and the availability of resources for implementation Assembling and analysing the scientific evidence and pollution impacts of wastes in order to formulate and disseminate recommended scientific criteria and guidelines for the environmentally sound management of solid wastes</p> <p>v. Establishing an information clearing-house with extensive networks at the regional, national and local levels to collect and disseminate information on all aspects of waste management, including safe disposal</p> <p>States should through bilateral and multilateral cooperation, including through the UN and other relevant international organizations:</p> <p>i. Identify, develop and harmonize methodologies and environmental quality and health guidelines for safe waste discharge and disposal</p> <p>ii. Review and keep information abreast with techniques and approaches of safe waste disposal and disseminating this information</p>	<p>It was estimated the average total annual cost (1993-2000) of implementing the activities of this programme in developing countries to be about \$15 billion, including about \$3.4 billion from the international community on grant or concessional terms</p> <p>Governments, municipalities and local authorities, with appropriate international cooperation, should</p> <p>i. Prepare guidelines and technical reports on the integration of land-use planning in human settlements with waste disposal</p> <p>ii. Undertake research on low-cost, low-maintenance waste-water treatment systems; ecologically safe waste disposal options etc.</p> <p>iii. Focus on the rehabilitation, operation and maintenance of existing facilities</p> <p>iv. Establish programmes to maximize source segregation and safe disposal of the hazardous components of municipal solid waste</p> <p>v. Provide training, focused on pollution control, waste treatment and disposal technologies, and operating and maintaining waste-related infrastructure</p> <p>vi. Undertake the requisite training for waste-related pollution monitoring and control enforcement</p> <p>vii. Create and strengthen independent environmental control bodies at the national and local levels.</p> <p>International organizations and donors should support needed upgrading of manpower skills and provision of equipment Creating and strengthening independent environmental control bodies at the national and local levels.</p> <p>Empowering of pollution control agencies with the requisite legal mandate and financial capacities to carry out their duties effectively</p>

Drawn with information from UN, 1992

9.7.4 Table B7 Summary of Extending Waste Service Coverage in Sustainable Solid Waste Management

Objectives	Activities	Implementation
<p>1. The overall objective of this programme is to provide health-protecting, environmentally safe waste collection and disposal services to all people.</p> <p>Governments based on their capacities and available resources and with the cooperation of the UN and other relevant organizations, as appropriate, should:</p> <p>i. By the year 2000, have the necessary technical, financial and human resource capacity to provide waste collection services commensurate with needs</p> <p>ii. By the year 2025, provide all urban populations with adequate waste services</p> <p>iii. By the year 2025, ensure that full urban waste service coverage is maintained and sanitation coverage achieved in all rural areas</p>	<p>Governments, based on their capacities and available resources and with the cooperation of the UN and other relevant organizations, as appropriate, should:</p> <p>i. Establish financing mechanisms for waste management service development in deprived areas, including appropriate modes of revenue generation</p> <p>ii. Apply the "polluter pays" principle, where appropriate, by setting waste management charges at rates that reflect the costs of providing the service and ensure that those who generate the wastes pay the full cost of disposal in an environmentally safe way</p> <p>Developing and applying methodologies for waste monitoring</p> <p>Data gathering and analysis to establish goals and monitor progress</p> <p>Develop waste management information system including Inputting information into a global information system building upon existing systems</p> <p>Strengthening the activities of existing information networks in order to disseminate focused information on the application of innovative and low-cost alternatives for waste disposal to targeted audiences</p> <p>The international community in general and selected United Nations organizations in particular should:</p> <p>i. Launch a settlement infrastructure and environment programme to coordinate the activities of all organizations of the UN system involved in this area and include a clearing-house for information dissemination on all waste management issues.</p> <p>ii. Undertake and systematically report on progress in providing waste services to those without such services.</p> <p>iii. Review the effectiveness of techniques and approaches to increasing coverage and identify innovative ways of accelerating the process</p>	<p>The average total annual cost (1993-2000) of implementing the activities of this programme was estimated to be about \$7.5 billion, including about \$2.6 billion from the international community on grant or concessional terms</p> <p>Governments and institutions, together with non-governmental organizations, should, in collaboration with appropriate organizations of the UN system, launch programmes in different parts of the developing world to extend waste services to the unserved populations</p> <p>Policy changes at the national and local levels could enhance the rate of waste service coverage Giving full recognition to and using the full range of low-cost options for waste management</p> <p>Assigning high priority to the extension of waste management services to all settlements irrespective of their legal status Integrating the provision and maintenance of waste management services with other basic services such as water-supply etc Research activities could be enhanced to find:</p> <p>i. solutions and equipment for managing wastes in areas of concentrated populations and on small islands.</p> <p>ii. Prepare and disseminate guidelines, case-studies, policy reviews and technical reports on appropriate solutions and modes of service delivery to unserved low-income areas.</p> <p>iii. Encourage active community participation including women's and youth groups in the management of waste, particularly household waste.</p> <p>iv. Promote inter-country transfer of relevant technologies, especially technologies for high-density settlements.</p> <p>International organizations and national and local Governments, in collaboration with NGOs should provide focused training on low-cost waste collection and disposal options Governments and NGOs should establish a special unit within current institutional arrangements to plan and deliver services to the unserved poor communities, with their involvement and participation Building institutional capacity and developing procedures for undertaking service planning and delivery.</p>

Drawn with information from UN, 1992