SUSTAINABLE SOLID WASTE MANAGEMENT IN A MOUNTAIN ECOSYSTEM: DARJEELING, WEST BENGAL, INDIA.

By

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A Thesis
Submitted to the Faculty of Graduate Studies
In Partial Fulfillment of the Requirements
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Master of Natural Resources Management

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A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of

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Of Master of Natural Resources Management (M.N.R.M)

ABSTRACT

This thesis considers the solid waste management system in Darjeeling municipal area, West Bengal, India, in order to develop a framework for sustainable solid waste management in future. The objectives of this thesis were: 1) to describe and explain the current waste management system and practices in Darjeeling; 2) to identify factors that influence waste management in Darjeeling, 3) to assess the newly proposed solid waste management system , and 4) to propose recommendations for development of a sustainable solid waste management system. The objectives were addressed primarily through semi-structured interviews and discussions with various stakeholders along with non-participatory method tools.

The study analyzed the current solid waste management system and identified the strengths and the weaknesses of the system. It was observed that the current solid waste management system practiced in Darjeeling is unsustainable. There is no provision for the segregation of waste. The collection and transportation of waste is inadequate and inappropriate. Officially, there is no provision for composting or recycling of the waste. Majority of the waste is dumped in open landfill and people are not involved in solid waste decision making process or the solid waste management system. Further, the study also analyzed the newly proposed solid waste management system. It was found that the newly proposed system is better than the existing system; the new proposal outlines a framework of two stream waste segregation system. The proposed waste collection and transportation system is an improvement on the current system. Composting of biodegradable waste is an important feature of the proposal. The proposed system, however, omitted critical

points which need to be addressed in order to develop a sustainable solid waste management system.

The study also identified and analyzed the factors that influence the solid waste management system in Darjeeling setting. It was found that the factors are: 1) existing decision making system. Basically the decision making process is top-down and bureaucratic, which dissuades people from participating in the solid waste management process, 2) people's perception of wastes as a problem vis-à-vis other existing problems. Even though many people regard wastes as a threat, they would rather have other problems such as employment, safe drinking water etc., solved before solving of waste problem, 3) gap between decision makers and people in terms of information transformation. Most of the people are not informed about the decision undertaken by the authorities, 4) the relationship between political stability and governance. Plans and processes initiated by one set of people in power is often abandoned mid-way when a new set of people come in power. For instance, an Integrated Solid Waste Management process started by the previous board was bunged by the new board altogether, and 5) presence of self-organized grass root level organization called *samaj*. These organizations can influence the solid waste management in a positive manner by involving and ensuring public participation in various programmes.

Taking all the issues and factors into consideration the thesis makes some recommendations for developing a sustainable solid waste management system for the future. Some of these recommendations are: 1) involving people for consultation with respect to solid waste management decision making process, 2) creation of three stream waste system, 3) promotion of reduction, reuse and recycling, 4) promotion of

community based composting, 5) doorstep collection of segregated waste and, 6) responsible bureaucracy.

The thesis summarizes that the current solid waste management system is not sustainable. The proposed system can be improved on following the list of recommendations mentioned in the thesis. The thesis concludes that people in Darjeeling municipal area are willing to participate and contribute towards the development of a sustainable system. Finally, a set of recommendations have been provided for laying the foundation towards sustainable solid waste management system in Darjeeling municipal area.

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No matter where I go or what I do, my family has always been there for me, prayed for me and have been my source of inspiration. I cannot mention all your names here since we are 30 strong, but I would like all of you to know, I miss you all and I want

to be with you all again. Thank you for your patience, support, love, care, sacrifices and everything else. I am what I am today because of you. I thank my friends and neighbors from Garidhura, Jorebungla for all your prayers and best wishes.

Most important of all, Rinchu, without you none of this would be the same. Thank you for your patience and sacrifices, for your belief in me and love.

Last but not the least, I thank God for all the blessings and also for the fact that the thesis is finally over.

DEDICATION

This thesis is dedicated to all the waste workers of Darjeeling, for your unseen, unheard and unacknowledged toil and dedication.

&

Ron and Gladys, without your support this thesis would not have been written.

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LIST OF LOCAL TERMS USED

- *Samaj*: A grass root level self-organized body, unique to Darjeeling hills.
- *Ghutka*: Chewing tobacco.
- *Bikrit*: Rag pickers
- *Raddiwala*: Rag pickers or itinerant buyers (used synonymously).
- *Rakshiwalla*: Moonshiners
- *Bhajan Mandali*: Self-organized religious hymn singers.
- *Sai samity*: Organization which undertakes volunteer works, formed by Sai Baba.
- Holdings: Households or business establishments registered with the municipality.
- DGHC: Darjeeling Gorkha Hill Council, a semi-autonomous body formed for the development of Darjeeling Hills i.e. The sub-divions of Darjeeling, Kalimpong, Kurseong, and parts of Siliguri.

CHAPTER 1: INTRODUCTION

1.1 Background

In a developing country, the problems associated with solid waste management are more acute than in a developed country (Zerboc 2003). Lack of financial resources and infrastructure to deal with solid waste creates a vicious cycle; lack of resources leads to low quality of service provision which leads to fewer people willing to pay for said services, which in turn further erodes the resource base and so on (Kuniyal et al. 1998; Zerboc, 2003). The problem is further complicated by rapid growth in population and urbanization, which adds greatly to the volume of waste being generated and to the demand for waste retrieval service in municipal areas. However, more often than not, an increase in population is not matched with an equal increase in revenue for the local municipalities for waste management (Zerboc 2003). Besides this, rapid urbanization means rapid growth of shanty dwelling units that are largely unplanned for, and add to the waste, health, and hygiene problems.

Another significant factor that contributes to the problem of solid wastes in a developing country scenario is the lack of proper collection and transportation facilities. Improper planning coupled with rapid growth of population and urbanization serves to add congestion in streets, and as a result the waste collection vehicles cannot reach such places, thus allowing filth to build up over time. Lack of monetary resources, at times, results in improper or no transportation vehicles for waste disposal adding another dimension to the ever rising cycle of problems (Jain 1994; Zerboc 2003).

In any developing country, the threats posed by improper handling and disposal of solid wastes (though often ignored) contribute to the high level of

mortality and morbidity (Medina 2002). Human and ecosystem health is also threatened due to improper handling of solid wastes.

In addition to all the problems mentioned above, mountainous regions in developing countries face additional challenges in solid waste management, in terms of their highly fragile environment and difficult terrain. The problems associated with solid waste in the mountainous region have serious cascading effects on the lower valley. Often solid waste is the number one threat to the fragile ecology of the mountainous environment (Jain 1994). Besides this, seasonal tourist inflow adds significantly to the demands on resource base and contributes considerably to the amount of wastes generated. Lack of proper regulations fails to encapsulate the waste generated by the tourists and fees to be paid there of (Jain 1994; Kuniyal et al. 1998; Cole and Sinclair 2002).

1.2 Study Area

This study was conducted in the Darjeeling Municipal area, one of the oldest municipalities in West Bengal, India. The area was selected because:

- Darjeeling is one of the most popular hill towns in the eastern part of India;
- it is a part of the eastern Himalayan complex, which has been declared a biodiversity hotspot; providing habitat to critically endangered species like the snow leopard, red panda and Himalayan black bear (figures 1 and 2);
- Solid waste management is emerging as a major problem.

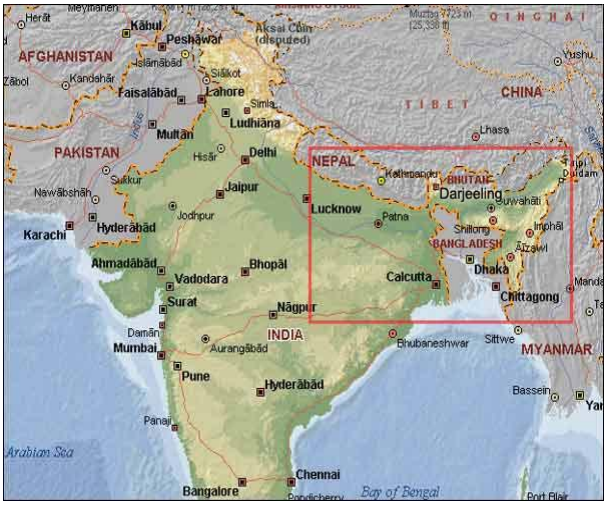

Fig: 1.1 Location of Darjeeling` within India

Fig 1.2 Darjeeling in Eastern India

Source: www.manjushree-culture.org

Figure 1.3: Study area

Source: www.atithidevobhava.com

1.2.1 Location

The study area lies in the mountainous north part of the state of West Bengal in India. Darjeeling municipality, is located between 26º31' and 27º31' North Latitude and 87º59' and 88º53' East Longitudes (Darjeeling municipality 2006). The altitude varies from 1982 meters to 2286 meters, above mean sea level.

1.2.2 Area

Darjeeling municipality town covers an area of 10.70 sq. km and has 32 wards, and two *mouzas;* Darjeeling and Jorebunglow and has around 22,000 household units, over 350 hotels, 370 restaurants, 25 vegetable markets, 10 fish and meat markets and 89 institutional holdings (Darjeeling municipality 2006).

1.2.3 Population

The population figures of the town along with the growth rate have been presented in the table below.

Table 1.1: Population changes in Darjeeling municipal area

Population shown in thousands				**Decadal change in population growth**		
1971	1981	1991	2001	1971-81	1981-91	1991-01
42,873	56,875	71,469	107,191	32.60%	26.30%	44.70%

Source: Census 2001 and Darjeeling Municipality

The rate of growth of population over the last four decades has been rapid as seen in the table (1.1) above. The composition of people is diverse and the steady rise in population is attributed to immigration of people from nearby places (Census 2001; Darjeeling Municipality 2007).

1.2.4 Climate and rainfall

Darjeeling town falls under the sub-Himalayan region of West Bengal. There is a high level of humidity, with an average humidity of 32%. The annual rainfall averages approximately 2812 mm. The temperature varies between an average maximum of 16.7 ºC and average minimum of -0.9 ºC. The town experiences all the seasons, however, monsoon (rainy) that lasts from mid-May to late-October and winter early-November to early-April dominate the weather seasons (Darjeeling municipality, 2007).

1.2.5 Topography and soil

Darjeeling municipal town rests on the hills made up of sedimentary and metamorphic rocks of various kinds, which in turn are greatly affected by the complexities of geological movements. The terrain has an inbuilt instability, thus making it highly susceptible to landslides and earthquakes (Darjeeling municipality 2007).

1.2.6 Existing land use

The town area is mainly used for housing and tourism related commercial enterprises. Commercial activities are predominantly undertaken keeping in mind the tourism industry, which is the main income source for the town people. Hotels, recreation facilities, markets and shopping centers dominate the hill town. Besides this there are also some tea gardens within the city limits (Darjeeling municipality 2007).

1.2.7 Waste management

Amongst the various problems Darjeeling faces today, solid waste management is on top of the list. The severity of waste problem in Darjeeling can be

assessed from the fact that currently, Darjeeling town produces about 50 metric tons of solid wastes every day. On an average around 62% of the waste is collected and disposed of by the municipality (Khawas 2003) [Refer to Table 1.2]. Darjeeling municipality has demarcated about 1.4 acres of land, which is used as the dumping ground. The dumping ground is located in ward number 18, which is close to the town and in "… [a] pathetic state …" (Khawas 2003).

Table 1.2: Solid Waste Management Scenario in Darjeeling Municipality Area

Management scenario		**Other Indicators**	
Total Waste Generated/day (tones)	50	Per Capita Waste Generated (Grams/day)	613
Waste Collected (tones)	31	Collection Performance (%)	62
No. of Vehicles	7	Vehicle Capacity-(% of Waste Generated)	21
No. of Labor engaged in conservancy	150	Road Length/Conservancy Staff (Meter)	662
No. of Disposal Sites	1		

Source: Darjeeling Municipality in Khawas (2003)

On February 26th 2007, an avalanche of garbage killed a 10 year old girl and seriously injured a lady; the accident should have been easily avoided, but it underscores the lack of solid waste management planning. In absence of a proper waste management system, the waste accumulates around the town and heaps of garbage (as shown in plates 1.1 and 1.2) can be seen around the town.

Plate 1.1: Waste being thrown in the middle of town

Plate 1.2: Waste waiting for an epidemic

Some of the major causes of solid waste management problems in Darjeeling can be summarized under two major headings: Rapid Growth and Urbanization

1.2.8 Rapid growth and urbanization

Significant growth in population as a result of growth in the tourism industry has created extensive infrastructural and environmental problems. Even though rapid growth and urbanization is a general trend in India, Darjeeling being in the fragile mountain region is perhaps close to a flipping point. The town was planned for a population of 10,000 people and 2,000 houses in 1935, but has grown six fold with over 12,000 houses and 110,000 population in 2001 (Census 2001). Environmental degradation (including denudation of the surrounding hills) and filth (because of unplanned disposal of solid waste) have adversely affected Darjeeling's appeal as a tourist destination. Any fall in tourist inflow will directly affect the standard of living of the people as the economy relies heavily of tourism. There is a growing crisis in terms of basic provisions like drinking water, health facilities etc; high growth in population adds significantly to the problem of solid waste management.

1.3 Research purpose and objectives

The purpose of this thesis was to examine the solid waste management system in Darjeeling municipal area, West Bengal, India, in order to develop a framework for sustainable solid waste management in future.

Within this context the objectives of this thesis were:

- To describe and explain the current waste management system and practices in Darjeeling municipal area,

- to identify the factors that influence waste management in the Darjeeling setting,
- to assess the new solid waste management system being proposed by the Darjeeling municipality, and
- to propose recommendations for development of a sustainable solid waste management system.

1.4 Research approach

1.4.1 Case Study Approach

I used Darjeeling municipality as a case study. The research objectives were met through the collection of primary data through interviews, workshops, and literature review. Secondary data was used (wherever available) to further enhance the understanding and to verify the quality of information gathered.

1.4.2 Participatory approaches to research

Data was collected concurrently (i.e. both primary and secondary data was collected at the same time) (Creswell 2003). The researcher relied on non-participatory research and drew upon the methods of participatory rural appraisal (PRA); semi-structured interviews, and non-participant observations (Chambers 1994) for data collection. In addition, the researcher undertook review of published materials, reports, key informant interviews, applicable policies, laws (if any) pertaining to the research purpose.

Methods used for the study involved open-ended interviews with different stakeholders, which allowed the study to incorporate a variety of views on the waste problem. Secondary was used for cross checking the findings wherever necessary and available. Current management practice was assessed in consultation with the local

people, municipal administration, and district authorities. Data were collected through direct observation by the researcher as well. By doing so, this study has been able to find out the nature and characteristics of waste management system; along with other strengths/constraints of the current waste management system (detailed methods have been discussed in Chapter 3).

1.6 Limitations

There are certain limitations to this study, originating from the ground situations including: political instability, lack of baseline data, and researcher bias.

Political instability: The research area (Darjeeling) is going through a major political upheaval; there was a popular uprising against the ruling Gorkha National Liberation Front (GNLF) lead Darjeeling Gorkha Hill Council (DGHC) under which the Darjeeling municipality falls. As a result the municipal authorities were regularly being changed and transferred, which was a hindrance to the collection of data, as my contact people were constantly being changed.

Lack of baseline data: Even though some studies have been carried out in terms of Darjeeling municipality as a whole, there was no study undertaken to study solid waste management system as a single entity. Further, a major fire had erupted in 1996, which lead to loss of all previous documents and any information of previous solid waste management system had to be collected from senior workers and senior citizens of the area.

Researcher bias: I was born and brought up in Darjeeling, and I was thus quite familiar with the situation prevailing in the study area vis-á-vis solid waste management. Therefore, I could understand the context of my objectives easily and I could place myself in the mindset of the people, while remaining a non-participant observer. Further, I am familiar with the language, culture and custom of the place;

these were bias of a positive nature which allowed me to study the context in depth. Since I am a native of Darjeeling, some interviewees found it difficult to relate to me as a researcher.

1.7 Thesis organization

This thesis is organized in six chapters. Following the introduction, Chapter 2 consists of the literature related to solid waste management in developing countries. Chapter 3 outlines the study methods. In chapter 4 the study area is described in detail as is the current waste management system. Chapter 5 outlines the considerations for the development of solid waste management in Darjeeling municipality area and Chapter 6 provides the summary, conclusions and recommendations.

CHAPTER 2: SOLID WASTE PROBLEMS IN DEVELOPING COUNTRIES

"Only within the moment of time represented by the present century has one species -- man -- acquired significant power to alter the nature of his world".
- Rachel Carson.

2.1 Introduction

Silent Spring by Rachel Carson published in 1962 marked the awakening of a new line of thinkers, who were not just concerned with society and economy but also with environment (IISD 2002). Since then, there has been a constant effort to understand the interdependence among various organisms and their environments (Takacs 1996). Interdependence of organisms and their ecosystem implies that all living beings have an effect on the environment; however, the impact of humans on environment is greater than that of any other species. From amongst all the different species that we see on earth, human beings are the only ones that modify nature so drastically to suit their purposes. This very nature of human beings to modify/change/transform nature according to their needs has led to pollution and thus, environmental degradation. Over time the size of the environmental impact grew from local (pollution, deforestation) to regional (draught, flooding, and landslides) and global (global warming, hole in the ozone layer, polar ice melting) levels. Over the past century, unconstrained economic development has led to major perturbations in the environment. Quality of land, air, and water resources depleted at an alarming rate.

Economic development plays a very important role in the life of modern society; however, such development has changed our consumption patterns to the point where we now generate more waste than we ever did. The period from 1950's to early 1980's, witnessed an unprecedented rise in the amount of natural resources extraction and environmental exploitation. By mid 1980's scientists (both natural and

social), started to realize the effects of human activities on nature (Colby 1991). The realization that the risks posed by mismanagement of environmental issues could lead to complex and varied problems, led to the emergence of need for development to be sustainable (Colby 1991), causing a paradigm shift from 'economic development' to 'sustainable development'.

2.1.1 Defining sustainable development

Sustainable development has been described by World Commission on Environment and Development (WCED) 1997 as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The paradigm of sustainable development has led us to re-think and reframe our approach towards environment, economy and society; generally more emphasis and focus is put on the environmental aspect of sustainable development, but sustainability is a much broader concept than just environmental protection. Sustainable development is related to the quality of life; the environmental, social and economic systems that form the community must provide a healthy, productive and meaningful life for all forms of life, both in the present as well as in the future (UNESA 2002). The paradigm of sustainable development has thus, made us aware of the necessity to prevent environmental degradation and live sustainably.

Environmental degradation leads to resource degradation, declining standards of living, the extinctions of large numbers of species, health problems in the human population, conflicts between groups fighting for dwindling resources, water scarcity and many other major problems (UNESA 2002). If this trend is allowed to continue, the long run impact of environmental degradation would result in local environments that are no longer able to sustain human populations. Such degradation on a global scale would, if not addressed, can lead to the extinction of human life on earth. In

order to achieve sustainable development, a conscious effort is being made today to sustain the environment and prevent further degradation; various local, regional and national governments and local, regional, national and international agencies have been working towards promoting environment friendly lifestyle and protecting the fragile ecosystems of the planet.

The paradigm of sustainable development requires equality and harmony of environment, economy and society. And sustainable development is not possible unless this equality is felt by the masses. The idea of sustainable urban development has been briefly summarized by Moningka (2002) as follows:

"Meeting the need of the present...."

• Providing social, cultural and health needs: for instance housing, water, sanitation, waste retrieval services; which should protect the masses from health and environmental hazards. A conducive atmosphere where one can practice their cultural and traditional lifestyle is also necessary.

• Economic needs: people should have means to earn a livelihood and have economic security.

• Political needs: people should have the right to make decisions on all issues.

"...without compromising the ability of future generations to meet their own needs"

• Minimizing use or waste of non-renewable resources includes minimizing waste of scarce mineral resources through reducing use of such resources, and re-using, recycling and reclaiming waste.

• Sustainable usage of renewable resources: threshold limit of the resources need to be maintained.

• Keeping wastes from cities within absorption capacity of local and global sinks.

Further, sustainable development has also been described as "…a process of simultaneously ensuring continuation of the economic, social and ecological basis of

human life" Chakrabarty (2002, p. 5). Hence, the paradigm of sustainable development combines improving the quality of life while controlling or limiting the harmful impacts of human activities on the environment. The goal of achieving sustainable development can thus, be incorporated in solid waste management as follows:

- to protect environmental health,
- to promote the quality of the urban environment,
- to support the efficiency and productivity of the economy,
- to generate employment and income, and
- to ensure and promote, health, hygiene and sanitation to people from all walks of life.

2.2 Mountain ecosystems

There are many types of ecosystem -- like forest ecosystem, grassland ecosystem, costal ecosystem, freshwater ecosystem etc. From amongst these, mountain ecosystems constitute the most vulnerable biogeographical domain. Mountain environments cover around 27 % of the world's land surface, and provide direct livelihood support to around 22 % of the world's people who live in mountain regions (UNEP 2005). Besides providing direct and indirect support to the people living in mountain regions and lower lands as well, mountain environments also cater to a wide range of goods and services, including water, energy, timber, biodiversity maintenance, and opportunities for recreation including the aesthetic and spiritual needs of the people.

According to the report "Mountain Watch" prepared by UNEP (2003) there are numerous pressures that threaten the mountain ecosystems and it includes: natural disturbances such as seismic hazards, fire and climate change as well as human

disturbances such as land cover change and agricultural conversion, infrastructure development, armed conflict and solid waste. These pressures have been degrading the mountain environments. However, degradation due to human actions has more severe impact than natural disturbances. Development of infrastructure, conversion of land, deforestation, rapid urbanization, tourism, hydro-development, unscientific disposal of solid waste etc., not only threaten the mountain ecosystem, but also cause irrevocable impact on lower lands (UNEP 2003).

From amongst the various threats facing a mountain ecosystem due to anthropogenic activities and interventions, which act as impediment to sustainable development, solid waste emerges as the one that poses the greatest threat. The threat posed by solid waste is not only to the immediate surrounding areas and environment, but it can also have cascading negative effects on lower regions, threatening both human and environmental health. The problems/constraints associated with solid waste management in a mountain ecosystem are varied and it differs considerably between the developed and developing worlds. I have tried to assimilate the problems associated with solid waste management in a mountain ecosystem setting, under the developing country framework.

2.3 Solid waste situation in a developing country framework

Currently solid waste management is one of the major challenges facing any developing nation globally. On the one hand, ever growing population followed by rapid urbanization produces a large amount of solid wastes; while on the other hand, the infrastructure in these countries are not equipped to deal with the problem. In the developed countries the collection, transfer and disposal of the waste has been generally assumed by municipal governments and this constitutes a basic and expected government function (Zerboc 2003). However, the municipal governments

of developing nations lack the ability to provide even this basic function (Medina 2002). In spite of the fact that waste management is not given priority or attention in the developing country scenario; solid waste management (SWM) has become a major area of concern.

2.3.1 Defining Solid Waste

Solid waste is broadly comprised of non-hazardous domestic, commercial and industrial refuse including household organic waste, hospital and institutional garbage, street sweepings, and construction wastes (Zerboc 2003). Domestic solid waste includes all solid wastes generated in the community and generally includes food scraps, containers and packaging, discarded durable and non-durable goods, yard trimmings, miscellaneous inorganic debris, including household hazardous wastes (for instance insecticides, pesticides, batteries, left over paints etc., and often, construction and demolition debris. A report prepared by World Bank (1999) lists eight major classifications of solid waste generators:

1. *Residential*: Includes waste generated in household units, such as food and fruit peels, rubbish, ashes etc.
2. *Industrial*: Has two components *hazardous*, which is toxic; corrosive; flammable; a strong sensitizer or irritant and may pose a substantial present or potential danger to human health or the environment when improperly processed, stored, transported, or disposed of or otherwise managed. *Non-hazardous* which includes inert and essentially insoluble industrial solid waste, usually including, but not limited to, materials such as rock, brick, glass, dirt, and certain plastics and rubber, etc., that are not readily decomposable
3. *Commercial*: Waste produced by wholesale, retail or service establishments, such as restaurants, stores, markets, theaters, hotels and warehouses.

4. *Institutional*: Waste that originates in schools, hospitals, research institutions and public buildings.
5. *Construction and demolition*: Waste building material and rubble resulting from construction, remodeling, repair, and demolition operations on houses, commercial buildings, pavements and other structures
6. *Municipal services*: Sludge from a sewage treatment plant which has been digested and dewatered and does not require liquid handling equipment etc.
7. *Process*: Treatment plant wastes principally composed of residual sludge and
8. *Agricultural*: Spoiled food wastes, agricultural wastes, rubbish, hazardous wastes.

In a developed country framework the waste generated from different sectors are generally treated separately while, in developing countries separate treatment of wastes generated from different sectors is usually not undertaken (Chakrabarti and Sarkhel 2003).

Improper handling and disposal of solid waste has multi-dimensional impact on human and environmental well being. Improper dumping can lead to

- pollution of air, soil, and water,
- contamination of surface and ground water supplies,
- clogging of drains,
- creation of stagnant water for insect breeding,
- floods in the plains and
- landslides in the hilly areas during rainy seasons[1].

[1] Last three bulleted effects of dumping may result from clogging of drains.

Improper incineration and burning of wastes contributes significantly to urban air pollution; greenhouse gases (GHGs) generated from the landfills and untreated leachate pose threat to human as well as environmental well being (Hoornweg et al. 1999). Therefore, the remaining section of the literature review largely focuses on the problems and issues associated with solid waste management in a developing country framework, so that the impediments to a sustainable solid waste management system are defined.

2.3.2 Rapidly growing urban population

The problems associated with SWM in a developing country framework are multi- dimensional and more acute when compared to the developed nations (Zerboc 2003, Nath 2003), the severest of them being the rapidly growing population. The growth in population causes tremendous increase in the concentration of population in the urban centers due to migration and immigration of people from rural areas and near by countries in search of livelihood. The World Development Indicators (2006) shows that there has been substantial increase in urban population since 1990's (figure 2.1); and the largest amount of growth has been recorded in developing nations/regions.

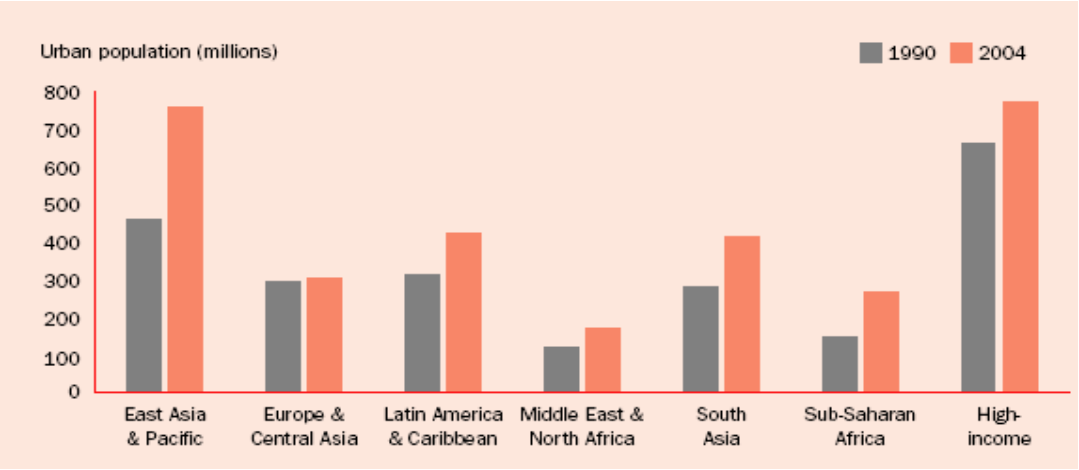

Figure- 2.1: Growth of urban population across different regions since 1990.

Source: World Bank 2006 (for details see http://web.worldbank.org/WBSITE)

This trend is expected to continue, as compared to 1960's when only about 20 % of the developing countries population used to live in cities, an estimated 60 per cent of population will live in cities by the year 2020 (Rapten 1998). The impact of rapidly growing urban population is reflected in two ways:

- Growth in waste generation

Several studies have shown that growing urban population leads to huge increase in waste generation (Schübeler 1996, Rapten 1998, Medina 2002, Zerboc 2003, Zurbrugg 2003). Especially in case of developing country scenario, the rate of waste generation far exceeds the infrastructural provision.

- Growth in slums with no waste management system.

Urbanization in the developing nations is accompanied by the expansion of slum areas and the creation of new ones as the migrants usually come from poorer regions and do not have the ability to live in /buy decent housing in the city, which leads to the development of slums. The pressure of ever-growing population on urban infrastructure in many cities overburdens the provision of urban services. Urban municipal governments are under intense pressure to meet the demand for basic services such as water, sanitation and solid waste management (Medina 2002). Most of the slums grow in an unplanned manner, and the local municipalities are ill prepared to provide basic facilities (like garbage collection) to the ever growing population. This causes garbage to be dumped in open spaces, leading to disastrous effect on the social, economic and environmental health of the area (Kuniyal et al. 1998, Medina 2002, Zerboc 2003); consequently this has resulted in financial and institutional constraints to manage the resulting solid wastes (Chakrabarti and Sarkhel 2003). Even those enjoying decent housing dump garbage in the open space, due to lack of organized waste collection system.

2.3.3 Lack of finances and infrastructures

In a developing country framework, though solid waste management accounts for 20 to 50 per cent of the municipal budget (Schübeler 1996, Bartone 2000), the service is provided to only about 50 per cent of the urban population; actual collection only accounts for around 60 to 70 per cent of the refuse (Gerlagh et al 1999, Khawas 2003). For instance, Latin American countries were generating approximately 275,000 tones of solid waste per day in urban areas, necessitating a fleet of 30,000 trucks and 350,000 m^3 of land a day to properly collect and dispose the waste (Chakrabarti and Sarkhel 2003). The insufficiency of services results in the deterioration of the urban environment in the form of water, air, and land pollution; which not only poses risks to human health but to the environment as well (Medina 2002).

Another impact of the increasing population is the creation of a vicious cycle of pollution. Rise in population is not met by equal increase in infrastructural facilities, which leads to increase in the filth and garbage. As filth gets accumulated, less and less number of inhabitants are willing to pay for the retrieval services leading to loss of revenue to the municipality and further deterioration of the quality of services rendered (Zerboc 2003). The impact of deteriorating services are directly felt, as there is visible increase in waste being dumped right besides the human habitats, which causes tremendous risk to both environment and human health. The present situation is expected to deteriorate even more due to rapid unchecked urbanization and growth in human population (Zurbrugg 2003).

2.3.3.1 Waste disposal

Lack of finances and infrastructure has multi-level impacts. Nowhere are these impacts more evident than in the case of waste disposal. In most of the developing

countries the main disposal method for solid waste is open dumping, more often than not the dumping sites are very near to areas of human habitation (Medina 2002). Little care is given to the status of water table, water pollution and emission of hazardous and toxic gases. The disposal of hazardous, biomedical, or slaughterhouse wastes are rarely controlled and in very few cases certain sections of the dumping grounds are designated for slaughterhouse and biomedical wastes (Inanc et al. 2004). Illegal disposal of wastes in water bodies is a common practice that not only causes toxins to get dispersed in the environment (Hoornweg et al. 1999, Zurbrugg 2003) but also often ends up coagulating the water bodies and destroying the whole ecosystem of the area.

2.3.3.2 Lack of effective collection and transportation facilities

The infrastructural problems are not just confined to waste disposal. Frequently, developing countries lack facilities for proper handling, collection and transportation of the generated wastes. Inadequate planning and layout due to rapid urbanization causes urban centers in the developing countries to be more congested and populated. Often the waste collection trucks cannot reach every part of the town, compelling the residents to throw their garbage in open dumping spaces near human settlement. Congestion of traffic makes transportation of waste more time consuming and as a result more expensive and less efficient (Zerboc 2003). Another problem associated with handing of waste relates to lack of "standardized containers" to store waste before being picked up causing the wastes to be infested by animals, pests or blown out in the street (Zerboc 2003, Zurbrugg 2003). In many towns in India, there is no "standardized container" to store waste; old oil cans are used to store wastes, before dumping it into nearby *jhoras* (small streams). Lack of proper transportation vehicles for waste also adds to the problem. For instance in Darjeeling, India, the

municipality uses open tractor trailers to transport waste and often some portion of waste ends up on the road through which other vehicle pass. Most of the vehicles used for transporting wastes are often outdated, improper and non-functional. Zerboc (2003) points out that the vehicles used for transporting wastes in developing countries do not function efficiently and often break down, thus adding further to the problem.

2.3.4 Waste composition

One of the most significant differences between the waste generated in developed and developing nations is in terms of its composition. The wastes generated in developed countries are mainly inorganic in nature, whereas organic contents form a large portion of waste in developing countries (Hoornweg et al. 1999, Medina 2002, Zerboc 2003, and Zurbrugg 2003). In the developing country scenario, the proportion of organic contents in waste is almost three times higher than that in developed countries (Medina 2002, Zerboc 2003). Even though the volume of waste generated in developing countries is much lower as compared to that in developed countries, the nature of waste is denser and has very high humidity content (Hoornweg et al. 1999, Medina 2002, Zerboc 2003, and Zurbrugg 2003). The nature and composition of waste is highly dependent on income and lifestyle of the population (refer Table 2.1).

Table 2.1: Solid waste composition in urban centers in Asia, (descending waste faction).

Waste Categories (average percentage of wet weight)							
City	Bio-degradable	Paper	Plastic	Glass	Metal	Textiles & Leather	Inerts (ash, earth) & others
Indonesia	74	10	8	2	2	2	2
Dhaka	70	4.3	4.7	0.3	0.1	4.6	16
Katmandu	68.1	8.8	11.4	1.6	0.9	3.9	5.3
Bangkok	53	9	19	3	1	7	8
Hanoi	50.1	4.2	5.5	n/a	2.5	n/a	37.7
Manila	49	19	17		6		9
India	42	6	4	2	2	4	40
Karachi	39	10	7	2	1	9	32

(Source: Zurbrugg 2003)

It is evident from the table that organic wastes form the largest percentage of solid wastes in developing urban centers around Asia, and research has shown that same is true for other developing nations across the world (Hoornweg et al. 1999, Medina 2002, Zerboc 2003, and Zurbrugg 2003). Being highly organic and humid in nature, solid waste management in developing countries presents both opportunities and constraints that are entirely different than the developed countries (Hoornweg et al. 1999, Zurbrugg 2003, and Inanc et al 2004).

2.3.5 Health problems

Serious public health problems arise due to uncollected solid waste and waste often leading to many infectious diseases including water borne diseases such as cholera and dysentery. Such incidence of diseases puts additional burden on the scanty health services available in a resource poor developing countries. Insect and rodent vectors are attracted to the waste and one may recall that as many as 200,000 people had to flee after the outbreak of pneumonic plague in Surat in Western India (1994). The outbreak is attributed to the uncontrolled fermentation of wastes which created favorable conditions for the breeding and growth of rodents and insects that acted as vectors of diseases (Venkateshwaran 1994). A similar study by WHO (1995)

observed in 1994 that 616960 cases of cholera resulting in 4389 deaths were reported in Angola, Malawi, Mozambique and Tanzania (UNCEA 1996) which can be linked to the fact that in Northern Africa as much as 20 to 80 per cent of urban solid wastes are dumped in open spaces (Chakrabarti and Sarkhel 2003). Contamination of ground water by disease causing organisms from water seeping through dumps is likely to include the viruses of hepatitis, poliomyelitis and gastroenteritis (Medina 2002); thus such water contamination may have long run health effects apart from dysentery and cholera. The U.S. Public Health Service identified 22 human diseases that are linked to improper solid waste management (Hanks, 1967 in Hoornweg et al., 1993). The most immediate health threat due to solid waste in developing countries is to the waste workers, rag pickers and scavengers. Waste workers and rag pickers in developing countries are seldom protected from direct contact and injury. The co-disposal of hazardous and medical wastes with municipal wastes pose serious health threat. Exhaust fumes from waste collection vehicles, dust stemming from disposal practices, and open burning of waste also contribute to overall health problems (Hoornweg et al 1993).

The magnitude of the health problems due to solid waste in case of developing countries are particularly alarming where the proper collection and disposal of solid waste is impeded by paucity of funds and technological capacity. The areas, which are not serviced, are left with clogged sewers and litters which create serious health problems for the resident population (Khawas 2003). Crowding and unsanitary conditions are important amplifiers of the transmission of infectious diseases. Many infectious diseases thrive where there is a lack of water, and inadequate drainage, sanitation and solid waste removal (Mcmichael 2002). In a report prepared for the

World Health Organization (WHO), Chang et al. (2001) recognized seven different ways, through which pollutants can transport back to affect human health.

Waste → soil → human.

Waste → soil → plant → human.

Waste → soil → plant → animal →human.

Waste → soil → atmosphere → human.

Waste → soil → surface runoff → surface water → human.

Waste → soil → vadose zone → groundwater → human.

Waste → soil → animal → human, waste → soil → airborne particulate→ human

Source: Chang et al. (2001) (for details visit https://www.who.int)

Hence, we find that in case of improper handling waste will eventually move back into the system and cause further harm to human health through the biomagnifications of toxins.

2.3.6 Environmental problems

The impacts of solid waste on environment is immense, from release of harmful green house gases (GHGs) to contamination of ground water, improper solid waste can wreck havoc on the environmental health. The most serious environmental problem in terms of solid wastes is the emission of GHGs. According to Thorneloe et al (2002), the waste management sector represents 4% of total anthropogenic GHG emissions and landfills contribute the largest anthropogenic source of methane, contributing 90% to the total GHGs release from the waste sector in the United States. Methane is a primary constituent of landfill gas (LFG) and a potent greenhouse gas when released to the atmosphere. LFG is created as a natural byproduct of decomposing organic matter, such as food and paper disposed of in these landfills and it consists of about 35-50 % methane (CH_4) and 35-50 % carbon dioxide (CO_2), and a

trace amount of non-methane organic compounds. Each day millions of tons of municipal solid waste are disposed of in sanitary landfills and dump sites around the world. According to Methane to Markets Partnership, website (2004); "globally, landfills are the third largest anthropogenic (human influenced) emission source, accounting for about 13 percent of global methane emissions or over 223 million metric tons of carbon equivalent" (MMTCE). The status of solid waste management system thus considerably influences the problems associated with climate change and global warming. Figure 2.2 identifies some of the countries with significant methane emissions from landfills.

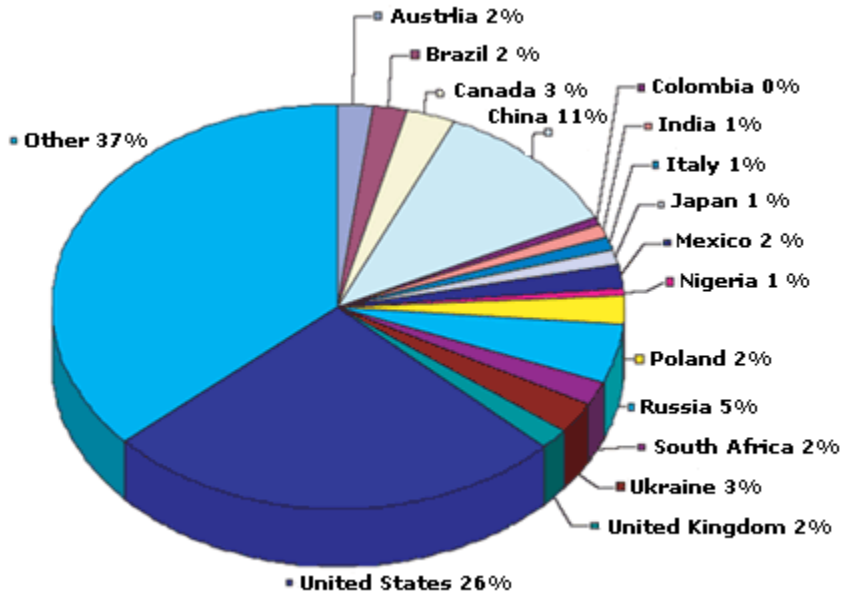

Figure 2.2: Global landfill methane emissions in 2000 (MMTCE).

Source: Methane to Markets Partnership 2004. (Visit http://www.methanetomarkets.org)

It is to be noted that global landfill methane emissions are more prevalent in developed countries as compared to the developing countries. Further, it has been observed that the major factors driving LFG emission levels are the amount of organic material deposited in landfills, the type of land filling practices, and the extent of anaerobic decomposition (Jokela et al. 2002). Higher the organic content, higher is the level of methane emission; considering the fact that the wastes generated in

developing nations have high organic content, the potential for environmental damage is immense. Although methane can be trapped and used as alternative energy source (Jokela et al. 2002), the lack of technology and finance impedes the trapping of methane in the developing nations.

Besides the emission of GHGs, solid waste cause ground and surface water contamination; as water filters through any material, chemicals in the material may dissolve in the water, this process is called leaching and the resulting mixture is called leachate (Mcmichael 2002). As water percolates through solid waste, it makes a leachate that consists of decomposing organic matter combined with iron, mercury, lead, zinc, and other metals from rusting cans, discarded batteries and appliances. It may also contain insecticides, cleaning fluids, paints, pesticides, newspaper inks, and other chemicals. Contaminated water can have a serious impact on all living creatures, including humans, and the ecosystem as a whole.

Generally in developing countries, dump sites are managed by indiscriminately burning the wastes. Burning causes heavy metals like lead, toxic gases and smoke to spreads over residential areas. The wind also carries waste, dust and gases caused by decomposition. Air pollution due to burning of waste and spreading of toxic fumes causes large number of damage to both environment and human health (Medina 2002). Putrefaction of waste in sunlight during daytime results in bad smells and reduced visibility and it ruins the ambience of the place.

2.3.7 Institutional problems

The most serious impediment for a sustainable solid waste management is that, there is a wide range of individuals, groups and organizations that are involved with waste as service users, service providers, intermediaries and/or regulators

(Zerboc 2002). The interests, agendas and roles of these actors form a complicated web, which defines and designs the prevalent waste management system in any developing nation (Sudhir et al 1997). Collection and disposal of refuse within an urban area has been traditionally perceived as the responsibility of the local municipal government (formal public sector). However, in a developing country scenario the provision of waste management system by the local government is generally inadequate, centralized, top-down and in most cases inefficient (Cointreau 1982). Following which, many developing nations have a dynamic informal sector that has evolved around wastes, which supports the livelihood of a large number of the urban poor. The most common occupations are informal refuse collection and scavenging, which are undertaken by unemployed, women, children, recent migrants, etc for their sustenance and livelihood (Median 2002). The informal sector consists of many "actors" such as waste-pickers, itinerant-buyers, small scrap dealers, and wholesalers (refer figure 2.3). In India, the informal sector is attributed with recycling about 10–15% of the solid waste generated in the cities (Sudhir et al 1997). Though a formal private sector (private companies dealing with all aspects of waste management) is emerging strongly in many developing countries, however, it is yet to be an alternative to the current formal public sector. In many cases it has been seen that private sectors are generally motivated by the idea of profit maximization; the poorer section of the society in many developing countries lack the financial resources to subscribe to the services provided by private waste management companies (Sudhir et al.1997). The interactions between these formal and informal sectors design the existing waste management system in most of the developing countries.

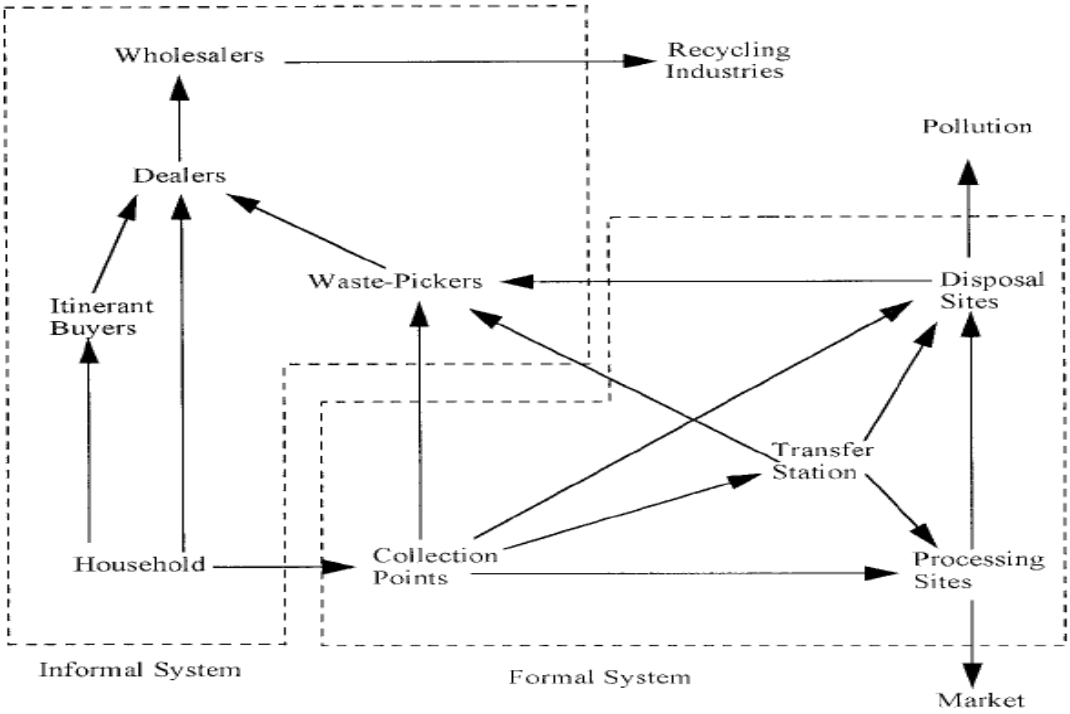

Figure 2.3: Material (waste) flow in a developing country framework

Source: Sudhir et al. (1997)

The economic well being of the general public in developed countries allows the formal sector to operate without much glitz. However, a large section of population in the developing countries cannot afford to subscribe to the services of the formal sector, which undoubtedly will require some financial contribution for the services rendered.

2.3.8 Summarizing the problems

The problems associated with waste management in a developing country framework can be briefly summarized as follows.

- Ever growing urban population.
- Lack of basic finance and infrastructure.
- Different waste composition; the waste density is 2-3 times greater than industrialized nations and moisture content is 2-3 times greater. There is large amount of organic waste

- Faulty management system: The management is generally centralized and undiversified, bureaucratic – top-down solutions; single solution for multiple problems, usually arrived at without community participation.
- Linear thinking: Generally only formal/conventional solutions are considered which involves sole participation of the formal sector (basically formal public sector), completely neglecting the existence and possible contributions of the formal private and informal sector that has developed around waste.

It is evident that solid waste management in a developing country framework faces numerous impediments, which can prevent the system from being sustainable. It is hence, necessary to seek possible solutions to ensure the long term sustainability of the existing system in a mountain environmental setting, against the backdrop of the developing country framework.

2.4 Integrated solid waste management

Given the huge complexity of issues and problems in various solid waste management systems across developing nations, it is apparent that the top-down solutions and management strategy will no longer be effective. Rather, a much broader and more integrated set of solutions will be needed to ensure long term sustainability of the waste management system. In the developed countries the most compatible environmentally sustainable development approach to waste is the "Integrated Waste Management" (Cole and Sinclair 2002, Medina 2002, Zerboc 2003). An integrated approach to waste management consisting of a "hierarchical and coordinated set of actions" (Medina 2002 p.17) seeks to reduce pollution, maximize recovery of reusable and recyclable materials, and protects human health and the environment. It will take into account community and region specific issues and needs and formulate an integrated and appropriate set of solutions "unique to each context"

(Daskalopoulos et al. 1998, Medina 2002, Zerboc 2003). Medina (2002, p. 17) states that the "integrated waste management aims to be socially desirable, economically viable and environmentally sound".

In case of solid waste management in a developing country framework, it is to be noted that solutions which work for some countries or areas may not be appropriate or applicable for others. Specific issues, problems, environmental conditions and existing socio-economic framework will determine the appropriateness of various strategies and technologies in solving the problem of solid waste. However, various studies on solid waste issues bring about possibilities of certain approaches as being at least adaptable to many developing country scenarios. The main emphasis is on the four R's – reduce, reuse, repair and recycle (creation of less waste and increased material recovery) and finding appropriate disposal options (Medina 2002, Zerboc 2003).

Zerboc (2003) lists out a series of questions as developed in the International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management (UNEP 1996) that needs to be asked while developing or evaluating integrated solid waste management plan or framework:

- Is the proposed technology likely to accomplish its goals given the financial and human resources available?
- What option is the most cost-effective in financial terms?
- What are the environmental costs and benefits?
- Is the project feasible given administrative capabilities?
- Is the practice appropriate in the current social and cultural environment?
- What sectors of society are likely to be impacted and in what way are these impacts consistent with overall societal goals?

Source: Zerboc (2003).

The answers to these questions are critical and will contribute immensely towards the understanding of the existing problems and societal framework and will allow the researcher to derive appropriate solutions in the given setting.

Some feasible solutions following the idea of integrated waste management have been briefly discussed as below:

2.4.1 Reduction in waste generation

"Prevention is better than cure", so goes an old adage, and it is one of the best method to deal with the problem of solid waste. By preventing (reducing) the generation of waste itself, we can minimize other problems (namely, disposal) related to waste to a great extent. In order to reduce waste generation several methods or tool can be applied, some of which may be:

- Enacting public policies that discourage the production, sale and consumption of products containing unnecessary packaging material. Places where flow of products cannot be controlled appropriate policy measures (extended producers responsibility, taxes, economic incentives etc) should be put in place to discourage unnecessary waste generation. Policies should also look into the aspect of encouraging reusable and recyclable products instead of disposable products (Medina 2002).
- Promotion of local grown products and less reliance on packaged food products go a long way in reducing wastes.
- Education can play a critical role by creating awareness regarding the waste and related issues among the masses.

In a developing country framework, reduction in waste generation should be targeted towards producers; because of excessive packaging, more waste is created. From the consumers' side, reduction in waste can be generated by educating the

consumers on ways to prevent waste; for instance asking the consumers to use a reusable bag for shopping rather than rely on goods being bagged in numerous poly bags, can significantly reduce the use of poly bags which are the main source of waste in numerous developing countries.

2.4.2 Reuse and repair

Reusing relates to the recovery of items to be used again. Reusing ensures reduction in raw material consumption saves energy and water, reduces pollution and prevents the generation of waste. Medina (2003) regards reuse of materials and products as more socially desirable than recycling the same materials. For instance, in India, soft-drinks (Coke, Pepsi etc) are sold in glass bottles and a deposit-refund system operates. A person deposits some amount of money on purchase of the soft drink, which he/she gets back on depositing the bottle, thus enabling the producer to regulate his supply of container without having to produce new ones. Products, such as office furniture and appliances, can also be reused. For instance Manitoba Hydro donated their old office furniture and building waste to Manitoba eco-network, which was used to build a new office for the network; thus saving both time and valuable resources for both Manitoba Hydro and Eco-network. A reuse program not only saves money, it also can be a source of revenue for the companies/households that implement it. The best example would be Interface, which reuses old carpets to produce new ones, thus saving valuable resources and promoting sustainability at the same time. Public policies that provide incentives for businesses and individuals to engage in reuse can have a significant and positive economic and environmental impact (Sudhir et al. 1997, Medina 2002, Zerboc 2003). In a developing country framework, it is to be noted that due to poor economic conditions, repairing and

reusing of materials and products is a standard practice, and generally people in the developing countries reuse much more than people living in the developed countries.

2.4.3 Recycle

Although recycling is one of the most important aspects of waste management in the developed nations, due to the composition of waste and other factors, recycling may not be much of an option in terms of developing country. Separation of waste materials at the household level is perhaps a universal phenomenon; more so in developing countries where separation of anything valuable is undertaken with care, which prevents valuables and reusable materials from being discarded. The existence of waste pickers, scavengers etc, recover other valuable materials from entering the waste stream. Especially in developing countries, itinerant buyers play a vital role in recovering materials for recycling, they buy every material that has some monetary value, news papers, plastic bottles, old shoes etc (Zerboc 2003).

It is however, evident that some improvement in these traditional systems can be brought about. A formalized waste recycling or recovery system supported by local municipality can go a long way in ensuring health safety for the workers, chances of better income for the rag pickers, scavengers and small time merchants dealing with waste (Zerboc 2003). Recycling waste can be a viable economic option even for some urban cities, where the nature and characteristics of waste is quite similar to the developed nations. In case of waste composition not favoring recycling, other options (recovery, diversion etc.) should be seriously considered. In the event that local municipal governments are unable to provide recycling facility due to lack of funds, private partnerships need to be encouraged and looked into as a viable option (Sudhir et al 1997, Medina 2002, Zerboc 2003).

2.4.4 Composting

For a developing country, looking into the waste composition and other socio-economic factors, the best form of waste reduction would be composting. It is a basic low-technology approach. Theoretically the waste of many developing nations would be ideal for reduction through composting, since it contains higher composition of organic material than industrialized countries. Hoornweg, et al (1999) calculated that on an average, urban centers in developing countries have 50% organic content in their waste stream. Early studies conducted by Cointreau (1982), found 78-81% compostable materials in the household waste generated in major cities of Indonesia and Srilanka (Bandung and Colombo respectively). In a more recent study conducted by Zurbrugg (2003) found that major Asian cities like, Hanoi, Karachi, Katmandu and many Indian cities has 68-82% compostable waste content (refer Table -2); however, it is ironic that composting is not widely practiced in the developing countries (Zerboc 2003).

The advantages of composting are numerous; it reduces the amount of waste significantly. It can be used as fertilizer and natural manure for agricultural uses, it also reduces the release of landfill gas emissions considerably and since it is a natural process, it reduces the damage to environment. Besides this, the foul stench covering any waste dump site is basically generated due to the rotting of organic waste, which will be controlled to a great extent if we go for composting instead of allowing the waste to rot (Sudhir et al 1997, Medina 2002, Zerboc 2003). Zerboc (2003) notes that composting can be undertaken in three levels: Household, community and large scale centralized level (throughout the municipality). Unfortunately, large scale operations have been a dismal failure; owing to huge amount of investment required, need to keep the equipments in working conditions etc. In India, 9 large scale composting

plants constructed during 1975-1985 had been shut off by 1996 (Zerboc 2003, Drescher and Zurbrugg 2006), the same was true in Brazil where only 18 of the original 54 facilities were in operation (Zerboc 2003). Some problems associated with the failure of large scale composting operations may be briefly summarized as:

- Lack of proper technical knowledge regarding composting.
- Lack of market and marketing initiatives.
- Lack of cooperation between composting operations and local municipal government.
- Lack of institutional support.

Source: Zerboc (2003), Drescher and Zurbrugg (2006).

Generally, composting has been most successful when done at household or community level. Drescher and Zurbrugg (2006) point out the advantages of household or community level (decentralized) composting as follows:

- Small-scale composting can function as a compliment to primary collection process, thus improving the overall performance of the municipal services and has the potential to significantly improve the hygienic conditions within the service area.
- Small-scale composting helps in diverting major proportion of waste generated close to the source of generation; thereby, significantly reducing transportation costs and prolonging the life span of landfills; besides enhancing the recycling activities and final disposal.
- Small-scale composting does not require large investment, and capital requirements can be distributed over long periods of time. This facilitates a stepwise approach towards integrated solid waste management.

- Due to their smaller size and location, small-scale composting projects are more flexible in management and operation.
- As composting is mainly labor intensive; composting schemes can be a source of employment particularly for poor and underprivileged people in the neighborhood/community.
- Finally, decentralized composting activities and the interaction between residents in issues of waste handling, hygiene, cleanliness and environment can significantly enhance environmental awareness in a community.

In a developing country framework household-level composting has the greatest potential for success, as most of the urban centers are surrounded by small/large scale agriculture in abundance (Drescher and Zurbrugg , 2006). Selection of site for composting can be a key factor in determining the success or failure of the project. The role of education cannot be ignored, as education is the key to promoting awareness regarding the advantages of composting at household or local level (Medina 2002). Many people do not indulge in composting due to their concern for possible disease, odors, and pest problems. Hence, the role of education should be focused towards spreading awareness regarding the possibilities of composting and how it can be done properly (Medina 2002).

2.4.5 Incineration

Incineration is the process of burning of wastes under controlled conditions, usually carried out in an enclosed structure. Although incineration has high rate of waste reduction (80-95%), there are many issues that make incineration not so viable an option in developing countries (World Bank 1999). Solid waste incineration plants tend to be among the most expensive solid waste management options, being highly

capital-intensive and require high maintenance costs they may be beyond the reach of many of the lesser developing countries (Medina 2002). As compared to other solid waste management options, incineration requires comparatively higher technically trained operators, and careful maintenance (World Bank 1999); which may not be practical or feasible for the developing countries. Besides this, there is a huge environmental hazard component of incineration; generally most of the developing countries are densely populated and any incineration operation near human habitat can pose a great threat to human life and environment because of emissions. Use of scrubbers in incineration can reduce the threat greatly. However, it requires huge financial contribution, which may not be possible for developing countries to bear (Medina 2002).

Another major hurdle towards proper functioning of incinerators in developing countries is the nature and composition of waste, due to high moisture content in waste, the incinerators do not function as efficiently as in developed countries, thus posing extra burden on the exchequer (Zerboc 2003). According to Medina (2002), in Lagos, Nigeria, incinerators were built at a cost of U.S. $ 10 million, but because of high moisture content of the wastes, extra fuel had to be added in order to maintain combustion, which significantly increased the cost of incineration process. The result was that the incinerators never operated normally. One was abandoned and the other turned into a community center. Similar experiences have been observed in India, Mexico, the Philippines, Indonesia, and Turkey. Medina (2002) concludes that because of all these reasons, incineration of MSW is likely to fail in many developing countries.

2.4.6 Sanitary landfills

A sanitary landfill is a facility designed specifically for the final disposal of wastes, which is marginally better than open dumping; the main difference between a sanitary landfill and open dumping is the amount of engineering, planning and administration involved (Zerboc 2003). Sanitary landfills minimizes the risks to human health and the environment associated with solid wastes. For a landfill to be considered as sanitary four basic premises needs to be fulfilled:

- Full or partial hydro geological isolation through the use of liners to prevent leachate infiltration into the soil and groundwater; collection and treatment infrastructure should be used where leachate is expected to be generated
- Formal engineering preparations with an examination of geological and hydrological features and related environmental impact analysis, waste tipping plan and final site restoration plan
- Permanent control, with trained and equipped staff to supervise construction and use.
- Planned waste emplacement and covering, with waste and soil placed in compacted layers as well as daily and final soil cover to reduce water infiltration and reduce odors and pests.

Source: Cointreau (1982)

Sanitary landfills also prevent the underground absorption of methane and may also include other pollution control measures, such as collection and treatment of leachate, and venting or flaring of methane. Production of electricity by burning methane generated from the landfill gases are being undertaken in many developing countries. Currently, over 82 MW of electricity is generated from landfill gas in

Canada (Environment Canada, 2003), but developing countries still lack the finances to trap the energy source from landfill gases.

Sanitary landfills are necessary; for safely disposing wastes that cannot be prevented, reused, recycled or composted. They mark a dramatic improvement over disposal of wastes in open dumps. Sanitary landfills reduce the threat of environmental pollution and risks to human health as compared to open dumping. However, disposing of all municipal wastes collected at landfills is not desirable from a social, economic, and environmental point of view (Median 2002). Sanitary landfills require municipal governments to make significant investments and finding a proper location for a landfill may be a problem. They cannot be constructed near places that are near human residences. However, landfills can help in creating new jobs, reduce pollution and conserve natural resources; hence, diverting the waste from landfills, by reusing, recycling, composting can not only help in extending the life of the landfill, but can also help in generating economic benefits (Medina 2002, Zerboc 2003).

2.5 Solid waste management problems in India

In the last two decades the amount of solid waste generated in India has been increasing at an alarming rate. According to recent studies conducted by Tata Energy Resources Institute (TERI), the per capita of SW generated daily, in India ranges from about 100 grams in small towns to 700 grams in large towns as compared to around 50 to 400 grams in the villages (Shaleen and Pandey 2001) respectively. This has been attributed to rapidly growing population and consumerism. On an average, the rate of waste generation in India is expected to increase at the rate of 1%-1.33% annually (Shekdar 1999). This implies that by the end of 2047, India will be generating around 260 tonnes of waste annually which is almost 5 times the amount of waste currently generated (Shaleen and Pandey 2001). In order to dispose that

waste nearly 1400 sq. kms of land is required (Shaleen and Pandey 2001), land diversion is physically impossible as population growth and urbanization has lead to serious scarcity of land.

Solid waste management in India is generally unscientific; so far the most widely practiced municipal disposal method has been uncontrolled dumping. Mostly the dump sites are very near to the cities and it leads to leachate, percolation and pollution runoff and contamination of soil, ground water, canals, and river ways (Joardar 2000). There is very little organized effort towards segregation of wastes at the source, collection points, or even disposal sites (Joardar 2000). High level of moisture and silt contents and low calorific value makes it possible for the waste to be turned to composting. However, due to lack of proper marketing for composts, the cost of composting ends up being much more than revenue generated from it (Bijlani 1996). Incineration is way too costly due to high organic content of the waste. In recent years, some scattered experimental projects on mechanized composting and landfill gas, incineration based power generation etc have been undertaken or are being contemplated in different parts of the country; however, their success stories are yet to be widely reported (Jordar 2000). Thus, to date, the most widely practiced municipal disposal method has been uncontrolled open dumping.

Solid waste management (SWM) in India is mostly labor intensive, and 2-3 waste workers are provided per 1000 residents served and the municipal agencies spend Rs. 75-250 per capita per year on SWM (Kumar and Gaikwad, 2004)**.** It has been estimated that a city of 1 million populations normally spends around Rs.10 Crores for SWM (Kumar 2005). In spite of this huge expenditure, the services provided do not cover all the areas and are technically unsound (Kumar 2005). India has the presence of a strong informal sector in waste related industries, which can be

used to facilitate the waste management system (Medina 2002, Zerboc 2003). This, however, has not been done so far. Solid waste management has always been undertaken by the formal public sector (municipalities), which is often insufficient and inefficient (Schübeler 1996). The inclusion of informal players in waste management system can not only create job and provide livelihood for many, it can also contribute in reducing pollution and conserving natural resources (Medina 2002). More efficient coordination within different sectors of solid waste management is required, involvement of other actors (besides municipalities), like private enterprises, micro-enterprises or the informal sector needs to be facilitated (Moningka 2000).

2.6 Chapter summary

Solid waste management in a developing country framework presents challenges and opportunities, challenges in terms of constraints (lack of finances, population growth etc) and opportunities in terms of creating jobs and preventing the loss of valuable resources and wealth. The literature points out that, in a developing country scenario, solid waste management can not only protect environmental health but it can promote better health, hygiene and economic opportunities for the poorer section of the society too. Management plans or strategies cannot not be generalized, more community involvement and community based management needs to be encouraged. Municipal policies and regulations needs to be directed towards community involvement and involvement of more private players. The informal sector (rag pickers, scavengers etc) can be made part of the mainstream waste management system. Planning and developing waste management strategies, needs to involve all sections of the society, and it needs to allow all stake holders (municipal governments, public, rag pickers etc) to voice their concern and issues regarding waste. Education needs to be made an integral part of the waste management

programme, and public should be made aware of the risk and opportunities associated with wastes.

Although, in terms of a developing country frame work most of the literature comes from technical peer reviewed journals. There is a literature gap in terms of the solid waste management in Darjeeling, not much study has been done to understand the sustainability of the current system. The researcher can however, follow some of the fundamental recommendations as stated in the literatures. Following the recommendations from most of the literature reviewed the researcher will take an integrated approach to the study.

CHAPTER 3: METHODS

3.1 Introduction

The field study was undertaken from May 2007 to December 2007. The study was developed to understand the solid waste management system in an urban mountain settlement in a developing country framework in order to suggest ways the system might achieve higher level of sustainability. It examined in depth the nature and features of the system and problems associated with it. In order to gain knowledge of the system being studied, interviews were conducted in conjunction with other methods for obtaining qualitative data.

This research is based on the paradigm of critical social science. The main approach employed for this study is a qualitative case-study of Darjeeling municipality, West Bengal, India. The case study approach allows use of inductive methods, such as interviews, focus group discussions, which allows for general conclusions to be drawn from particular facts.

3.2 Critical social science

The research has been based on the paradigm of critical social science, as the research seeks to critique and transform social relations in terms of solid waste management. This research helps in unraveling the problems related to solid waste management in Darjeeling, which in turn provides direction for people to change the system towards greater sustainability. The main reason for following the paradigm of critical social science is that, I believe social realities change over time, and with my understanding of the problem and possible solutions, the prevalent system of solid waste management in Darjeeling can be definitely made sustainable in the long run.

3.3 Conceptual framework

The conceptual framework for this study has been adopted from previous work done by Schübeler et al (1996). It takes into account three important dimensions (refer figure 3.1):

- Scope of waste management activities i.e. what needs to be covered?
- Actors and development partners i.e. who can contribute for taking the system towards higher sustainability?
- How to address strategic objectives and issues i.e. what is the best course of action to take?

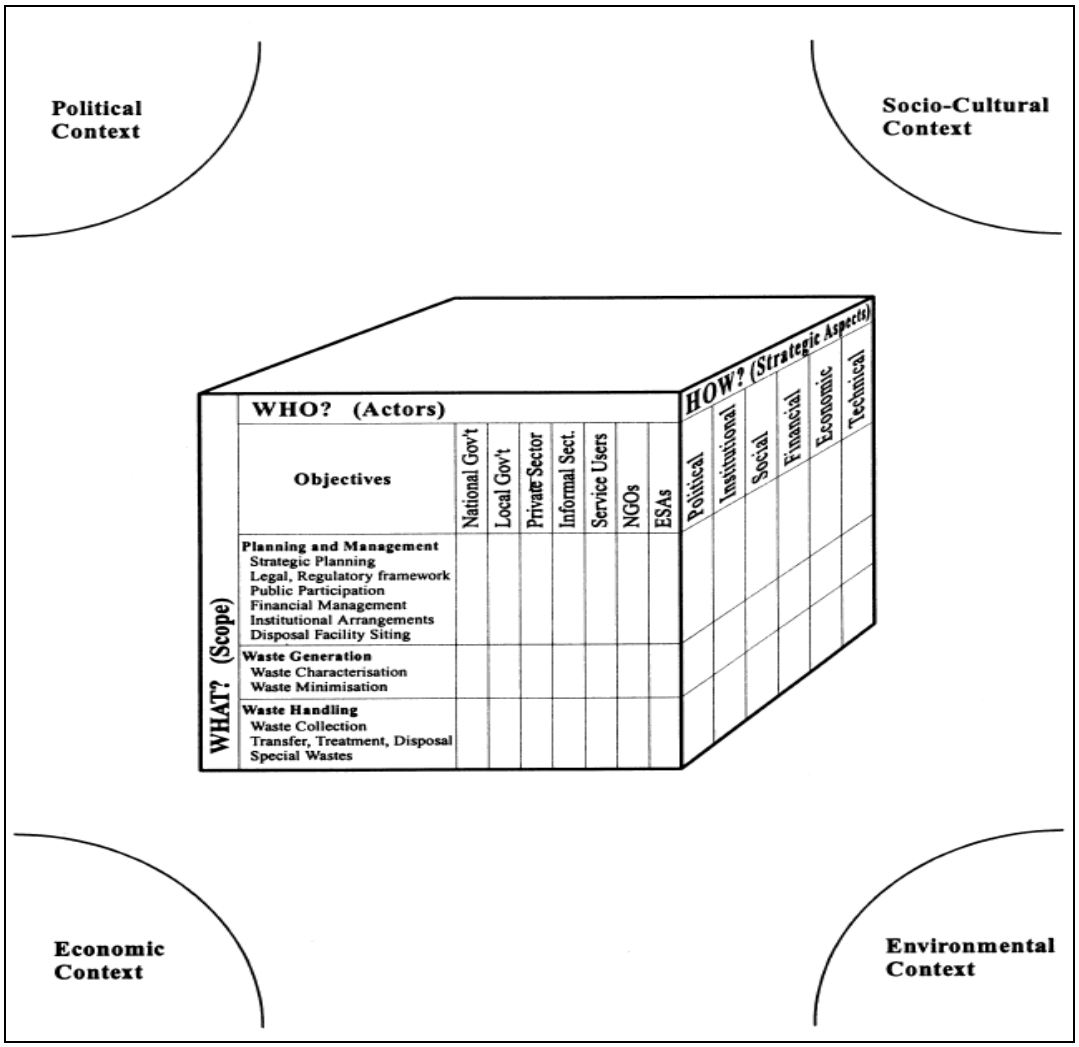

Figure 3.1 Conceptual framework

Source: Schübeler et al. 1996 p 17.

This framework is a modified version of the work done by Krueger and Mitchell (1997). The researcher will use this framework to triangulate and conceptualize the data generated from the field study.

3.4 Qualitative research

Qualitative research generally involves interactive and participatory methods of data collection; strong emphasis is given to the need for the researcher to build rapport with the participants and involvement of the participant in the discussions (Creswell 2003). Qualitative research is emergent and process oriented; several aspects emerge during the study, which allows the researcher to "view social phenomenon holistically" (Creswell 2003, p. 182). However, Creswell (2003, p. 182) asserts that the "more complex, interactive and encompassing the narrative, the better the qualitative study".

The objective of this study is to recommend measures that will ensure long term sustainability of the solid waste management system in Darjeeling. Hence, I needed an approach, which was both flexible yet organized. Keeping in view the above requirement, a qualitative study was the most appropriate approach to follow. Qualitative research allows for the use of multiple methods, which allowed me flexibility in my selection of tools. A qualitative research approach also helped me in conducting formative evaluations. These evaluations will eventually help me to improve the existing solid waste management system, rather than simply assessing the value of the existing system (Maxwell 1996).

3.5 Case study approach

I undertook a single-case exploratory case study (Yin 2003), as the strategy of inquiry for conducting the qualitative research. The case study strategy allowed me to

explore the solid waste management system in Darjeeling in detail. I collected detailed information using a variety of data collection procedures, which allowed me to study solid waste management system in an urban mountain environmental setting; which in itself is heavily dependent on the context (Yin 2003). The research involved "how" and "why" questions and the researcher had no control over the behavioral events, characteristics that make a case study strategy suitable. Furthermore, this study is set in a contemporary context, which satisfies Yin's (2003) criteria for the use of a case study as a research approach.

3.6 Data collection

I have drawn different methods from PAR toolbox. The methods used involved semi-structured interviews, mapping, trend and change analysis and non-participant observations (Chambers 1994). Besides these, I have reviewed reports, published information, and interviews with key informants and participation of local community people, community groups and non-governmental organizations.

3.6.1 Semi-structured interviews

I relied on semi-structured interviews to gain individual perspective of the community members and local administration in terms of waste management. How they perceived the problems associated with the current waste management system, what they felt are the major areas of concern and the impediments to sustainable solid waste management and their aspirations for a future system. The respondents were divided into four categories: general public, administrators, business personnel and NGO representatives. Questions asked were different for different groups of people (see appendix I, II and III for each set of interview questions and appendix IV for ethics approval). The respondents were asked a set of prepared questions; however,

the interview was fairly flexible. The flow and directions of the interview were modified according to the responses of the interviewees. Even though the respondents were asked the same set of questions, the pattern of the interview was adapted according to the interviewees, i.e. the question sequences were modified according to the responses of the interviewees.

Further, semi-structured interviews allowed different stakeholders to share their thoughts and concerns in private if they so desired. In order to ensure that important data was not missed, I used computer recording when participants agreed, as well as taking down notes, while conducting the interviews.

In order to identify potential interviewees I initially spent some time in meeting with people and different sets of community organizations asking about key informants. The potential interviewees (including key informants) were selected from different stakeholder groups and consist of the following categories: politicians, administrators, waste workers, members of the public, members of community groups, members of business community and NGO representatives.

The participants consent was undertaken at the outset of the interview (see appendix IV for ethics approval) and all materials (voice recordings, notes) will be erased or shredded on completion of the research. No individual has been directly quoted without their prior approval.

Semi-structured interviews allowed me to gain individual perspectives of the different stakeholders. Open-ended questions allowed me enough flexibility to keep the flow of interview going according to the comfort level of the interviewee (Chambers 1994) and helped me to understand the problems in the existing system from different perspectives. This also allowed the participants to share their personal concerns and perspectives on the waste management system; which was useful in

charting the possible roadmap to a more sustainable solid waste management system. The interviews conducted at the household level lasted for approximately an hour, and was one session interview. The NGO and government representatives along with community leaders were interviewed up to 90 or more minutes and the interviews lasted more than one session.

3.6.2 Non-participant observation

The objective and essence of this study necessitated me to spend a relatively long period of time within the study area (Darjeeling), and allowed me to be part of the community and culture where the study took place (Bernard 1988). However, owing to prevailing ground situations, I opted for non-participant observation to study the system and the people. As a non-participant observer, I studied various aspects of the present waste management system, for instance the waste collection system, waste disposal site, recycling system, etc. Much of this work is reflected in the pictures in this thesis. Non-participant observation helped me to visualize and verify the response of various participants; and I used it to compare and analyze the existing system. It enabled me to understand the role of the ecological and cultural setting of the study area, and also the socio-cultural context of the community. Besides this, talking to the community people and observing the ground realities, further enhanced my understanding and help me in forming strategies or developing policy recommendations with the help of community members.

3.6.3 Review of secondary data

The research involved collecting data from numerous sources, community members, waste workers, administrators' etc. Besides collecting primary data I have also looked into data available in books, publications, reports, local news papers, and

data from NGOs such as DLR Prerna, PRO-Darjeeling etc. The secondary data obtained from various sources have been used for enhancing the understanding of the problems, rules and laws pertaining to waste management etc and also for triangulation and verification of the primary data collected. It has helped me in ascertaining the reliability of the data collected and thus, the study.

3.7 Data analysis

As the data have been collected from various sources, I transcribed the data. The data was classified according to the contents. The organized data was then overviewed to get a general sense of emerging trends, patterns and concepts. The data was divided into broad categories that were developed from the review of literature. Some of these categories were: waste generation, waste collection and transportation, waste decision making process, public involvement in the decision making process and so on. The emerging trends and patterns were further elaborated upon and the help of committee members and other experts was taken to formulate possible policy recommendations and strategies.

I have heavily drawn upon the expertise of NRI faculty members and CREATE while developing policy recommendations and strategies.

CHAPTER 4: SOLID WASTE MANAGEMENT IN DARJEELING

The purpose of this chapter is to establish the current solid waste situation in Darjeeling and it is divided into three parts. The first part describes the general structure of the Darjeeling municipality. The second part of this chapter describes the existing solid waste management system. The final part of this chapter focuses on public participation in solid waste management decision making in Darjeeling.

4.1 Darjeeling Municipality – A Brief Background

Darjeeling municipality lies in the district of the same name; it was established on July 1, 1850. The town of Darjeeling was originally planned as a sanatorium for the British administrators, and the town was planned for a population of 20,000 to 30,000 people. However, the town and the population have now grown almost fourfold, without much change in the civic infrastructure or services. Until the 74th Amendment of Indian Constitution, Darjeeling municipality derived its power from Bengal Municipal Act of 1932 (operational till 1994). The 74th Constitutional Amendment Act (CAA), passed in 1992, provided for the formation of local self governing body in urban areas. Prior to the CAA, urban bodies did not have constitutional sanctions (Khawas 2001). Following the CAA, the West Bengal government developed the West Bengal Municipal Act (WBMA), in 1993, which became operational starting July, 1994. This act is applicable to the whole of West Bengal. Darjeeling municipality has been divided into 32 wards for administrative ease and efficiency.

4.1.1 Darjeeling municipality – composition, powers and functions

Under the West Bengal Municipal Act (1993), the authorities charged with municipal area administration are as follows:

- the municipality,
- the Chairman-in-council, and
- the Chairman.

The municipality refers to the Board of Councilors which is composed of elected municipal councilors from respective wards and non-elected members who are nominated by the state government. The Board of Councilors is charged with the authority for the municipal governance of the town. Decisions are made by a majority voting system; it should be noted that the non-elected members do not hold voting rights.

The Chairman is elected by the Board of Councilors from amongst its members. Usually the leader of the party with majority on the Board of Councilors is elected as the Chairman. The Chairman is the executive as well as the administrative head of the municipality, and presides over the meetings of the Board of Councilors, as well as the Chairman-in-Council. In her/his absence the role is taken over by the Vice-chairman.

The WBMA provides for the Chairman-in-Council system of governance, which consists of the Chairman, the Vice-chairman and other members depending on the size and classification of the municipality. The Chairman nominates the members for the Chairman-in-Council, and distributes responsibilities to those members. For the Darjeeling municipality there are seven Chairman-in-Council members. All the executive powers of the municipality rest with the Chairman-in-Council. The executive actions of the Chairman-in-Council are taken in the name of the municipality.

The administrative functions of the municipality are exercised through various committees that are headed by the Chairman-in-Council. Administrative functions are separated into:

- health and sanitation (including solid waste management),
- markets and estates,
- buildings,
- leases and finances, and
- establishments and assessments.

4.1.2 Ward Committees

The WBMA provides for the formation of ward committees in each municipal ward. The composition and function of the ward committee is determined by the state government. WBMA requires the elected councilor for the ward to act as the chairman of the ward committee along with ward residents. Person(s) with special qualifications may also be included in the committee regardless of their residence. The primary function of the ward committee is to assist the municipality in the planning and execution of the development programmes, in addressing citizens' grievances, as well as in the realization and detection of statute violation. The committee is expected to hold an annual public meeting to discuss the administrative report of the municipality and future plans and programmes.

Despite the provisions laid out in the WBMA (1993), the Darjeeling municipality did not follow the WBMA guidelines and failed to form the ward committees. It eventually started in 2002 with much reluctance on the part of the municipality. Khawas (2001, p. 10) states, "navigation at the micro level especially

with the core staff members highlights the fact that the fear of negative political consequence seems to be the major reason that stymied the provision to take its shape, as it was believed the creation of ward committees meant the division of power."

The WBMA lists the officers whom the municipality may appoint, including the Executive Officer, Health officer, Engineer, Finance officer and the Secretary. In addition, the Board of Councilors is empowered to decide which posts are necessary and may appoint these posts with prior sanction of the state government. The Executive officer is the principal executive of the municipality and all other employees of the municipality are subordinate to her/him. The Executive and Finance officer exercise powers and functions as notified by the state government under the supervision and control of the Chairman.

The WBMA further bestows obligatory and discretionary powers and functions to urban local bodies independent of the state. The major areas under which the municipality extends its obligatory and discretionary functions include:

- public works,
- public health and sanitation,
- town planning and development,
- administration,
- education, and
- social and economic development.

All of these functions could have implications for the solid waste management in Darjeeling.

The WBMA allows the state government to transfer certain of its functions to the municipality. These may include town and country planning, urban water supply and sanitation, urban employment schemes, health and family welfare, and environmental improvements and safety, as well as other issues.

The WBMA outlines the functions of the municipality covering urban infrastructure and services. The District Planning Act (DPA) of 1994, and the Municipal Act (1997 amendment of WBMA), provide a framework for the development planning of the area under local bodies. Furthermore, the WBMA also obliges the municipalities to develop a Draft Development Plan (DDP) once every five years and an Annual Development Plan (ADP) each year. In this regard, the Board of Councilors is empowered to prepare a Draft Development Plan for the municipal areas in consultation with the District Planning Committee (DPC) and the various Ward Committees. Further, the local bodies are enabled to extend their activities to include social and economic development programs and projects.

Prior to the WBMA, preparation and physical planning for the entire state was governed by the West Bengal Town and Country Planning (Planning and Development) Act of 1979. Under WBMA, the state government would notify and constitute a Planning Authority and Development Authority (PA/DA) for "specific areas" (Khawas 2001). Even though the Siliguri sub-division of the Darjeeling district was included in the Siliguri-Jalpaiguri Development Authority (SJDA), the rest of the Darjeeling district was not included under the so called "Specific Areas", and thus PA/DA is absent in the rest of Darjeeling district, including Darjeeling municipality (Khawas 2001).

It should be noted that the district of Darjeeling (including Darjeeling municipality) lacks a town planning department or any other development authority

(Siliguri sub-division being an exception). Further, the state government has yet to constitute a DPC, thus DDP has not been sought at the district or the municipal level, although all the municipalities do prepare annual development plans (Khawas 2001).

It must be mentioned, however, that in terms of DDP which started from 2002, not much progress has been made. According to the Darjeeling municipality Annual Report (2006-07), the awareness campaign and data collection (socio-economic profile) for DDP is at the initial stage.

4.2 Solid waste management in Darjeeling municipality

The Darjeeling municipality currently oversees a population of around 110,000 individuals, which can increase to roughly around 215,000 people per day during the tourist season. It has over 22,000 household units, over 350 hotels, 370 restaurants, 25 vegetable markets, 10 fish and meat markets and 89 institutions (Darjeeling Municipality 2007). It is interesting to note here that according to official figures (as provided by the Darjeeling Municipality), the number of registered households and other establishments (excluding institutions) are approximately half of the total figures stated above. This makes it particularly difficult for the municipality to implement solid waste management across all parts of the town.

At the municipal level, the official planning and execution of solid waste management is based on a hierarchical system. Decisions are made by the Chairman-in-Council and passed on to the three sanitary inspectors and a sub-assistant engineer, who are responsible for different sections. The sanitary inspectors and sub-assistant engineer execute the work allotted to their respective sections.

Solid waste management is undertaken by the Chairman, with the help of the Vice-Chairman and the Member-in-Council responsible for conservancy and health.

The official in charge of the day to day running of the administrative business is the Medical Health Officer (MOH). Under the MOH there are three sanitary inspectors who monitor work in their designated areas and a sub-assistant engineer who takes care of the departmental construction and repairs. Under them, there is a team of 15 conservancy inspectors, 225 permanent sweepers and roughly around 180 daily wage workers (refer to Figure 4.1).

The entire jurisdiction of the Darjeeling municipality is divided into 15 conservancy zones, including ropeway and vehicle section. The Darjeeling municipality has around 120 dustbins, 76 of which are central vats. Central vats refer to a centralized waste dropping point, centrally located within a particular area (refer to plate 4.2 and 4.3). These vats are located throughout the municipal area. The local sweepers and residents drop the waste in these vats and the municipal transportation vehicles ferry the waste from the vat to the dumping grounds. If an area is not accessible by municipal trucks or pick-up vans, the sweepers use hand carts to collect the waste. In some areas, due to the terrain, even handcarts cannot be used; in such areas the waste is disposed in *jhoras*.

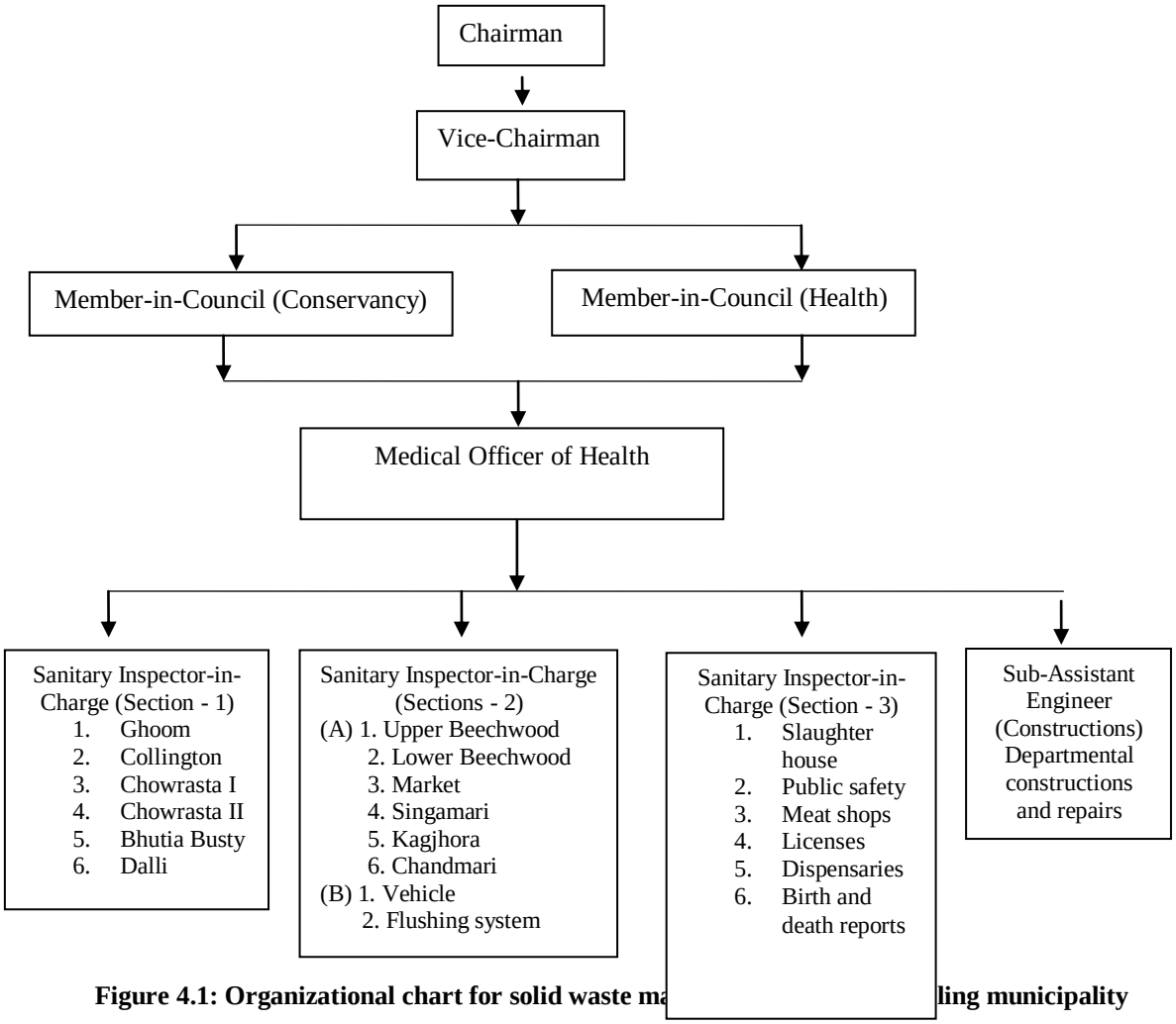

Figure 4.1: Organizational chart for solid waste ma ling municipality

The Darjeeling municipality largely depends on its own sources of revenue for sustenance. However, it receives additional funding from the state government for various projects under special allocations (Darjeeling Municipality 2007). Incomplete information regarding the revenue generated for the municipality, and the expenditures incurred for the conservancy department for 2006-2007 was provided to the researcher. An overview of this information is presented in Table 4.1.

Table 4.1: Revenue generated and expenditure incurred for 2006-07

Expenditure of conservancy		**Revenue collected (own sources)**
Items	**Amount spent (in Rupees)**	
Pay and allowance	19,797,465	
Overtime allowance,	18,000	
Ex-gratia payment	363,000	
Wages to casual workers	3,772,440	**29,029,457**
Contingencies	1,600,000	
Drainage and sewerage		
Pay and allowance	364,000	
Total	**25,914,905**	

Different issues that cater to the broad themes developed from the literature review have been discussed below to analyze the solid waste management system in the Darjeeling municipality. These issues have been viewed from four perspectives – household/individuals, municipal authorities, business establishments and NGO representatives – to give a more holistic view of the various issues relating to solid waste management in Darjeeling.

4.3 Collection and transportation of waste

The collection of waste is undertaken by the municipality. The issues related to the collection and transportation of the waste can be understood as follows.

4.3.1 Improper disposal and littering

Darjeeling still practices dumping of its waste irrespective of its nature and composition. Waste is put in a waste bin and either dumped in a municipal vat or drained in *jhoras*. From there, the waste is either collected by municipal waste collection vehicles and taken to (and dumped at) the municipal dumping chute near the Hindu burial ground or it is washed away by the water collecting at the *jhoras (*see plate: 4.1).

Plate 4.1: A typical site - waste dumped into a *jhora.*

The problem is further aggravated by the difficult terrain which marks the hill town. As mentioned earlier, Darjeeling lacks an urban planning body. Thus, the municipal areas have developed randomly, resulting in the development of areas where basic services like ambulances, garbage collection trucks, and fire trucks cannot reach. According to the literature, this is typical for developing nations (Schübeler 1996, Rapten 1998, Medina 2002, Zerboc 2003, Zurbrugg 2003). The

people who live in these areas are forced to throw their waste in the nearby j*horas*, since there is a dearth of space for developing accessible collection site.

4.3.2 Vats

The municipality has constructed vats in different parts of the town where the people from a particular locality are expected to dump their waste. The idea is to have a central point in the locality where people can dump their waste; from here the waste can be collected and moved to the dumping grounds. The majority of these vats, however, are uncovered and open, which attracts many animal, flies, and insects of all kinds. The most worrisome aspect of these vats is that due to their proximity to population, they pose a serious health threat to the locals. More often than not, these vats are not serviced regularly, except for those that are along the main business district and tourist attraction points (plates 4.2 and 4.3). This allows the garbage to accumulate over time and there is a spill over. Since the majority of the vats are open, dogs and other stray animals drag all manner of waste along the street, which again poses a health risk to the people.

Plates 4.2 and 4.3: Waste spilling over the municipal vat is a common site

The municipality has also placed garbage bins in various parts of the town, however, the concentration of these bins is limited along the main roads and tourist attraction points. Lack of garbage bins induces people to litter the town and throw their garbage anywhere they see fit.

When asked to comment on how often the vat is cleared by the municipality, a respondent from ward no. 1 indicated,

> "… the service is not regular in our parts, perhaps once a week, I am not sure... but the main point is even the vats need maintenance from time to time… I have never seen vat in my area being renovated so far."

Mrs. Sabitri Gupta, who owns a small shop near a vat in ward 29, says, "… it is such a mess as you can see, the municipality does collect the waste, but not on a daily basis, which is why dogs make a ruckus everyday". Municipal workers, however, differ in their opinions about the regularity with which the vats are serviced. According to one waste collector, "vats are our priorities and every day we collect waste and transport the waste to the dumping ground… it could so happen that we may miss a spot or two at times due to lack of space in the vehicle." When asked about the garbage bins, a municipal officer said,

> "… we place garbage bins all across the municipal area, and collect waste from the bins on a daily basis. However, we cannot keep an eye on each and every bin; sometimes they get damaged or stolen but no one informs us. Thus the bins are not replaced… I guess people should inform us if the bins are to be replaced or if they are inadequate."

The concentration of garbage bins are confined to certain parts of the town, like Chowrasta (a popular tourist hangout), mall road and along Laden La road (where the municipality office is located). Places outside the business district did not seem to have any garbage bins provided by the municipality.

4.3.3 Transportation of waste

It is presumed that waste is collected on a daily basis from the vats across the municipal area and taken to the dumping chute. It was observed that the waste is transported in open tractors or trucks and has the tendency to fall off at every bump or pothole on the road. According to the literature, this is a typical problem for developing nations around the world (Hoornweg et al. 1999, Medina 2002, Zerboc 2003, Zurbrugg 2003). Flies cover the truck and follow it on its journey to the dumping ground (Medina 2002). From these vats, daily collection of waste is undertaken by a fleet of seven vehicles which includes open bodied trailers and tractors, trucks and a pick-up truck (plate 4.4). The municipal supervisors decide which areas will be covered by whom. One truck is expected to collect the waste from Jorebunglow, covering Ghoom, Gandhi Road, D. B. Giri Road up to the railway station in two trips. Another truck covers St. Paul's School, Rockvale Road up to Governors house, Robertson Road, Mohanlal petrol pump in two trips. A third vehicle covers Singmari and surrounding areas and other vehicles cover areas in and around the business center.

Plate 4.4: Waste transported in an open trolley tractor

At the dumping ground, the trucks are lined up against the chute and the workers throw down the chute. This is a very risky endeavor, and the workers are in constant threat of losing their balance and falling down the chute. This has happened in the past; recollecting this one of the waste worker said "one of our friends missed his shovel and he went reeling down the chute and he is in a vegetable state now." When asked if anything was done for the worker who met with the accident, another worker said "No, he was a temporary worker and they have this policy of no-work no-pay, after he fell down the chute he could not work anymore, so he receives no pay. Maybe there is insurance for permanent workers, but there is nothing for temporary workers." When asked about the adequacy of the collection vehicles and staffing, one municipal worker said,

> "… no, it is not… that's why our town looks so dirty. Both the number of staff and number of vehicles are inadequate; moreover the distribution of staff is also not uniform. Some vehicles have four staff, some vehicles have seven

staff. It's a free world everyone does what one pleases, as long as they have some connection with higher authorities."

When questioned on the alleged practice, a municipal supervisor said,

> "…no it's not like that; we send our staffs on the basis of how much load they are expected to clear, see it varies from area to area… However, we are short staffed and that's the truth, we don't have enough staff or vehicles to collect all the waste from so many areas on a daily basis".

The waste workers do not have any safety or security while handling the waste. They are not given gloves, shoes or any kind of safety equipment while handling the waste (plate 4.5). When asked on this issue one of the waste workers said,

> "No, we are completely dependent on God for our safety. For so many years we did not get even a single Tetanus shot from the municipality, it was only last year that they gave us a shot of some kind and we were told that it would save us from infections of any kind. Besides this we do not receive any kind of safety items like water proof boots, raincoats, gloves nothing."

Plate 4.5: The waste workers dumping the waste in the chute without any protection

4.3.4 Landfill

The landfill/dumping ground is located in the lower reaches of the Darjeeling town; it sits besides the Hindu burial ground in ward number 18. This site was developed by the British and they had a ropeway system which would take the waste down to the dumping grounds. When asked about the ropeway, one of the residents living near the dumping grounds said, "The ropeway was functional and no one ever knew why it was stopped, it is kind of sad to see that no planning has been undertaken besides whatever little planning the British had undertaken while developing this town." The ropeway system now lies dysfunctional; all the collected waste is taken to the dumping grounds with the help of vehicles.

Highlighting the significance of the ropeway system, one waste worker said, "the system was very rational; the ropeway would go all the way down to the Rungit *khola*. It could be stopped at different sections, and there were different sections for animal carcasses, hospital waste and other wastes… now there is no ropeway we just dump everything down the chute." When asked about this, Mr. Thatal the Executive Officer of Darjeeling municipality said, "…the rope way was a very old and we could not get any repair parts, so we had to abandon using it. However, we are thinking of introducing a new ropeway in the future."

The effects of this practice are very tangible; while walking down to the chute a person can smell the rot from around half a kilometer away, the flies are buzzing all around the place (plate 4.6). There are, however, more serious issues which relate directly to dumping in this manner. Sharing his experience Mr. Roshan Rai says "We started working with the people in a rural community called Mineral Spring in the outskirts of the town. We were helping the people with sustainable farming and

livelihood generation. We had this situation where we noticed that the river/ravine flowing through Mineral Spring was coagulated by the waste dumped in Darjeeling."

An additional problem is that there is no separation of special wastes such as hospital waste or animal carcasses (plate 4.7). When asked about this, one municipal worker said, "…all the waste is dumped here. Be it hospital waste, animal death or carcass, rabid animals, waste from houses, from town, everything comes down here and it's all dumped in the same place." This is typical in a developing country framework, as seen in the work done by Inanc et al. (2004). Further, studies conducted by Venkatshwaran (1994), WHO (1995) UNCEA (1996) have linked diseases like the plague, cholera etc. to solid waste being dumped in open spaces. The United States Public Health Service has identified 22 human diseases that are linked to improper solid waste management (Hanks 1967 in Hoornweg et al. 1993).

Plate 4.6: Trucks' moving towards dumping ground, in the background the dumping chute is visible

The lack of any safety mechanism at the dumping ground is evident. Commenting on this, one of the dumping ground workers said, "… this is one of the riskiest places in Darjeeling. Recently one young girl was killed, another time I was just roaming around here and I heard a blast coming from the chute, as I looked down I saw a rag picker being buried under waste, promptly I called others for help and we rescued her." When asked what this blast was another worker said "well the waste produce gas of their own (probably methane?)… Whenever there is enough heat to ignite it we get the blast. The blast is fairly regular and at times it's scary as it blasts when we are actually working in the chute."

Plate 4.7: Dumping ground

4.3.5 Recycling

In the case of recycling, most of the people or individuals within establishments do salvage some recyclables. This is basically done for economic gains, as recyclable materials can be sold. Formal recycling as described in the literature is non-existent; however, Darjeeling has a strong network of informal recyclers who buy the recyclables from door to door. When asked about any centralized recycling or recycling undertaken at the household level, Bidya Rasily a resident of ward 21 said "Not that I am aware of. We dump our waste in the *jhora*".

However, another respondent, Mr. Bishal Subba pointed out "Yes, we segregate bottles and newspapers and sell it to the *bikrit*."

Responding to the same question, the business establishments had similar answers. One of the respondents who owns a hotel said,

> "Well! We do not directly recycle; however, we encourage our customers to use different bins to throw away recyclables and garbage. As you are aware, Darjeeling lacks a recycling facility and as a private organization, there is only so much we can do. More often than not our staff collects and sells recyclables, and we encourage that. But we do not have any company policy on recycling.

Mr. Amitab Ghosh of Fortune Hotel Central had a similar take on the issue of recycling. "…we don't recycle, I mean, we don't have any recycling facility in Darjeeling. However, we do sell papers, plastic bottles, metals etc to *raddiwalla,* so we have some sort of recycling, but that's informal." This was further supported by Bhagwati Limbu of Windamere Hotel and Resorts (a heritage hotel):

> "…we don't have any recycling programme. We try to keep all the saleable materials separate and sell them occasionally (the staff do this and this is not done by the organization). Generally, we collect, news papers, plastic and glass bottles."

When asked about the same issue Kapil Rai said, "what we lack in Darjeeling is recycling, we don't have any recycling facility in Darjeeling, and so what we do is we sell our recyclables as scrap. *Bikrits* travel from door to door buying the scraps, which they hopefully recycle." When asked about recycling, Mr. Thatal said, "recycling is carried out by individuals at household level, the municipality has not looked into a centralized recycling programme as of yet". Mr. Bimal Chettri, a municipal waste worker who works as waste collector and dumper, further said,

> "Once the collected waste arrives at the dumping chute we try to salvage whatever we can. We salvage plastic bottles, glass bottles, plastics, cardboards

etc. We then sell this waste to *raddiwalla*, different kinds of waste fetch us different prices, but the prices paid are very low" (plate 4.8).

Plate 4.8: Plastic bottles that are recyclables after being salvaged by the waste workers at dumping ground

The lack of a centralized waste segregation or recycling programme can be described as the main cause of indiscriminate dumping of waste by the people living in the Darjeeling municipality. Only a certain section of population has the incentive to segregate waste and use it, be it for use as manure after composting, to feed their livestock, or to sell certain items for recycling. Those who do not own livestock or gardens do not feel the need for segregation. This problem is further magnified by the lack of a separate dumping place/facility for organic wastes at the municipal level and the absence of any formal recycling structure. Thus, even those who may want to segregate waste do not have any separate place to dump the segregated waste, and consequently, the majority of the people end up dumping waste in one place.

4.3.6 Informal Recycling

The presence of informal recycling structure in Darjeeling in the absence of a formal recycling mechanism is consistent with the literature reviewed. According to Sudhir et al. (1997), the informal recycling sector contributes 10-15% towards

recycling in India. Further, Medina (2002) states that the lack of formal recycling structure allows an informal recycling sector to thrive, and it provides employment to unemployed men, women, children and migrants. Darjeeling, as stated above, has a very strong network of informal recyclers (called itinerant buyers in the literature). These itinerant buyers are generally rag pickers from the plains, who buy recyclables and take them down to Siliguri. There, a whole buyer (middleman) buys the products from them and bulks them for sale to parties who either recycle the products or reuse them. The most popular recyclable items are plastic bottles, newspapers, cardboards and metals (especially tin or aluminum).

When asked about informal recycling, Mr. Dinesh Thakur, one of the itinerant buyers said, "…it is very difficult work, we travel almost five to ten kilometers every day looking for whatever we can collect or buy, we then take it to Lalaji who buys it from us." The system is very simple; these itinerant buyers work in groups of two to four individuals and collect or buy those items that can be sold to a whole buyer (plates 4.9 and 4.10). They pile what they collect at a central point, and in about a week a truck full is collected. The load is then transferred by truck to Siliguri (where most of whole buyers are based). Depending on market fluctuation and the composition of the load, a truckload of recyclables fetches anything between Rs. 1500 to 3000 (CDN $35-$70). When asked about what is done with the items, Ram Prasad (a Darjeeling based whole buyer) said, "It depends, newspapers are bought by people who make paper bags and other items like that, plastic bottles are bought by people from Kolkata, and they probably recycle it, other items like glass bottles are bought by *rakshiwallas* and so on".

An important fact that emerged is the significance of this informal sector in terms of diverting waste from the landfill. Commenting on this, Mr. Kapil Rai said,

"these people come from the plains and they travel to different parts of the town, buying and collecting items that can be re-sold, I am not so confident about all the items being sold to those who recycle, they do, however make use of it…. I mean reuse." If this informal sector was absent, the rate of diversion from the landfill would be much smaller. Responding on similar lines, even the waste workers acknowledge the contribution of this informal sector in diverting waste from the landfill. "They do take some load off us, if they would not come and buy items that can be salvaged, I am sure we would be dumping everything," said one of the waste collectors.


Plates 4.9 and 4.10: Rag pickers collecting recyclables

It is interesting to note that all the recycling currently undertaken in Darjeeling is directly or indirectly related to this informal sector. However, some local people have different concerns. "These *raddiwallas* steal a lot, last year we caught two of them trying to steal a tin roof from the shed, that's why we don't allow them in our village any more" said a resident of ward 21. When asked what they did with the recyclables, he said, "we don't have much to recycle anyhow, we give our newspapers

to shopkeepers and they use it to wrap items, as for bottles and other items kids collect from everyone and sell it to Daulatram (another whole buyer based in Darjeeling)."

Most of the recyclable items are reused rather than recycled. The absence of a recycling facility in the Darjeeling municipality area makes it difficult for everyone to recycle. Most of the people were observed to be dependent on the informal recycling sector for whatever little recycling is currently being undertaken.

Solid waste collection and segregation system – an example from Darjeeling

"Most successful men have not achieved their distinction by having some new talent or opportunity presented to them. They have developed the opportunity that was at hand."

– Bruce Barton.

Hermontage, Ward Number 30, looks like any other area in Darjeeling. What is distinct about Hermontage is that you will not find any litter lying in the streets and you will not find any foul smell, indicating the absence of a garbage dump nearby. Actually, there used to be an area right outside the perimeter of the Governor's house where everyone used to dump their waste. That area had gone on to become a threat to the village, and there was a chance that a landslide could occur any moment. The people living in that area took charge of the situation and changed the face of the whole area. Now they hope to inspire other parts of Darjeeling hills.

In the initial stages, they were helped by the municipality. "Experts were brought in by the municipality and around four councilors also visited; they helped us set up a collection point for dry waste. However, they have not come for past nine months and they seem to have lost interest," reminisces Mr. Subba. He added:

> "We did not know much about solid waste, and then two people came from Kolkata to our area, they were experts and they had already done it successfully in Coochbehar. They told us the basics of solid waste

> management, and told us that we need to form a committee to oversee the project and that we needed to work in collaboration with the municipality that's how we started…We formed the committee in our area and I was given the responsibility to make the committee function. So I took the initiative and started to work towards the idea shared by the experts from Kolkata, this was one year back".

Since then, Hermontage has come a long way in devising a system that has worked perfectly, given the usual constraints. They have two males and one female working as waste collectors, the males collect the wet waste (degradable) and take it to the main road where they deposit the waste in municipal vehicles where from the waste is transferred to municipal dumping ground. The female collects the dry waste such as cardboards, papers, bottles, tin cans, and plastics etc., which are stored in the shed the municipality helped build (plate 4.11). They collect a monthly fee of Rs. 30 from every household, Rs. 50 from shops and the hotels in their area pay between Rs 100 to 200. When the truck is full, they take it down to Siliguri and sell it, adding to their funds. The people selected to collect the waste in the area are from "economically backward" groups from within this area. "This is like a part-time job for them, they work for one hour every morning and we pay them an honorium, from the money collected. We keep some as deposit, but that is again used to support our waste collectors," says Mr. Subba. He further adds, "…all these wastes are very harmful to the environment, but we collect these items and we are helping people economically. This not only keeps our area clean, the environment is saved and our economically backward people have benefited."

Plate 4.11: Mr. Subba proudly showing us the shed for collection of recyclables

When asked if they segregated wastes, Mr. Subba says, "Actually that's what needs to be done and we are trying. We even distributed separate buckets [to households] so that the people could drop in their kitchen and vegetable wastes in a separate bin, but people find it too time-consuming. Even though we have not been able to achieve 100% segregation, I'd say we segregate around 50% of the total waste generated in our area. Many people have started to understand and they have started to segregate waste."

This area has bigger plans for the future. "We want to spread this concept all over Darjeeling. We want to be the model others can learn from" says Mr Subba.

This is not the only successful story, says Mr. Roshan Rai, who actually started this process in communities that are situated above the Court and Hooker road area. "I will not call it a perfect system, but it is better than having nothing. These two

communities are self-organized and they collect Rs. 30 per household. With this money they employ some local unemployed youths who collect the waste from door to door and take it up to the municipality vehicle." This process is still working in these areas; however, they have not indulged in selling recyclables as the people in Hermontage area have done.

The old adage "where there is a will there is a way" seems to be applicable here. Even though Hermontage may not have a perfect system, it has, however, gone beyond other areas in Darjeeling and it is aspiring to be better in coming days. If it is possible in Hermontage, it is possible in other areas of Darjeeling as well.

4.3.7 Composting

Segregation of waste into bio-degradable and non-degradable items at the individual or household level is sporadic and confined to interested individuals. The municipality, or other institutions have not encouraged any segregation of waste so far. Some amount of segregation is undertaken by individuals or establishments, however, segregation of waste is completely dependent on the individuals' will, and it is not a standard practice.

When asked at the household level if segregation was undertaken, some of the respondents said that it was done up to a certain extent, "We segregate vegetable waste and use it for our gardens through composting. Inorganic wastes are thrown in the nearby *Jhora*" said Bikram Chettri a resident (ward 1). While Mrs. Sujata Bomzan (ward 5) said, "No, we don't segregate waste, there is nothing to segregate, we throw our waste in the *Jhora*".

Respondents from the business community were divided along similar lines. "Yes! We use our degradables to do our own composting, for which the gardeners are

in charge. We use the compost in our garden, and let me tell you this, our gardens are beautiful. The rest of the materials are sent to the municipal dumping grounds," said Mr. Raizwanur Ali of Mayfair resorts. In contrast, Mr. Kiran Pradhan of Elgin Resorts said "No, we don't have any segregation."

Mr. Bir Prasad Pradhan, vice-president of *Gram Bikas Samity* (ward 1), responding to the question of segregation, says "Segregation is usually undertaken by people who have vegetable or flower gardens and also by people who have livestock like pigs, cows or goats, the rest do not segregate because there is no point in segregation if they cannot make use of it". Echoing the same view, Mr. Kapil Rai, an environmental studies teacher, said,

> "We do not engage in segregation of waste and that I feel is our main problem. Visit our municipality office or dumping grounds, they don't have segregation even there. Then again, some people segregate waste to use as *mal* (manure) in their home or gardens, but there is no provision for those who do not have gardens. We do not have separate places to dump our segregated waste, so eventually people are forced to dump it in one place".

Plate 4.12 Waste of all kind is thrown in the municipal vat.

Highlighting the need for and significance of segregation, Mr. Roshan Rai said,

"Our understanding from our previous experience was that, around 70% of Darjeeling's waste was composed of organic materials, which means they could be composted. As of now the system is that you just roll it down the hill. If you could address that part of the problem, and compost it, we would reduce the burden of waste to a great extent (plate 4.12)".

While the authorities had a different take on the matter, they did agree that segregation had not been a priority in the past, but they were aiming for segregation of waste in the future. "…. we have bought around 9000 plastic buckets, these come in two colors one is for disposing regular waste and other is for disposing vegetable waste. This way we will segregate the waste and take the vegetable waste for composting, the municipality has definite plans for segregation and composting…" said Mr. R. Thatal, executive officer of Darjeeling municipality.

The lack of interest in segregating and recycling can also be understood in terms of lower opportunity costs – those with costs of segregation and recycling lower than the cost of substitutes available from the market would support segregation. However, the cheap and easy availability of substitutes acts as a deterrent for many to pursue segregation or recycling. In the case of the rag pickers and those who own vegetable gardens, the opportunity cost of collecting recyclables or composting is higher than buying those products in the market.

4.4 Poly bag ban

The Government of West Bengal and the West Bengal Pollution Control Board issued a series of directions imposing a blanket ban on plastic carry bags at various sites in the state. On March 7, 2006, the WBPCB issued a circular restricting plastic carry bags in specific areas in the state. All manufacturers, distributors and users were directed to comply with the guidelines of the Board regarding use of plastic carry bags to avoid regulatory sanctions as provided under Section 5 of the

Environment (Protection) Act, 1986, and also legal actions as warranted under Section 15 of the Environment (Protection) Act, 1986. Compliance, however, has been very sporadic throughout the state.

4.4.1 The Ban

In Darjeeling it was the death of a 10 year old girl, Susmita Sarki, which caused the authorities to realize the threat posed by solid waste mismanagement. She was buried alive at the dumping chute and her body was recovered only after three days of intense search. "The governor (for the state of West Bengal), Mr. Gopal Krishna Gandhi, happened to be in the town and he heard of the incident, he then asked me to ensure that nothing like this will happen ever again… the death was shocking and appalling in itself and following his orders we decided to act affirmatively," says Mr. Rajesh Subarno, Superintendent of Police Darjeeling. This led to the police chief forming a group called "Plastic *Mukti* (freedom) Group" (PMG) with other likeminded individuals and organizations including a cluster of NGOs (called PRO-Darjeeling) from all over the Darjeeling municipality.

The PMG did a brief background study and realized that the pollution control board (PCB) had banned plastics of all kinds in Darjeeling hills. "Since banning all kinds of plastic was impossible, we focused on banning the use of poly bags which was the crux of all troubles," said the superintendent of the police. In order to make the ban work, the PMG undertook a series of stakeholder meetings with people, community and business organization. "For the ban to be effective, I took the help of a thin piece of law and the defaulters were warned that they will be booked under Section 34 of the IPC (creating nuisance in public place) and anyone found littering or using plastic bags would be fined Rs 100," said Mr. Subarno.

The initiative was further boosted by the Darjeeling police placing about 30 dustbins, in two different colors for degradable and non-degradable wastes across the town (plates 4.13 and 4.14). Further, the police department in collaboration with the business communities offered a candy for each plastic bag deposited at various police booths. “The response from children was so good that we ran out of chocolates very soon, as a result, we were forced to offer only one chocolate per five plastic bags returned,” said Mr. Subarno.

Plates 4.13 and 4.14: Bins placed around Darjeeling town by Darjeeling Police

The town residents joined to express solidarity with the no-plastic campaign. “Citizens walked hand-in-hand with schoolchildren, district and municipality officials and politicians to send a message that they were ready to follow the ban on plastic use and the prohibition was not being forced upon them,” said Mr. Subarno. “The placard ‘We are not afraid of the ban, we are afraid only of plastics,’ seemed to say it all.” (The Telegraph March 5th 2007). Signs and placards declaring the ban on plastics in general and poly bags in particular were printed and placed around the town (plate 4.15, 4.16 and 4.17).

Plate 4.15: Placards placed all over town to encourage ban on plastic

The campaign to eradicate the plastics from Darjeeling started in earnest during the research period. However, according to Mr. Subarno, "public memory is short and we decided to keep the campaign in public eye by regularly organizing events and we hope to continue doing so until we eradicate plastic completely." In order to do so, PMG organized a grand send off for the plastic that had been collected so far. "A well known local figure Fr. Van proudly flagged off the four trucks full of plastic," said Mr. Subarno. In keeping with the idea of constant public attention against plastic, PMG organized a marathon on the May 13, 2007. This run was very successful and generated a lot of awareness across various sections of people in town (plate 4.18).

Plates 4.16 and 4.17: School and college students participated whole heartedly to generate awareness

The ban on the use of poly bags was complemented by another positive effort. Widows whose husbands were from the police force started to make paper bags in order to replace the demand for poly bags. This helped in two ways: it generated a cleaner and sustainable alternative for poly bags, and also helped these widows raise money for their livelihood.

Plate 4.18 Run organized by PMG

The concept is not new, according to Ms. Anju Subba, an NGO worker: "the municipality did impose ban a few years back, however, poly bags started to resurface once a new board came to power." When asked about the consistency of the programme, Mr. Subarno said, "I am a government employee and I will be transferred

to other places in coming days, I will monitor the progress as long as I am here, after me, hopefully the momentum will carry on."

4.4.2 Public perception of the ban

The ban, as stated above, seems to have been accepted and encouraged by the people in general, but not all were convinced regarding the effectiveness of such bans. Even though many people supported it, there was a sense that it would fail again prevalent among the people. When asked if they supported the ban, Mr. Bishal Lama, a resident of ward 23 said, "I have to say that I feel happy they banned the poly bags, our town needed that and now I realize that we can make this town lot cleaner and better by changing our habits a bit. I am definitely impressed how cleaner our town already looks, so I have to say that poly bag ban was a good move." Similar sentiments were echoed by the business community; Mr. Ratan Agarwal, a hotelier said:

> "The main problem in Darjeeling in terms of waste is growing reliance on use of plastic and plastic based products. A ban on the use of plastic bags is a welcome relief and from the perspective of an hotelier we welcome this ban. In a mere two months the town does look much cleaner. Plastic bag ban should not be the end; it should be a start to make this town even better in coming days. More such initiatives need to be undertaken".

Not everyone, however, shared the same sentiments, Mr. Rupak Rai, a resident of ward 1 said:

> "Look they have banned the poly bags but the town is still dirty, what's the use? They should put more focus on simple ideas like putting more garbage bins in and around the town. Except for Chowrasta [main tourist attraction of the town] very few other parts of the town has a garbage bin".

Some sections of people believed that a poly bag ban alone would not bear any results. "See this is just for the time being, you wait and watch another two months

poly bag will be in and the ban out," said Shiva Prasad Gupta, a wholesale trader. Even though the ban was welcome, one resident had other concerns: "some people were making a livelihood by selling poly bags, now they don't have any livelihood, how do you justify that?" Mr. B P Pradhan of *Gram Bikash Samity* summed it up,

> "The ban is good, it seems to be working. But people are not aware; people have supported this ban because they are afraid of the law. Can this be continued is another question altogether. The ban is working for the time being, but if you really want poly bags to stop coming in Darjeeling, educate people, make them aware."

Surprisingly the municipal officers did not seem too happy about the police department getting involved in the ban. As Mr. Thatal insisted, "… it was the municipality which imposed the ban, but after a while the shopkeepers started to use [poly bags] again. Moreover, the police department is not entrusted with the responsibility of imposing the ban; it is the prerogative of the municipality. It should not be doing this." He further stated, "This is only temporary, people will start to use poly bag in near future again. People will support because they fear the police and don't want to get in the wrong side of the police." When asked if municipality was doing anything to complement this process he added, "actually it was the municipality that initiated the ban, so it is the police department which has complimented our process and not the other way around." A definite clash of jurisdiction and proprietorship of the issue is apparent.

4.4.3 The poly bag ban stalls

During the initial five months of this study, the ban was strictly followed. However, due to certain political problems, the police department had to focus on maintaining law and order in Darjeeling hills, which led to the reduction of vigilance

with regards to maintaining the ban in place. Since, September 2007, poly bags started to make a comeback in Darjeeling municipal area (plate 4.19).

Picture 4.19: ISN'T IT IRONIC? Sign in Nepali reads "Dumping of garbage in and around heritage post office is prohibited"

It is disheartening to see that after about six months of attempting to eradicate poly bags, the initiative is waning. I had a chance to interview Mr. Roshan Rai. When asked about the regression seen recently vis-à-vis poly bag resurfacing in the market, he said,

> "…we have noticed this in terms of solid waste management. We have cycles, the highs and lows. The plastic ban is not new in itself; the municipality tried it before and lots of other groups and organizations. This year it happened to be the chief of police, many likeminded organizations and individuals got together, but yeah! It did not sustain and definitely plastic carry bags have started to resurface in the market".

4.4.4 Reasons for regression

Numerous factors have contributed to the poly bag ban being stalled. Some said it was the top down approach of the police chief, some said it was the lack of awareness. Another group of respondents attributed the failure to a lack of proper

legislation and political will. One respondent said, "See the *ghutka* and chips wrappers are not banned, so banning poly bags doesn't mean that waste is banned, as long as we have people throwing these items in the street, I don't think just banning poly bag will be enough." Similar views are expressed by some in the business community: "how can you expect me to stop using poly bags when majority of the product comes wrapped in other forms of plastics? For the ban to be really effective, stop the product from entering Darjeeling altogether." A similar sentiment was echoed by Kalsang Lhamu, a resident of Ward 7: "there has to be alternatives, which seems to be lacking. The government needs to ban the wrappers and I guess it cannot be done at the municipal level."

Community leaders such as Mr. B. P. Pradhan had a different perspective: "it is always better to have grass root level awareness, as awareness will lead to people refusing to use poly bags altogether." When asked about the level of awareness generated before the introduction of the ban, Mr. Kapil Rai says,

> "…the decision was made by the authorities and thrust down upon the people. See, right now the police department started this ban, and people fear the police so they are not using the poly bags, but if this SP gets transferred then the next police chief may not be so interested and poly bags will resurface again in a big way. So I feel it should come from the people and people should say we don't want poly bags, if we don't demanded poly bags then the supply will cease, we are not aware and that's where the problem lies".

The poly bag ban has been successful at least in terms of creating more awareness among the masses, and the contributions made by the police department and the police chief are commendable. However, a gap is noticeable and even though people seemed ready to be persuaded, they did not seem to appreciate decisions made without proper consultation. Perhaps this is the major reason why poly bags continue to make comebacks in Darjeeling. Furthermore, the ready availability of poly bags in

the market sets the opportunity cost of not using poly bag higher than of using them. Hence, people prefer to use poly bags rather than to use something else for their grocery shopping.

4.5 Factors influencing solid waste management in Darjeeling

It is important to consider factors and issues other than the solid waste management system that influences solid waste management decision making. These factors are discussed below.

4.5.1 Changing nature of waste

According to the literature (Medina 2002, Zerboc 2003), littering is a common practice for any developing country, however the logic was explained in simple terms by Governor G. K. Gandhi,

> "In India, people are used to throwing their garbage away; it's been a time standard practice. Earlier we didn't have non-degradable items and anything thrown away in the field used to get degraded automatically so we didn't have to worry. But now we have non-degradable items and people need to change their outlook".

The changing nature of waste is evident in Darjeeling and during the course of study, almost everyone acknowledged that the waste composition has changed over the years, and particularly so since 1990s when the Indian economy was opened. Emphasizing this Karan Tamang from University of North Bengal states,

> "Prior to 1990s most of the products were Indian and generally these were biodegradable, even the wrappings used were card board boxes but since liberalization numerous multinational corporations (MNCs) entered the Indian market and change the whole face of consumerism and product perception in India and this directly relates to changing nature of waste. Particularly so in terms of Darjeeling, this place has always been a tourist hot-spot and any new product that enters India enters either major cities like Delhi, Mumbai or tourist towns like Darjeeling, Shimla".

People perceive the change in waste composition, when asked how the composition of waste has changed, a waste worker said, “use of plastics has increased so much now, look around our town what’s the first thing that strikes you? All the garbage you see, the majority consists of plastic and plastic based products. Earlier, all we had was bio-degradable products made from local materials.” Another respondent said, “I still remember carrying a shopping bag whenever my mother used to go for shopping, she still does. But most people use plastic bags and that’s where the trouble starts.” The business community has similar views: “now more and more products come in disposable packaging. Earlier we never got Coke or Pepsi in plastic bottles, but now it’s so easy for people to take their food around in plastic containers. So, I guess the uses of plastic based products have gone up, and there is not much we can do about it.”

The changing nature of waste is a major factor which needs to be considered for solid waste management decision making. Rapidly increasing use of non-degradable materials poses serious environmental and health risks (Chakrabarti and Sarkhel 2003). Non-degradable waste tends to cause pollution of the air, soil and water. Further, untreated leachate of harmful chemicals poses threats to human as well as environmental well-being, as pointed out by Hoornweg et al. (1999). A major problem in terms of mountain ecosystems vis-à-vis non-degradable waste is the clogging of drains leading to landslides (Chakrabarti and Sarkhel 2003). Hence, the changing nature of waste should be accounted for in solid waste management decision making.

4.5.1 Problem of perception

Different stakeholders may not necessarily subscribe to identical political, economic, environmental and socio-cultural values. None of them have access to

identical educational or technological resources, which gives rise to the differences in perceptions. In the case of the solid waste problem in the Darjeeling hills, the difference was clearly evident. When asked about how they ranked solid waste management in terms of a priority vis-a-vi other issues, the difference in opinion was evident. Bijay Limbu a student from St. Joseph's college said:

> "… it is a big problem. But I am more worried about drinking water; you know we have to buy drinking water even in monsoon? I am worried about my future, in terms of employment. Even education is not good in Darjeeling, all the technical colleges are down there in the plains and many parents can't afford to send their kids to study there. Even though waste is a big problem there are other pressing issues,

The business community had a similar view. "From an hotelier's perspective, there are more pressing issues, like drinking water, better roads, maintenance of existing tourism infrastructure and facilities. The problem of waste management does rank high and should be taken care of, but to be honest there are more pressing issues," said Mr. Rizwan Ali of Mayfair resorts. Another respondent, Mr. Bisweshar Prasad who owns three restaurants in town, said, "For me, drinking water is the most important problem which needs to be tackled immediately, followed by better roads and communications system. Waste is a problem all right, but, I would rather see drinking water problem solved before they solve the waste problem."

Community leaders also argue on the same lines. "Well it is important, in a sense that this issue is getting more and more aggravated by the day, so earlier we address it the better it will be for all. However, from Darjeeling's point of view unemployment, infrastructural development, drinking water ranks higher than the waste problem," said Mr. Uday Dukpa of Dukpa Welfare Association. Another respondent said, "we have so many problems in Darjeeling and wastes is definitely one of them, but look at the reality, why will people care about waste problem if their

immediate problem is to earn enough to be able to afford one square meal a day for their family?"

Those who have worked in solid waste management sector hold a different view, though Roshan Rai says, "for me it's very high, definitely. But for the community, I don't think so. For them lack of employment is a far greater issue. Then we move on to social infrastructure and we have lack of drinking water, medical facilities, and roads and then waste could feature." When asked what would be the reason behind this Mr. Rai further says,

> "Environmental issues are something that does not affect your life immediately or strongly; your life still continues. So if you look at any environmental issue it has been a carrot and stick kind of thing. The attitude that 'your life still continues even if there is plastic and waste lying around in town' is perhaps why people do not take it as a big problem. When it comes to plastic waste people realize it, but are not bothered at the same time. I guess people will respond only if there is a crisis of some kind".

Authorities, however, do perceive waste as a serious problem. As stated by a municipal engineer, "for us the priority is drinking water, waste and sanitation... there are numerous other problems, but those do not fall under our jurisdiction, we are trying our best to ensure that we are able to provide optimum services to the people in our town."

It should be noted that, priorities do change with alterations in the level of education, economic wellbeing, availability of technology and socio-cultural setting. Darjeeling is currently going through a period of change and transformation. The fact that people have started viewing unmanaged waste as a problem is a positive indicator.

4.5.3 Governance

A very important factor that emerged during the course of the study was the linkage between the political set up and solid waste management. Decisions made by one set of political players are often not followed up by the new set of players who come to power, thus undermining the work already completed previously, leading to the loss of time and valuable resources.

One such example has been the shelving of the integrated solid waste management process and plan, which was started by the municipal board under the chairmanship of Mr. Passang Bhutia. This board, understanding the significance of solid waste management, started developing an integrated solid waste management approach, by taking all the stakeholders into confidence. Stakeholder meetings with various communities and groups in the municipal area were conducted and consulted. Besides this they had invited solid waste management experts like Mr P. U. Asnani of the United States – Asia Environment Partnership (USAEP) to sensitize people and to help in designing an integrated approach to solid waste management. This board in collaboration with local NGOs had even released a documentary titled, "A New Dawn," highlighting major issues like what was being planned and how individuals and community organizations could become a part of the whole process. This documentary was distributed across the municipal area to make people aware. However, a new board was formed after elections and this process and plan have been shelved since.

Talking about the issue, Mr. Roshan Rai, who was a key figure in the development of the then integrated solid waste management plan, says,

> "… we had envisioned this sort of master plan for Darjeeling, which had everything from composting to segregation. But, unfortunately the elections were declared and the new board did not see eye to eye with the old board, so

> the science and technology of solid waste management got caught up in politics and over ridden in personal issues of ego. It was not just a single person but many experts had contributed towards the development of the master plan and it was prepared keeping in view the Supreme Court directive. So I feel it was a complete plan, which could not take off and personally for me it was very frustrating".

When asked about the issue of political rivalry affecting developmental projects, Mr. Karan Tamang said, "…it is a very unfortunate practice in not only Darjeeling, but the rest of India as well. One party may have a great plan going, but may lose the election and the next thing you know the great plan is quashed. So the political scenario dictates the governance issue and it is very unfortunate, something needs to be done to ensure the continuity of a good plan." He further asserts,

> "…it is evident that there is a direct relationship between politics and governance. In Darjeeling we have DGHC and for the town we have Darjeeling municipality, it is a civic body but run by a political party. So the will of the political party becomes very significant as the decision of the political party becomes the decision of the civic body, if they wanted to I guess they could continue doing any good work previously started".

Even the bureaucrats agree that there is a problem owing to abandonment of plans and policies that were developed by the outgoing board by the new board. "See whoever wins the election (majority) forms the board, and takes the decision. Some decisions taken by the previous board are continued, while many decisions are quashed by the new board and we often end up starting many things without completing them" said a municipal officer.

Speaking on the interrelationship between society and politics and its effect on the governance Mr. Rai said:

> "If I speak on solid waste management, I think the same will be applicable on other issues as well. I think ownership of planning process is not there from the people's perspective. And also from the people in power the general tendency of all political parties in Darjeeling hills, I am not talking about rest of India but definitely in Darjeeling hills decision making tends to be leader centric and not necessarily people centric. So it depends on a single person, I

> think that is the biggest challenge in terms of good governance. The second challenge I would say is that a certain amount of community responsibility is not there and we tend to think especially when it comes to environmental issue "it still is not my concern it is the issue that should be tackled by the municipality." The ownership of the process is not there".

In addition to the above mentioned issues, many other such plans and approaches have been left incomplete. Discontinuity of plans adds further burden to the resource base which is meager to begin with.

Over time, Darjeeling has developed a unique community-based organization popularly called *samaj*. It is a self-organized grass-roots level social institution. People contribute small amount of money in the form of annual fees, and in return they get assistance and support for social issues. The role and geographic area covered by the *samaj* can vary from place to place; some *samaj* may provide assistance in birth and death issues while others may even organize scholarships for meritorious students. The area covered by a *samaj* can vary from one village to a cluster of villages. All the people living in an area are usually the members of the *samaj*, and the office bearers appointed to run the *samaj* are from within the members.

Speaking on the significance of the role of *samaj*, Mr. Roshan Rai said:

> "Darjeeling has this unique community organizations we call it Samaj. It helps in dealing with death, birth, marriage, social issues and a bit of a conflict resolution. As I mentioned before we took the help of s*amaj* in helping the two communities to come up with the proper waste disposal system. The *samaj* collects the money and employs the unemployed youth, while at the same time keeping the community clean. S*amaj* do have tremendous potential to spread the awareness in terms of solid waste management. Darjeeling town has around 130 and the potential of these organizations to transform Darjeeling is tremendous".

Hence, the issue of governance needs to be analyzed and given due consideration in terms of solid waste management decision making. Involvement of local social organizations like *samaj* can induce grassroots level involvement and has the potential to make the decision making process decentralized and inclusive.

4.5.5 Public participation

The concept of public participation in solid waste management decision making in India was introduced by the Ministry of Environment and Forests notification, dated September 25, 2000. It is seen that the participation of the general public in terms of waste management is limited to the segregation of waste. Actual participation, however, is not envisioned in the notification.

Schedule - II (2) of this notification states:

In order to encourage the citizens, municipal authority shall unitize awareness programmes for segregation of wastes and shall promote recycling or reuse of segregated materials.

- The municipal authority shall undertake phased programme to ensure community participation in waste segregation. For this purpose, regular meetings at quarterly intervals shall be arranged by the municipal authorities with representatives of local resident welfare associations and non-governmental organizations.

Public participation is a critical ingredient towards the success of any solid waste management system. Participation can be in two forms: participation in the solid waste management decision making process and participation in the system.

Public participation in decision making process: When asked about the decision making process in Darjeeling, community leader Mr. B. P. Pradhan said, "… participation is restricted to electing the representatives, beyond that the role of common people in decision making is almost nonexistent." Technically, there are supposed to be ward committees in each ward in the municipality, however, as asserted by Khawas (2001), creation of ward committees was equated to the division

of power by political parties; hence, actualization of the grass roots level decision making process is taking much longer to implement in Darjeeling as compared to other parts of India.

At the municipal level, public participation in decision making is limited to the election of their respective ward councilors. When asked about public participation at the municipal decision making process, Mr. Roshan Rai said, "when I look at decision making from the perspective of levels of participation we have some amount of discussion, participation does not reach everyone but at least it is a slightly wider discussion base. But participation is still at the level of 'this is the plan I have; you all come and say yes to it.'" He further states that the nature of bureaucracy has a lot to do with this impediment: "…the bureaucracy is still archaic in the sense 'we are the ones who know, so we plan for you all and then you come and participate in our plan.' That's the level of participation we have, the whole idea of public discussion is yet to arrive."

It is safe to state that the level of public participation in solid waste management decision making in Darjeeling varies from very little to nonexistent, as is evident from the following responses. When asked if they were ever invited to deliberate the waste management situation in Darjeeling, Mr. Bikram Chettri, a resident of ward 1 said, "No, we have never been invited to any waste management situation discussion. We once went for Clean Ghoom project sponsored by *Sai Samity* and N.S.S as volunteer from school." Even the business community has not been involved, said Mr. Kiran Pradhan of Elgin Resorts: "No, not really. But once we were invited for a seminar and it was almost four or five years ago and they discussed a new initiative that municipality was about to undertake, but after that we did not hear anything more." When asked if they were ever invited to share their ideas by the

municipality, a waste worker responded, “No, we have never been invited. Even the previous time when we undertook composting, it was RCDC (DLR Prerna) who helped us set it up and who initiated the project and they even helped us to market the compost. But the municipality has never invited us or asked us for our opinion on any matter.”

When asked if they were happy with the current decision making process, one respondent said, “no, people are not at all involved.” But, not everyone shared the same view; during the course of study it was found that certain sections of the people felt that the process could improve but they were not complaining at present. Answering the same question, Rizwanur Ali of the Mayfair Resorts said:

> “You cannot have a direct answer to a question like this. Because in some respect the decisions being taken are made by our representatives and in democracy this is how things work. But on the other hand, our representatives tend to make decisions arbitrarily, which leaves out the advantage they could have if they invited public opinion…But again, you cannot invite people to give an input all the time. I guess any major issue should involve views from all side. I mean for any tourism related issue, I’d prefer the decision makers inviting hoteliers and travel agents, as this directly involves us”.

The authorities however, feel that the process is democratic: “The decision is made by the Municipal Board and they are all representatives of the people so in a way the people are making the decisions.”

Public participation in solid waste management system: It was observed during the course of this study, that people did participate in solid waste management system. Even though the system is rudimentary at the best, people do follow whatever little rules and regulations are in existence vis-à-vis solid waste management. It was observed that the majority of people disposed their waste in designated vats. In spite of the lack in a framework for formalized recycling, many people undertook recycling at the household level. Composting was also undertaken by many people, which is

remarkable, as formalized composting has not yet been introduced. There is potential for a formalized solid waste management system to succeed.

4.5.6 Draft development project (DDP)

The DPA and the Municipal Act provide a framework for the development planning of the area under local bodies. In addition, they also lay down the obligation on the part of the municipalities to develop a Draft Development Plan (DDP) once every five years and an Annual Development Plan (ADP) each year. In this regard, the Board of Councilors is empowered to prepare a Draft Development Plan for the municipal areas in consultation with District Planning Committee (DPC) and the various Ward Committees. Darjeeling municipality has taken the opportunity provided by the DDP process to sensitize people regarding solid waste management issues.

Talking about DDP, Mr. Thatal said:

> "We have started DDP; this is a grass root level planning tool. Here the people from all the places can tell us what they require and what they need. See, some village may need drinking water, some may need better sanitation. Through DDP these people decide what the need is. Based on that, we formulate the plan and the budget and send it for approval, if it gets approved we start the work. So the grass root level planning process has started and we are very happy about this".

When asked how long this process has been in place, Mr. Thatal said, "Well it was recently introduced; in fact it has just been almost over a year. So far we have gone to different wards and mentioned the DDP to people and informed them as to what their role is. People are very enthusiastic about it. We are starting to get very positive feedback from our people and this will help our town in a big way."

The DDP was initiated to ensure decentralization of the decision making process and requires for the municipality to form ward committees, which will in turn decide what needs to be done in their respective wards. In the case of the Darjeeling municipality, the ward committees were formed only since late 2006, and not much has been done except to inform people of what DDP is. When asked if he was aware of DDP community leader, B P Pradhan said, "I am aware of it, as Darjeeling municipality had invited various organizations from Ward: 1 and 2 to the community hall for a meeting/seminar. We were invited and our Secretary, Mr. Tenzing Tamang and I had represented our samaj." When asked if there was a follow up of any kind, Mr. Pradhan said, "actually that was the only meeting we had. Our ward councilor Mr. Babar Gazmer and Mr. Pemba Tshering Bhutia (councilor ward 2) and the executive officer of Darjeeling municipality had addressed the meeting and these people informed us about DDP. There has been no follow up action whatsoever."

This is not a unique case; DDP has not been implemented in real terms, in fact many people were not even aware of it. For instance, when asked if he was aware of DDP, Mr. Karan Tamang said, "I have heard of it, but I don't know much about it." When asked if his area councilor had informed him, he replied, "No, nothing like that has been done." Mr. Kapil Rai was also asked if he was aware of DDP or if he was involved with it. He responded:

> "I have not been directly involved in DDP, which seems like a very good process, but in the month of April, 2007 Darjeeling municipality had invited representatives from samaj level to inform them regarding DDP. I live in ward number 7 and representatives from our samaj were also invited, and they informed us that we had to submit projects that we want undertaken in our area. But, unfortunately our ward councilor died and we could not become part of it".

When asked if there was any follow up to implement DDP, Mr. Rai further said, “No, no one has come so far. I am not aware of any.”

Public participation in decision making is a critical component of good governance and for any process or plan to be successful public participation is not only essential but should also be made an integral part of the decision making process (Moote et al. 1997) According to Sekher (2001), local organizations play a pivotal role in promoting awareness and sensitizing people regarding many socio-economic issues, and these organizations directly affect the nature of participation and contribution towards participation, “depending on the process, different local organizations create restraints, provide opportunities and confer legitimacy differently” (Sekher 2001, p. 137). This will not only help people to share their knowledge, but this will make it easier for the administrators to reach out and inform the people as to what they are doing or planning to do. In the long run, both sides gain and it will bring more transparency to the system.

Plate 4.20: A DDP sensitizing programme organized by Darjeeling municipality

The sensitization of people regarding DDP was still an ongoing process at the end of 2007 (plate 4.20). Following this, the municipality had started some basic surveys in certain areas to ascertain the socio-economic profile of the people. However, the progress was slow and when the final interview with the executive officer of Darjeeling municipality was done, only basic socio-economic data was being collected. The researcher was not allowed access to the data. Darjeeling municipality has plans to use this data to determine the number of people and equipment required to introduce a two stream solid waste management system, which is discussed in greater detail in Chapter 5.

4.6 Chapter summary

The solid waste management system prevalent in Darjeeling can be described as fairly typical for any developing country. It has all the features and attributes as

mentioned in the literature (Schubeler 1996, Kuniyal et al. 1998, Rapten 1998, Gerlagh et al. 1999, Medina 2002, Chakrabarti and Sarkhel 2003), such as, existence of slums, leading to congestions and development of areas that cannot be accessed by municipal vehicles. Lack of adequate funding leading to dearth in infrastructural facilities, and lack of proper collection and transportation of waste. Lack of a formalized waste segregation, composting or recycling system and so on. There has been a rapid growth of urban population in Darjeeling, which has led to the growth in waste generation and the changing nature of waste. As shown in the other studies of solid waste management situations (Kuniyal et al. 1998, Medina 2002, Zerboc 2003), the growing urban population in Darjeeling has not been equally met with development of waste management services to all the areas. There are many areas where the only form of waste management is dumping the waste in ravines.

The solid waste management system currently being practiced in Darjeeling is primitive and rudimentary. The basic system and related problems can be described as follows:

Collection: Waste is collected in vats at a central point in a locality/area. People dump their waste in the vat, from which the municipality collects the waste and transports it to a central dumping ground/landfill, which is located in the south-western part of the town. The vats are open and often waste spills out from these vats. Waste in not disposed of in proper manner as stated in the literature.

Transportation: The collected waste is transported in open trucks or tractor trolleys. Majority of the time, the waste gets spilled over during the time of transportation.

Disposal: The collected waste is dumped in the municipally owned dumping ground/landfill. The dumping ground is open and the collected waste is dumped in the same place irrespective of the waste composition.

Recycling: The majority of the people were observed to undertake separation of recyclables such as newspapers, plastic products, glass bottles, metals etc and to sell them. The buyers are part of a thriving informal recycling system, in the absence of a formal recycling programme.

Composting: Segregation of waste for composting is basically confined to people who have gardens or flowers. The compost is used as manure for the gardens. A formal composting programme has not yet been initiated.

Infrastructure: Another major problem associated with solid waste management in Darjeeling is the lack of infrastructure and finances. According to Darjeeling municipality annual report 2006-07, over 89% of its own revenue was spent on conservancy. There is a shortage of transportation vehicles, and there are not enough dustbins across the municipal area

Dumping: Officially, Darjeeling still dumps its waste, a scientifically constructed landfill has not yet been built, and there is no segregation or recycling of waste. The dumping grounds are open and pose a health risk to not only the waste workers but the whole town and also to the people living downstream.

As stated in the literature (Cointreau 1982), solid waste management decision-making processes are typically centralized and bureaucratic in nature. The solid waste management system in Darjeeling still conforms to this norm. Even though decentralization of the decision-making process is underway, it may be a while before the results start to show. There is a lack of sincerity on part of the administrators to deal with the prevailing situation. Socio-political set up affects the decision-making process and there is a discontinuity in planning owing to new people coming to power and abandoning the process started by their predecessors. There is a definite gap

between the municipality and the common people; most of the people are not even aware of the plans or processes initiated by the municipality.

There is a definite lack of innovation and imagination on the part of the administrators. As stated in the literature (Medina 2002, Zerboc 2003), only conventional solutions have been tried, which have failed to bear results time and again. The informal sector is still not made a part of the formal sector, even though it is the informal sector which undertakes whatever recycling or reusing is done in Darjeeling. For any future management plans to be fruitful, these issues need to be dealt with.

CHAPTER 5: POSSIBILITIES FOR SUSTAINABLE SOLID WASTE MANAGEMENT

This chapter is divided into three sections. The first section describes in brief the solid waste management system recently proposed by Darjeeling municipality (2007). The recommendations made in the written proposal to the municipality [hereby referred to as "the proposal" in this chapter] have been adopted by the Darjeeling municipality and execution of the recommendations has been undertaken. The second section of this chapter discusses the strengths and weaknesses of the proposed system and the third section provides some considerations for the future that will result in a more sustainable solid waste management waste system.

The Union Government of India notified the Municipal Solid Wastes (Management & Handling) Rules (2000) under Sections 3, 6 and 25 of the Environment (Protection) Act (1986), for the purpose of managing municipal and urban wastes/garbage in an environmentally sound manner. Following this, the Pollution Control Board (PCB) issued the directive to the state government to formulate solid waste management plans for non-KMA (Kolkata Municipal Authority) areas. The Municipal Engineering Directorate (MED) was entrusted with the responsibility of developing the plan for all of West Bengal. Following this order, the MED proposed a solid waste management system for Darjeeling; the recommendations made in this proposal were adopted by the Darjeeling municipality in 2007.

5.1 The Proposal

As alluded to in the previous chapter the proposal focuses on developing a two stream waste system i.e. segregation of waste into two categories "bio-degradable"

and “non-degradable”. The basic idea is to have the waste segregated at the source itself. For segregation, it has been proposed that the municipality should organize extensive sensitizing programmes and awareness campaigns through the organization of group meetings in each ward. Furthermore, it has been proposed that leaflets on waste segregation would be distributed widely in each ward to ensure public participation in waste segregation. Further it is proposed that the municipality provide each household with two “polythene containers” (Proposed SWM system 2007) for segregation.

5.1.1Collections of solid waste

The proposal recommends that each ward should be divided into two or three beats comprising of 175-200 waste generating points. It recommends appointing one person for the purpose of waste collection for every beat, and a female supervisor for every ward. The proposal recommends the use of “one wheel barrow or three wheeled motor van” (pp. 51) for two or more beats per ward. Segregation of the waste is to be undertaken at the source, and every waste collector is expected to have separate bins to put the segregated waste. Further, partnership with local NGOs for waste collection is recommended (pp. 52). A small charge varying from Rs 10 to Rs 20 per month is to be levied for the services provided. The waste, thus collected, is to be transferred to waste transportation vehicles which will have separate sections for bio-degradable and non-degradable wastes. Bio-degradable waste is to be taken to the composting site and non-degradable waste is to be taken to the landfill.

5.1.2 Transportation of solid waste

The transporting of solid waste is recommended to be carried out using specially designed trucks or two wheeled refuse trailers. Further, the proposal

recommendation includes “waste collected in transfer station to be taken to the site within 2 to 3 hours in a train” (pp. 53).

5.1.3 Processing of solid waste

The proposal recommends disposal of solid waste through “sanitary landfill method and composting” (pp. 43). It recommends further that the compost, produced, from the bio-degradable waste, should be marketed in collaboration with local NGOs dealing in compost. However, it is further states that the manure should be packaged and marketed by the municipality. To accomplish this, it is recommended that a dealers’ and distributors’ network should be developed, and packaging is to be made in 25kgs and 50kgs bags respectively. It is further suggested that the government of West Bengal may initiate marketing the manure produced by various municipalities across the state under a common brand name. Formation of a state level cell for overall monitoring of the production and quality control of compost is also suggested. The income generated from composting is expected to be used for making the system more efficient. For disposal of the “non-degradable, inert waste” the proposal suggests dumping in the landfill on a daily basis. The proposal states “variety of non-degradable waste can be recycled after processing” (pp. 41); further, it states “NGOs may be encouraged for employing daily wage earners to collect the non-degradable waste to sale them” (pp. 41). The proposal is however silent on where the bio-degradable waste would be composted.

5.1.4 Solid waste management administration

The proposal recommends decentralization of the administration relating to solid waste management, “for effective performance”. A three-tiered decentralized

administration is proposed: ward, zonal and city level. Each tier is given specific responsibilities as outlined below:

Table 5.1: Proposed waste management administration and responsibilities

Level	Responsibilities
Ward level	Awareness campaigns, motivation, collection of waste, supervision and grievance redressal
Zonal level	Transportation of waste, training and capacity building of staff, construction and maintenance
City level	Processing, disposal and overall management, research and development, monitoring and upgrading, procurement of vehicles, equipment and land, and coordination.

Source: proposed solid waste management system (Darjeeling municipality, 2007)

In addition, the proposal also suggests that the state government should organize regular interactive meetings. These meetings are aimed at the subordinate officers in charge of solid waste management in various local bodies to exchange ideas, information, and the sharing of experiences. Public participation is referred to in section 3.1.2 (pp. 17): "success of the effective solid waste management particularly primary collection system largely depends on the proper co-ordination between people who are the generator and the staff who are the collector."

5.1.5 Creation of a planning and monitoring unit

The proposal suggests creation of a planning and monitoring unit "headed by a person having qualification and experience in public health engineering (pp. 56)." It is further recommended that this body should be subordinated to the MED, Department of Municipal Affairs, Govt. of West Bengal. The planning and monitoring unit is recommended to analyze and compare the standards, perform environmental impact assessments, determine the level of mechanization and labor required and provide feedback to the municipality and the Government of West Bengal. Further, this unit is

supposed to monitor the processing and marketing of compost. The proposal finally recommends waste collection, temporary storage, transfer, processing and disposal of waste to be made a mandatory precondition in urban planning.

5.2 Strengths and weaknesses of the proposed system

The proposed solid waste management system has many strengths and weaknesses; however, it seemed very clear that the components of the program were not designed specifically for Darjeeling. While there were statistics from Darjeeling, the plan itself was boiler plate.

5.2.1 Waste segregation

The most significant aspect of the proposal is the emphasis on developing a system which promotes segregation of the waste at the household level, which is not a regular practice in Darjeeling as shown in Chapter 4. Segregation of the waste as proposed, at the source itself is a very important feature of the proposal. It was noted in the literature review that, with the segregation of waste at the source point, the amount of waste going to the landfill is greatly reduced (Sudhir et al. 1997, Medina 2002). Segregation of waste can save valuable resources in the form of saved man hours required to deal with the un-segregated waste. Further, in the absence of the waste segregation, composting is not possible. In addition to this, the environmental damage and filth associated with un-segregated waste poses a health threat to the people, which can be avoided by following proper segregation method (Medina 2002).

The proposal is, however, mute on the segregation of non-degradable wastes into recyclables and garbage. As seen from the literature review (Medina 2002), certain types of waste cannot be recycled or composted. The absence of a mechanism

for dividing the waste into bio-degradable, recyclable and garbage is one of the main drawbacks of the proposed system.

5.2.2 Reduce, reuse and recycle (three R's)

As seen in the literature review (Medina 2002, Zerboc 2003, Drescher and Zurbrugg 2006), the three R's (reduce, reuse and recycle) are not only important, but they are the critical components of a sustainable solid waste management system. One of the major drawbacks of the proposal is that it completely fails to address these basic tenets of solid waste management. The proposal does not mention the promotion of waste reduction or reuse in the proposal. The proposal only fleetingly touches on the subject of recycling, which is one of the most important components of any sustainable solid waste management system. This is a critical omission, since the bulk of non-degradable waste is usually recyclable. Even though, recycling has been included in the discussion sections and also under basic considerations on page, in the recommendations there is no mention of recycling. Furthermore, the discussion sections (mentioned above) do mention the participation of the non-formal recycling sector and NGOs and how they might be included in any new system. The proposal, however, fails to capitalize on these discussions to form a basis for the introduction of a formalized recycling system, which can include the municipality, the community and the informal sector.

5.2.3 Waste collection

The introduction of a decentralized waste collection system is another significant feature of the proposal. As seen in Chapter 4, the current system is based on the centralized dumping of the waste in a municipal vat. The proposal recommends doorstep collection of the waste. This method of collection is preferable and more

favored than the existing system of waste collection (Sudhir et al. 1997). The inclusion of economically backward people/families as suggested in the proposal for the collection of waste is a positive step towards better collection process and provides a framework for income generation to this section of the population.

5.2.4 Waste transportation

The proposal fails to adequately address the issue of safe transportation of the waste adequately. Even though the proposal recommends the use of specially designed covered trucks for the transportation of bio-degradable waste, the use of two-wheeled refuse trailers to transfer non-degradable waste (which is the current practice) does not help in improving the system. The system can be facilitated further by adding bigger and more efficient vehicles. Further, as in the case of waste collection, some suggestions are not relevant or applicable in the Darjeeling context. For instance, the recommendation includes "waste collected in transfer station to be taken to the site within 2 to 3 hours in a train" (pp. 53). It may be mentioned here that, the train that plys in Darjeeling is a UNESCO world heritage steam engine train, popularly known as the "toy train" and completely inappropriate for this task. Furthermore, collection using "three wheeled motor van" (pp. 53) is not possible in Darjeeling; given the difficult terrain a three wheeled motor van cannot ply in the region.

5.2.5 Waste processing

Processing of waste in order to convert it to compost is a very significant recommendation made in the proposal. As seen in Chapter 4, currently there is no mechanism developed or supported by the Darjeeling municipality to promote composting. As seen in the literature review, composting is one of the most

significant aspects of sustainable solid waste management (Sudhir et al. 1997, Medina 2002, Zerboc 2003). Composting assists in the reduction of waste to a great extent. Besides the production of organic fertilizer, composting also promotes environment friendly practices. Such as reduction in the release of landfill gas emissions, foul smell covering the dump site will be greatly reduced, and composting can be an excellent source of revenue generation.

Another important feature of the proposal is the partnership between the municipality, NGOs who practice composting, and the public (communities). By fostering and promoting this partnership, the municipality can reach a broader mass base for support. The idea of a centralized marketing body for marketing the compost to be formed by the state government is another welcome recommendation. Since the state government will have access to more human and other resources, it can promote marketing of the manure produced not only within the state, but it can set up channels to export the compost to other states or countries.

The main drawback of the proposed waste processing mechanism for composting is the idea of a centralized composting system. As seen in the literature review, centralized composting systems have more often than not failed in developing countries in general and India in particular (Zerboc 2003, Drescher and Zurbrugg 2006). It can be attributed to the fact that transportation of bio-degradable waste to composting facility is a big problem for any developing nation owing to inadequate transportation facilities (Zerboc 2003).

5.2.6 Waste management administration

The decentralization of solid waste management administration is another significant recommendation made in the proposal. The formation of a three-tier administrative setup as mentioned in the proposal could promote efficiency in the administrative setup. However, public participation in the solid waste management system is confined to participation in waste segregation. Further, the role of the people in the solid waste management administration and decision making process is not defined. Public participation in the decision-making process is a critical factor for the promotion of a sustainable solid waste management system (Schubeler 1996, Bijlani 1996, Jordar 2000, Chakrabarti and Sarkhel 2003) and should be at least recognized in the proposal.

5.2.7 Planning and monitoring unit

The development of a planning and monitoring unit to analyze and compare the standards, perform environmental impact assessments, determine the level of mechanization and labor required and to provide feedback vis-a-vis the solid waste management system is one of the most significant recommendations in the proposal. As seen in Chapter 4, Darjeeling currently lacks a planning body and the formation of any such body will be a definite improvement over the current situation. Further, the lack of monitoring in the current system is evident and the development of a monitoring body to access and monitor the progress of the solid waste management system can help the system move towards greater sustainability. The subordination of this body to MED, the Department of Municipal Affairs, the Government of West Bengal, will allow this body to generate support and backup for the development of any plans. The proposal fails to mention however, who will constitute the body. If

there is non-inclusion and participation of community leaders and people in general, this body can become hierarchical and take a top-down approach to planning, which has been the main problem with the current planning systems.

The recommendations made in the proposal to make waste collection, temporary storage, transfer, processing and the disposal of waste a mandatory pre-condition in urban planning is another significant feature of this proposal. This will help the municipality to design and plan the future development of the city in such a manner that a mechanism for sustainable solid waste management will be automatically incorporated.

The roles of various actors as envisioned in the proposed solid waste management system can be thus summarized as follows (see table 5.2):

Table 5.2: Roles of various actors as envisioned in the proposed SWM system

Objectives		**Municipality**	**Service users**	**Business establishments**	**Local organizations and NGOs**
Planning and management	*Strategic planning*	Develops the plan	No role identified	No role identified	No role identified
	Legal and regulatory framework	Developed by municipality	No role identified	No role identified	No role identified
	Public participation	Informs people about the plan	Follow the plan	Follow the plan	Assist in sensitizing people regarding the plan
	Financial management	Controls the finances	Pay user fees	Pay user fees	No role identified
	Institutional Arrangement	Decision makers	Elect municipal representative	No role	Collaboration for sensitizing people
	Disposal facility	Responsible for operation and maintains	No role identified	No role identified	No role identified
Waste generation	*Waste characterization*	Promotes two stream waste segregation	Two stream	Two stream	No role identified
	Waste	No role	Segregation	Segregation into	No role

	minimization	identified	into degradable and non-degradable	degradable and non-degradable	identified
Waste handling	*Waste collection*	Door step collection	No role identified (besides two stream segregation of waste)	No role identified (besides two stream segregation of waste)	Collaboration for collecting of waste and recyclables
	Transfer treatment disposal	Overall in-charge for collection and composting	No role identified	No role identified	Collaboration for marketing of compost
	Special wastes	No role identified	No role identified	No role identified	No role identified

5.3 Moving beyond the plan

This section discusses issues that can be investigated in order to initiate sustainable solid waste management plan in the future. It also highlights the roles people see themselves playing to promote better management. Further, this section will show the perception of different sections of the communities with regards to what role they see for other stakeholders in promoting such a system.

5.3.1 Initiating better management

Depending on socio-economic and political factors different sections of the community will have different perceptions regarding the solid waste problem. This is equally true in the case of suggesting solutions. During the course of the study, it was found that people were open to sharing ideas and suggestions regarding development of a sustainable solid waste management plan. When asked what can be done to initiate better management of solid wastes, Mrs. Rewati Pradhan a resident of ward 7, said, "People can start by dumping waste in a proper place so that the authorities can collect it. Besides this, there is a need to promote awareness and involvement of the people." Answering the same question another respondent said, "I guess, telling

people and informing them would be a good start. I am willing to participate in any waste management plan and so are most of us in our area, but the municipality should inform us."

The business community is equally in favor of "something better", and they seemed willing to share their views and follow a common goal. When asked what can be done, Mr. Rizwanur Ali said:

> "I guess, the most important thing is to educate people regarding the harmful effects of waste in terms of their health, the outlook of the city and how it can hamper tourism which is definitely one of the most employing sectors in Darjeeling. Involvement of people from all different sectors is a must. See, people in Darjeeling are passionate and all it takes is to make people realize the significance of the issue and how it is going to affect their lives. Everyone from the town chipped in to collect 1 crore rupees to buy a CT-scan machine, if it's possible to buy a CT-scan machine, it is also possible to keep the town clean".

Echoing the same view, Mr. Niresh Agarwal a member of Darjeeling Chamber of Commerce, said, "Better management of solid waste requires involvement of every stakeholder. I may keep my place clean but it's not fair if I dump my waste in your garden. So, involvement of everyone is necessary."

Involvement of the people, through awareness, education and participation, is the common theme that emerges in relation to how to make the system better. Sharing similar sentiments Mr. Karan Tamang said, "… see the target area is very important, what is being tried to achieve? From here people who are knowledgeable in this issues like academics, community people or leaders etc. should be involved in the decision making process. At the least, these people should be asked for their opinion on the issue." The communication gap between the common people and the municipal administration seemed apparent, and it was confirmed by one municipal employee: "… you cannot blame municipality 'the body', but you can blame municipality 'the people'. There is a definite communication gap, but the fault lies with ward

commissioners, it is their responsibility and duty to ensure that people in their respective wards are informed and involved."

5.3.2 Willingness to change

The development of a sustainable solid waste management system is dependent on the active participation of all the stakeholders. People in general are willing to participate in developing a system which will be better than the prevailing system. When asked what they were willing to do to ensure the functioning of such a system, people were initially surprised by the question but gave positive responses. "I will do all I can to make our town cleaner. I will segregate waste, separate them and put them in proper places, pay the fees etc., but the municipality should take care of the waste after that and not let the waste collect for weeks on end like it does currently" said Ms. Anamika Lama a resident of ward 7. When asked the same question Mr. Bardhan Mukhia a student of RKSP high school said, "I can volunteer to convince people in my area and help in spreading awareness. I can also volunteer my labor. I can give in my free time to help in whatever way I can."

The business community in Darjeeling also sees itself playing certain roles in terms of making the current situation better. When asked one restaurant owner responded, "… as an individual, I will be willing to train myself in waste management activities. From our organizational perspective, I can then train my staff." Larger business organizations such as resorts and hotels are also open to this idea. Responding to the query Mr. Ali said,

> "…as I said before, it is not just for me say what I am going to do. From the hotel side we can support any initiative that is beneficial to us and to the local people in general. We are already composting and we are ready to recycle, provided there is a system in place. As an organization we can help by providing sponsorships to any efforts made towards educating the people, and we will do the same with our staff".

When asked about the role of educational institutes in spreading awareness Mr. Kapil Rai said:

> "As the adage goes "today's students are tomorrow's future", so educational institutes can play a major role in transforming the society. Make one student aware, he/she will make his/her family aware and they can in turn make their village aware. In this way our society can progress, instead of people in power thrusting their decisions on people. For something to succeed it has to start from the grassroots".

Emphasizing the role educational institutes can play, Mr. Karan Tamang said, "Educational institutes definitely have a big role to play. The role or impacts of educational institutions are tremendous, since they have greater social responsibility. They are not only making people literate they are imparting knowledge, so they can give direction to a society."

It is evident that people are open to the idea of being included in the solid waste management program and they are willing to contribute their time and resources to make the system work better.

5.3.3 Stakeholder participation

Participation is the key to the success of a solid waste management plan, but participation should be uniform and a complementary process to the efforts made by different stakeholders. When asked what role they saw other stakeholders playing, a resident who lived near the dumping chute said.

> "…the hotels need to inform the tourists and municipality needs to improve its services. The municipality is very corrupt, they are the real problem, and these corrupt people may not let the system run smoothly. We need to change our politicians they are more like dictators. Sincere people need to be roped in, like people who know about waste management and who are not hungry after money or power".

Local social organizations like *Sai samity, samaj, bhajan mandalis* etc. emerged as very important factors in terms of management and social perspective. As one respondent said,

> "… schools and colleges can help by keeping their compound clean and also by keeping their nearby area clean as well. NGOs and Organizations like S*ai samity* and *bhajan mandalis* and clubs and s*amaj* can help physically. Authorities can provide financial help and also conduct awareness programmes."

Speaking on what role other stakeholders can play, Mr. Mohammed Asif, a businessman said, "…everyone must contribute positively, and it should be a common theme, rather than sporadic efforts. School and colleges can help by spreading awareness, municipality can help by providing back up and support and the state government can provide funds". Similar sentiments are echoed by Mrs. Suman Gurung who runs a vegetable stall, "…municipality must do their work properly, and they should make sure that the rules are being followed properly, while other people can follow the guidelines as laid by the municipality."

When asked on the role of the municipality, Mr. Thatal said, "people can contribute by throwing the waste in proper places to begin with, we are going to start this segregation programme soon and people should segregate their waste properly, business community should also be equally involved and responsible."

5.3.4 Decision making

As stated in the literature decision making process in a developing country is basically hierarchical and generally it is a top-down process (Cointreau 1982), which can be an impediment for the development of a sustainable solid waste management process. Hence, it is important to promote a bottom-up approach to decision making. When asked if they wanted to be included in the future decision making process the

answer was an emphatic "yes". People want to have a say in future policy development and they want to contribute positively. Speaking on the issue a senior lecturer at the Loreto College, Darjeeling, said,

> "…the authorities start something, and for few days people follow it, but eventually process fails again. What the authorities fail to understand is why? And I guess, because people are not informed and people are not told about the issue people stop caring about it after a while. If people are made part of a process which explains why something needs to be done, I guess people will follow the decision they made".

"If I am allowed to have a say in decisions made then I will definitely follow the decision arrived at after due consultation, who will not?" questions Aarati Gurung a college student.

For the future, "I will support more bans, like not just poly bag but items like g*hutka* packets, chips packaging, and if they prevent people from littering the place it's even better", said Sonam Tenzing a resident of ward 12. Many other people supported the idea of possible future bans on certain items. "I guess, chips and ghutka wrappers should also be banned or somehow controlled…. if some how these items and items like plastic bottles could be controlled, Darjeeling would be much cleaner", said a respondent. Answering the same question Mrs. Radhika Sharma said, "Yes. The next step should be to either ban the use of ghutka or make people pay fine if they throw the *ghutka* and chips packets in the streets."

Mr. Karan Tamang said, "…the lack of our involvement in decision making and the inability of authorities especially our elected representatives to consult us or inform us is I believe the main problem with current system. No one knows who is doing what and why. Hence, for any future system to be successful, involvement of people, information to people and transparency are the basic requirements". Similar sentiments were echoed by Mr. Kapil Rai:

> "…the decision is always made by someone in authority, but that person cannot be everywhere, he/she cannot visit every part of the municipality. So what he/she can do is to allow people from ones respective area to document the issues there. These people being locals can document issues and give pointers as to what people aspire for, what they need and how the goals can be achieved? After this, they can develop a plan, and this should be followed by a period of awareness, for which the municipality can take the help of school and college students. Once people are aware, it will not only ensure faster implementation of plan but also support and encouragement of the locals. So, if plans are undertaken with the approval of people we can work better and faster and our future as a society will be brighter".

An engineer working with DGHC had a simple and straight forward solution to offer, "Formulate a plan with the help of communities and experts; involve people in the implementation of the plan. Make people feel that this is their plan and not something being thrust upon from the top." The Darjeeling municipality acknowledges that people's participation is crucial, and though late it has started the process of including people in decision making process. In regards to this, Mr. Thatal said,

> "…our immediate goal is to complete the socio-economic profile under DDP. Once it is completed we will go for further discussion with local people and we will inform them and consult them on regular basis. See we have already formed ward committees, and the committee members are local citizens, they will now suggest how their respective area can be developed. So we are entering a new kind of planning process, called collaborative planning. I am sure this will be better than our previous approaches".

Talking about the future, Mr. Roshan Rai, however, had a different but interesting view point:

> "I will start with an example people do not believe in composting. So we need people to be convinced, what we require is some good examples of segregation and composting within the town, so that people can go and see for themselves. So, I would look at some strong physical pilot initiatives for people to see and take notice of, this is a very common and important practice in terms of introducing a new solid waste management initiative. We need strong examples in Darjeeling, institutional examples, community examples and individual examples. Examples lead by people from Darjeeling in Darjeeling. The solid waste management rules need to be contextualized in terms of social, economic, geographical and political scenario of the place, we don't have that, and we need to do that. We should develop enough physical infrastructures to support for these ideas to move forward".

Hence, it is seen that the people want the future system to have mechanisms which will allow them to participate in the decision-making process. The importance of information sharing and communication on the part of the municipality has also emerged strongly. A system which lacks active public participation is bound to fail again, as on many previous occasions.

5.4 Short term plan of action for solid waste management in Darjeeling

Having looked at the current solid waste management scenario and issues related to it, the need for the development of a comprehensive and sustainable solid waste management plan is of paramount importance. As outlined, the current plan only covers one aspect of a sustainable waste management system, namely segregation for composting. This will allow the municipal authorities to take an iterative step towards a sustainable solid waste management plan.

In the meantime, there are certain steps that can be undertaken to jump start a long term planning process. Such steps are contained in the following short term plan of action (herein referred to as "the short term plan of action").

5.4.1 Develop a base line data

Developing baseline data consisting of: 1) the population distribution within the municipal area. This will help in identifying potential areas where more resources in terms of waste collection etc. needs to be concentrated, 2) amount of waste generated in different parts of the municipal area. This could also help in determining those parts of the municipal area that could require more concentration of municipal services, 3) composition of waste. This will help in identifying areas where concentration of composting facilities may be more viable than others, 4) socio-economic condition of the people. This will allow the municipal authorities to identify

potential candidates who could be employed for the doorstep collection of the waste and composting, 5) existing institutional arrangements, and 6) hydro-geological issues. This will enable the municipality to identify potential collaborators, such as community organizations, educational institutions, NGOs etc. with which the municipality can get into partnership for solving the waste problem. These parameters will enable the decision makers to take a holistic view of the issue and allow them to make decisions or develop policies based on available parameters.

Drescher and Zurbrugg (2006) have argued that, all the factors need to be considered for developing a long term plan. This can be done through expediting and broadening the scope of the data collection process already started through DDP. Various *samajs* and traditional organizations need to be involved in the data generation process. The participation of school and university students can expedite the data collection process. The responsibility of the data collection related to population distribution, amount of waste generation and waste composition should be given to local organizations like *samaj*; and they should be assisted in the process of the data collection by educational institutions. School and university students can also be involved for sensitizing people. It will be easier for the local organizations and educational institutes to collect these data in their respective localities. There should be a ward level monitoring committee, which will provide necessary support to the local institutions. Experts, scientists and decision makers should be in constant contact with the ward committees while the data is being collected, so that the data collected is relevant and appropriate. Data relating to socio-economic condition, institutional arrangement and hydro-geological issues could be conducted by the municipality or could be conducted in collaboration with local colleges (university sections) or NGOs that have the expertise. Funding for the data collection should

come from the municipality, however, if in case the municipality lacks necessary funding, the Central or the State government or various developmental and funding agencies can be approached for the same.

Triangulation and analysis of the collected data should be undertaken by a committee of experts. In case of the municipality lacking necessary expertise, the State government or local colleges (University sections) could be approached for providing the same. Any policy or administrative decision that is arrived at after the analysis of data, should be undertaken after due consultation with the people or community leaders and organizations.

5.4.2 Develop immediate targets

Targets should be developed in order to move the existing system towards sustainable solid waste management system. The targets should be developed in consultation with local people (communities), and experts. Necessary targets could include: 1) diversion of the waste from going into dumping ground/landfill. Reduction of waste is the key to developing a sustainable solid waste management system and one of the most important parts of an integrated waste management plan (Sudhir et al. 1997, World Bank 1999); 2) increase in the recovery of materials for recycling; 3) introduction of ward level composting initiatives; 4) public involvement in the decision making process and waste management system. Mechanisms should be put in place to include the people in the decision making process. Mechanisms could be in the form of a policy requiring compulsory community participation and consultation etc. The same people involved in DDP should also be trained in sensitizing people. In addition, assistance should be sought from existing social institutions like *samaj*, *sai samity*, local educational institutions, and clubs etc. to conduct mass awareness

programs. This will also be beneficial for including public opinion in the decision-making process.

5.4.3 Promoting three stream waste segregation

The segregation of waste should be done at the source. As seen from arguments made by Medina (2002) and Derscher and Zurbrugg (2006), the waste should be segregated into three streams i.e. bio-degradable, recyclable and non-degradable. The municipality should immediately modify their current plan to include three stream waste system. More frequent collection of waste from the vats and also the doorstep collection of waste should be introduced. Adequate infrastructure should be provided for transportation of segregated waste (Medina 2002, Zerboc 2003). The municipality should make appropriate provisions for the collection and transportation of waste. Closed waste transportation trucks with separate compartments for segregated waste should be immediately commissioned. The informal sector could be included in the formal process, by developing a role for them. The informal sector could be involved in the doorstep collection of recyclables.

5.4.4 Promote community-based composting

As stated by Zerboc (2003) and Derscher and Zurbrugg (2006) centralized composting has been a failure in developing countries in general and India in particular. Instead of centralized composting, as recommended in the proposal, community-based composting should be promoted at the ward level. The area selected for composting should be decided in consultation with the local community. Economically backward people from the locality could be employed for the doorstep collection of compostable. Operation of the compost site can be undertaken with the money collected from household and business units. The municipality can also market

the composts in collaboration with local NGOs or business enterprises and generate revenue by selling the compost at competitive prices in the market.

5.4.5 Promoting the three R's (reduce, reuse and recycle)

Immediate focus should be placed on promoting waste reduction, reuse and recycling of waste. Segregation of waste will enable people to divert recyclables and bio-degradable items from going to the landfill. Informal waste collectors should be included and made part of formal recycling system (Kumar and Gaikwad 2004). This will help by saving resources and the existing market for recyclable items can be exploited without having to invest heavily in marketing (Medina 2002). The role of the formal sector should be more oriented towards educating people and toward promoting recycling, and the informal sector should be made a part of the formal recycling system. Moningka (2000) argues that coordination within different sectors of solid waste management will ensure efficiency and emphasis should be placed on the involvement of other actors besides the municipalities. Hence, a coordinated approach to reduce, recover and recycle should be undertaken.

5.4.5 Continue the ban on poly bags

The ban on poly bags has been recognized as a positive step towards waste reduction. Hence, the ban should be continued. In order to get the ban back on track, the municipality could work in collaboration with the local community groups, NGOs and educational institutions to generate awareness among the population. It should be followed with deposit-refund system for plastic bottles and packages for chips and *ghutkas*. In case the deposit refund system is not practically applicable, people should be encouraged to throw these items in designated bins. A fine may be imposed for those who litter.

5.4.6 Development of a comprehensive sustainable solid waste management plan

It should be noted that a comprehensive solid waste management plan should be prepared as early as possible. The general public, community-based organizations and other stakeholders should be made part of the decision making process. The plan should be implemented with the help of community people and organizations.

This short-term course of action plan as suggested by the researcher, will lay the ground work for the development of a comprehensive and sustainable integrated solid waste management plan in the future. The roles of various actors as envisioned in this study are summarized in (Table 5.3).

Table 5.3: Roles of various actors as envisioned in this study

Objectives		**Municipality**	**Service users**	**Business establishments**	**Local organizations and NGOs**
Planning and management	*Strategic planning*	Develops the plan in collaboration with people, NGOs and community organizations	Actively participates throughout the planning process	Actively participates throughout the planning process	Provides backup and support and monitors the whole process
	Legal and regulatory framework	Developed by municipality in collaboration with other actors	Actively participates and shares ideas	Actively participates and shares ideas	Gives inputs and monitors the process throughout
	Public participation	Involves people and NGOs and community organizations for the decision making process	Actively participates	Actively participates	Assist in sensitizing people regarding the plan, provide back up and monitor the whole process
	Financial management	Provides scope for community level management of funds	Actively participates in ward level committees	Actively participates in ward level committees	Monitors the whole process
Planning and management	*Institutional Arrangement*	Facilitators and provides specialists and support	Becomes part of the decision making body	Becomes part of the decision making body	Facilitators, provides coordination
	Disposal facility	Responsible for operation and maintains in collaboration with other actors	Participates in identification and operation of local compost sites	Participates in identification and operation of local compost sites	Monitors local compost site, coordinates collection and employment of workers for compost sites.
Waste generation	*Waste characterization*	Promotes three stream waste characterization	Segregates waste into degradable, recyclables and garbage	Segregates waste into degradable, recyclables and garbage	Promotes waste segregation and monitors the process at community level

Objectives		Municipality	Service users	Business establishments	Local organizations and NGOs
Waste generation	*Waste minimization*	Promotes reduction, reuse and recycling	Segregates waste into degradable and non-degradable	Segregates waste into degradable and non-degradable	Promotes reduction, reuse and recycling and monitors the process
Waste handling	*Waste collection*	Door step collection	Segregates waste, takes degradable to local compost sites.	Segregate waste	Involves informal sector for collection of recyclables
	Transfer treatment and disposal	Overall in-charge for collection and transfer of non-degradable, non-recyclable and hazardous wastes	Disposes waste after proper segregation	Disposes waste after proper segregation	Collaborates for marketing of compost and recycling with informal and private sector.
	Special wastes	Overall in-charge of harmful and hazardous waste. Treats scientifically	Takes proper precaution and segregates harmful and hazardous wastes	Takes proper precaution and segregates harmful and hazardous wastes	Monitors overall process

5.5 Chapter summary

The proposed solid waste management system for the Darjeeling municipality has many strengths and drawbacks. The proposed system is a positive step towards development of a sustainable solid waste management system in Darjeeling.

The proposal recommends the development of a two stream waste management system. The emphasis on the segregation of waste at the source is a very strong feature of the document. Even though it is an improvement on the existing system, it fails to address the issue of the three R's: reduce, reuse and recycle, which is an integral part of any sustainable solid waste management system. The proposed waste collection system is scientific; however, certain features of the collection method do not apply to the Darjeeling municipal region. The proposed transportation of waste is definitely an improvement on the current system, but recommendation on the use of open bodied trailers for the transportation of non-degradable waste is questionable. The proposal also suggests methods of transportation that are not applicable in the Darjeeling municipal region.

The proposal suggests processing of the waste and production of composts, along with proposed marketing strategy to be developed in partnership with local NGOs. A decentralized administrative set up is also suggested. The main drawback of this proposal is the failure to emphasize public participation in solid waste management administration and decision making. In the absence of public participation any solid waste management system may be difficult to sustain.

People in general were open to sharing responsibilities and ideas in terms of developing a sustainable solid waste management system. They saw a role for themselves and others as well. People are ready and willing to contribute time and resources to develop a better system. People want to get involved in the decision-making process and they want transparency and openness on behalf of the municipality. The Darjeeling municipality, on the other hand, wants people to support its policies. It has started the process of initiating DDP, even though this process should have come earlier, but as the adage goes, “better late than never”.

CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This research responds to the need for an assessment of Solid Waste Management in Darjeeling, West Bengal, India. The objectives of this research were: 1) to describe and explain the solid waste management system and practices in Darjeeling; ii) to identify the factors that influence solid waste management in the Darjeeling setting; iii) to assess the newly proposed solid waste management system, and iv) to propose recommendations for development of a sustainable solid waste management system.

Darjeeling municipality is situated in the sub-Himalayan mountainous region of West Bengal in India. It is a part of the eastern Himalayan complex, which has been declared a biodiversity hotspot, providing habitat to critically endangered species like the snow leopard, red panda and Himalayan black bear. Nepali is the primary language of communication for the majority of people living in the Darjeeling municipality.

Field work for this study was undertaken between May 2007 and December 2007. The field work involved interviewing 40 different individuals from four different groups of people: general public, business personnel, NGOs and community leaders and municipal authorities. In addition, an extensive review of secondary data and published material was undertaken and integrated with the research. This enabled the researcher to generate a holistic view of the problem and perceived solutions.

Analysis of collected data was undertaken and emerging trends and patterns provided critical insight into the solid waste management scenario in Darjeeling. Keeping in view the trends and patterns, a short-term plan of action was developed.

The short-term plan of action developed in this study will complement the proposed solid waste management system and recommends the development of a comprehensive integrated solid waste management plan in the future.

6.2 Conclusions

This research provides an assessment of the existing solid waste management system in the Darjeeling municipal area, including a review of the proposed solid waste management system (2007). Analysis based on the key factors, such as waste generation, waste disposal practices, waste collection and transportation, changing nature of waste etc. shows that the current solid waste management system (both existing and proposed) is unsustainable in the long run. The proposed system is an improvement upon the existing system and has many strengths, but it does not address the whole issue. The municipal government has initiated a process of solid waste management change that has the ability to develop over time. The municipal government is open to new ideas. General conclusions that relate to the study objectives are detailed below.

6.2.1 Current system

Solid waste management system as currently practiced is unsustainable in the long run. Waste is not segregated, and the collection and transportation of waste is basic and inadequate. Collection and transport methods are rudimentary and pose both human and environmental risk. People, in general, indulge in dumping waste in street corners, *jhoras,* or municipal vats, which are open and often overflowing. Collection services were found to be infrequent and inadequate. Recycling and composting of the waste is undertaken by individuals with interest, however, there is no provision for composting or recycling of solid waste by the municipality. Recycling is completely

undertaken by the informal sector, which is inefficient, hazardous and risky. Darjeeling lacks a sanitary landfill and the municipality practices open dumping. The dumping ground is near the fringes of the town, thus posing a health threat to the people living near the dumping ground, and an environmental risk to the entire area. There are no safety measures in place for waste workers; immunization and basic services such as the provision of safe clothing and proper equipments are not provided by the municipality.

6.2.2 Factors influencing solid waste management

Among the many factors influencing solid waste management, five key factors were identified: 1) decision making process; 2) public perception of the waste problem; 3) lack of transparency and information sharing; 4) relationship between political stability and governance, and 5) self-organized grass roots level organizations.

It was found that basically, decision making is top-down and bureaucratic. There is a gap between decision makers and the people in terms of information transformation. Most of the people are not informed about the decision undertaken by the authorities. People in general are not aware of the decisions made and the municipality does not involve public for discussion or consultation. It results in the majority of the executed plans failing due to the lack of public support and participation. It was further observed that even though many people regard wastes as a threat, very few people regard waste as a priority problem. In addition, it was found that the plans and processes initiated by one set of people in power are often abandoned mid-way if a new set of people come in power. Finally it was observed that the grassroots level organizations such as *Samaj, Sai Samity* etc. have the

potential to influence the solid waste management in a positive manner by involving and ensuring public participation in solid waste management system and the decision making process.

6.2.3 Proposed solid waste management system

The municipality proposes improving the current system by developing a two stream system, and it is an improvement over the current practices; however, the proposal has many strengths and weaknesses. The proposal fails to address critical issues like public participation in overall waste management and decision making, reduction, reuse and recycling of the waste are not mentioned. The proposal recommends centralized composting, which has been a failure in India so far. The role of informal sector for recycling is not mentioned. Some of the recommendations made in the proposal are not applicable and irrelevant in the Darjeeling setting. Development of a planning and monitoring unit and marketing of manure produced under the state government are perhaps the most relevant recommendations made in the proposal. The proposal completely ignores the roles that can be played by local social organizations such as *samaj*, *bhajan mandali* etc. One gets the feeling that the proposal has been developed for somewhere else and common themes have been copied and pasted. The proposal needs to be redesigned to fit local needs through a participatory process

6.3 Recommendations

The sustainability of any solid waste management system depends on numerous factors; however, the most important factor is the will of the people to change the existing system and develop something better. People in the Darjeeling municipal area in general are willing to contribute positively and participate in a solid

waste management system. The Darjeeling municipality seems open to ideas and opinions and it has initiated the process of implementing a Draft Development Plan (DDP). Given this background recommendations for development of a sustainable solid waste management system are as follows.

6.3.1 Public consultation and involvement

Policy development in Darjeeling has always been the prerogative of those who are in power. Given the complexity of issues and problems, it is apparent that the top-down solutions and management strategy for solid waste management will not be sustainable, because sustainable solid waste management depends on the participation of citizens in the system. For any future solid waste management system public consultation should be made a prerequisite. By doing so, the Darjeeling municipality stands to gain on many different fronts. Foremost, public involvement in decision making may help the Darjeeling municipality to bring the issue at hand to the people. This may in turn help in informing the people and making them aware of the existing problems or solutions proposed. People may be able to share their ideas, thoughts and concerns regarding various aspects of solid waste management in Darjeeling. This may make the system transparent and efficient, as decisions once taken with general consensus will be easier to execute and people will be hopefully more willing to help to execute the plan by reducing their waste, segregating their waste and so on.

Consultation can be achieved through participation of the general public or through a body selected, elected, or appointed by the people at the ward level. The idea of a ward committee as mentioned in the WBMA (1993) is one such body. However, care should be taken that the ward committee is composed of people from all sections of the society. Another way to ensure participation may be through *samaj*.

These grass-roots level organizations already have an existing structure of their own and a widespread reach in the community, and since these organizations work purely on voluntary non-profit basis, consultation can be undertaken at the *samaj* level.

Social organizations such as s*amaj*, *bhajan mandalis*, and institutions such as schools and colleges should be used in spreading awareness and information transformation. This will save time and valuable resources for the municipal authorities. Regular ward level meetings should be organized to keep the people involved and informed. Baseline data on the status of waste - generated, collected, properly disposed, recycled, composted and thrown in the street etc - should be generated. For this, too, local bodies and institutions can play a substantial and an active role. Research and development should be promoted and encouraged.

6.3.2 Set targets and goals

The Darjeeling municipality needs to set targets and goals in terms of what it wants to achieve in the future. A realistic proposition would be to set a target of diverting at the least 15% of waste each year from going to the landfill. A goal of ensuring maximum possible diversion may be set to be achieved within five years. In terms of recyclables, targets should be set to improve collection and recovery of recycling materials, involvement of informal sector in recovery of recyclables should be achieved within first two years.

Littering in all forms should be discouraged, and people who litter should be made liable for legal action. Education, awareness and information sharing regarding solid waste issues, should be made a priority. People should be made a part of the solution. Certain indicators should be developed to monitor the progress. For instance, no plastic bottles being thrown in the garbage could be an indicator of success in

terms of recovering recyclables. The Darjeeling municipality should set a target town, i.e. a town it may want to look like in next five or ten years. It could be mountain town from within India, say Munnar or from outside India, say Whistler, in British Columbia, Canada.

6.3.3 Creation of three stream waste system

Long-term sustainability of the solid waste management system also depends on the level of segregation of waste. Segregation of waste should be three stream i.e. bio-degradable, recyclables and garbage/waste; this will also help in finding appropriate disposal options. Segregation of waste should be done at the source itself. Segregated waste can be collected on a weekly basis from households and on a daily basis from business establishments.

6.3.4 Promotion of reduction, reuse, and recycle

Emphasis should be placed on the three R's – reduction, reuse, and recycle. This will help in creating of less waste and in increased material recovery. Reduction can be achieved by starting a deposit-refund system, i.e. it should be made compulsory for certain types of waste to be taken care of by the company producing them under extended producer's responsibilities. In order to ensure that these particular wastes go back to the producers, an extra deposit (20-30% of the price) could be charged when someone purchases these items, and this deposit should be recoverable on return of the items (say cover/foil/plastic bottles etc.). This may reduce the burden of waste to a great extent. Wastes such as chip packages, *ghutka* wrappings, drinking water bottles, soft-drink bottles, etc. should be included in this system.

The recycling of waste is another important requirement for sustainable waste management practices. In the case of the Darjeeling municipality a formalized waste recycling or recovery system, should be undertaken by the municipality. NGOs or private firms may be enlisted in organizing and including the non-formal recycling sector as part of the formal system. Rag pickers or itinerant buyers should be allocated in such a manner that the maximum amount of waste is recovered for recycling.

6.3.5 Composting

Large scale composting can be expensive and may not work in Darjeeling; hence the focus should be on developing ward level, or preferably community level, small-scale composting processes. Community-based composting helps in diverting a major portion of the waste generated close to the source of generation, thereby, significantly reducing transportation costs and prolonging the life span of landfills. Furthermore, community-based composting may enhance recycling activities, and facilitate the final disposal of waste in a proper manner. People who are from economically backward categories may be employed for composting schemes. This can be a source of employment and income generation for both the people employed for composting and the municipality as well. Community level composting may be efficient and easier to manage. Community level composting can be undertaken at the local level, thus, it will save money and resources for the municipality.

6.3.6 Collection of waste

Collection of the waste should be undertaken at the doorstep level and people from economically backward sections may be employed for the same. These people should be properly trained and equipped. The collected non-degradable materials should be removed using covered trucks and trailers. Care should be taken not to spill

the waste during transportation. All the collection workers should be provided with proper handling equipments and their safety should be ensured by the municipality.

6.3.7 Waste disposal

Disposal of the waste should be undertaken in a prescribed scientific manner. A sanitary landfill designed specifically for the final disposal of wastes should be built. Sanitary landfills minimize the risks to human health and the environment associated with solid wastes. Formal engineering preparations with an examination of geological and hydrological features and related environmental impact analysis should be carried out before a sanitary landfill is built. Staff working in the sanitary landfill should be properly equipped and trained. Darjeeling municipality should find a proper location for a sanitary landfill.

Disposal of hazardous waste such as medical or toxic waste should be undertaken with the help of the state government. Special provisions should be made to adequately deal with these wastes, and special transportation facilities and specially trained staff should be employed for dealing with hazardous wastes. The municipality should immediately seek help from the State and the Central government in this regard.

6.3.8 Responsible bureaucracy

Bureaucrats are the back bone of any civil organization. In case of volatile and continuously changing political situations, the bureaucrats ought to play a pro-active role in ensuring that the projects and plans and processes are not affected by the prevalent political situation. In the case of a change in government at the municipal level, provisions should be made to grandfather the plans and processes, started by the previous board. Plans and processes ought not to be allowed to be abandoned mid-

way, which results in loss of time and resources. Bureaucracy can play a dynamic role in ensuring the smooth functioning of the municipality and this mechanism should be included in the planning process itself.

6.3.9 Development of long term plan

The above mentioned recommendations are applicable in the short run and can be undertaken immediately. However, there is a need to develop a long term plan, which will take into consideration all the factors and stakeholders. Thus, the development of an integrated solid waste management plan is recommended.

6.4 Final thoughts

Following the understanding of the socio-cultural, and geo-political setting of the area, along with the understanding of the strengths, weaknesses and problems associated with current waste management system and practices recommendations were made here based on the literature review, understanding of the issues and inputs from the thesis committee members. These recommendations have the potential to make the solid waste management system in Darjeeling, West Bengal, India, more sustainable in the future.

This research endeavors to include a holistic view of the solid waste management situation in Darjeeling. Prior to this study, no research or studies had been carried out in terms of the solid waste management system in the Darjeeling hills; this study has partially filled that gap. However, a complete study of the problem including geographical, hydrological, environmental and socio-economic factors could help in providing new avenues for knowledge generation. Thus a complete interdisciplinary study undertaken with the help of GIS and satellite mapping technology will help further understand the problem and solutions.

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APPENDIX – I: HOUSE HOLD INTERVIEW SCHEDULED

- How many members are there in your family?
- Is your family involved in any waste management plan or system? If yes, can you briefly describe it?
- Do you undertake any segregation of waste at home? Please describe in brief
- Is there any composting of organic wastes that you are aware of? Is there any centralized or backyard composting? Is there any institutional composting e.g. by municipality office, school, etc?
- Are there any recycling programmes in your locality/area/ward? Describe (if any) and give details of collection and separation.
- What are the major constituents of waste (Organic, biodegradable, non-degradable, inorganic, plastics etc)?
- How has waste composition changed over the years (trends and changes)?
- What has been the major area of concern in terms of waste composition (particular article/item, changing nature of composition etc)?
- Do you think that the geographical location of your place plays a hindrance towards proper solid waste management?
- What is the role of local municipality in Waste Management?
- Were you ever invited by the various Govt. Depts. to discuss or deliberate waste management situation in Darjeeling?
- What do you think about the process that is being followed by the Govt offices? Top-down bottoms up etc.
- How has the ban on the use of poly bags influenced your perception about the waste problem? Has it contributed to changing/educating your view/attitude towards environment in general or any environmental problem in particular? If yes how?
- Do you feel the need for more such bans or policy initiatives?
- Are you satisfied with the current process of decision making? If no then what changes do you suggest should be incorporated to make the current decision making process better?
- What is your perception about the solid waste management situation in Darjeeling, ranking the problem vis-à-vis other problems prevailing here, like law and order, drinking water, health facilities, communication system – road, telephone, internet, drainage facilities etc.
- What can be done to initiate better management of solid wastes? What role do you see for yourself to do the same? What role do you see for other stakeholders to complement your effort? (Participation can be at two levels – with time and with financial resources).
- How much time or resources are you willing to contribute? What are your expectations from other stakeholders? Will the collective effort be enough to take care of the problem at hand? If no, what will be the shortfall? Who will have to be roped in?
- Can such a mechanism suggested be sustained? What efforts are necessary to sustain the system once operational?
- How can government (at the levels of village, block, district, state, national and international) and informal sector be involved? Which individuals/

groups/organizations can be the key in achieving government/informal sector involvement/support?

- What are/ could be the major impacts of existing government policies on conservation and environmental education in terms of ensuring cross-scale institutional collaboration with special reference to solid waste management?

APPENDIX – II: BUSINESS COMMUNITY SURVEY LIST

- How many rooms does your hotel have? How many passengers do you cater to in a year?
- Does your hotel have a waste management plan or system in place? If yes, can you briefly describe it[2]?
- Do you have any segregation of waste? Please describe in brief
- Is there any composting of organic wastes that you are aware of? Is there any centralized or backyard composting? Is there any institutional composting e.g. by municipality office, school, etc?
- Are there any recycling programmes in your organization? Describe (if any) the programs for paper, glass, metals, cardboard, and plastic. Give details of collection and separation.

    i. What are the major constituents of waste (Organic, biodegradable, non-degradable, inorganic, plastics etc)?
    ii. How has waste composition changed over the years (trends and changes)?
    iii. What has been the major area of concern in terms of waste composition (particular article/item, changing nature of composition etc)?

- What is the role of local municipality in Waste Management?
- Were you ever invited by the various Govt. Depts. to discuss or deliberate waste management situation in Darjeeling?
- What do you think about the process that is being followed by the Govt offices? Top-down bottoms up etc.
- How has the ban on the use of poly bags influenced your perception about the waste problem? Has it contributed to changing/educating your view/attitude towards environment in general or any environmental problem in particular? If yes how?
- Do you feel the need for more such bans or policy initiatives?
- Are you satisfied with the current process of decision making? If no then what changes do you suggest should be incorporated to make the current decision making process better?
- What is your perception about the solid waste management situation in Darjeeling, ranking the problem vis-à-vis other problems prevailing here, like law and order, drinking water, health facilities, communication system – road, telephone, internet, drainage facilities etc.
- What can be done to initiate better management of solid wastes? What role do you see for yourself to do the same? What role do you see for other stakeholders to complement your effort? (Participation can be at two levels – with time and with financial resources).

[2] The first two questions were asked to the hotels only, rest of the questions are common for all business community.

- How much time or resources are you willing to contribute? What are your expectations from other stakeholders? Will the collective effort be enough to take care of the problem at hand? If no, what will be the shortfall? Who will have to be roped in?
- Can such a mechanism suggested be sustained? What efforts are necessary to sustain the system once operational?
- How can government (at the levels of village, block, district, state, national and international) and informal sector be involved? Which individuals/ groups/organizations can be the key in achieving government/informal sector involvement/support?
- What are/ could be the major impacts of existing government policies on conservation and environmental education in terms of ensuring cross-scale institutional collaboration with special reference to solid waste management?

APPENDIX – III: AUTHORITIES, COMMUNITY LEADERS & NGO SURVEY LIST

- Who/which agency is responsible for solid waste management in Darjeeling? Where does this agency derive its power from (constitution, acts, and regulations etc)?
- Does the agency hold enough power to formulate rules, laws or policies pertaining to solid waste management in Darjeeling? If not, which agency/government (state, central) formulates such rules, laws or policies?
- Who/ which agency/government finances solid waste management in Darjeeling? Is it the local municipality, state government or the central government? What are the financial provisions? Does the local municipality collect taxes, levies etc for solid waste management?
- What is the current population being catered to by the waste management agency?
- What is the situation in terms of infrastructure (number of waste collection vehicles, personnel employed for waste collection and management etc)?
- How is the waste collected and transported in Darjeeling municipality area? Describe the method of collection, e.g. pick-up by tractors/trucks; individual drop-off, transfer station, and frequency of collection;
- Are there any user fees.
- How are special wastes (solvents and paints, used appliances, used oil and filters, used tires, medical wastes, dead animal and carcasses) handled?
- How many dumps/landfills are in operation? How far/near are they from the town? Are there any households/villages near these dumps?
- Is there any abandoned dumps/landfills? Where are they located?
- What are the major components of solid waste management currently practiced?
- Identify problems with the system, e.g. dumping along the access road.
- Any other unofficial dumping sites?
- Is there any reduction or reuse programmes? Describe in details if any.
- Is there any composting of organic wastes? Is there any centralized or backyard composting? If so, how many households participate? Is there any institutional composting e.g. by municipality office, school, etc.
- Describe any barriers to participation in composting activities
- Is there any recycling programmes? Describe (if any) the programs for paper, glass, metals, cardboard, and plastic. Give details of collection and separation.
- Describe any barriers to participation.
- How many dumps/landfills are in operation? How far/near are they from the town? Are there any households/villages near these dumps?
- Is there any abandoned dumps/landfills? Where are they located?
- Any other disposal practices?
    i. Frequency of burning? Is it an official practice? Where does burning take place?
    ii. Is littering an uncommon phenomenon or a major problem?
    iii. Is there any instance of waste burial? If yes, where?
- What is the state of dump/landfill?
    i. What is the estimated size of the dump?

ii. What is the estimated amount of garbage deposited annually? (Volume or weight estimate)
iii. The particular features of this facility?
    1. How long has it been in operation?
    2. Are there any dedicated areas for different types of wastes?
    3. Is there any existence of monitoring well, liner, leachate collection (if any)?
    4. What is the expected remaining capacity (in volume or years)?

- What is the state of operation for this dump/landfill site?
    i. Who manages the operation of landfill/dump?
    ii. Is the site supervised during operation hours?
    iii. Is the access to the site is controlled (fenced, locked)?
    iv. What kind of waste is not accepted in the dump site?
    v. Are the wastes separated? If yes, How?
    vi. What is the method for filling (trenching, burying, dumping down a hillside, piling, compacting, covering etc)?
    vii. What are the problem with this site (at or near capacity, odors, health hazard due to rodents/animals/birds, windblown or scattered garbage, groundwater contamination, distance from other land uses, etc)
- Questions on nature of waste composition
    i. What are the major constituents of waste (Organic, biodegradable, non-degradable, inorganic, plastics etc)?
    ii. How has waste composition changed over the years (trends and changes)?
    iii. What has been the major area of concern in terms of waste composition (particular article/item, changing nature of composition etc)?
- How can government (at the levels of village, block, district, state, national and international) and informal sector be involved? Which individuals/ groups/organizations can be the key in achieving government/informal sector involvement/support?
- What are/ could be the major impacts of existing government policies on conservation and environmental education in terms of ensuring cross-scale institutional collaboration with special reference to solid waste management?
- How do we promote exchange between formal and informal waste management sectors for effective and sustainable waste management system? How can the communities be involved in management?
- Are existing policies adequate to promote sustainable waste management? If not, what are the policy issues that needs to be looked into? Who are the main players? How to bring them to a common platform? What are possible road maps in this regards?
- What should be the areas of priorities in terms of waste management (reduction, composting, source separation, improving collection and transportation of waste etc)?
- Can/should private sector be involved in sustainable solid waste management? If yes, what role can be played by the private players?

- Can/should tourists be involved in sustainable waste management system? If yes, how? What incentives/disincentives should be designed in order to promote sustainable waste management system?
- What role can general people/ local solid waste management experts/ community/Non-governmental organization/development agencies/government at various levels, can and should play in promoting sustainable solid waste management?

APPENDIX – IV: ETHICS APPROVAL

APPROVAL CERTIFICATE

27 September 2007

TO: **Upendra Mani Pradman** (Advisor T. Henley)

Principal Investigator

FROM: **Wayne Taylor, Chair**

Joint-Faculty Research Ethics Board (JFREB)

Re: **Protocol #J2007:061**
"Development of a Plan for Sustainable Solid Waste Management in a Mountain Ecosystem, at Darjeeling, West Bengal, India"

Please be advised that your above-referenced protocol has received human ethics approval by the **Joint-Faculty Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement**.** This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note:

- **if you have funds pending human ethics approval, the auditor requires that you submit a copy of this Approval Certificate to Kathryn Bartmanovich, Research Grants & Contract Services (fax 261-0325), <u>including the Sponsor name</u>, before your account can be opened.**

- **if you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.**

The Research Ethics Board requests a final report for your study (available at: http://umanitoba.ca/research/ors/ethics/ors_ethics_human_REB_forms_guidelines.html**) in order to be in compliance with Tri-Council Guidelines.**