CHAPTER-I

INTRODUCTION

1.1 Background

Nature, current technology and existing and easily achievable productive capacities taken together could provide everything needed by the entire world's people. In pursuit of fulfilling their needs, people consume food and use other materials and in this process they produce waste (Pearce, 1989). These waste known as solid waste refers to non-gaseous and non- liquid unwanted materials disposal off by man, which can neither flow into streams nor escape immediately into the atmosphere. It includes municipal garbage industrial and commercial wastes, sewage, sludge, waste of agricultural and animal husbandry, demolition and construction wastes and mining residues.

There are two types of wastes: biodegradable and non-biodegradable. Biodegradable waste such as paper and other organic wastes are able to be broken down by natural processes. The inorganic waste which is not able to be broken down by natural processes is known as non-biodegradable wastes.

Solid wastes or its generation has changed with the changing stage of human civilizations. In the agricultural stage, mostly organic materials were generated as waste. It was easy to dispose without any nuisance, because plenty of area was available. But later, with the growing population, urbanisation and industrialization more of inorganic waste is generated. Today, solid wastes are growing environmental pollution issue especially in urban localities. They are pollutants of soils, air and water with important implication for public health. They are also aesthetic or

visual pollutants. They are primarily urban problems of the world. Therefore, management of solid waste is necessary.

Solid waste management is a recently developed concept which has been felt by the world's people. Once it was commonly thought of as simple "pick up the waste and go dump it in a hole somewhere". Today, nothing can be farther from the truth. When done well solid waste management successfully blends the diverse interests of a large "stakeholder" community together. Waste management still is a linear system of collection and disposal, creating health and environmental hazards (Gupta, 2004).

Solid waste management includes all activities that seek to minimize the health, environmental and aesthetic impacts of solid waste through different methods like recycling, land filling and composting etc. It entails for more than the removal of waste from the place of its origin to the remote disposal location. It requires technically appropriate and economically viable collection, handling, transportation and disposal system and day to day control and direction of many activities. Above all, it requires profound change in attitude and behavior of the target population itself.

In early times, the disposal of waste did not pose significant problem for the population was small and the amount of land available for disposal was sufficient. The quantity of waste produced was not very significant and the community had own system of managing wastes, but today, as the density of the population and the volume of traffic increase with the urbanisation process, the total quantity of waste discarded by the community now cannot be accepted by the nature. The impact of uncontrolled and accelerated urbanisation in Gangtok has been most serious in terms of waste disposal.

Different projects have been approved by the State Ministry of Urban Development and Poverty Alleviation in Sikkim with the assistance of the Ministry of Urban Development and Poverty Alleviation, Central Government of India. At present department maintains fleet of garbage disposal.

Under the Sikkim Non- Biodegradable garbage (control) act 1997 and the Sikkim Non- biodegradable garbage (control) rules, 2001 no one is allowed to throw biodegradable or non- biodegradable waste in any public place or in any drain ventilation shaft pipe and fitting connected with the private or public damage except in appropriate garbage receptacles.

From the year 2000, the sanitation rules for towns of Sikkim have been extended to whole of Sikkim vides notification no.104 (181)/BD and HD/1986 2000 dt. 17. 60 2000.

1.2 Statement of the Problem

Rapid urbanisation, one of the most important demographic and social changes of the centuries has both positive and negative environmental impacts (Brandon and Ramankutty, 1993). Nevertheless, its expansion rate differs from place to place and from time to time due to different factors such as growing population, rising income, increase in living standard, infrastructure development health and education facility and employment opportunities etc in the region.

The quantities of solid waste generated in developing countries are increasing rapidly and may double (UNCHS, 19994), by the end of the decade. People have been facing many problems in managing solid waste. The problem includes collection, transportation and disposal of solid waste. Most of the waste produced in the cities remain uncollected and are dumped on vacant lands or into sewers and rivers. And those, which

are collected, are often disposed off in open dumping grounds on an unacceptable manner, which stimulates numerous discomforts to the communities.

Similarly, with the rapid growth of urban population and increase in tourist traffic there has been proportionate increase in the quantum of garbage and wastage in the town and bazaar area of Gangtok. The lack of proper management of solid waste disposal has been felt in Gangtok. Waste has been haphazardly disposed over empty lands, streets, footpaths and *jhoras*. In addition, the traditional rural habit of throwing waste outside the house still exists in urban areas. Beside there is a lack of social awareness and inadequate technology, technical manpower and knowledge has also attributed to the problem of solid waste management.

Problems from solid waste not only pose serous problems with regards to health and environment but also deteriorate the intrinsic beauty of Gangtok.

1.3 Objectives of the study

The objectives of the study are as follows:

1. To examine the current solid waste management system in the study area.
2. To analyze the sources and composition of solid waste.
3. To explore the problems and prospects of solid waste management.

1.4 Significance of the study

At present solid waste management has emerged as a serious urban environmental problem. Currently, some efforts are being made to tackle these problems. However, it does not seem to be sustainable. This study tries to view the overall waste problem and waste management system of the Gangtok Bazaar.

The present study is important as it gives information about how the concerned authorities are dealing with solid waste problem in order to manage them properly using modern and advanced technology.

1.5 Limitations of the study

The limitations of the study are as follows:-

1. The present study has been confined within the defined area i.e. Gangtok Bazaar, so the findings derived from this study may not be applicable for wider generalization.
2. The composition of the wastes has not seen shown in terms of chemical or biological components.
3. Many of the information are based on field observation so the researcher is not responsible for any change that is seen after field observation.
4. The study may not be a high theoretical value since it is basically descriptive one.

1.6 Organization of the study

The study is composed of following contents. Chapter I includes introduction part of the study, statement of the problem, its objectives and limitations. Chapter II comprises with the review of literature and Chapter III deals with the methodology of the study. Likewise Chapter IV introduces with the study area, Chapter V describes the results and discussion of the study. Lastly, Chapter VI comes out with conclusions and recommendations.

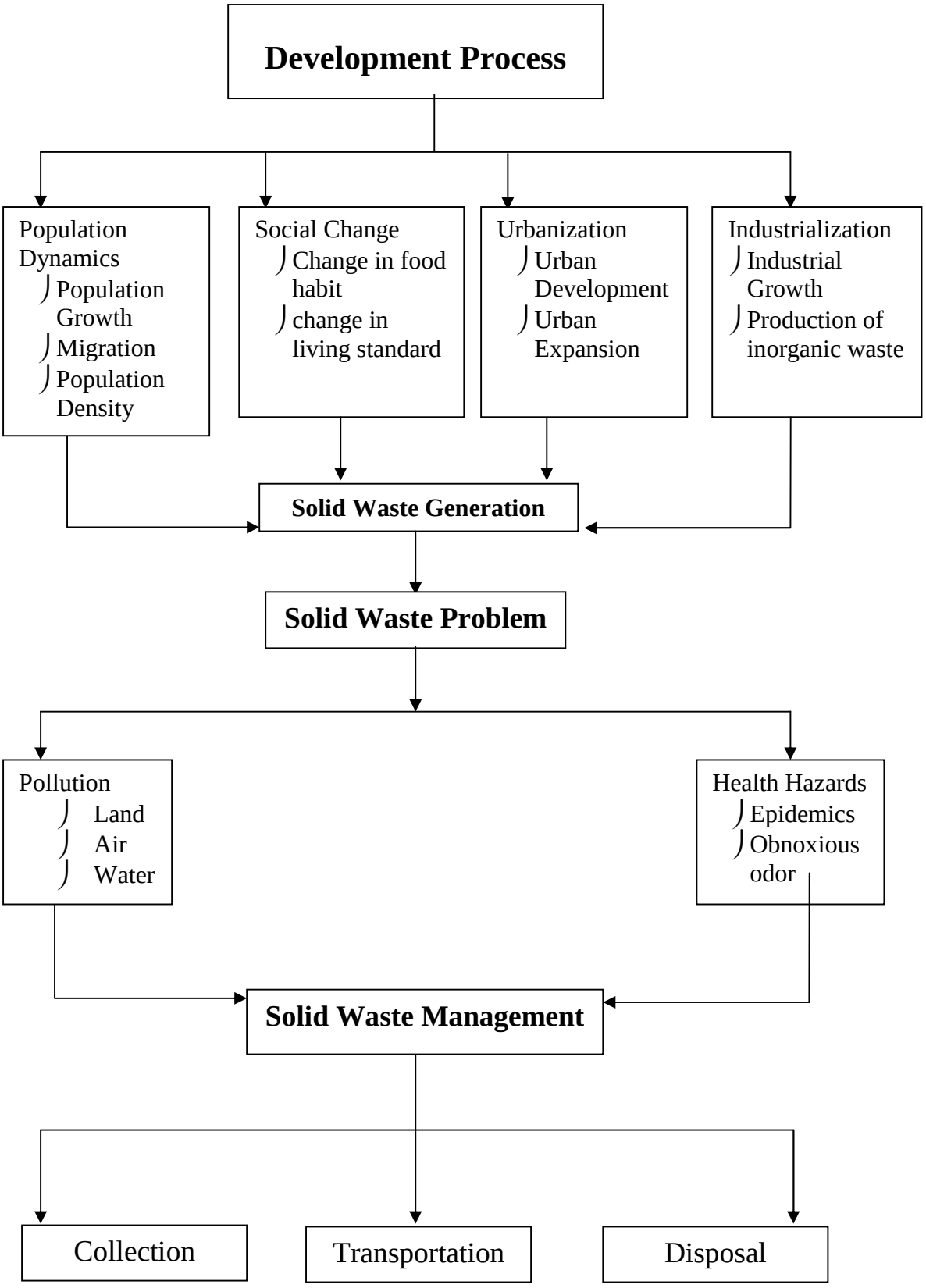
CHAPTER II

LITERATURE REVIEW

Economic growth and the increased pace of urbanization and industrialization in many countries have confronted cities through out the world with the increasingly complex task of managing tons of solid wastes that are being generated daily. Generation of waste also depends on income and consumption habit of the people. Increasing urban migration and high density of population also adds to the generation of waste and all ' these factors will make waste management a difficult issue to handle in the near future, if a new paradigm for approaching it is not created (Gupta, 2004). Since waste generation is continuous and ever lasting process, its solution must be found out in right time and thereby to provide healthy environment and hygienic living condition. Attention to such problem has been attracted a number of scientific researches, empirical studies and reports. This study consists of solid waste and its generation, sources and composition and its management. In this light, review of literature has been reviewed through journals, articles, reports, academic researches and published books.

2.1 Conceptual Framework of the study

Figure: 1



2.2 Review of Literature

2.2.1 Solid waste and its Generation

Booth-(2001), has stated that solid waste includes the whole range of rubbish, garbage, sludges and other discarded solid materials, including those from industrial, commercial and agricultural operations and from community activities that are no large wanted or needed by their users.

Gupta (2004), has mentioned that waste generation has a strong relationship with consumption, linked to per capita income. As per capita income rises, more savings are spent on goods and services. According to him, waste can be wealth as it has immense potential not only for generating livelihoods for the urban poor but also enrich the earth through composting and recycling.

Palnitkar (2000), has defined solid waste as a term specially used to describe non-liquid waste material that arises from domestic trade, commercial, agricultural and industrial activities.

Spreen (1995), analyzed that the waste production is the result of urbanization and Industrialization. Migration from rural to urban areas and improved medical care, combined with birth rates, led to an enormous growth of urban population a development, which of course, increased waste volume greatly. Industrial development has led to the manufacture of many new inorganic substances. He concluded that, since, these substances cannot decompose; the natural process of waste transformation does not absorb these substances.

Pradhan (2004), discussed that increase in the volume of solid-waste generation is directly related to the rapidly growing population, change in consumption pattern and social behavior. He further adds that the rapid urbanization and industrialization has added to the heaping of solid waste which is the most visible problem in the country and its management is becoming a problem day by day.

A report submitted to UNDP/Nepal (1992), states that the rapid growth of urbanization leads to the corresponding increase in living standard of people which further leads to the increase in per capital waste generation. As a result the traditional method of disposal ceases to function.

2.2.2 Type, sources and composition

Munasinghe (1995), has categorized urban solid wastes as (i)Municipal solid waste which contains paper, plastics, glass, metals and various other household items, including street sweepings and general refuse from commercial and institutional establishment, (ii) Hazardous industrial waste includes waste from manufacturing plants and (iii) Clinical and Medical wastes contains waste from hospitals and medical shops.

Jadhav (1995), has mentioned that the sources of solid wastes are municipal from street sweeping and sewage treatment plants; domestic from garbage, rubbish and other large waste; industrial from manufacturing units, mining from coal mining and similar fertilizers and pesticide residues.

Becker (1997), made a study on community organization and assessed that change in quality and composition of municipal solid waste in south Asian cities is directly related to political- economic and social factors. He assessed that the composition of waste in Nepal has shifted toward more inorganic and non- biodegradable waste since 1950s. Besides, the major reasons for the change in composition can be traced to rising standard of living and change in public taste.

2.2.3 Solid waste management

Miller (1988), has discussed about the 3 major ways to deal with solid waste: throw away output approaches, resource recovery output approaches and input approaches. He said that the throw away output approaches on which we primarily rely should be shifted to a sustainable earth or low-waste approach. With this approach most of what we throw away would not be viewed as solid waste but as wasted solids, which should be reused, recycled or burned to provide energy. He further adds, this resource recovery output approach can be coupled with input approaches designed to produce less solid waste.

Asnani (1990), has made a study on solid waste management in the city of Ahmedabad in which he describes about the beauty of the historic city being marked by Garbage sites all over the city. His paper draws attentions to the World Bank assistance to tackle the problems and modernization plan for better understanding. Besides, the paper also hopes that the system' introduced by municipal cooperation of Ahmedabad would be able to provide a much healthier environment to the citizens by keeping the city clean.

Cointreau (1991), analyzed the effectiveness of waste collection in the developing countries. He concluded that waste collection differs rather strongly and priority is usually given to commercial areas, main streets and more prosperous neighbors. In addition, many of urban poor live in unplanned and unauthorized areas and are, therefore, not eligible for municipal service. Most municipal solid waste management schemes spend 90% of their budget on collection and transportation of waste, but only 50% to 70% of the waste the generated is collected and less than 50% of the population is served.

A study done by JICA (2005), shows that appropriate solid waste management could not be always functioned well because of lack of common consciousness, frequent communication and technical knowledge and skill in addition to the existence of a kind of the territorial imperative. However, through the study, it can be set a high valuation on the fact the all concerned especially Technical Working Group (TWG) and Task Force (T/F) members could stand up and work together for proper management of solid waste.

Divan and Rosencranz (2001), carried out the study on the Environmental law and Policy in India in which they discussed about the report prepared for the Planning Commission in 1995 in India. This report acknowledges the progressive decline in the standard of services with respect to the collection and disposal of waste.

Thapa (2000), made a study on the solid waste management of Dharan Municipality. The study has been divided into two zones in order to show the spatial analysis of waste production: - fringe area, those areas extended to the municipality boundary and core area, those wards that do

not extend to the municipality boundary. According to her, core zone produce higher amount of waste because the main market center of the municipality lie in this zone and are well served by the waste management activities. On the other hand, in the fringe zone waste production is least as compared to the core areas.

Jumelet et.al. (1999), mentioned solid waste management-as an essential urban services, which intends to achieve the objectives such as protection of pubic health, promotion of hygiene, recycling of materials, and reduction of emissions and residuals. According to him, healthy city must have a planned programme for collection and proper handling and disposal of solid so as to create a safe and pleasant urban environment.

Sinha (1990), presented a paper about solid waste management in urban areas in Malaysia. In this paper, she mentioned that the proper storage, collection, transportation and disposal of urban solid waste were essential to protect public health. She emphasized that the disposal of municipal's solid waste was an obligatory and function of the local authorities under the existing urban legislation.

Thapa and Devkota (1999),carried out the study of Waste Management System in Kathmandu and have categorized management system of solid waste into three categories primary or household, secondary and tertiary level of management. They assessed that if these three levels of waste management go systematically then obviously there will be appropriate solid waste management. But there is dissatisfaction in each and every level of management due to which the service has been inadequate and ineffective and urban people are facing problems.

Garg et.al. (2002), studied about the Management and Handling of .solid waste in India. Further, they have mentioned about the Municipal solid wastes (Management and Handling) Rules, 2000 notified by Ministry of Environment and Forest (India) on 27th September, 2000 to regulate the management and handling of the municipal solid waste. This is an attempt to provide a set of rules and responsibilities for all the municipal solid waste in a scientific manner.

Klundert and Scheinberg (2000), considered, institutional, social, environmental, political, technical and financial aspects, while emphasizing the critical role that different stakeholders- including waste pickers, women, micro and small enterprises- play in waste management operations such as collection, treatment, recovery, reuse, recycling and prevention.

2.2.4. Problems

Divan and Rosencraz (2001), discussed that in most cities, the collection, transport and disposal of municipal solid waste is haphazard, segregation of organic, inorganic and recyclable wastes at the household level does not exists. Also door to door collection is rarely practiced; community collection bins are poorly designed and are usually no more than open dumps on the roadside.

Thirmurthy (1992), in his study attempts to fulfill the crisis of solid waste management which is due to the lack of appropriate technology by formulating an appropriate systems dynamics model comprising four major sectors, namely, the population, economic activity, environmental facility and urban developments programmes.

Katyal and Satake (1998), have assessed about the solid waste management system, comparing developed and the developing countries, while in the developed countries high technology are used for resource recovery, in many cities in developing countries garbage is sorted out by hand for reuse. Developed countries like Japan, UK, and USA are in the vanguard of waste utilization. On the other hand though several materials are recycled and reused, but by and large waste utilization has still not taken roots in the developing countries.

Beukering et. al. (1999), have discussed about the urban government in developing countries which are constrained by limited finances and inadequate services which prevent them from tackling the problem effectively. This paper attempts to understand the solid waste management process on the basis of an evaluation of the waste flow in the study area of Banglore. The flow evaluation highlights various priority issues that need to be addressed in future solid waste management planning in Banglore as well as other Indian cities.

Gupta (2004), has made study on the problem of urban solid waste in India, analyzing the fact that India is likely to face a massive waste disposal problems in the coming years. Closer look at the current and future scenario reveals that waste needs to be treated holistically, recognizing its natural resource roots as well as health impacts. Though there have been a variety of policy responses, yet sustainable solutions either of organic or inorganic waste remains unattended.

2.2.5. Effects

Brandon and Ramankutty (1993), have analyzed the disposal system of solid waste in the Asian countries. They concluded that the

difficulty of finding and managing landfills combined with the strain of keeping up with growing demand have led to inadequate solid waste disposal systems. Besides, in landfills site, solid waste creates problems including obnoxious odors, smoke from fires, leaching of chemicals into surface and ground water and breeding of rats, flies and other disease vectors due to which the local people have to face the problem.

Munasinghe (1995), has mentioned that waste collected in the developing countries are often dumped in peri-urban areas which poses a great concern to the poor neighborhoods who occupy the least expensive urban areas that are next to industrial sites, dumps sites and areas with high population. The affected population range from municipal workers who collect and dispose of the garbage to the scavenging families who live and work at the dump sites- but all affected groups represents the urban poor.

Katyal and Satake (1998), have studied about the solid waste pollution. They have provided an idea about the extent and nature of wastes available in the country. Giving an example of open dump outside Ring Road in New Delhi, they analyzed that the disposal of garbage and other solid waste appears to be much simpler but the real magnitude of the solid waste problems becomes apparent. Municipal waste is generally carried to the city periphery where it is dumped in open landfills on neighboring village lands. These dumps are poorly managed and are swarmed by vermin and mosquitoes.

Roa (1999), presented a paper about perception on effects of environmental pollution in Hyderabad city. In this paper, he explained that the urban environmental pollution and health hazards are being

increased rapidly. This study provides important clues to all the concerned authorities because they also consider the social costs and benefits of people in making decision and implementation of the policies.

Pandey (2004-05), studied about the health problem among the waste workers. He concluded that the waste workers suffer highly from neighborhood health problems since dumping sites are the only places where they can reside. He has highlighted the waste workers of KMC who are suffering from different health problems like physical injuries such as cuts, bruises and ruptures in the body and physical pains and aches and poisoning problems can also occur while handling rotten wastes. Allergies are serious health problems among the waste workers such as skin rashes, itching, irritations and eye irritations etc. There are also other diseases such as respiratory tract diseases and gastrointestinal diseases from which the waste worker suffers.

CHAPTER - III

METHODOLOGY

3.1 Selection of the study area

Gangtok, the capital city in the East district of Sikkim has been selected for the study purpose however, a quick survey of Gangtok shows that the bubble of modernization has burst with a bang in the town. The capital is definitely not behind in the rest of the world in terms of urbanization. Besides, growing population also has led to increase in waste generation rate. Thus these days managing the waste has come up as a major problem in Gangtok.

3.2 Sources of Data

This study was based on the following data sources. They are as follows:-

3. 2. (i) Primary Data

This study is basically based on primary information. The primary data were collected during the fieldwork by interview and questionnaire. Responses of local peoples were regarded as the major sources of field information.

3. 2. (ii) Secondary Data

Secondary data were also collected for this study and they have been collected from the concerned agencies such as department of Urban Development and Housing Development (UDHD) Government of Sikkim. Beside these, different books and reports related with solid waste have also been collected for this study.

3.3 Methods of Data Collection

Different methods have been adopted to gather data necessary for this study. They are briefly discussed as follows:

III. 3. (i) Sampling Size

Systematic sampling has been done for the collection of data. Main Street i.e. Mahatma Gandhi Marg of Gangtok Bazaar was selected for this study. M.G. Marg is the heart of capital city. It is the main commercial area of Gangtok and maximum waste of Gangtok is generated from this area. Total of 60 samples were collected, 30 of residential area and 30 of commercial area. First household were selected systematically at an internal of 3 households.

Attempt was to cover all the 60 households but only 53 households were surveyed due unavailability of authentic information.

III.3. (ii) Questionnaire Method

Both the structured and semi-structured questionnaire was used in the study area for the primary data collection.

III.3. (iii) Interview Method

Informal and open interviews were conducted with the officers and staff members who were directly or indirectly related to this study.

III.3. (iv) Observation

Field observation was made to gather the knowledge about the existing situation of waste and its management system. Field observation was also done for the institutional area of Gangtok, it was carried out from M.G. Marg to institutional area of Gangtok where Gangtok Degree

college, government schools, Sikkim Time Coperation and Sikkim Jewels are located.

The total distance of institutional area from M.G. Marg is 5 km. 10 stations were selected for observation with the distance of 500m of each station. Data were collected for both sides of the road between one to next station.

3.4 Methods of Data Analysis

Data derived by questionnaire method are analyzed mostly by descriptive method. All the data collected are processed by simple statistical tools like tabulation and percentage have been used to analyze the collected data. Necessary maps, diagrams and charts are also presented for further illustrations and findings.

CHAPTER IV

INTRODUCTION TO THE STUDY AREA: GANGTOK

4.1 Location

Gangtok is the capital of Sikkim, a small Himalayan state which is the second smallest state in India. Gangtok means the 'Hill top' situated at the height of over 5800 ft. It occupies the west side of a long ridge flanking the Rani River.

Sikkim is divided into four districts: Mangan in North, Gyalshing in West, Namchi in South and Gangtok lies in East district. The division of the districts is based on the dividing lines of the two river systems- Tista and Rangit.

Gangtok with an area of 367sq.miles only became the capital in the mid-1800s (previous capitals were at Yuksom and Rabdsantse). It was a small hamlet until the construction of the Enchey monastery in 1840 made it a pilgrimage centre. It became a major stopover between Tibet and British India at the end of the 19^{th} century. After India's Independence in 1947, Sikkim became a nation state with Gangtok as the capital. Gangtok is also a centre of Tibetan Buddhist culture and learning with numerous monasteries and religious educational institutions.

Quality of population to a large extent depends upon the pace of urbanization. According to Devi Prasad Boot, urbanization is a very recent phenomenon in Sikkim. Gangtok was the only urban centre according to the census of 1951. In Gangtok, alone 72% of the urban population lives. It is the only class III towns. Other than Gangtok, the towns are classified as class VI towns. Today, Gangtok has undergone rapid urbanization in recent years. It has developed into a composition flavors where old charm and hospitality exist along with the internet age.

4.2 Physical Settings of the study Area

4.2. (i) Geography

Gangtok lies at hilltop. It is located between latitude $27^{o}2^{'}$ to 28^{o} North and longitude 88.4^{o} to 89^{o} East. It is situated in the lower Himalayas at an altitude of 1780 meters (5800 ft) in South East Sikkim. Its geography is dominated by most majestic mountain chain in the world which includes the Kanzchendzonga, the word's third highest mountain and is worshipped as the guardian deity to their land.

4.2. (ii) Climate

The climatic variation is determined by latitudinal change as well as elevation. The climatic conditions within the Sikkim vary from the tropical in the south to the alpine in the north. Gangtok enjoys a mild temperate climate all year round because of its elevation and sheltered environment. The average temperature has recorded to a maximum of 20.7 ^{o}c to minimum of 13.1 ^{o}c in summer and a maximum of 14.9 ^{o}c to minimum of 7.7 ^{o}c in winter. Temperature below freezing are rare. The average annual rainfall is 3894 mm.

4.2. (iii) Drainage System

The configuration of the state is partly due to the direction of main drainage which is southern. The Tista and Rangit are the main rivers of Sikkim which forms the main channels of drainage run nearly north to south. The valley cut by these rivers and their chief feeders are very deep. Valleys are rather open towards the top, but usually attain a steep gorge like structure when it approaches the bed of the rivers. There are two important lakes in Gangtok, the famous Tsomogo Lake and Aritar Lake. The other important rivers are Rangpo, Dikchu and Rani.

4.2. (iv) Vegetation

The flora of Sikkim shows a bewildering degree of admixture of species within different stands of vegetation. Vegetation graduates from alpine to subtropical and temperate deciduous. Gangtok includes temperate, deciduous forests of poplar, birch, oak and elm, as well as evergreen, coniferous trees of the wet alpine. A wide variety of rare orchids are often featured in flowers shows around the city. Bamboo grows in abundance along the slopes of Gangtok, providing a perennial source of spring water. The total area covered by the forest is 2646 sq.km. (36 percent) of the total land area.

4.2. (v) Soil

The soil type of the study area are mixed, black loamy soil in the central and southern area where the elevation ranges from 700 meters to 1600 meters and the northern part of the area i.e. 1600 meters to 2200 meters is covered by mixed red loamy soil. The black loamy soil and mixed red loamy soil are good for cultivating rice, maize, millet, wheat, buck wheat and oilseeds.

4.3 Social and Economic Settings

4.3. (i) Population

The decadal population variation in the study area is high and has changed with the passage of time. The total population of Gangtok was 25024 in 1991 which increased to 29354 in 2001 (Census 2001) and is still increasing. The density of population in east district, Gangtok is 257 person sq. km, which is the high density in terms of district wise. The capital city, Gangtok is regarded as the largest urban agglomeration in the state. In Gangtok alone 72% of the urban population lives.

Table 1: Pouplation of Gangtok - 2001

Population	No. of Population	Percent (%)
1. Male	15914	54
2. Female	13440	46
Total	29354	100

Source: Statistical Profile, 2004-05

4.3. (ii) Religion and Ethnic Group

Hinduism and Buddhism are the two largest religions in Gangtok. Gangtok also has a sizeable Christian population.

Ethnic Nepalis, who settled in the region during British rule, comprise the majority of Gangtok's population, Lepchas, native to the land and Bhutias also constitute a sizable portion of the populace. Additionally, a large number of Tibetans have immigrated to the town in recent years. Beside these, there are other ethnic groups such as Gurungs, Magars, Tamang, Sherpa and Marwari and others.

4.3. (iii) Literacy

According to census 2001, the average literacy rate in Gangtok is 84.86%. The average male literacy rate is 83.67% as against 80.29% for female.

Table: 2 Literacy Rate in Gangtok - 2001

Population	No. of literates	Percent (%)
1. Male	13035	57
2. Female	10012	43
Total	23047	100

Source: Statistical Profile, 2004-05

4.3. (iv) Occupation Structure

In Gangtok most of the people are engaged in government service followed by business and others. According to 2001 census, the total worker in Gangtok is 40.50%. The average male worker is 56.02% and the average female worker is 21.87%.

4.3. (v) Transport and Communication

Sikkim does not have any airport or railheads because of its rough terrain. The closet airport, Bagdogra Airport, is near the town of Siliguri, West Bengal. The airport is about 124km away from Gangtok. The closet railway station is New Jalpaiguri which is situated 16 km from Siliguri. There is only one national highway 31A which links Siliguri to Gangtok. The highway is all metalled road which mostly runs parallel of the river Teesta, entering Sikkim. Numerous public and privately run bus, jeep and taxi services connect the airport, railway station and Siliguri to Gangtok.

In terms of communication, Gangtok is well served with telephone service, post office and electricity connected to network brings people quite easy to get message and keep in touch with the existing world.

4.3. (vi) Tourism

Being a capital city there is a maximum number of tourist inflows. 'Top of hill' lures visitors with its fabulous views of magnificent Mt.khangchedzonga. Its strategic location, a strong Buddhist presence and heady cultural offerings are a tempting insight into this stimulating land. Situated a short distance from it is the ancient Rumtek monastery. The town is a convenient base for trips to the etheral environs of the mystical Tsomgo Lake and Nathula Pass.

Similarly there are other tourist places such as Himalayan Zoological Park, Burtuk waterfall, and other holy places such as Enchey Monastery, Gonjang Monastery and Pal Zurmang Kagyud Monastery in the surrounding areas.

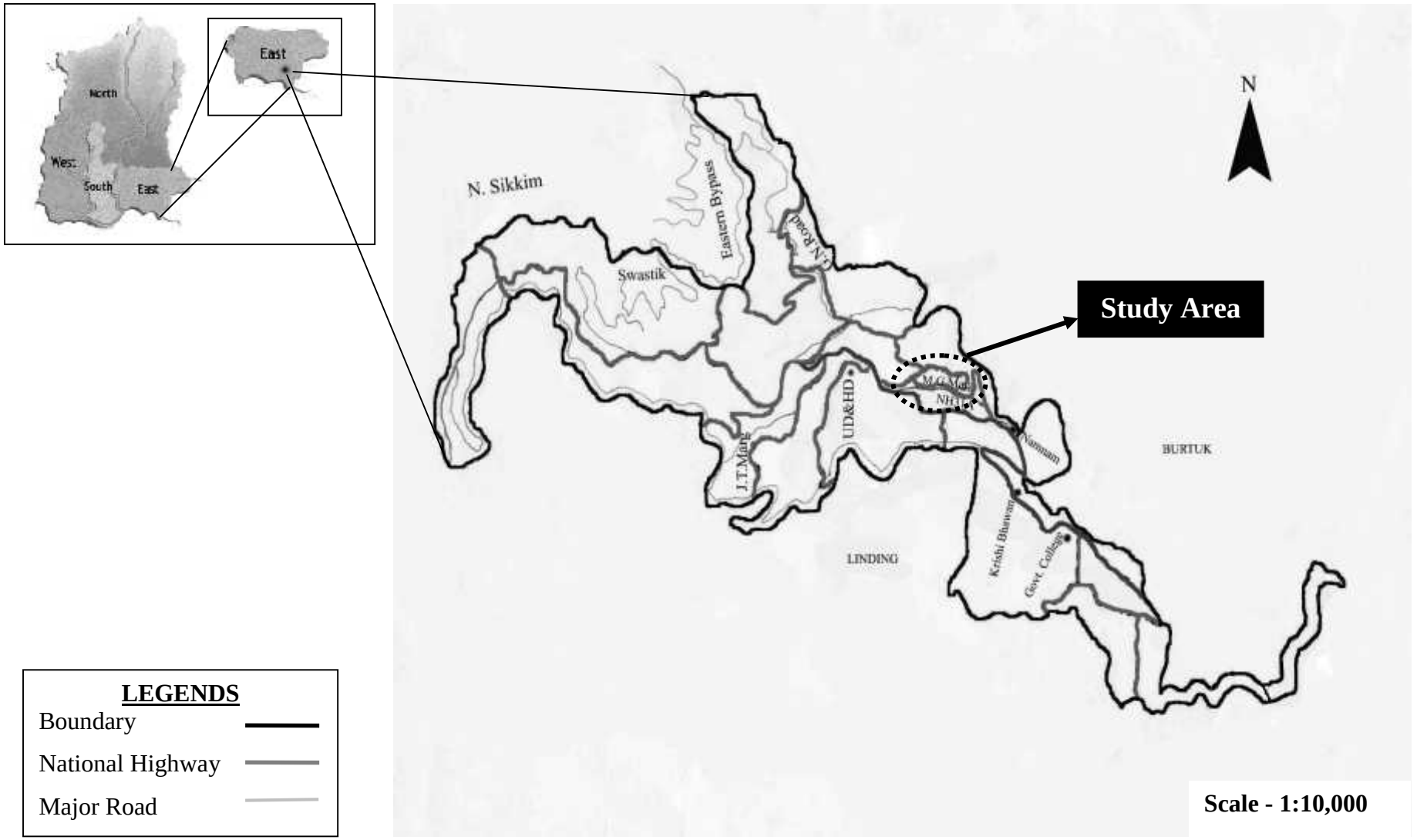
4.3. (vii) Infrastructure

Due to the abundance of natural springs in the vicinity, Gangtok does not suffer from a water shortage. It also has an almost uninterrupted electricity supply due to Sikkim's numerous Hydroelectric Power Station and has the state's only cardiac hospital. Only 30% of Gangtok has a sewerage network and it is estimated that Rs. 28 crore is required to upgrade the system.

Though Gangtok has many good government schools but there is single college offering degree in arts, science and commerce. There is also one institute named Institute of Tibetalogy offering diploma in Buddhist literature. The problem of unemployment has been compounded with the growing unemployment in the stale, due to the lack of large-scale industries.

Gangtok has many administrative offices and social services. Capital city has one Sikkim Legislative Assembly and is also home to the High Court. The existing infrastructure and civic amenities like parking areas, marketing yard, alternative footpaths, recreational parks etc. are being developed to cope with the rapid urbanization. This becomes even more important as Gangtok, the capital of Sikkim.

Map 1: Map of Municipal Corporation



CHAPTER- V

RESULTS AND DISCUSSIONS

5.1 Historical Analysis of Solid Waste Management of Gangtok

Gangtok has not much concerned about the sanitation condition since its establishment. In early days, population in Gangtok was small, requirements were few and resources were abundant and the generations rate was also very low. Such that it get naturally recycled being most biodegradable. Land availability was abundant and people used to dispose their household wastes in the open field. Beside the nature of its location has helped a lot in managing the waste naturally. It is especially on the rainy season that all the wastes are being swept away along by the surface running water.

After 1975, when Sikkim merged with India as a state, urbanization took place in the capital city. Interstate migration started and there was increase in population. Further, infrastructural development, change in food habit and living standard of people led to the increase in generation of waste. Neither nature nor local people could manage the waste. As a result, its management was felt by the Sikkim Government.

During 1990s, government formulated a master plan for the management of solid waste. Department of UD and HD, Sanitation Section was given the responsibility for its management and till now the same department is engaged in solid waste management. Before any regulatory action by the government, people used to dispose their solid waste in the valley sides of roads generally as there was no designated dumping yard. Garbage/ wastes/ spoils were alternatively dumped by the pubic indiscriminately into the jhoras (natural permanent drains). Shopping plastic bags were used and littered freely. Because the plastic

bags/ materials were light weight, rain water carried them along its course but got stuck on the slightest obstruction in the flow. The jhoras were full of them. Drains and sewage pipes got chocked or blocked leading to diversion of the discharge and consequential damage to life and property in the valley side which course they undertake naturally in the hills. Due to the lack of proper management, solid waste are scattered in the streets, *gallis*, *jhoras* and many other open spaces in Gangtok.

On 3rd April.1997, the state government enacted the Sikkim Non-Biodegradable Garbage (control) Act, 1997 (Depts. UD and HD, Govt. of Sikkim). Silent features of the act were as follows:-

- Ban on plastic bags
- Prohibiting the throwing of non- biodegradable garbage in public drains and sewage.
- Provision for placement of community bins for deposit of garbage in different places.
- Maintenance of separate bins as prescribed for the Biodegradable and Non-biodegradable waste.
- Duty of department workers to collect the waste disposed by the households and dumps it in the dumping site.
- Continuous monitoring on the implementation of the provisions of the Act and Rules.

At present, the department is fully involved in solid waste managing activities, i.e. collection, transportation and disposal.

5.2 Present Scenario of Waste Management System

The rapid growth of urbanization and high density of population give rise to many problems like solid waste management etc. Like in many urban areas, Gangtok is also facing the problem of solid waste

management. The increasing amount of municipal solid waste being generated has become a serious problem to urban managers due to its impact on pubic health and sanitary condition. More over, municipal solid waste management effects the local, regional and global environments. Therefore, it is essential to treat municipal solid waste properly in order to decrease the negative effects on human health and ecosystem. However, in developing cities, there are barriers, to proper municipal solid waste management, such as the lack of management capacity, financial resources, expertise and knowledge.

5.2. (i) Waste Management System of the Concerned Authority

In Sikkim, department of UD and HD (sanitation section) is responsible for managing the solid waste or in simple words, keeping the town areas clean. At present, the manpower involved in municipal waste management are Joint secretary, 2 Bazaar officers, the Sanitary inspectors, drivers and Safai karmacharis (SKs). Lowest work force is observed in Gangtok. There are fleets of 18 Vehicles including trippers and utility. Hand driven push cart are used to collect the wastes from inner part of the city. Besides, other tools such as long handle broom, bamboo baskets and spade are also used for managing the waste.

The tools and equipments available at present are of traditional type and are not adequate for proper waste management. Thus, the authority is unable to provide service throughout Gantgtok. The waste management system of the concerned authority is divided into different categories. They are discussed below:-

5.2.i. (a) Working Norm of the waste management

The working procedure of the UD and HD department is categorized into three groups. They are as follows:-

(i) Collection

(ii) Transportation

(iii) Disposal

(i) Collection of the Municipal waste

Being a capital city, Waste collection in Gangtok is done regularly. Community bin system of collection is adopted. The local people dump their household/commercial waste in the evening and morning into permanent community bins or mobile garbage provided by the government. If any one is found dumping their solid waste in the afternoon, he/she have to pay fine for it. Garbage littered outside are collected by SKs and deposited into these bins. In bazaar area, the government has distributed two types of bins and is given below:-

i. (a) Green Color Dustbin

The green color dustbin is for the wet waste such as organic waste.

i. (b) Blue Color Dustbin

The blue color dustbin is for dry waste such as paper, plastic, rags, metal and other inorganic waste.

Everyday in the morning the waste collection vehicles come for waste collection with bell system or ringing bell. The collected wastes are loaded on the vehicle by SKs. The wastes collection vehicles make a round of all the streets for waste collection. Waste collection from core area is a challenging and tough job. There is no door to door collection system in Gangtok. Therefore, households are requested to dump solid waste on roadside community bins.

The total accumulation of solid waste in the capital town of Gangtok is estimated to be 45 to 50 MT per day but only fraction of the quantity is being collected and dumped. The rest are still thrown into the jhoras and elsewhere despites of restrictions.

Table 3: Waste Collection System

Collection Systems	Frequency	Percent (%)
1. Door to Door	3	6
2. Dumping by local people	33	62
3. Waste Collecting by street sweeping	15	28
4. Other	2	4
Total	53	100

Source: Field Survey, 2006

Table 3 describes about the waste collection system adopted by the concerned agency. Dumping of waste in the community bins is the most popular system in Gangtok. It accounted for 62% of the total respondents. Door to door collection system of waste is rare as said by the 6% of the respondents and according to 28% of the respondents waste collection has been done by street sweepers.

Table 4: Spatial Location of Containers

Location	Frequency	Percent (%)
1. Beside the Road	43	81
2. Open place	6	11
3. Others	4	8
Total	53	100

Source: Field Survey, 2006

Table 4 present the place of location of containers. This table shows that the maximum numbers of containers are located beside the

road as 81% of the respondent said so. Other places of the location of containers are open place.

(ii) Transportation of Municipal solid waste

All the wastes that are collected from the city area are transported for the final disposal. Nearly 75%-80% of all collected residential and commercial solid wastes are sent to open dumps. Vehicles like trippers and tractors are used for waste transportation. The waste transportation is done once a day but it is also done twice a day whenever needed.

(iii) Disposal of Municipal Solid Waste

The concerned authority segregates the dry waste and wet waste that are produced. The final disposal of the wastes is done at the outskirts of Gangtok. A land measuring around 12.18 acres has been acquired at Martam which is about 23km away from Gangtok. Disposal of garbage presently is being done by Open Yard Degradation system. The state government is in the process of installation of manure processing plant.

Figure 2: Municipal Solid Waste Management System

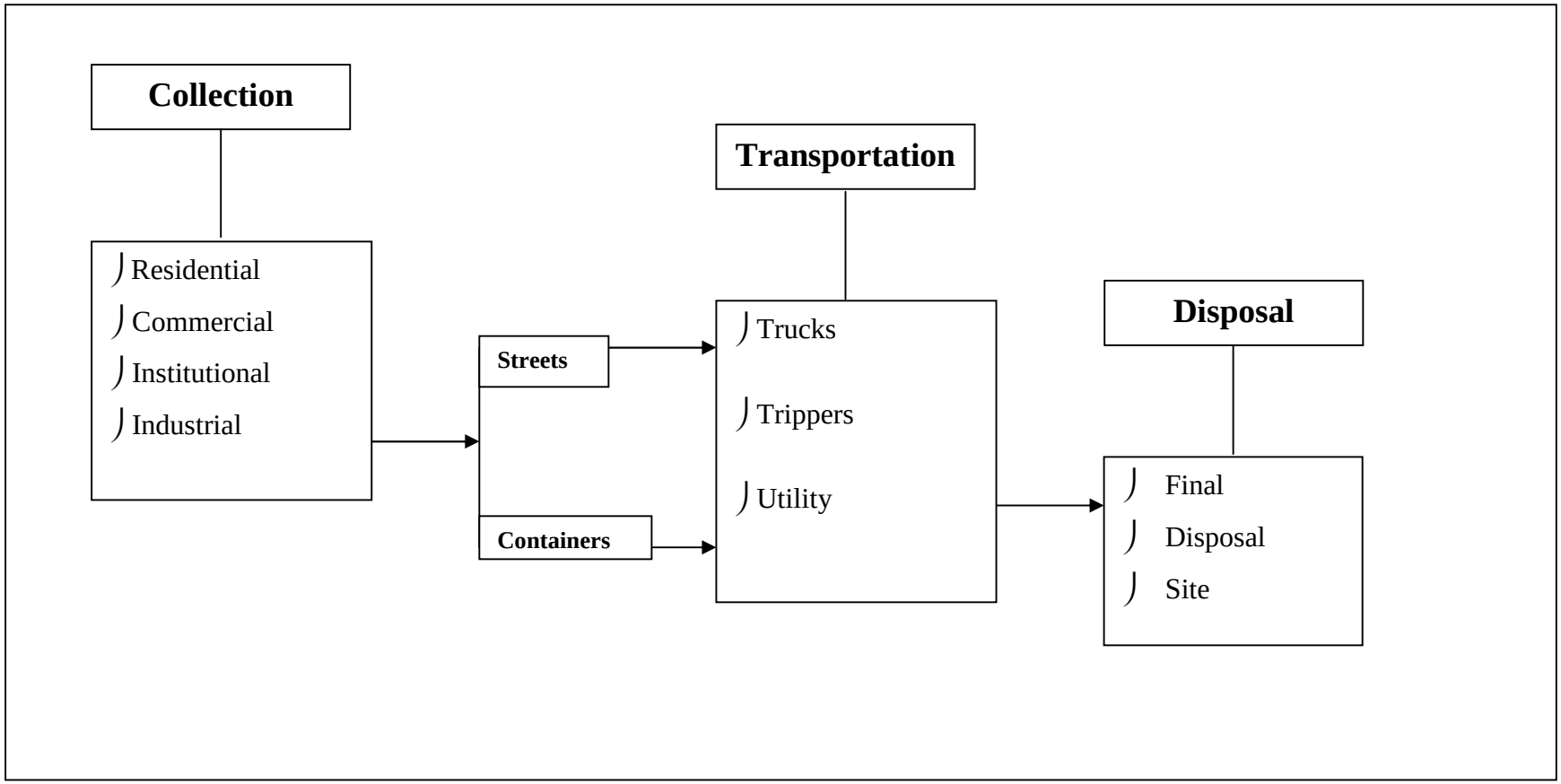


Table 5: Solid Waste Generation by HH_S Per Day

Generation(Kg/day)	Frequency(hh)	Percent (%)
1. below 1	18	34
2. 1 - 2	23	43
3. 2 - 3	10	19
4. 3 - 4	2	4
Total	53	100

Source: Field Survey, 2006

Table 5 gives information about the amount of waste generated by the HH_s per day. It is found that the maximum numbers of households generate 1 - 2 kg/day of waste which is generated by the 43% of the households and only 4% of the household generates 3 - 4 kg/day of waste.

Figure 3: Waste Generation Rate

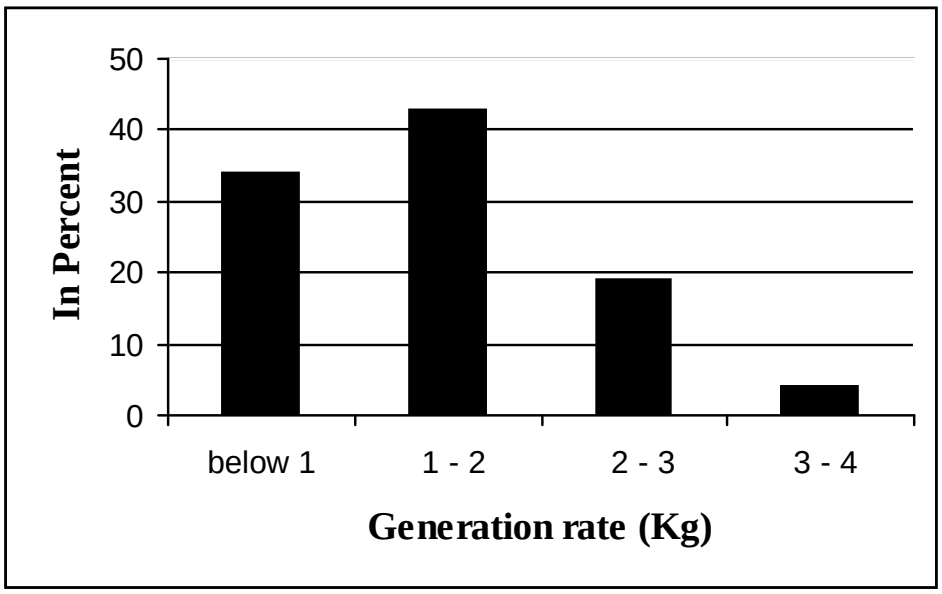


Table 6: Tools used to collect solid waste by HHs

Tools	No of HH_S	HH_S IN (%)
1. Plastic Bucket	37	70
2. Plastic Bags	6	11
3. others	10	19
Total	53	100

Source: Field Survey, 2006

Table 6 gives information about the different types of tools used by the respondents to collect their household wastes. Plastic buckets are the most common mode of onsite collection, as said by the 70% of the respondents. Only 11% of the respondents collect their household's wastes in plastic bags .Other means includes bamboo baskets and tins etc.

Table 7: Payment System for Solid Waste Disposal

Statement	Frequency	Percent (%)
1. Yes	33	72
2. No	15	28
Total	53	100

Source: Field Survey, 2006

Table 7 describes about the pay system that the concerned agency charge for the waste collection service from the households. The 72% of the respondents who are facilitated by the collection service daily said that they have pay for the service since they resides in the main streets or main areas of Gangtok. They said that the individual households have to pay Rs 30 per month. The 28% of the residents who resides in the core or

inner areas said that they don't have to pay for the service or they don't have any idea about it since waste collection is not done regularly.

Table 8: Public satisfaction from the present service

Satisfaction	Frequency	Percent (%)
1. Yes	42	79
2. No	11	21
Total	53	100

Source: Field Survey, 2006

Table 8 gives information about the satisfaction of the local people from the present service. We can see that the out of total only 21% of the respondents are not satisfied with the service from the concerned agency. On the other hand, 79% of the respondents are satisfied from the service. It reveals the fact that the concerned agency is providing a good service in terms of waste management from which maximum numbers of respondents are satisfied.

5.2.i. (b) Time Table and Vehicle Routing For the SWM

The waste collection in Gangtok is done everyday. The concerned authority has classified the working hours into three shifts. The working hour for the first shift begins early in the morning from 4:30 AM to 9:30AM, the second shift starts from 11:30 AM to 2:30 PM and finally, the third shift begins from 2:30PM to 4:30 PM.

Collection of waste in the morning is done regularly and is carried out with the bell system especially in the main market. In the afternoon, collection is done without bell system. Lastly, in the evening shift, collection is done less often only on any request and complaints from local people.

Table 9: Frequency of waste Collection (Day)

Day and Time	Frequency	Percent (%)
1. Daily	44	83
2. Alternate Day	2	4
3. Once a week	1	2
4. Other	6	11
5. Total	53	100

Source: Field Survey, 2006

Table 9 mentions the frequency of waste collection in Gangtok. In the main streets and the bazaar areas of Gangtok waste collection is done everyday as said by the 83% of the respondents. The inner areas which are inaccessible to the road are served in the alternate days. Waste collection once a week is rare as 2% of the respondents said so.

Table 10: Frequency of Waste Collection (Time)

Time	Frequency	Percent (%)
1. Morning	45	84
2. Evening	4	8
3. Others	4	8
Total	53	100

Source: Field Survey, 2006

Table 10 describes the time table of waste collection system in Gangtok. Everyday in the morning waste is collected from the community bins and it accounted for 84% of the total respondents. Only 8% of the respondents said that waste collection is done on the evening.

5.2. (ii) Waste Management System of the Residents and Commercial Establishment.

Waste management system of the residents and the commercial establishment also varies according to the service they get from the concerned authority. Those residents and commercial establishment that are facilitated by the service manage the waste by throwing it into the community bins provided by the government. But the residents and the commercial establishment that are deprived from the present service have their own way for managing the waste. It is found through field survey that 25% of the total respondents usually practiced household waste management system.

Table 11: Practice of Waste Separation

Statement	Frequency	Percent (%)
1.Yes	14	26
2.No	39	74
Total	53	100

Source: Field Survey, 2006

Table 11 describes about the practice of waste separation followed by respondents. Out of total only 26% of the respondents segregates their household waste by themselves at home. They sell reusable waste to the waste businessman, waste foods have been given to the pet animals and they dispose other waste into the community bins. But it is also found that the residents or commercial establishments that lie along or nearby jhoras and open space throw waste into it.

Table 12: Present Practice of Waste Disposal

Present Practice	Frequency	Percent (%)
1. Container	40	75
2. Backyard	7	13
3. Own field	4	8
4. others	2	4
Total	53	100

. *Source: Field Survey, 2006.*

Table 12 shows the present practice of waste disposal adopted by the respondents. It is encouraging to see that the majority of the people dispose their household waste in the container i.e.75%. Backyards and respondents' own field are also used for waste disposal which account for 13% and 8% respectively.

5.2. (iii) Observation of Magnitude of Waste in the Institutional Area.

In order to gather information about magnitude of solid waste in the institutional area, observation was done from main street i.e. M.G. Marg up to the institutional area of Gangtok. As already mentioned in Chapter III, ten stations were selected with the distance of 500m of each station. Apart from residential and commercial areas, institutional areas also contribute a lot in solid waste generation.

Table 13: Left Right Distribution of Solid Waste

Base Station	Left					Right				
	Organic (%)	Paper (%)	Plastic (%)	Others (%)	Total (%)	Organic (%)	Paper (%)	Plastic (%)	Others (%)	Total (%)
1.	35	20	30	15	100	45	15	30	10	100
2.	45	30	25	-	100	50	20	25	5	100
3.	15	25	60	-	100	-	-	-	-	-
4.	-	-	-	-	-	70	15	10	5	100
5	60	30	10	-	100	25	60	10	5	100
6.	55	40	5	-	100	40	15	20	25	100
7.	20	10	5	65	100	25	10	15	50	100
8.	30	60	5	5	100	55	35	10	-	100
9.	60	20	15	5	100	60	25	5	10	100
10.	25	45	10	20	100	20	55	15	10	100
Grand Total	345	280	165	110	900	390	250	140	120	900
Total (%)	38%	31%	19%	12%	100%	43%	28%	16%	13%	100%

Source: Field Survey, 2006.

Table 13 presents the left right distribution of solid waste from M.G. Marg up to the institutional area of Gangtok. It is found that mostly organic wastes are produced in both, the left and right side of the road which account for 38% and 43% respectively. Plastics contribute the least proportion i.e. 19% in the left and 16% in the right sides of the road. In the 3rd and 4th station proportion of waste is found to be negligible because there are no settlement or commercial establishments.

5.3 Sources and Composition of Solid waste

Nature of solid waste depends upon the sources from which the wastes are generated. In general, rural areas produce more biodegradable waste, whereas in urban areas biodegradable and non- biodegradable waste are found because of the varied sources of solid waste. The different sources of waste generation in the study area are discussed below table 14:-

Table14: Sources and Types of Solid Waste

Sources	Types	Frequency	Amount (%)
1.Residential	Organic waste, paper, plastics rags, cloths, bottles and others	5	17
2.Hotel/Restaurant	food waste, paper plate, disposable cup and spoon, plastics and others	6	20
3.Grocery shop	Rotten vegetables, peel off	3	10
4.Fish/Meat shop	Feathers, Hairs, Horns and Bones and others	4	13
5.Institutional area	paper, plastics, rubbish ashes, food waste	3	10
6.Hospital/Clinic	paper, plastics cotton, serienges, gauge, rags, cloths, rubbish ash	4	13
7.Industry/Factory	food waste, paper, packing materials, cloth, ash, scrap, rags and others	5	17
	Total	30	100

Source: Field Survey, 2006

Table 14 mentions the sources and composition of solid waste generated in the study area. Different types of waste are generated from the different sources. It is found that maximum waste is generated from

the residential and industrial area which account for 17%. The least waste is generated from the grocery shop. Other source of waste generation includes hotels/restaurants, fish/meat shop, institutional areas and hospitals/clinics.

The composition of solid wastes is similar throughout the world, but the proportions vary widely. The generated waste is composed of both biotic and abiotic elements. Biotic elements contain degradable waste like garbage, combustible material such as the branches and yard trimmings, dead animals, rags and temple offerings, some industrial waste and sewage waste. Abiotic elements are non-biodegradable components consists of waste such as old machine parts, demolition waste and construction waste etc. Over the years, it is likely that changes occur in the composition of waste for reasons such as:-

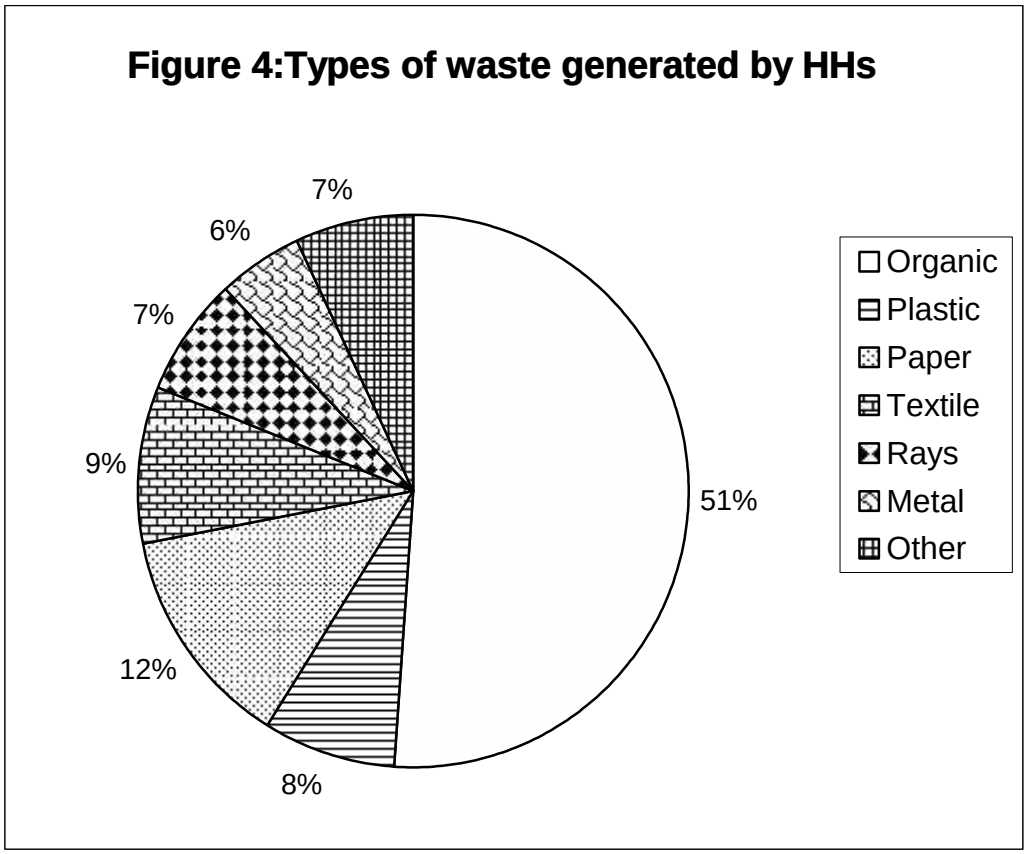
- A rising standard of living and changes in public taste which particularly influence the proportion of non-biodegradable waste;
- Changes in food technology (food processing and packaging) to increase the use of materials such as plastic, tins, metals and paper and
- Paving of roads which could cause a decline in inert materials.

Table 15: Types of waste generated by HH_S

Waste Type	Frequency	Amount (%)
1.Organic	103	51
2.Plastic	15	8
3.Paper	25	12
4.Textile	17	9
5.Rays	14	7
6.Metal	12	6
7.Other	14	7
Total	300	100

Source: Field Survey, 2006

Table 15 presents the composition of waste generated by the households. Majority of household generates organic waste which account for nearly 51% of the total waste generated. Plastic shares the least proportion i.e. 6% because plastic bags are totally banned in Sikkim as already mentioned. Other waste such as paper, textile, rags and metal shares 12%, 9%, 7% and 8% respectively.



5.4 Participation of local people in Solid Waste Management

With a view to gaining direct benefit from development activities, stress should be laid on people's active participation in the formulation of programme for which voluntary agencies should be actively involved in the planning and implementation process. Similarly, public participation is indispensable for a sustainable solid waste management. This demands people's active engagement in planning, implementation and monitoring of the management system in addition to cash, kind and labor contribution. Past experience shows that in Gangtok the participation of the local community was not given much importance thinking that the government is the only institution that is fully responsible for the development. As a result, series of development planning in diverse fields encountered failure. So the involvement of local people is very essential for the effectiveness of any programmes.

Due to the lack of proper awareness among the people about solid waste and its management, they dump their household waste in the open space or wherever they find efficient. Segregation of wastes are not adopted by the people though there is request from government to the people to segregate the bio-degradable and non-biodegradable waste before dumping it in the community bins provided by the government. Only few of the household segregate the waste at home. Almost all of them are aware of the effects of the uncollected waste still the resident feel that the solid waste problem should be solved from concerned agencies.

Only in the recent years, public participation in waste management is seen in Gangtok, though in negligible number. Efforts are being made by the government for the maximum involvement of local people for the proper co-ordination and linkages of various activities, particularly solid waste management, extensive extension support, training, organization and motivation of local people is emphasized.

There was maximum use of various mass media like audio, visual; papers, pamphlets, magazines etc. to inform the people about the consequences of solid waste due to its improper management. With this effort, people of Gangtok have started participating in solid waste management programmes.

Table 16: Reasons of Waste Increment felt by Public

Reasons	Frequency	Percent (%)
1.Increase in Population	36	68
2.Change in food habit	4	8
3.Not taking care of it	9	16
4.Others	4	8
Total	53	100

Source: Field Survey, 2006

Table 16 describes about reasons the waste increment in Gangtok. Increase in population is the primary reason for increase in waste generation rate, as 68% of the respondents said so. Change in food habit and negligence in waste management also accounts for generation of waste.

Table 17: Impact made by solid waste

Impact	Frequency	Percent (%)
1.Pollution	37	69
2.Health Hazards	10	19
3.Bad Smell	3	6
4.Others	3	6
Total	53	100

Source: Field Survey, 2006

Table 17 describes about the impact made by municipal waste. Out of total 69% of the respondents feel that land and air pollution by solid waste is the most environmental impact. Other impact of solid waste includes health hazards and bad odors etc.

Table 18: Methods for Sustainable Waste Management

Methods	Frequency	Percent (%)
1. Recycling	35	66
2. Landfill Method	6	11
3. Composting Method	7	13
4. Others	5	10
Total	53	100

Source: Field Survey, 2006

Table 18 presents the alternative measures for sustainable waste management as suggested by the local people. Apart from the primary waste management activities such as collection, transportation and disposal of waste, recycling method is the best for sustainable management of waste as said by the 66% of the respondents. Other methods such as landfill method and composting methods are also suggested by the 11% and 13% of the respondents respectively.

5.4 (i) Involvement of NGOs in Solid Waste Management

Private sectors also play an important role in the field of proper solid waste management. Involvement of private sector in Gangtok is found to be at an initial stage. There are only 5 NGOs who are engaged in waste management activities with their limited service. They organize community based activities including public awareness camp and behavior change, they make the slogan familiar among the local people keep "Gangtok clean and green" and they organize health camps regularly.

Golden circle, Global touch, Arithang committee, Gangtok transpose and Garbage waste management committee are some of the

NGOs. They comprises of public representatives of the area and two responsible persons of the area and the representative of the department.

Maximum involvement of NGOs is seen necessary in Gangtok which is still lacking. Both the government and local bodies should equally participate to reduce the aftermath of improper management of solid waste.

Table 19: Involvement of Private Sector

Statement	Frequency	Percent (%)
1.Yes	10	19
2.No	34	64
3.No idea	9	17
Total	53	100

Source: Field Survey, 2006

Table 19 gives information about the involvement of the private sector. We can see that, out of total respondents only 19% of them have said that there is involvement of the private sectors whereas 64% of the respondents said that private sectors are not fully involved in waste management. It becomes clear from the table that the waste management activities are fully done by the government.

5.4. (ii) Benefits after the involvement of local people in Solid Waste Management.

- The town and bazaar are free from plastics and appears clean.
- The drains and jhoras and the sewerage lines have force flow and hence reduced chances of calamity.
- Chances of diversion of rainwater due to clogging is almost nil.

- Subsequently a new system to collect garbage from shops, houses of the towns in the National Highway directly from the shops/houses to the garbage collection vehicles was introduced.
- Awareness among people has increased greatly about solid waste management.

5.5 Action Plans of Waste Management

The state government is in a process to launch many programmes related to solid waste management. Some of the Action Plans are as follows:-

- Installation of manure processing plant converting biodegradable garbage into agricultural compost.
- Municipal solid waste management for Gangtok city including eco-friendly treatment of city garbage.
- Construction of landfill site at Marchok about 15km away from Gangtok.
- Installation of dustbins or garbage carry bags in all the vehicles so that the passengers should put used food packing material wrappers, empty mineral water bottle etc. in the dustbin/garbage carry bag kept in the vehicles and not to throw here and there on the road while traveling.
- Community composting programme
- Awareness Rally

5.6 Problems and Prospects of Waste Management

Waste is a part of human activity from time immemorial and its management is essential. Management of solid waste has become a

problematic job in recent years. The basic problems of solid waste in the study area are as follows:-

- Lack of dumping site
- Improper management of waste from the concerned agency
- Lack of technology for managing the waste
- Unable to enforce proper rules and regulation.
- Lack of public awareness.

The range of key issues that have to be tackled when seeking to improve solid waste management includes:-

- Daily waste collection service to be provided
- Door to door waste collection service to be provided
- Proper implementation of rules and regulations.
- Public awareness programmes to be launched
- Proper location of dumping site
- Maximum numbers of containers to be provided
- Proper management of solid waste from the concerned agency
- Both government and private sector to come forward for proper management of solid waste.

The prospects given by the local people are the outcome of their day to day experiences. It is necessary to in corporate the mentioned suggestions while making any solid waste management strategy in Gangtok.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Solid wastes are a growing environmental problem in Gangtok. Increase in population along with the rapid urbanization has led to the increase in waste generation rate in Gangtok. Furthermore, change in living standard of the people and change in food habit have increased the rate of inorganic waste. All these have added to the problems in solid waste management which is a global issue.

The major sources of solid waste in Gangtok are municipal, domestic, commercial and agricultural, which consists of both organic and inorganic. The total waste generated in Gangtok has been increasing day by day.

The management of waste is fully maintained by the UD and HD department, (sanitation section), Government of Sikkim. The department provides different services such as collection, transportation and disposal of waste. There is no door to door collection of domestic waste. Local people have to dispose their household waste themselves in the near by community bins provided by the government.

Waste collection is done everyday early in the morning. The waste collection vehicle comes ringing the bell. The waste workers collect the waste and separate the dry and wet waste. The collected waste is disposed by open dumping.

The concerned authority is lacking modern and advanced technology for handling municipal waste. There is no experts and trained person who can help to develop some strategic planning for proper waste management. The main bazaar is well served by the department but it is

due to the lack of sufficient tools and manpower, the concerned authority is unable to provide service in all areas of Gangtok.

Involvement of NGO_S is at initial stage in Gangtok. They do not provide any collection, transportation or disposal service of waste. They only organize awareness camps and clean-up camps.

The local people are also not much concerned about the municipal waste. Though they manage their household waste by disposing it in the community bins but they have not shown any interest to find out the sustainable management of municipal waste. There is lack of public awareness and participation for proper management of solid waste. Only few of the households segregate their household waste at home before dumping. Rests of them dump it without segregation. The concerned authority is trying their best to make maximum community participation.

Different projects have been launched by the government for the proper management of solid waste and to keep the city clean and green.

6.2 Recommendations

Based on the findings of the study the following recommendations are suggested for further improvement in the solid waste management in Gangtok.

- The concerned authority should provide door to door collection service because being a hilly region; most of areas are inaccessible to the road.
- The citizen should be encouraged by the authority for the segregation of wastes at household level. They shall promote recycling or reuse of segregated materials.
- Waste minimization efforts should be motivated at the primary and secondary levels of waste collection. The citizen should be encouraged by the authority for the segregation of waste at

household level and for composting of waste for stabilization of wastes.

- The concerned authorities should adopt suitable technology, a combination of such technologies to make use of wastes so as to minimum burden on landfill.
- Landfill should be restricted to non-biodegradable and other wastes that are not suitable either for recycling or for biological processing.
- The concerned authority has to appoint more employees in order to extend their service area.
- Various targeted "Action Plans" for solid waste management should be conducted systematically and utilized for effective operational management.
- Community participation should be increased and local NGOs should be mobilized in solid waste management.
- Lastly, the enforcement of these measures has to be ensured through appropriate laws and regulation and regular monitoring of development activities.

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Appendix-I

"A"

Questionnaire for the study of

"SOLID WASTE MANAGEMENT IN GANGTOK BAZAAR"

(Used for thesis work leading to the Degree of Masters in Geography)

Surname of respondent: - Occupation:-

Educational Status: - Ward No/ House No:-

Family Size: - Male: - Female:-

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1. How much solid waste does your house generate per day?

.....

2. What are the different types of waste generated in your house?

Waste type	Quantity(kg/day)
Organic	
Plastic	
paper	
Textile	
Rags	
Metal	
other	

3. How do you think the solid waste in increasing day by day?

a. Increase in population b. Change in food habit

c .Not taking care of it. d. Others

4. Do you separate your household waste?

Yes ( ) No ( )

i) If yes, why do you separate?

a. Easy to dispose b. Reuse c. Others

ii) If No, why?

a. Not necessary b. others

5. Where do you dump your household waste?

a. Container b. Open space c. Backyard

d. Roadway e. Own field f. Others

6. What is the frequency of the waste collection?

a. Once a week b. Daily

c. Alternate day d. Others

and when?

a. Morning b. Evening c. Others

7. Where is the Municipal container located?

a. Open place b. Beside the road

8. Is there any waste collection system in your locality?

Yes ( ) No ( )

9. What type of waste collection system do you have in your locality from the concerned agency?

a. Door to Door. b. Dumping

c. Waste collection by street sweeping d. Others

10. For how long this waste collection system has started?

.....

11. What type of problem do you face when these waste were not collected?

a. Land Pollution b. Health Hazards

c. Bad smell d. Others

12. How had you used to manage the waste before this prevailing waste collection system?

a. Throwing it in open space b. Roadway

c. Backyard d. Others (Jhoras)

13. Do you have to pay for the waste collection service?

Yes ( ) No ( )

14. If yes, how much do you have to pay for the service per month?

.....

15. Is there waste collection by any vehicle?

Yes ( ) No ( )

16. If yes, at what time does the vehicle comes for waste collection?

a. Morning b. Evening

and at what time?

.....

17. Is there any warning system of vehicle while coming for waste collection?

Yes ( ) No ( )

18. Are you satisfied with the waste collection system?

Yes ( ) No ( )

19. Are there any NGOs involved in this activity?

Yes ( ) No ( )

If yes, what type of service do they provide?

a. Collection b. Transportation c. Others

20. Do you have any idea about the best collection system?

.....

21. Which process would be more appropriate for sustainable waste management?

a. Recycling Method b. Landfill Method

c. Composting Method d. Others

22. Do you have any suggestions regarding solid waste management system?

.....

23. How can we have the long term solution of the problems emerging from solid waste?

a. Public awareness b. Wards responsibility

c. Community based efforts d. Others

24. What are the problems of solid waste management?

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