UNDERSTANDING THE EFFECTIVENESS OF THE CURRENT WASTE MANAGEMENT SYSTEM IN THIMPHU CITY, BHUTAN

BY

RAI Saha Bir

APU Student ID: 51213615

September 2015

Research Report Presented to the Higher Degree Committee

of Ritsumeikan Asia Pacific University

in Partial Fulfilment of the Requirements for the Degree of

Master of Science in International Cooperation Policy

(Master of Engineering in International Material Flow Management)

Certification

I hereby certify that this work is done to the best of my own knowledge and is authentic and original and all other information are referenced and credited appropriately.

Saha Bir Rai

Acknowledgement

I sincerely thank my supervisor Professor Dr. Ken ARII, and Professor Dr. Peter Heck, for your kind support during the research. I would also like to thank my colleagues especially Dr. Vineeta Kaila, Ms. Korrakoon Silaphet of Asia Pacific University, Japan and Mr.Prabhat Kumar Mukhia, Sr. Research Officer, Department of Forest & Park Services, Bhutan. I would also like to thank Research Office (RCAPS) of the Ritsumeikan Asia Pacific University for kindly granting me the scholarship for the conduct of the research which covered my travel expenses. I also thank for the DAAD scholarship from IfaS, Germany as well as tuition reduction scholarship from Ritsumeikan Asia Pacific University to pursue this IMAT programme without whose support, it would have not been possible for me to write this research report. I thank each and every individual including my friends and family who have been patience with me while writing this research report.

Content

List of tables

List of figures

Abbreviations

ADB: Asian Development Bank

BBP: Bhutan Biogas Project

DoL: Department of Livestock, (Ministry of Agriculture & Forests, Bhutan)

DRE: Department of Renewable Energy

HEG: High Economic Growth

MFM: Material Flow Management

PCBs: Polychlorinated Biphenyls (PCBs)

RGoB: Royal Government of Bhutan

SMS: Sound Material-Cycle Society

SNV: Netherlands Development Organisation

SWMTSC: Waste Management Technical Support Center, Ministry of Urban Development, Nepal

Abstract

The effectiveness or the sustainable waste management for a city consists of addressing all the vital aspects such as economical, social, environmental, technological effectiveness including the presence of political willingness. In this study, the focus has been made to understand the social aspect of the Thimphu City waste management system in Bhutan through the use of statistical tool to analyse the data obtained through the field survey, visit and the literature reviews. The result establishes the positive evidences to support the initial understanding that there is a systemic flaw in the Thimphu waste management system especially the social aspect of the effective waste management system.

Key words: Effective waste management system, sustainability, social effectiveness of waste management system

Chapter 1: Introduction

In this chapter, discussion shall be on the rationale and the scope of the study to understand the effectiveness of the current waste management system in Thimphu, a capital city of Bhutan in light of the global waste problems and the status.

1.1 Background of Sustainable and Effective Waste Management

Waste Management system has been defined as the collection, sorting or separation, transportation, treatment, recycling or reuse and disposal of waste in an area.

Further, the integrated and sustainable municipal waste management system includes a complex inter-woven linkages, cooperation and coordination between and among mainly the five aspects viz: 1) Economical, 2) Environmental, 3) Social, 4) Technological, 5) Political aspects. Some believe the efficient institutional set up is important aspect as well. This integrated approach of waste management is also known as an Effective Waste Management System or an Integrated Waste Management System. Basically, the system is effective if it is economically profitable, environmentally feasible, socially acceptable, technologically achievable and politically stable.

Many authors have highlighted and pointed out that the municipal authority or the local government has a very important and crucial role to play in a successful and sustainable waste management for a particular area (Schübeler, Wehrle, & Christen, 1996). According to (Schübeler, Wehrle, & Christen, 1996), as high as 20% to 50% of the total Municipal budget is consumed by the municipal solid waste management alone in the developing countries. The various aspects of the sustainable and integrated waste management system as per (Yuan, 2013) includes economic, environmental and social.

However, as per (Schübeler, Wehrle, & Christen, 1996) the additional two aspects mainly the technological, political and institutional aspects are mentioned to be very crucial for the effective waste management in a given area.

1.3 Challenges and alternative ways to overcome it

Challenges for waste management obviously arise from the fact that it is an inter-disciplinary and very complex problem. Throughout the history, development of global waste management system faced the severe waste pollution problems in periods before, during and after the World War II. However, the countries like Japan and Germany represent and demonstrate the best how they have overcome these problems with much dedication and effort. And now, the developing countries and the underdeveloped countries are starting to have and face the similar wastes and its management problems to what those developed countries faced since 1950s.

But good news is that the developing and underdeveloped countries have the opportunity not to follow the same path of waste management that the developed countries once followed. The new approach and mechanism of using the technology from developed countries in order to avoid the socio-economic and environmental problems that were once faced by he developed country is called as the Kurznets Curve as depicted in the Figure 1. This approach is widely practiced in countries for instance China, India and Brazil. This approach and such attitude towards waste can have immense impact on achieving a sustainable and integrated waste management in the developing and under developed countries. Since the integrated and sustainable municipal waste management systems are too complex and inter-woven, it requires

linkages, cooperation and coordination between and among many stakeholders which can be categorized under five main aspects viz: 1) Economical, 2) Environmental, 3) Social, 4) Technological, and 5) Political aspects.

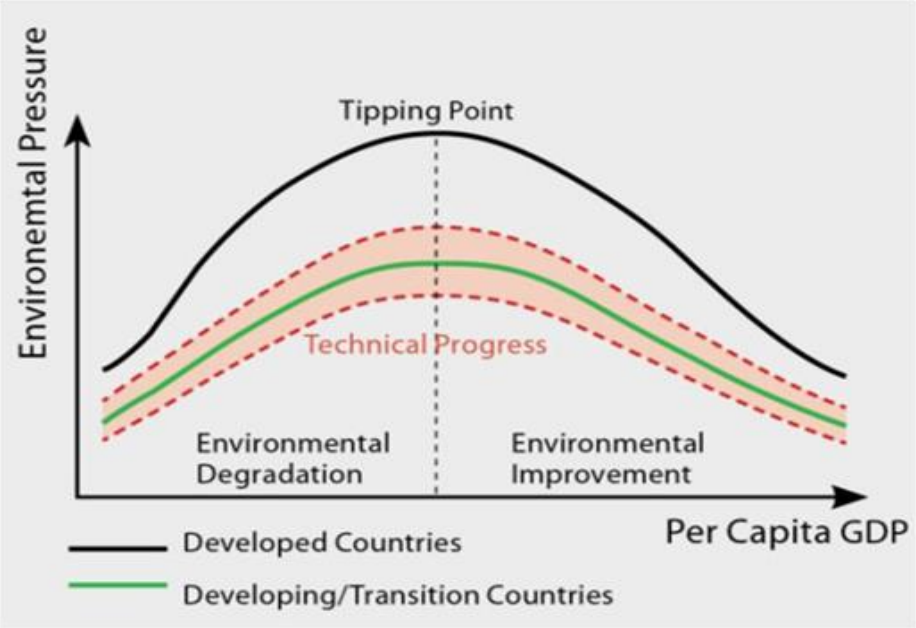


Figure 1.1: Environmental Kuznets Curve; Source: IfaS, 2014

1.4 Background of the study

Most of the past studies in Thimphu has been focussed in understanding the economical and environmental aspects. And very little has been done to have a detailed idea on the peoples' knowledge, perception and attitude towards waste and waste system in Thimphu city. Therefore, this study is focussed to understand the social aspects of the effective waste management system in Thimphu city.

This study is directed towards understanding one of the main aspects of sustainable and integrated waste management system that is social aspects of the

existing waste system so that we can bring about any changes or intervention for better management. A survey methodology consisting of semi-closed questionnaires were used. The sampling of the respondents was done based on judgement and convenience sampling methods under a non-probability sampling method. The effectiveness of the existing waste management system based on the three aspects is studied viz. the knowledge on the waste and the waste problem and management system in the city (mainly collection, separation, disposal/treatment, recycling/recovery system); the perceptions or the opinion or the satisfaction level on the existing waste management system in the city; and the behaviours of the people towards the wastes. It is targeted not only to the waste generators such as individuals and industries but also to the waste managers both public and private managers in the Thimphu City.

Chapter 2: Review of literature

This chapter has three broad sections viz. the discussion about the Global waste problems; waste management system in developed countries where Japan and Germany have been selected for the case study and finally the waste management system in developing or underdeveloped country. Here the comparison has been drawn between the developed and underdeveloped country like Nepal with Bhutan to show the seriousness, benefit and importance of effective waste management system.

2.1 Global waste problems and its management

Waste problem today is the most challenging, critical and important task for any city in the world (Wilson, et al., 2014). Challenges for waste management obviously arise from the fact that it is an inter-disciplinary and very complex problem. As per the (Zotos, Karagiannidis, Zampetoglou, Kontogianni, & Tchobanoglous, 2009) the problems of waste in the world is characterized by the increasing waste per capita generation of waste irrespective of the developing state of the country in the world. Further, the waste streams change continuously in time and space which makes it continuously complex and difficult to deal with. Therefore, this continuously increases the investment in the waste management systems in terms of money, resources, technologies and individual efforts. Therefore, sustainable waste management must be dealt with a very efficient and "holistic" inter-agency or even inter-governmental collaboration both technically and as well as theoretically for better solutions (Caniato, Tudor, & Vaccari, 2014). And it is highlighted throughout the history that the

importance of local authority is very crucial in the sustainable waste management of an area.

The history of global waste management obviously starts with developed countries like Germany and Japan where they faced severe waste pollution problems in periods before, during and after the World War II. While on the other hand, the developing countries and the underdeveloped countries are starting to have similar waste problems to what those developed countries faced in since 1950s. Unlike what the developed countries faced the problems with waste in the past, the developing and underdeveloped countries now have the opportunity not to follow the same path of waste management that the developed countries once followed. This approach and attitude towards waste can have immense impact on achieving a sustainable and integrated waste management in the developing and under developed countries.

Therefore, the global waste management basically can be divided and discussed into two categories:

a. Waste management in developed country, and
b. Waste management in developing and underdeveloped countries.

2.2 Waste management in developed countries

This section shall discuss about the waste management system in developed countries and obviously the Germany and Japan can best represent the developed countries in the sphere of waste problems and its sustainable management through the time.

2.2.1 Waste management in Japan

2.2.1.1 History

Lack of enough habitable space as well as the unique geographic location has been the main driving force for realizing the sustainable waste management in Japan (Schreurs, 2005, p. 15) as early as 1950s. The congested metropolitans and cities saw the waste problems and disasters that forced Japan to act decisively which lead Japan to what we see now as one of the most experienced and leading countries in the waste problems and its sustainable modern solutions.

Therefore, it can be rightly said that the sustainable waste management in Japan has evolved through the immediate necessity and experiences aided with a major policy reforms & dedicated implementations which ultimately paved the way for what presently called as Sound Material-Cycle Society (SMS). So the sustainable waste management in Japan started as early as 1954. The entire Japanese waste management development period can be divided into different periods that mark the important changes at the perceptions of general mass, policy formulation and implementation levels (Figure 2.1).

The first era marks the era of rapid/ high economic growth (HEG) right after the World War II (WW II) to until the later period of 1985 or in the beginning of the so called "Bubble Economy". This period was marked with Japan's high focus solely on the economic development without much focus on other aspects of sustainability such as social and environmental (Schreurs, 2005, p. 20). This period has also seen aggressive economic development policy. This resulted into various social and environmental

problems and disasters which forced Japan to develop appropriated strategy and technology on the various problems thus created. This period marked the drastic changes in the life styles and food habit of the people. The migration of the people to the metropolitan areas was at maximum. The literature suggests that the main reason for these changes in food habit and living styles were mainly attributed to the television technology and advertisements (MoE, Japan, 2006, p. 3).

The second era of waste management in Japan was marked by the fact that the waste generation by far exceeded the capacity of municipal disposal systems in place during the late 1960s. This led to the enactment of Japan's first waste management law in 1970 which helped recognizing wastes as a social problem in Japan. Many more strict protocols, waste classifications and procedures were established for all the categories of waste generators and managers; such as collection, disposal of all sorts of wastes (Schreurs, 2005, p. 29). The period is also marked as the period of high economic growth in the Japanese developmental history.

The period of high economic growth was followed by the period of "Bubble Economy" (Schreurs, 2005, p. 36) which can be categorized as the next era of waste management in Japan. This was the term given for the period after the high economic growth period in Japan; between 1986 to 1991; where it was seen that the accumulated wealth or asset increased drastically due to increased economic activities (Schreurs, 2005, pp. 36,27). It was also observed that the cash flow and credit increased at an uncontrollable rate. This resulted into the increased waste generation both in quality and quantity.

The fourth period is the period of "we have to get rid of the environment problems by any means" kind of approach by 1983 (MoE, Japan, 2006, p. 9). This approach was necessitated by the subsequent environmental and social problems from the bubble economy and high economic growth period. This period was marked with major industrial, environmental and social disasters and many hazardous products were banned such as Polychlorinated Biphenyls (PCBs), alkali, dioxins etc.

2.2.1.2 Current status

After having experienced all the ill effects of high and bubble economic periods during the late 1990s, Japan started to see the waste as a resource. Therefore Japan moved from policy development to strengthening 3Rs (Recycle, Reduce, Reuse) framework thereby promoting the use of "Circulative Resources (CRs): useful things among wastes" (Government of Japan, 2000, p. 2). Various measures were introduced in order to curve the waste problems and towards support of 3Rs strategy. Enactments of recycling laws for various waste types and the introduction of polluter pays principle (PPP) were the best examples where-in the agency or individual who produces wastes has to pay for its disposal and treatments.

2.2.1.3 Challenges

Japan has made enormous effort to considerable time to gain the current height in the sustainable waste management experiences, knowledge and technology. Presently,

Japan is working towards Sound Material Cycle Society (SMS) which is the advanced form of the 3Rs concepts.

The Japanese in the beginning were not different in terms of their perceptions towards wastes when compared to those people in modern developing and underdeveloped countries. The lesson Japanese waste management system teaches to the modern world is that, the need of persistent collective effort by the authority, people and technology are needed. Every individuals has to be made responsible for the waste management in the country since very young.

However, the major challenges ahead have been noted in the literature that it is the enormous challenge not only to change the One-Way Society to the Recycling-based Society but also the problem of mass production, mass consumption, and mass disposal. Other imminent challenge is to penetrate the mass taking the message and habit of SMS approach at an individual level. Today Japan stands together with only a very few countries in the field of sustainable resources management. The major events that took place in the evolution of Japanese sustainable waste management is depicted in the figure below (Figure 2.1)

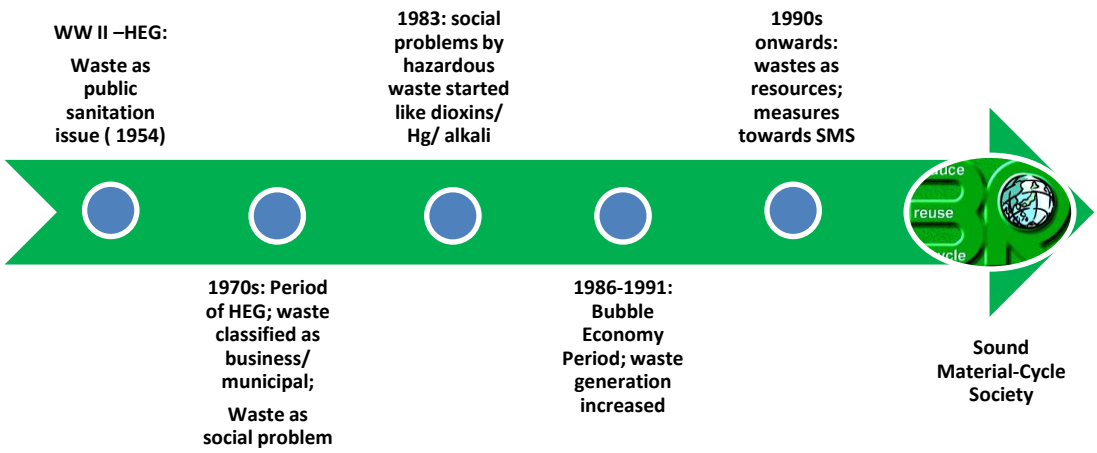


Figure 2. 1: Evolution of Japan's sustainable waste management system; Source: self

2.2.2 Waste Management in Germany

2.2.2.1 History

Another best case country to talk about the sustainable waste management is Germany. There is much similarity between the evolution of waste management between Japan and Germany. Federal Republic of Germany consists of sixteen Federal States (Bundesländer) and has the shared responsibility of waste management and environmental protection with the national Government and the local authorities (Fischer, 2013). Although at the national level the Ministry of Environment decides, participates in environmental and waste management activities, plans and laws for the whole nation, the individual Federal State prepares and implements their own waste management acts that is in line with the national law. Further, Germany does not have a national waste management planning and planning is done individually by each Federal

States (Fischer, 2013, p. 5). Instead, each Federal State develops a waste management plan for its area (EEA, 2009 cited in (Fischer, 2013, p. 5)).

Although the concept of waste resource recovery existed as early as 1920s in Germany (Bergmeier, 2003, p. 1360), the systematic waste management in Germany can be dated back to the time when the European Union passed the "precaution and polluter pay" principles; councils directive of 15th July, 1975 (Johnke, 1992). And Germany became the first country in Europe to adopt the producer responsibility" principle in 1991 which gives responsibility to the producer of a product when it becomes waste (Fischer, 2013, p. 5). Thereafter, a series of acts on the waste management and related matters has been enacted in Germany. For instance, Waste Avoidance and Waste Management Act (Abfallgesetz of August 27, 1986); The Act for Prevention of Harmful Effects on Environment Caused by Air Pollution, Noise, Vibration and Similar Phenomena-The Federal Emission Control Act (Bundes-Imissionsschutgesetz; first version from March15, 1974, amended May 14, 1999) (Johnke, 1992); etc.

In 1990s, the incineration of wastes picked up in Germany with almost everything being incinerated though with certain environmental protocol and it replaced the land fillings to a larger extent which was supported by the various national policies in Germany in 1990s. This incinerating method of waste treatment became an integral and an important part of the integrated waste management system not only in Germany but as well as in the entire European countries (Johnke, 1992, p. 307).

2.2.2.2 Current status

The waste recycling has picked up ever since the land filling was limited in 1990s. The result was that we can see as of 2010, the total waste recycled was 62 %, the incineration of waste was 37% while the land filling of waste was decreased to nearly zero percent (Fischer, 2013). Currently, Germany is achieving around 70% of recycling rate for the waste materials (www.earth911.com, 2014). Today, Germany is one of the top countries where most of the waste is recycled. At the moment, the per capita waste generation in Germany is about 1.67 kg per person per day which is much higher than the Japan's per capita waste generation at 0.9 kg per persion per day (Kawai & Tasaki, 2015) whose case study is done in this research.

2.2.2.3 Challenges

One of the reported challenges is due to the fact that there is no national waste management planning in Germany. Different Federal states have their own planning which are not consistent though they are supplementary to the national laws. This results into inconsistent reporting (Fischer, 2013). Further, waste segregation and recycling concepts are not always followed by every individual and there are cases of illegal dumplings as well.

Therefore, the experiences in Germany also confirm that the human or the social aspects of the waste management is very crucial and it has to be guided very carefully with the aid of different policies/ acts/ principles and also the technological developments.

2.3 Waste management in under-developed/ developing country and waste problems

Waste management in developing or underdeveloped countries needs an immediate attention in order to avoid any complex problems associated with it. Under this section, Nepal shall be discussed along with the waste management in Bhutan as these two countries share similar socio-economic conditions and also similar geographic locations. Therefore, the two countries shares similar waste related problems.

2.3.1 Waste Management in Nepal

2.3.1.1 History

As per (Thapa, 1998) waste management in Nepal was said to be neglected until mid 1980s. There is no available data for the waste management prior to this period. However, the municipal waste used to be dumped into the courtyards which were in turn were cleaned and the wastes were finally dumped into the river banks or out of the visible areas (Thapa, 1998, p. 102). Though there were public efforts in the collective waste collection and its disposal, there were no public endeavours towards sustainable waste management system in Nepal. The initials studies are mainly concentrated to the capital city of Nepal, Kathmandu. And moreover, the Nepalese government emphasized the need to spread the economic and developmental activities to other secondary cities such as Bharatpur etc as well with out the strategy of sustainable waste management systems. For instance, the Bharatpur city which came up in early 2000 was not planned properly and the migration of people from different part of the country made the waste management an upheaval task. The river banks were reported to be used as dumping site for the wastes. The ADB funded project called Urban and Environmental

Improvement project was implemented in 2005 which propagated the concept and need of sustainable urban developments. The project established the improved infrastructures for "clean water supply, drainage, and sanitation" in the city (ADB, 2013). This had brought an enormous change in the overall situation of the city (ADB, 2013). This successful project has be an exemplary for the similar projects in other secondary cities of Nepal.

2.3.1.2 Current status

Just like in many developing countries including Bhutan, the systematic waste management in modern Nepal has started only after the enactment of Nepal's Solid Waste Management Act 2001. The Solid Waste Management Act's main objectives are the maintaining of clean environment and avoid adverse impact on public health. The act has provisioned the responsibility of collection, separation and disposal including the construction of infrastructures to the local bodies like municipalities following the concepts of 3 Rs (Reduce, Reuse, and Recycle) (ADB, 2013). Further, the act also authorizes the collection of fees and charges in any activities related to solid waste management in the country by the implementing agencies such as municipalities. The Solid Waste Management Technical Support Center (SWMTSC) under Ministry of Urban Development, Nepal is responsible for providing all technical support and Research & Development initiatives to all the 58 municipalities and other implementing bodies. The study by (ADB, 2013) suggested that the organic matter comprises of 66% for household wastes while it is 43% for the commercial wastes. The per capita waste

generation ranges from the types of waste generators to the location and climatic conditions of the area. The household waste generation per day in Nepal is reported to be 0.317 kg per person per day while the waste generation from the school and hotels were reported to be as high as 4 kg and 5.7 kg per school and per hotel per day respectively.

2.3.1.3 Challenges

Lack of baseline data on solid waste management for all cities is reported to be the major challenge for any sustainable waste management interventions in Nepal (ADB, 2013). Other challenges for waste management in Nepal were reported to be the adverse climatic conditions coupled with lack of expertise, financial capacity, technology and political instability (ADB, 2013). Though there is huge fraction of organic waste, the management methods used is reported to be a traditional composting method. Like in the developed countries, the challenge to change the habit and attitude of mass do exists though at very much greater level as compared to those in developed countries which is mainly attributed to the low level of literacy in the country.

Therefore, it is also ascertained that the social aspect or the human aspects of the waste management is very crucial not only in developed countries but also in the developing or underdeveloped countries. These human aspects or the perceptions towards waste are also seen to be very much dependent on the level of literacy of the individual or the mass about the wastes.

2.3.2 Waste Management in Bhutan

2.3.2.1 History

The history of sustainable waste management in Bhutan is relatively new subject. However, the basic knowledge on waste management is not new either. The waste management is linked to the culture and life style of Bhutanese where many Bhutanese have been using their kitchen wastes and farm waste for making compost as early as 1960s during the times of green revolution. The modern composting started in 1960s when the agriculture took off. As per the modern approach of waste management, waste is defined as the "resources at wrong time and wrong place". The waste management has been a complex and difficult global task as also mentioned by (Guerrero, Maas, & Hogland, 2013) that it is the issue of multi-dimension in nature and can only be managed to best when managed through ecological, social, economical and the technological perspectives. Due to such interwoven nature of the waste management, it is of great challenge to a developing country like Bhutan to effectively manage the waste system in the city which is increasingly becoming complex.

Therefore, Bhutan is no exception when talking about the waste management issues. With the increasing complexity of waste types triggered by the increasingly changing habit of consumption by population, the task of waste management is getting increasingly difficult and it is evident from the land fill explosion in most cities. Currently, the land filling is the most commonly advocated method of waste management in the country. However, even this obsolete method is not being implemented properly. The attention to sustainable waste management in Bhutan is far

below than what it is required to. However, the future of waste management in Bhutan looks brighter with the policy and regulations in place which is expected to guide the waste management in the near future in better way. Towards this direction, the enactment of National Waste Prevention and Management Act 2009 in 2009 followed by the National Waste Prevention and Management Regulation in 2013 has paved the systematic strategy for waste management in Bhutan.

2.3.2.2 National Waste Prevention and Management Regulation 2012 of Bhutan

Although there were endeavours and serious concern to the waste problems before, the first major steps towards systematic waste management in Bhutan was the enactment of National Waste Prevention and Management Act 2009. As per the act and the regulation, the National Environment Commission is the apex body for implementing and monitoring all environmental acts through various regulations in Bhutan. Bhutan adopted National Waste Prevention and Management Regulation in 2012 as mandated by the National Waste Prevention and Management Act 2009 with the purpose to establish procedures, identify roles and areas of implementation for a sound waste management system including monitoring procedures at every organization level, through efficient collection, segregation, treatment, storage, transportation, reduction, reuse, recycling and safe disposal of solid, liquid and gaseous wastes; levy fees, charges and fines for non-compliance; and control and prohibit illegal dumping or releasing of waste into the environment. (RGoB, National Waste Prevention & Management Regulation, 2012)

2.3.2.3 The current status and structure of Waste Management system in Bhutan

Currently, every city, districts, county have identified the landfills with the help of National Environment Commission (NEC). Even the villages in rural areas have waste collection system enforced but due to unavailability of proper landfills and isolated settlements, it is common practice to burn the garbage inside the pits villagers use to dispose wastes (Kuenselonline, Setting trash afire, 2012). However, many landfills have already exploded. And Meymeylakha Landfill in capital city of Bhutan, Thimphu has been the best case. However, restoration and relocation works and efforts are under process. It receives about 60 tons of waste every day (kuenselonline.com, 2013). Further, the 'Fukuoka method' (kuenselonline.com, 2013) adopted at the landfill shows that the large volume of resources are being wasted at the cost of environment. Despite the numerous public regulations, awareness, training on waste management and several private companies and volunteers, the waste management problem in rural and other cities of Bhutan are not very different. There exist a mismatch between the increased waste generation in Bhutan and the infrastructures, facilities and services to ensure sound waste management (NEC, 2013).

The per capita waste generation in Bhutan was reported to be 0.53 kg per day (Phuntsho, et al., 2009) out of which 49 % of the total waste is organic waste (see Figure 2.2*)*. This suggests that there is a great potential to tap the resources in the form of compost or biogas which are currently sent directly to the landfills. Although there are few entrepreneurs in the waste management sectors, but they are primarily involved in collection, segregation and exporting of recyclable solid wastes. No waste is being

recycled inside the country. However, there is a better future prospective and potential for this private waste manager in their endeavour as an important stakeholder in sustainable waste management in the city's existing waste management structure. The Greenerway is reviewed as below for understanding the state of private waste dealers in Thimphu/ Bhutan.

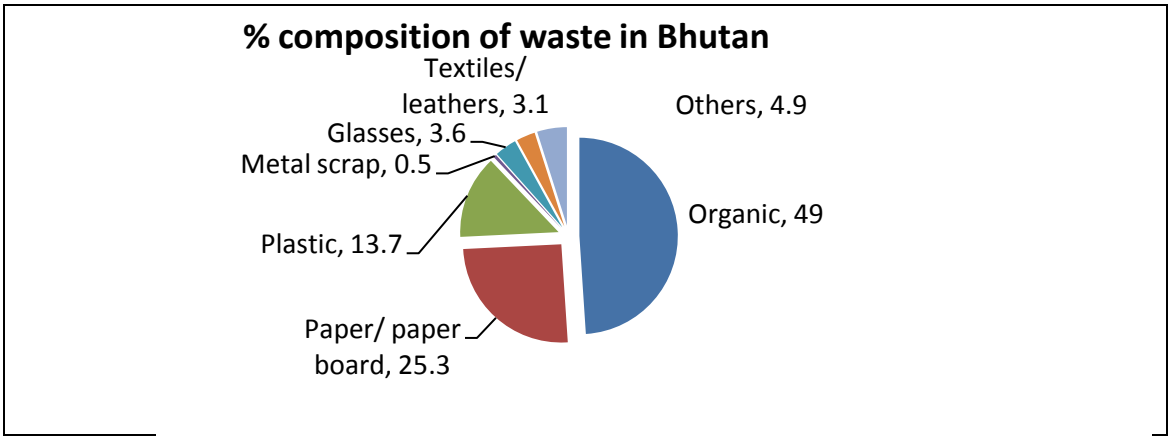


Figure 2. 2: % waste composition of Bhutan; Source: National Solid Waste Survey 2007 cited in (Gyeltshen, 2008)

2.3.2.4 Greenerway

2.3.2.4.1 History & constitution

Greenerway is a private company located in the capital city of Bhutan, Thimphu established since 2010. It is one of the first waste handling companies in the country. It consists of 37 staffs headed by Chief Executive Officer (CEO) and has four departments: Operations, Marketing & Public Relation, Business development, Human Resource & Administration, Finance with departmental head (Figure 2.3)

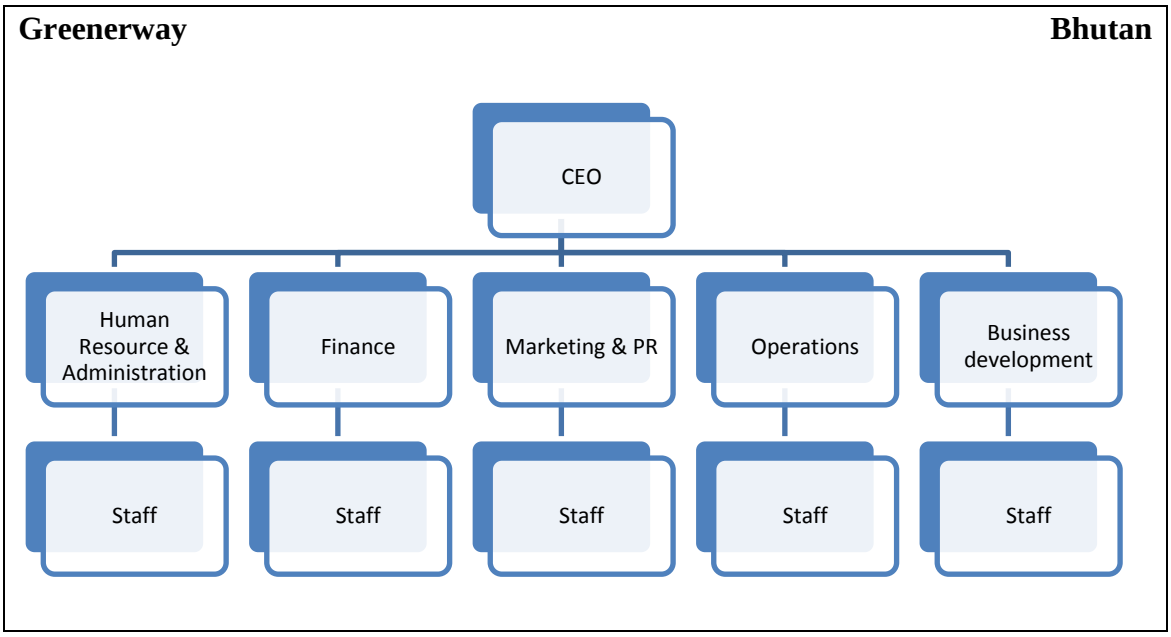


Figure 2. 3 Organogram of Greenerway Bhutan; Source: (Sharma, 2013)

At the moment Greenerway's main activity is the waste collection and segregation in Thimphu city (Sharma, 2013). Activities expansion to other areas and sectors could be a profitable alternative. They are not currently involved in the processing though they have the future plans to establish recycling plants for all recyclable wastes (Sharma, 2013). Currently, they are striving to establish an efficient collection and disposal system. Further, they are dealing only with the inorganic waste in the city. Organic wastes are being handled by the Thimphu City Corporation where the wastes are sent to the landfills. As per the report, the gross annual profit of the company is only about Nu: 120, 000 (1USD=62 Nu.) which in combination with its nature of activity, suggests that the company is merely acting as a middleman to supply the wastes to India rather than creating and adding value in the city.

Important development in favour of Greenerway is that the Thimphu Municipality has outsourced its responsibility in the waste management to private

partner; Greenerway where Greenerway is doing a business. In order to understand the current status of the flows of material in Greenerway, a simple analysis has been done diagrammatically as shown below (Figure 2.4)

Current Material Flows in Greenerway

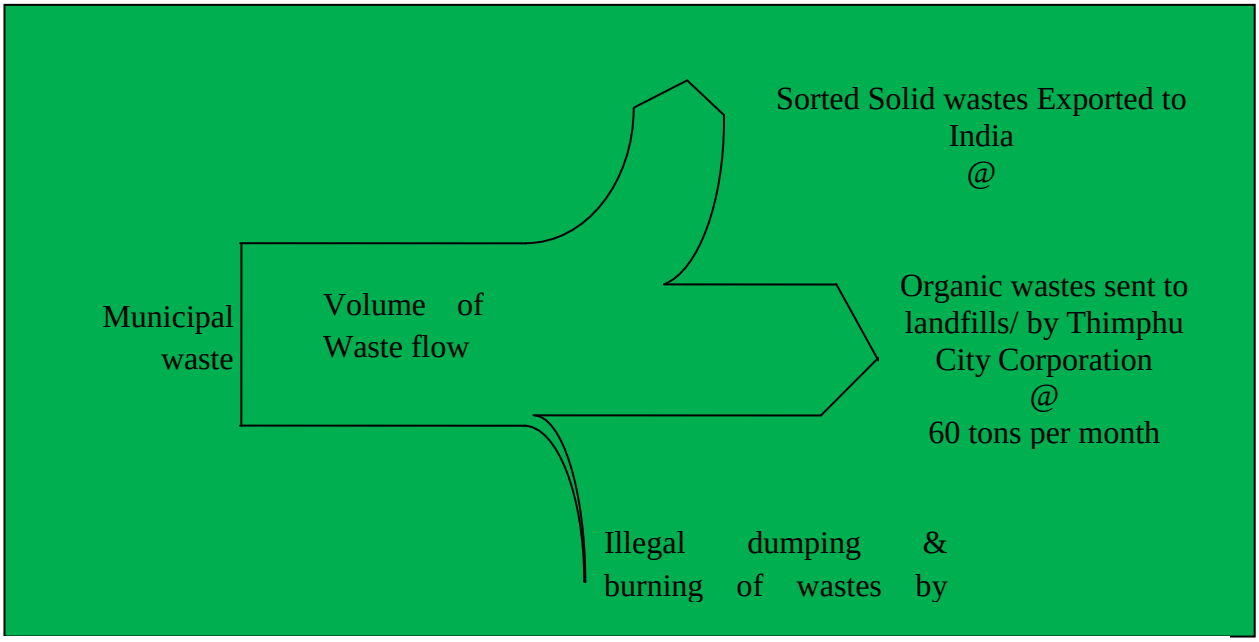


Figure 2. 4 Overview of the current waste material flows in Greenerway; Source: Self

However, the above scenario is expected to have been changed already with their activity being expanded as a municipal waste management in the city along with the Thimphu Municipality. The above material flow diagram (Figure 2.4) clearly suggests that there is a great potential to harness the energy/ material which otherwise until now is either being wasted/ dumped in the landfills (organic wastes) or exported (inorganic wastes). Therefore, the dire need for a systematic and sustainable material flow management of towards zero waste or zero emission strategy is being seen as

urgent and necessary steps to curb the increasing waste problems in Thimphu city as well as in entire cities and villages of Bhutan.

Therefore, based on the literature reviews and an online interview with the private company, the Greenerway, the research areas were identified to be the existing waste management system of Thimphu City which is being increasingly felt by the general public that it is not working properly. Other various challenges identified were to be the only land fill; Memeylakha landfill of Thimphu city is already out of its carrying capacity.

These findings have been the driving force for the development of the theoretical frameworks which is discussed in the following chapter.

Chapter 3: Theoretical Framework

This chapter shall be discussing about the research questions, hypothesis and the theoretical framework for the research and analysis developed based on the findings from the literature reviews. The analytical framework in this research which has the basis on the findings of the literature reviews comparing the waste management systems among the developing/ underdeveloped as well as developed countries and their challenges and lesion learnt (that also include the review of the waste management in developed country like Germany and Japan; developing or underdeveloped country mainly Nepal and Bhutan); primary data acquired from field research through survey and finally the data analysis using the IBM SPSS Statistics 19.

3.1 Hypothesis

Based on the literature reviews, it is understood that one of the very crucial aspects for the sustainable or integrated waste management system is the Social aspect which is not really understood very well and its detailed study has not been conducted in Bhutan.

Therefore, it is hypothesized that there is a systemic problem in the waste management system of Thimphu City, Bhutan.

3.2 Research Question

Following research questions have been used to conduct this research study:

1. How aware are people of the waste and its management system (knowledge on the waste and its system)

2. What is the perception (satisfaction) level of people for the current waste management system
3. What is the attitude of people towards waste and its management

3.3 Purpose and Objectives

This sub-section will be discussing on the purpose and the objectives of the research report. The research target is to understand which part of the current waste management systems are already effective and which are not through understanding the three aspects of information (objectives) mainly from the individuals, organizations as well as the waste managers both private and public point of views. The core idea of the research is that it is important to understand about the existing waste system, the weakness and intervention points must be identified so that the waste generated in Thimphu city must be recycled within Thimphu city itself thus achieving circular practice. In other words, the waste generated in Thimphu city must be collected, segregated, treated and recycled as much as possible in the City.

3.4 Purpose

The waste management in Thimphu has been widely discussed but very little has been done at both academic as well as in the ground. Also not very much of research materials about waste management in Bhutan are available at present. Further, the waste management is becoming an issue that requires an immediate attention of the policy makers and implementers not only in the capital city, but also in all other cities, towns and villages of Bhutan. Therefore, in this study, only a city; Thimphu is selected for the study as it is the best case example in Bhutan where the waste is increasingly becoming

not only an environmental problems but also social and economical problems. The waste dump yards and scenic places are becoming the reason for shame and discomfort to present to the guests of Bhutan. This is further aggravated by the lack of technologies, knowledge and experiences in the country regarding the sustainable waste management. Therefore, in order to ascertain the effectiveness of the current waste management system from social aspects of sustainable waste management system in Thimphu city, this research has been carried out with partial fund support from the Ritsumeikan Asia Pacific University Research Office; RCAPS, Japan especially for the travelling expenses with the following objectives:

3.5 Objectives

Based on the literature review, this report tries to understand the current status of the waste management, its effectiveness and the approach and attitude towards wastes of the people or agencies who are waste generators as well as those who manages the waste in the city both private and public. These understandings would be important foundations to suggest any improvements and also make the general mass, aware of the wastes problems the city is facing. So the questionnaire has been designed to assess the existing waste management system in Thimphu City with following objectives:

1. *To find out the actual problem of the city's WMS*
2. *To understand the city's existing/ current WMS*
3. *To understand the knowledge, perception and the attitude/ behaviour of the people in the city on waste and WMS of Thimphu City, Bhutan*

The people's knowledge on the waste and the waste problem and management system in the city is mainly focussed in understanding the actual problem of the city's existing waste management system such as the knowledge of people in the sectors of waste collection, separation, disposal/treatment and finally the recycling/recovery system in place. Also the perceptions or the opinion or the satisfaction level on the existing waste management system in the city, their behaviours or the attitude of the people towards the wastes by the population in Thimphu city is very important information to understand.

3.6 Theoretical Framework

As per the literature reviews, the effectiveness of a municipal waste management system are characterized by the five main aspects of integrated and sustainable waste management system. The effectiveness of the waste management system is studied based on whether the system is economically profitable, environmentally feasible, socially acceptable, technological achievable and politically stable including the effective institutional capacity. They are equally important and are very much interlinked. However, in this study, all the five aspects are not directly studied due to the complexity involved and also the time as well as budgetary constraints faced to conduct the study. Therefore, the main focus has been maintained to the social aspects only. However, there is certain area touched where all the other three aspects are overlapped as well.

In order to understand the social aspect of the effectiveness of the current waste management system of Thimphu city, the study has targeted both to the waste managers

that includes private as well as public managers and the waste producers that includes all categories of waste generators like individuals, organizations, agency, company or institutions. This is done to understand the effectiveness of the existing waste systems of the city from three main points of views viz: knowledge about the waste and the existing waste system; satisfaction on the waste system; and the attitude of people towards the waste and the waste system.

The idea is that in order to understand the existing waste management systems in the city, both the waste generators as well as waste managers are very much necessary to understand. Therefore, the social science approach has been employed to understand the human attitude as well. And finally, it is very crucial to understand the current system for any interventions aimed at improvements.

The whole theoretical idea and approach adopted to understand the existing waste management system in Thimphu City is depicted diagrammatically in the Figure 3.2 below:

The figure 3.1 is the basis for developing the methodology for the research and the information flows which is discussed in the next chapter.

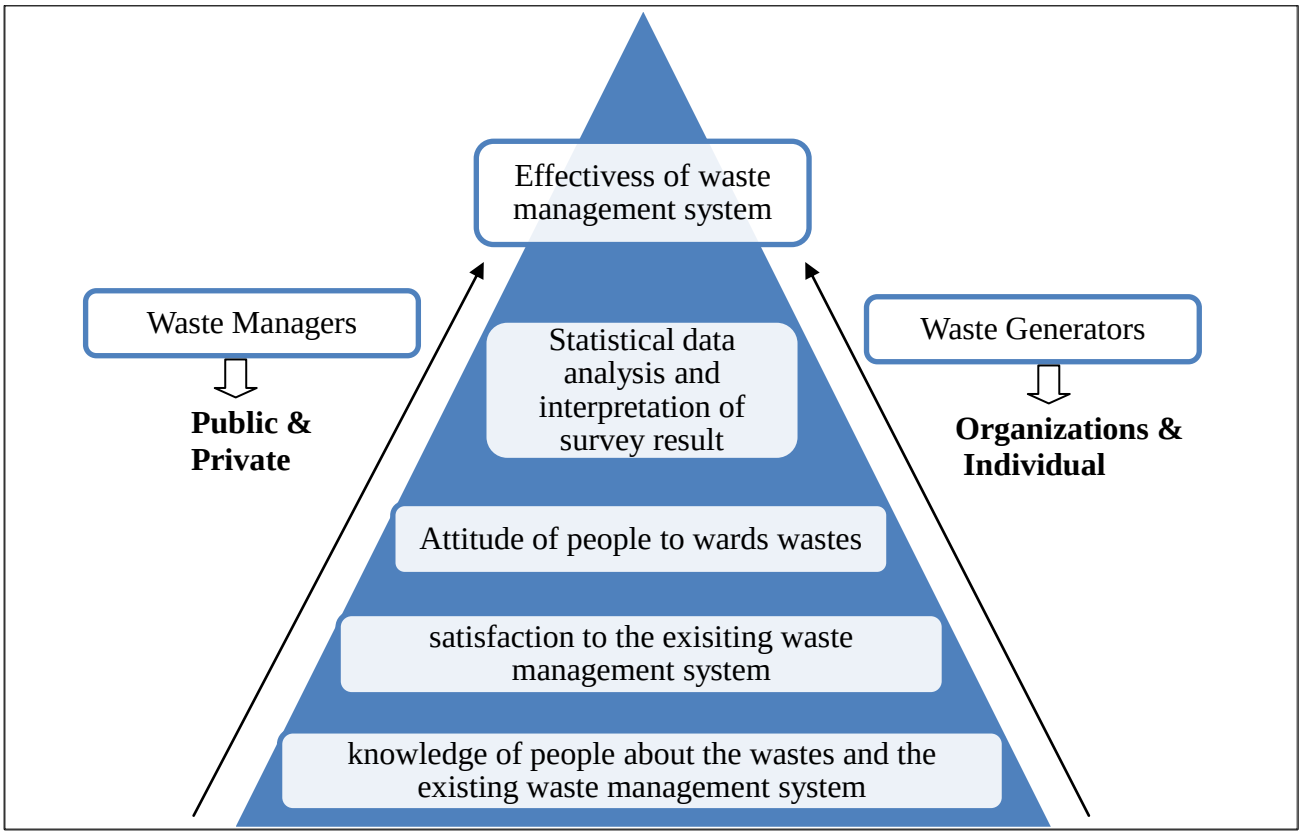


Figure 3. 1 Flow of information in the research **Source: Self**

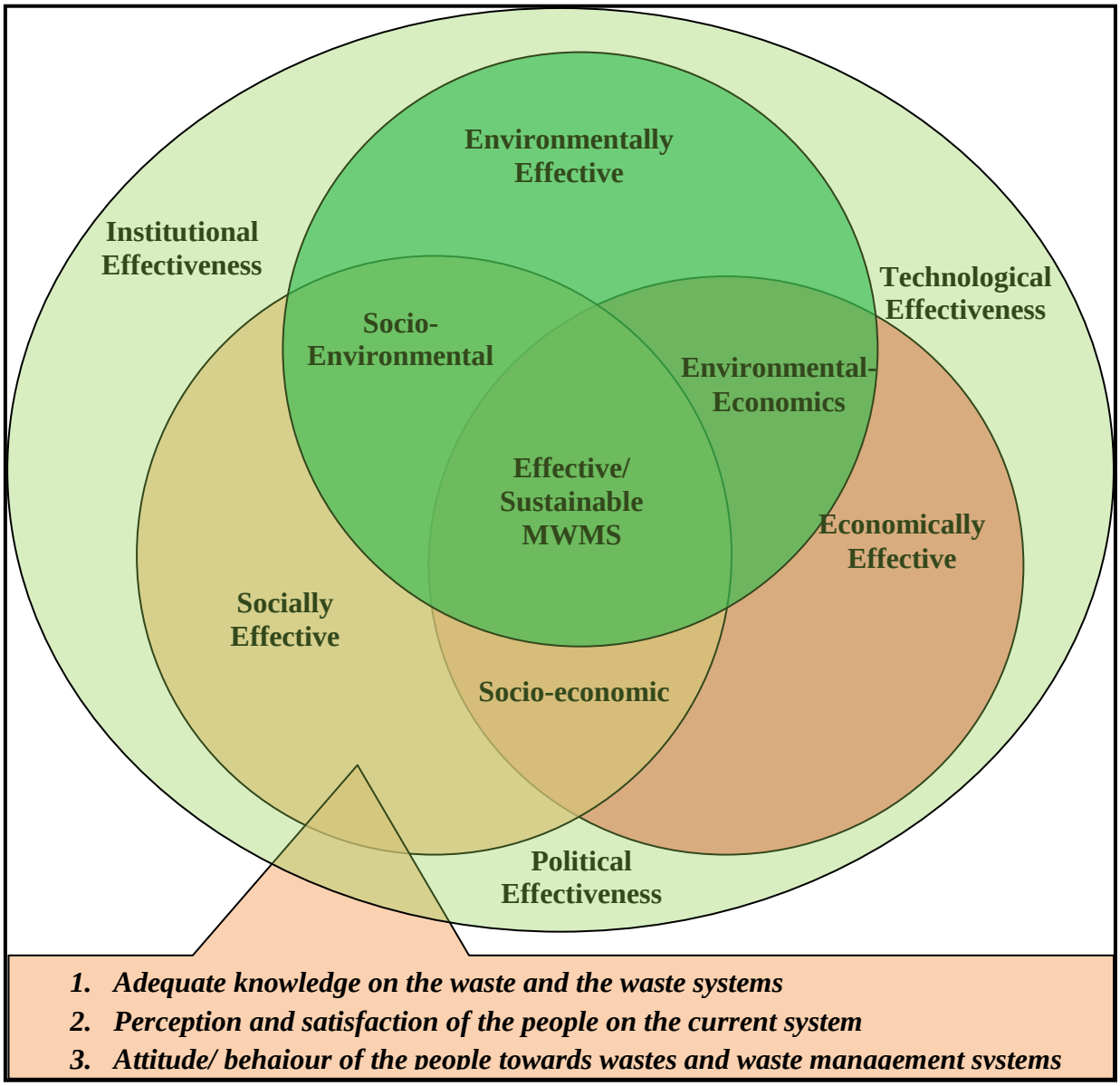


Figure 3. 2: Spheres of Effective Municipal Waste Management System; Source: Adapted, modified and integrated from (Yuan, 2013); (Schübeler, Wehrle, & Christen, 1996)

Chapter 4: Methodology

Under this chapter, the methodology adopted and used during the research study is discussed. After the reviews of literatures from different waste management systems both in developed world as well as under developed countries, the pressing issues has been identified for the existing Thimphu City waste management system in Bhutan. These issues are such as the waste land fill, people's attitude, knowledge of waste & waste management system both by the waste generators as well as waste managers and the perceptions of the people on the existing waste management system in the city.

4.1 Secondary Data

The various journals, web articles, governmental/ organizational repots, books, news papers both national and internationals and internet sources were used to acquire the secondary data for the research. In the Chapter 2: Literature Review, these information or data like sustainable waste management system, waste management Acts, Solid Waste Management Rules and Regulations, Recycling laws and Acts, historical developments of waste management, current status of waste management situations and the challenges were used and analyzed.

The information on the waste generation, collection, recycling, treatment or disposal data were acquired from the literature of Thimphu City including the private waste manager.

4.2 Primary Data

The main source and mode of primary data acquisition includes both face-to face as well as email surveys interviews using semi-closed questionnaires; the field

visits to the lagoon type of sewage waste treatment plant of Thimphu City at Babesa, field visit to the composting plant and visit to land fill at Memeylakha, discussions with the Thimphu City officials and as well as the discussions with the private waste manager: Greenerway. The details of questionnaire preparation, selection of the questionnaire methods, field works and data collection are described and discussed in details hereunder in the subsection "Method of field work and Data collection":

4.3 Method of Field work/survey and Data Collection

This subsection is further sub-divided into questionnaire, survey methodology and data collection. It is discussed as below:

4.3.1 Questionnaire

Based on the objectives of the research that resulted from the literature review, a draft questionnaire was fed with the feedbacks from the waste managers as well as organizations and individuals from Bhutan. The comments and feedbacks from my supervisors of APU, Japan were also used. Thus thorough consultations were exercised prior to the finalization of the questionnaire (see *Annexure I for Final Questionnaire*). A total of 50 questionnaires were decided based on the distribution of the target respondents which shall be described under the "Data collection" in detail.

4.3.2 Field work or survey methodology

For this research study, a survey methodology consisting of semi-closed questionnaires were used. The sampling of the respondents was done based on judgement and convenience sampling methods under a non-probability sampling method. The effort was also made to select only those potential respondents who could

provide the information without failure. This mode of sampling method was selected as the target area, Thimphu City is very much familiar to the author and thus it would save much time and resources with much precise information. The questionnaire was prepared keeping in mind the objectives of the research; that is to see the effectiveness of the existing waste management system from three main angles:

1. The people's knowledge on the waste and the waste problem and management system in the city (mainly under the heading of collection, separation, disposal/treatment, recycling/recovery system);
2. The perceptions or the opinion or the satisfaction level on the existing waste management system in the city; and
3. The behaviours or the attitude of the people towards the wastes.

The above objectives were already elaborated and discussed in detail in Chapter 3. It is targeted not only to the waste generators such as individuals and industries but also to the waste managers both public and private managers in the Thimphu City.

4.3.3 Data Collection

The collection of data was the second most difficult task under this chapter after the task of the preparation of questionnaire. Both the face-to-face survey as well as the email survey (where the questionnaire were emailed to the respondents with instructions for filling up the questionnaires) was conducted.

The mail survey was opted along with face-to-face survey because it has several advantages such as it is much cheaper and less time consuming as compared to other mode of survey. Further, it was also possible to send the same questionnaire to several

respondents in the city via email saving lots of time and resources making easy to administer for the author. Since the research fund was supported only for the travel allowances, it was one of the reasons opted to minimize the cost as well. Most of the respondents contacted had better and positive response and felt good to have soft copy of the questionnaire via email and filled the form or questionnaire with much ease and at their own time and place. In this research study, the response was almost 100 percent as opposed to the literature which mentions that, mail survey's response rate is very low in many cases. In this study, the response was overwhelming. This high response rate is believed to be due to the familiarity of the author with the respondents and that and also due to the fact that all most all of the respondents were relatively young and familiar to the computer and internet usage.

This mode of survey was found by the respondents handy and easy to answer. The questionnaires consisted of the semi-structured questions with both closed and open ended questions. A total of 50 questionnaires was decided following the non-probability sampling method; mainly the convenience and judgement sampling methods has been applied to decide on the number of samples that is judged to represent the whole city. The sampling was done based on the detail personal knowledge of the author regarding the density and distribution of the population, offices, schools, in the city. The author divided the Thimphu City into 14 different areas and gave the individual area a code as follows (also in Figure and Table 4.1):

Main City	1	Dechencholing	8
Trashichhoedzong	2	JDWNRH Hospital	9
Zilukha	3	Changidraphu	10
Kawazangsa	4	Changzamtok	11
Chubachu	5	Olakha	12
Langjophakha	6	Semtokha	13
Taba	7	Babesa	14

Consequently, 50 questionnaires were judged to adequately represent the whole Thimphu city areas as given in the Figure 4.1 below:

Further, the each area was awarded the number of respondents adequate enough to represent the population. The details are present in Table 4.1 below:

Location code	Area/ location	No. of Respondents by its group			Total respondents by Area
		Individual *Residents* *Shopkeepers* *Civil servants*	Organization	Managers	
1	Main City	1	1	3	5
2	Trashichhoedzong	11	2	0	13
3	Zilukha	1	0	0	1
4	Kawazangsa	3	2	0	5
5	Chubachu	0	0	0	0 (covered by Area code 2)
6	Langjophakha	1	1	1	3
7	Taba	2	0	0	2
8	Dechencholing	2	0	0	2
9	JDWNRH Hospital	2	1	0	3
10	Changidraphu	2	0	0	2
11	Changzamtok	2	0	0	2
12	Olakha	2	4	2	8
13	Semtokha	2	0	0	2
14	Babesa	2	0	0	2
Total respondents by group		33	11	6	50

Table 4. 1 Number of questionnaires distributions in each area and under each respondent group

All the responses and questionnaires were received for those sent via emails except one from the area code 2 (Chubachu under organization (Bank)) (see Table 4.1 above).

The other method of survey interview adopted and used in the field was the face-to-face interview which is also known as in-person interview by different researchers. It is said to be the most widely used in the world to get the information or data. It is also believed to be the oldest method of getting information through interview. The combination of the face-to-face method with that of email survey was adopted to minimize the number of non-response and improve the data quality gathered from the respondents.

The face-to-face interviews are best for getting information that are very sensitive or usually that information which are not available from the general public. Therefore, it was very appropriate to use this method as well as the mail survey both of which encourage the respondents not to hesitate in sharing the information about the waste and about the existing system which are generally not able to share or hear publicly. The waste in general is still considered to be a taboo in Bhutan. Therefore it was necessary to choose these methods where the explanation about the question can also be provided in better ways.

The semi-closed ended questionnaire that were prepared (50 questionnaires) keeping in mind the need of the research and the different categories of the target respondents were used to collect information from all stakeholders with the main objective to assess effectiveness of the current waste management system in Thimphu

City and thereby identifying the weakness and opportunities for possible intervention for improvements.

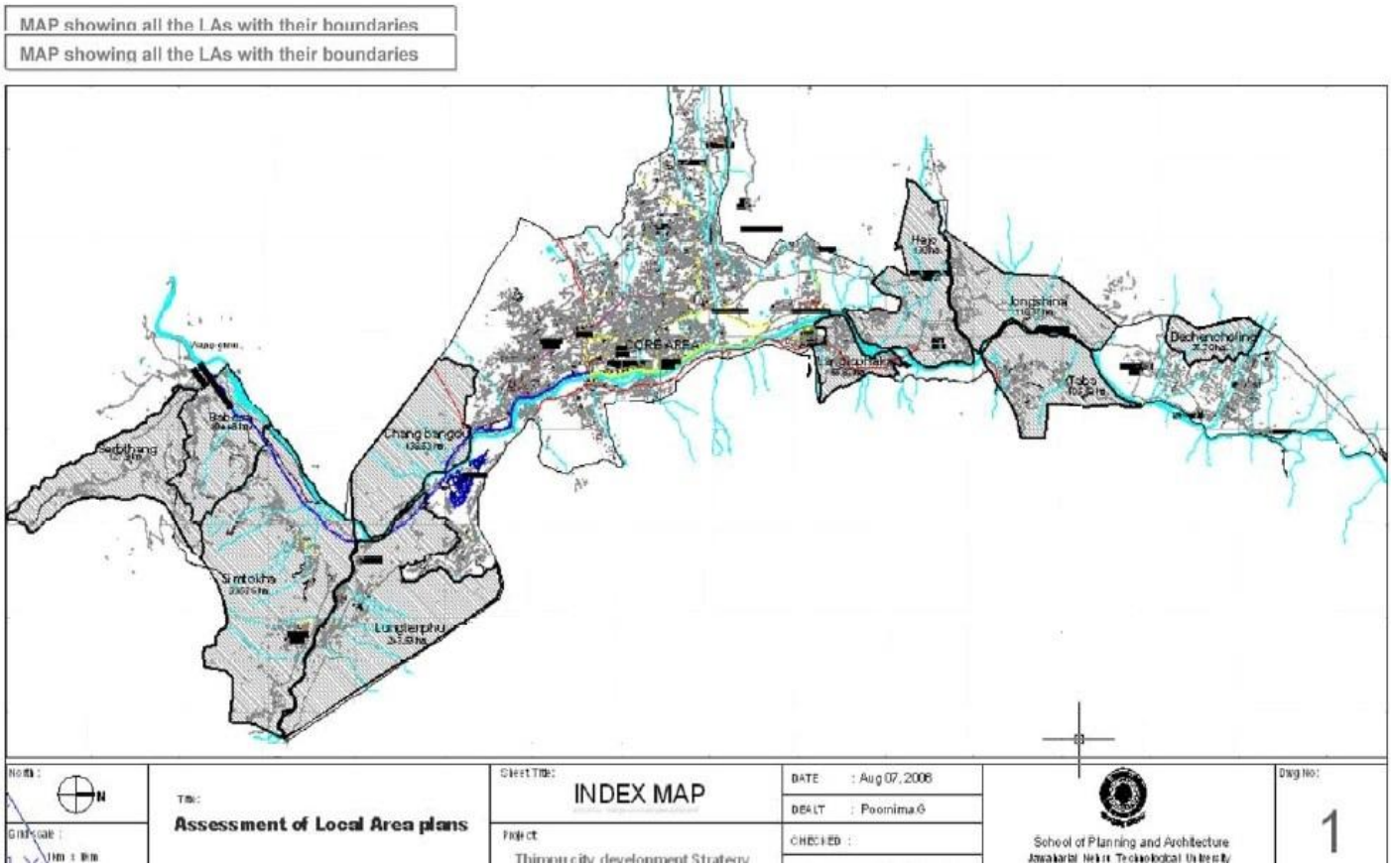


Figure 4. 1 Thimphu City divided into different areas with code; Source: Adapted map from (MoWHS/RGoB, 2008)

The main area of focus was on the knowledge, behaviours and perceptions of residents and organizations towards waste problems and managements in the city. The survey was also designed to provide the highlights and feedbacks to the future actions being planned for waste management.

The main stakeholders that were identified and interviewed were waste generators: individual citizens, organizations or offices; and the waste managers: both public and private managers as below:

1. Greener way Bhutan: is the only private waste manager in Thimphu city
2. Thimphu Thomde (City Corporation): A Government office responsible for waste management in the Thimphu city
3. Department of Renewable Energy, Ministry of Economic Affairs, Bhutan which is partly related to biomass related policies
4. SNV Bhutan, Thimphu: This office influences the policy makings.
5. Bhutan Biogas Project, Thimphu: Has potential to use organic waste.
6. JDWNRH Hospital, Thimphu: This is a source of mainly medical wastes.
7. High School: place to propagate the waste management education and awareness
8. Primary School: place to propagate the waste management education and awareness.
9. Early learning Centre: very important and effective places to impart the waste management education and awareness.
10. Market vendors: They are considered to a major waste generator
11. Shopkeepers: there are waste generators
12. Vehicle Workshops: mainly oil waste generators apart from others.
13. Residents (both private and government quarters)

4.3.4 Study Area description

The study area selected, Thimphu city is the capital city of Bhutan, a small Himalayan country. The recent statistics shows that the capital city has population little more than hundred thousand. But the population of the city is rapidly increasing due to high rate of migration of people from other parts of the country in search of new and better economic opportunities. Bhutan governments have been facing this problem of rural to urban migration since many years now just like in many other parts of the world. The capital city is located in the valley of a river called Wangchu between the mountains (Figure 4.2). The space for the extension of the city is limited and its carrying capacity will be soon surpassed for which Bhutan government is trying to reverse the rural urban migration trend by bringing about plans to distribute developmental activities throughout the country.

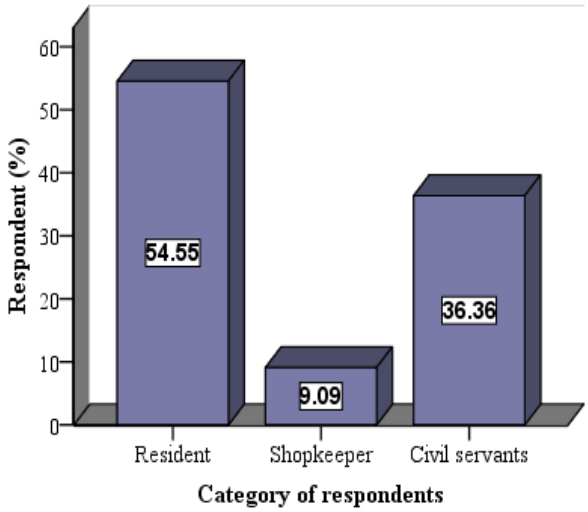
Figure 4. 2 View of Thimphu City; Source: self

Chapter 5: Results

In this chapter, the raw data collected through the survey is processed using the IBM SPSS Statistics 19 package utilizing its frequency table and Chi-square analysis tool for social science survey and is presented under the different sections by groups of respondents as follows:

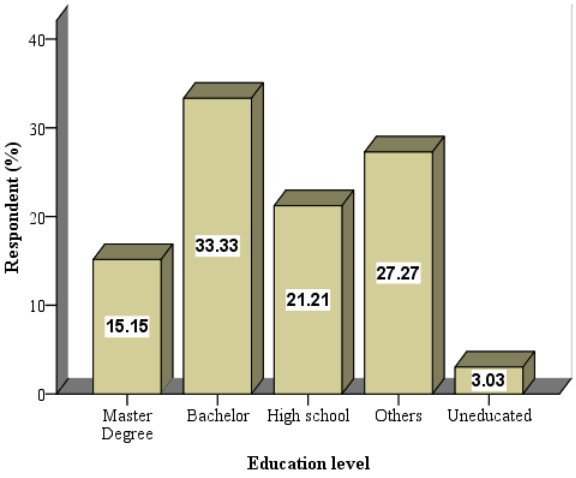
5.1 Individual Groups

The individual groups consisted of the respondents like residents, shopkeepers and civil servants. They are the waste generators. The informations from this group of respondents are presented below:



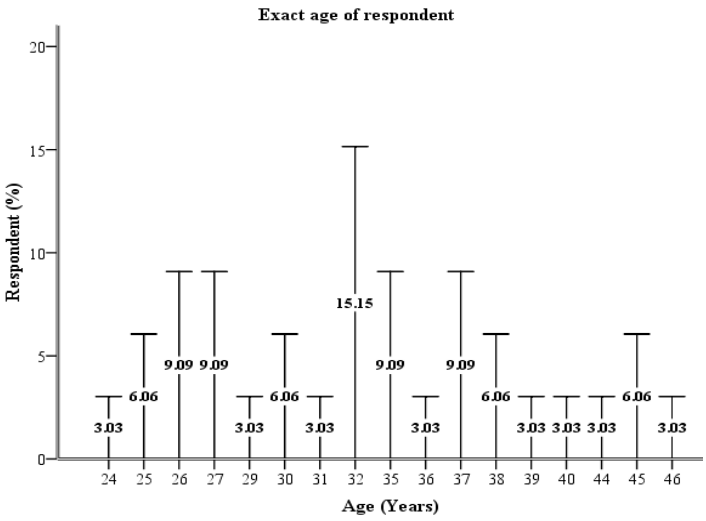
The Figure 5.1 shows that the residents were the most respondents under individual group (54.55%) of the waste generator during the survey while shopkeeper category was the least interviewed respondent (9.09%) during the survey.

Figure 5. 1: % distribution of respondents by category under Individual group



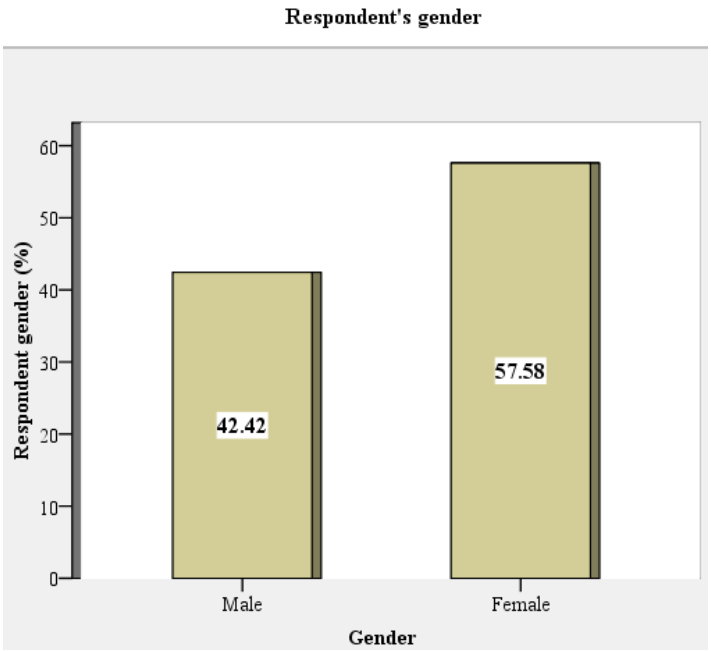
As per the result of the survey (Figure 5.2), the maximum number of respondents questioned in individual groups was of degree holder followed by others (diploma). The uneducated respondents were the lowest; which also suggests that the respondents interviewed could have less impact on the accuracy of the response.

Figure 5. 2: Percentage education level of respondents in Individual group



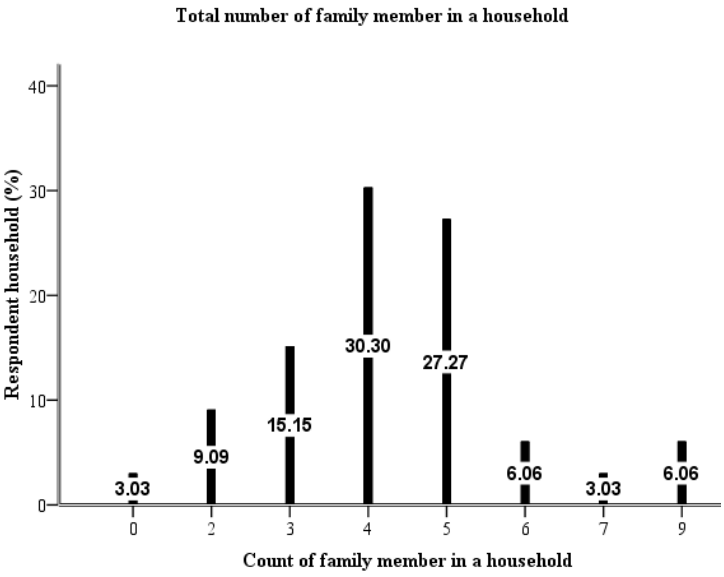
The Figure 5.3 indicates that the age of the individuals questioned mostly was 32 years old. While the oldest respondent was of 46 years old and the youngest respondent was of 24 years old.

Figure 5. 3: Individual respondents by age



The total female respondents was much higher (57.58%) than the total male respondent under the individual group of the respondents interviewed (Figure 5.4)

Figure 5. 4: % individual respondent by gender



About 30% of the individual respondents reported that their family strength consisted of the 4 individuals/ persons while about 3% of the respondents mentioned that the family strength also ranged 1 member (Figure 5.5)

Figure 5. 5: Individual respondents and their family strength

.

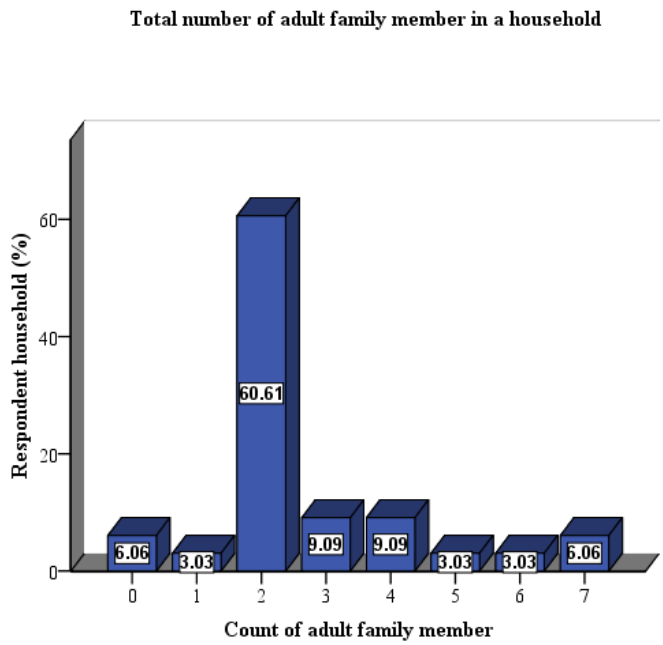


Figure 5. 6: Number of adult in a family

The maximum number of adult individuals in a family under the individual groups respondents interviewed was 2 (Figure 5.6)

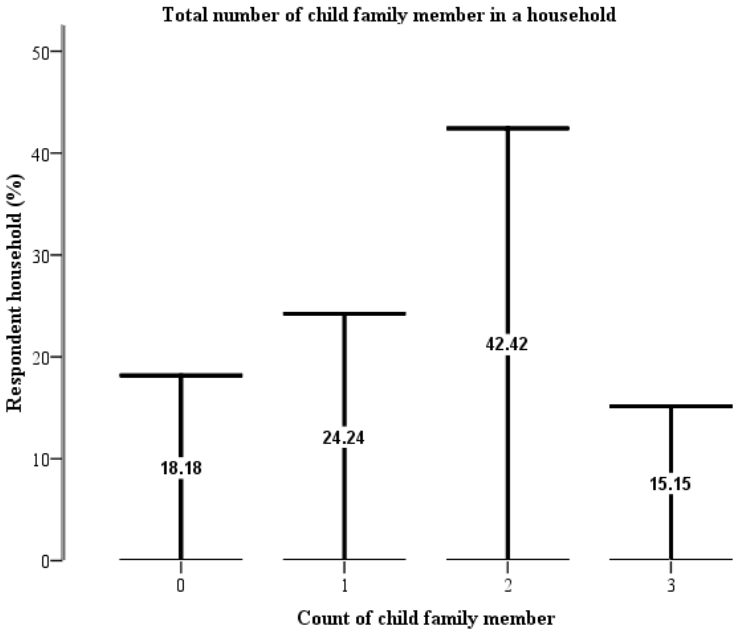
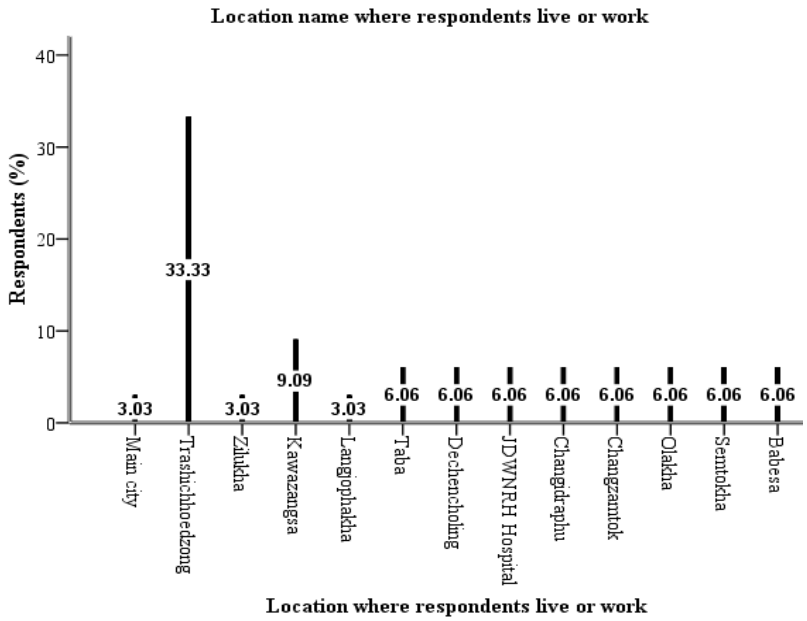


Figure 5. 7: No. of child in a family

About 42 percentage of the respondents reported that the family consisted of 2 children under individual groups (Figure 5.7)

.



The Figure 5.8 shows the distribution of the individual group's respondents in city in different locations. The maximum respondents were from Trashichoedzong and it is the place where they work

Figure 5. 8: The distribution of respondents in the city

	Meaning of waste	Satisfaction level with the waste management service in Thimphu city	Is the waste problem growing over time in the city	Frequency of waste collections per week
Chi-Square	3.667	11.848	25.485	23.121
df	1	7	1	3
Asymp. Sig.	0.056	0.106	0.000	0.000

Table 5. 1: Chi-Square Tests

Significant at ($p<.05$)

Table 5.1 Chi-Square Tests (Asymp.) show that, all the respondents gave very positive response on the waste management in Thimphu city. There was significant association between the notion of respondent and the waste management. When observed frequency table, about 67% of the respondents instantly said the meaning of waste as "*Unwanted things that should be get rid off or out of sight*". The Chi-Square Tests (Asymp.) deduced the following significant association level: Meaning of waste, $\chi 2$ (1) = 3.667, p < .056, Is the waste problem growing over time in the city, $\chi 2$ (1) = 25.485, p < .000, and for the Frequency of waste collections per week, $\chi 2$ (3) = 23.121, p < .000. However, the satisfaction level with the waste management service in Thimphu has mix feeling deducing non significant association, $\chi 2$ (7) = 11.848, p < .106.

	Satisfaction level for the current frequency of waste collection in the city	Greater distance discourages to dispose waste to the garbage truck	Awareness about the different coloured waste bins	Different coloured bins necessary for separation	Different coloured bins necessary for awareness
Chi-Square	10.909	0.758	13.818	13.364	16.030
Df	8	1	2	1	1
Asymp. Sig.	0.207	0.384	0.001	0.000	0.000

Table 5. 2: Chi-Square Tests

Significant at ($p<.05$)

Table 5.2: There is no significant of association on the variables like Satisfaction level for the current frequency of waste collection in the city and Greater distance discourages to dispose waste to the garbage truck, $\chi 2$ (8) = 10.909, p < .207, and $\chi 2$ (1) = .758, p < .384 respectively. Contrary the tests showed a very strong significant of association in the variables like Awareness about the different coloured waste bins, Different coloured bins necessary for separation, and Different coloured bins necessary for awareness, with the tests values of $\chi 2$ (2) = 13.818, p < .001, $\chi 2$ (1) = 13.364, p < .000, and $\chi 2$ (1) = 16.030, p < .000 respectively. This illustrated that the use of such variable items in the waste management will be highly effective.

	Different coloured bins_No as the garbage goes to same truck at the end	Different coloured bins_I don't know	Do you separate waste types	Importance of waste separation at source	Types of wastes separated_plastics
Chi-Square	29.121	25.485	8.758	44.364	1.485
Df	1	1	1	2	1
Asymp. Sig.	0.000	0.000	0.003	0.000	0.223

Table 5. 3: Chi-Square Tests

Significant at ($p<.05$)

Table 5.3: The Chi-Square Tests of different variables showed, highly significant association, as for Different coloured bins_No as the garbage goes to same truck at the end, $\chi 2$ (1) = 29.121, p < .000, Different coloured bins_I don't know, $\chi 2$ (1) = 25.485, p < .000, Do you separate waste types, $\chi 2$ (1) = 8.758, p < .003, and Importance of waste separation at source, $\chi 2$ (2) = 44.364, p < .000 respectively. It predicted that the mix feeling of people on the waste management, even people said it is being important to do segregation of waste at source but at the same-time they tend not to separate any waste since the variable like Types of wastes separated_plastics deduced no significant relationship, $\chi 2$ (1) = 1.485, p < .223.

	Types of wastes separated_ pet bottles	Types of wastes separated_organic wastes	Types of wastes separated_non -organic dry waste	Types of wastes separated_papers	Types of wastes separated_ metals
Chi-Square	1.485	3.667	3.667	22.091	25.485
Df	1	1	1	1	1
Asymp. Sig.	0.223	0.056	0.056	0.000	0.000

Table 5. 4: Chi-Square Tests

Significant at ($p<.05$)

Table 5.4: It is revealed through frequency table that about 61% of the respondents don't separate pet bottles with other waste and eventually, the Chi-Square Test also showed no significant association for the variable, Types of wastes separated_pet bottles, $\chi 2$ (1) = 1.485, p < .223. This determined that sometimes people segregate pet bottles and sometimes not. Significant association are there for Types of wastes separated_organic wastes, and Types of wastes separated_non-organic dry waste with a similar test value of $\chi 2$ (1) = 3.667, p < .056. Whereas there is highly significant association for Types of wastes separated_papers, $\chi 2$ (1) = 22.091, p < .000, and Types of wastes separated_metals, $\chi 2$ (1) = 25.485, p < .000. According to analyzed frequency, it is deduced that people do not segregate papers and metals with other wastes.

	Types of wastes separated_glasses	Types of wastes separated_e-wastes	Waste disposed at_others	Waste disposed at_Specify_Compost pit	How often the waste are disposed off
Chi-Square	13.364	29.121	35.636	29.121	22.152
Df	1	1	2	1	3
Asymp. Sig.	0.000	0.000	0.000	0.000	0.000

Table 5. 5: Chi-Square Tests

Significant at ($p<.05$)

Table 5.5: The test showed a strong significant association in all the variables, Types of wastes separated_glasses, $\chi 2$ (1) = 13.364, p < .000; Types of wastes separated_e-wastes, $\chi 2$ (1) = 29.121, p < .000, Waste disposed at_others, $\chi 2$ (2) = 35.636, p < .000; Waste disposed at_Specify_Compost pit, $\chi 2$ (1) = 29.121, p < .000; and How often the waste are disposed off, $\chi 2$ (3) = 22.152, p < .000. According to data, this test means that none of the activities mentioned as variables are followed by the people and maximum people throw-off the waste at-least once in a week.

	Do you pay for disposing your waste	Ready to pay for disposing off waste	Choose the waste payments system	Distance to nearest waste treatment plant from house_0 to 5 km	Distance to nearest waste treatment plant from house_6 to 10 km	Distance to nearest waste treatment plant from house_11 to 15 km
Chi-Square	25.485	8.758	16.030	22.091	25.485	0.273
Df	1	1	1	1	1	1
Asymp. Sig.	0.000	0.003	0.000	0.000	0.000	0.602

Table 5. 6: Chi-Square tests

Significant at ($p<.05$)

Table 5.6: Most of the variable showed a strong significant association at confidence level of $p < .000$ as not done or agree with the activities stated as variables. There is no significant association in regard to Distance to nearest waste treatment plant from house_11 to 15 km, $\chi 2\ (1) = .273$, $p < .602$, since almost equal number of respondents have said for some it is near and for some it is far away where the waste treatment plant located.

	Distance to nearest waste treatment plant from house_16 km above	Distance to nearest waste treatment plant from house_I dont know	Compost used for_Vegetable garden	First information on recycling wastes through_leaflets	First information on recycling wastes through_government awareness campaign
Chi-Square	13.364	13.364	0.030	29.121	10.939
Df	1	1	1	1	1
Asymp. Sig.	0.000	0.000	0.862	0.000	0.001

Table 5. 7: Chi-Square tests

Significant at ($p<.05$)

Table 5.7: It is determined highly significant association with $p < .000$ or .001 as all have said that waste treatment plant is located nearer and most of them admitted there is no first-hand information on waste recycling neither through leaflets nor from government awareness programme. On use of waste as compost for vegetable garden, there was almost equal number of respondents said yes or no, because of this the Chi-Square test deduced as no significant association, $\chi 2\ (1) = .030$, $p < .862$.

	First information on recycling wastes through_Movies	First information on recycling wastes through_social media	First information on recycling wastes through_others	First information on recycling wastes through_Specify_Schools	How important is the reuse and recycling of materials for you	Preference to buy and use recycled material or product
Chi-Square	3.667	3.667	42.727	16.030	54.545	39.818
Df	1	1	6	1	2	2
Asymp. Sig.	0.056	0.056	0.000	0.000	0.000	0.000

Table 5. 8: Chi-Square tests

Significant at ($p<.05$)

Table 5.8: The Chi-Square Tests for the variables like First information on recycling wastes through_Movies, and First information on recycling wastes through_social media determined significant association as for both, $\chi 2$ (1) = 3.667, p < .056, meaning no such activities happening as of now according to most of the respondents (by about 67% as per frequency computation. Rest of the percentage of respondent acknowledged such activities). For other variable activities, the test deduced highly significant association with the probability, p < .000, illustrating schools does give awareness information on recycling wastes and emphasized that it is important to reuse and recycling the materials. Most of the respondent said the preference of buying and using recycled material or product, $\chi 2$ (2) = 39.818, p < .000.

Table : Chi-Square Tests

	Materials prefer to be reused_PET bottles	Materials prefer to be reused_plastics	Materials prefer to be reused_Papers	Materials prefer to be reused_woods	Materials prefer to be reused_Food wastes	Materials prefer to be reused_e-wastes
Chi-Square	1.485	22.091	1.485	29.121	39.818	22.545
Df	1	1	1	1	2	2
Asymp. Sig.	0.223	0.000	0.223	0.000	0.000	0.000

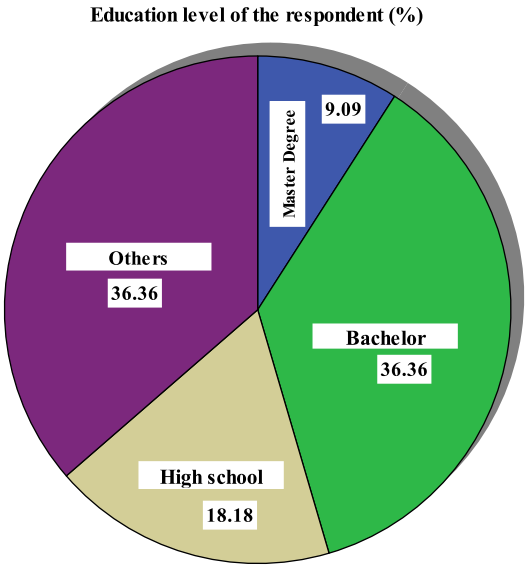
Table 5. 9: Chi-Square tests

Significant at ($p<.05$)

Table 5.9: On Materials prefer to be reused_PET bottles, the test showed, none significant association, $\chi 2$ (1) = 1.485, p < .223, meaning most of the respondent don't preferred it and same interpretation deduced for Materials prefer to be reused_Papers. The Chi-Square Tests for Materials prefer to be reused_plastics, $\chi 2$ (1) = 22.091, p < .000, Materials prefer to be reused_woods, $\chi 2$ (1) = 29.121, p < .000, Materials prefer to be reused_Food wastes, $\chi 2$ (2) = 39.818, p < .000, and Materials prefer to be reused_e-wastes, $\chi 2$ (2) = 22.545, p < .000 that are the strong significant of association deducing most of them don't want and the same effect for to have.

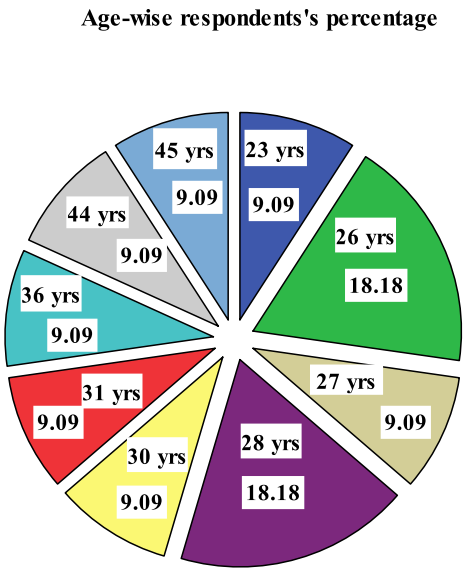
5.2 Organization Group

The organization groups consisted of the respondents like companies, hotel, schools, offices, hospitals, workshops and industries. They are the waste generators. The informations from this group of respondents are presented below:



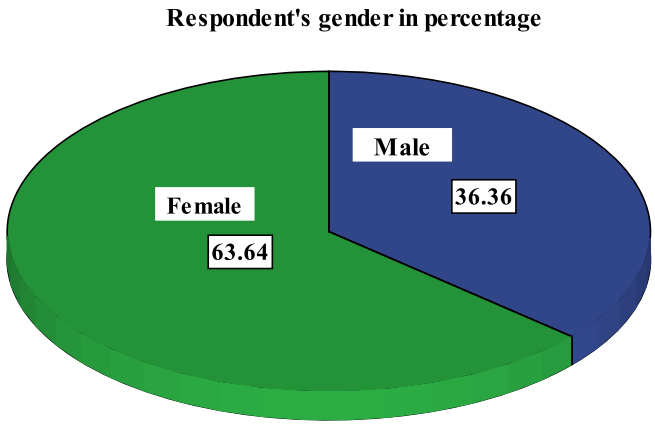
In the Figure 5.9 the respondents with bachelors and other (Diploma) level education were equally distributed under the organization group.

Figure 5. 9: distribution of organization respondents by age



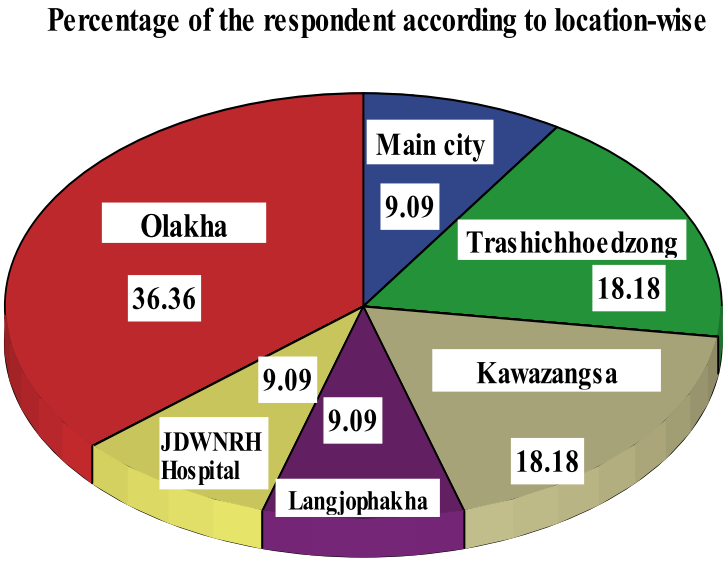
The most of the respondents were aged 26 and 28 years old constituting of 18.18 % each out of all the respondents in Organization group (Figure 5.10)

Figure 5. 10: Organization respondents by age



About 64% of the respondents constituted of female in the organization group (Figure 5.11)

Figure 5. 11: Organization respondents by gender



The distribution of the respondents of organization group was mostly concentrated to Olakha region (Fiigure 5.12) with about 36% of the total respondents under organization group.

Figure 5. 12: Distribution of organization respondents by area in the city

	Waste materials generated by organization_wooden waste and disposal problems	Waste materials generated by organization_PET bottles	Waste materials generated by organization_papers & cardboards	Waste materials generated by organization _ kitchen wastes	Waste materials generated by organization_ glasses
Chi-Square	7.364	2.273	2.273	4.455	4.455
Df	1	1	1	1	1
Asymp. Sig.	.007	.132	.132	.035	.035

Table 5. 10: Chi-Square tests

Significant at ($p<.05$)

Table 5.10: The Chi-Square tests (Asymptotic) analysis for Waste materials generated by organization_wooden waste and disposal problems showed a significant association, $\chi 2$ (1) = 7.364, p < .007. According to description of frequency table, 90% have admitted that, organization won't generate wooden waste. Medium association is deduced for kitchen wastes and glasses as waste materials generated by organization with a test value of $\chi 2$ (1) = 4.455, p < .035. This means very few waste of such kind will be there from organization. Some said yes and some no, for the waste generated by organization as PET bottles, papers or cardboards and this showed there is no significant association as, $\chi 2$ (1) = 2.273, p < .132. This test showed a very mix result with not much of confidence.

	Waste materials generated by organization _e-wastes	Waste materials generated by organization _engine and gear oil	Waste materials generated by organization_used tyres and rubbers	Waste materials generated by organization _metals	Waste materials generated by organization _plastics
Chi-Square	2.273	4.455	4.455	4.455	7.364
Df	1	1	1	1	1
Asymp. Sig.	.132	.035	.035	.035	.007

Table 5. 11: Chi-Square tests

Significant at ($p<.05$)

Table 5.11: Asymptotic Chi-Square tests determined that there is no any related association with the variable e-wastes as waste materials generated by organization, $\chi 2$ (1) = 2.273, p < .132, meaning that almost all the respondents said organization do not generate e-wastes. Medium significant association is there for the variables like, engine and gear oil, used tyres and rubbers, and metals as waste materials generated by organization, $\chi 2$ (1) = 4.455, p < .035. It attributed that no such wastes are generated. There is strong significant association in regard to waste materials generated by organization as plastics, $\chi 2$ (1) = 7.364, p < .007, predicting no waste generated like plastic. It is a contemplated test of analysis.

	Waste materials generated by organization_waste soil and sands	Waste materials generated by organization_medical wastes	Waste materials generated by organization_herbal wastes	Waste generated is disposed at_dumped in the landfill	Waste generated is disposed at_sold to another party outside the country
Chi-Square	7.364	7.364	7.364	4.455	4.455
Df	1	1	1	1	1
Asymp. Sig.	.007	.007	.007	.035	.035

Table 5. 12: Chi-Square tests

Significant at ($p<.05$)

Table 5.12: There is high significant association with regard to variables like soil and sands waste, medical wastes, and herbal wastes as waste materials generated by organization, $\chi 2$ (1) = 7.364, p < .007 deduced through asymptotic Chi-Square tests. It strongly attributed that; organization would not generate such types of waste. For variable like waste generated is disposed in the landfill illustrated medium significant association, $\chi 2$ (1) = 4.455, p < .035. According to frequency generated, 81% of the respondents said the wastes are not dumped in landfill site. Same significant association is there for the waste generated would be sold to another party outside the country. This means only about 19% (analyzed frequency) of the respondents agreed upon the asked activity.

	Waste generated is disposed at_City truck	Waste generated is disposed at_Private waste dealers	Any activity by organization in support of waste management in the city	Can organization contribute to waste management in the city	Have any waste related business activities	Any future plans and programs in support of waste management in the city
Chi-Square	.818	.818	.818	7.364	.818	.091
Df	1	1	1	1	1	1
Asymp. Sig.	.366	.366	.366	.007	.366	.763

Table 5. 13: Chi-Square tests

Significant at ($p<.05$)

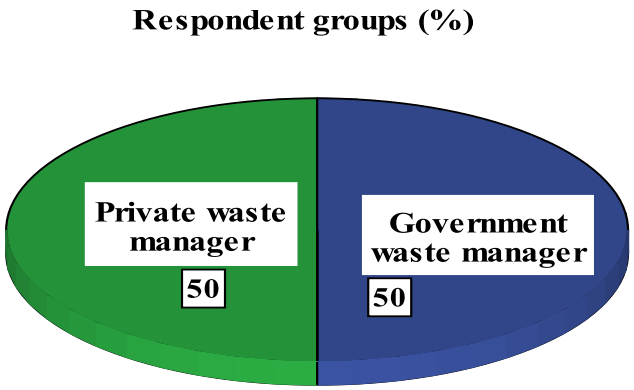
Table 5.13: There is no significant association with the variables, waste generated is disposed at_City truck; waste generated is disposed at_Private waste dealers; any activity by your organization in support of waste management in the city; have any waste related business activities; and Any future plans and programs in support of waste management in the city. This indicated that there is almost equivalent numbers of respondents stated either YES or NO. Asymptotic Chi-Square Tests illustrated a high significant association on the variable, can organization contribute to waste management in the city, $\chi 2$ (1) = 7.364, p < .007. This predicted very strongly that, organization can contribute something to waste management in the city. However, over test is of mix perception with no concrete determination.

5.3 Waste Manager Group:

The waste manager groups consisted of both the public waste managers and the private waste managers including few organized scrap dealers. The informations from this group of respondents are presented below:

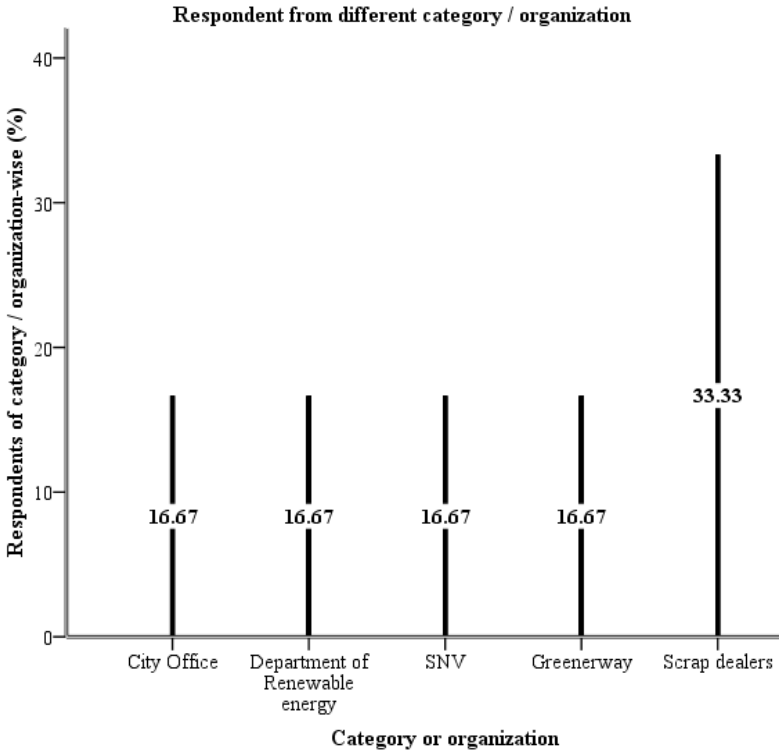
The figure depicts the percentage distribution of respondents in the city for waste managers. The main city constituted 5 percent of the respondents (Figure 5.13)

Figure 5. 13: Distribution of the waste manager respondents in the city area



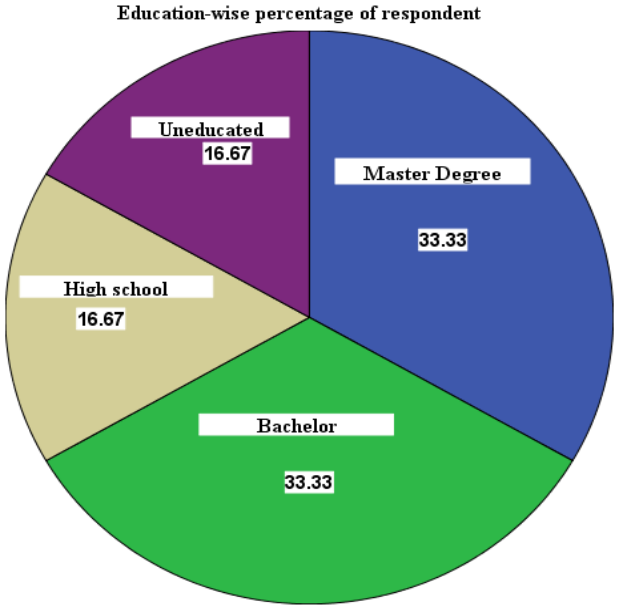
The equal number of private as well as government respondents was involved in the survey interview (Figure 5.14)

Figure 5. 14: Waste Managers (private and public



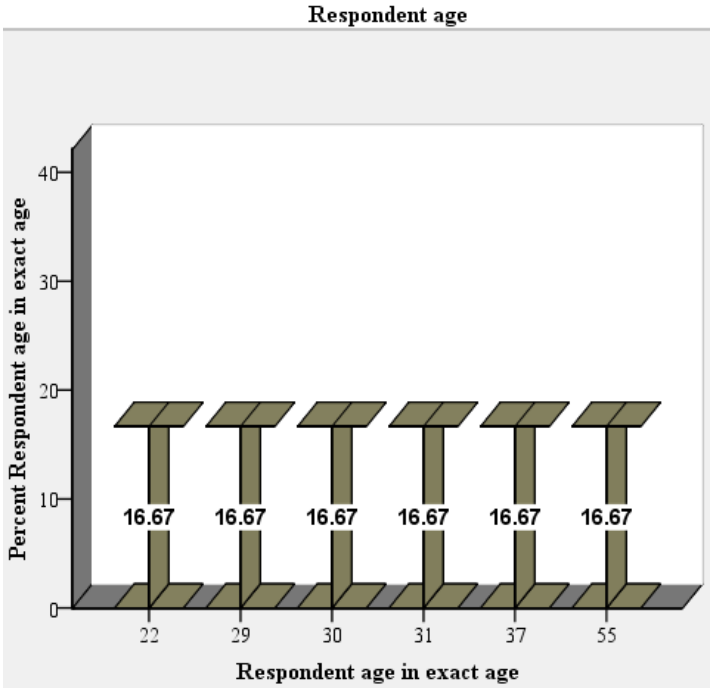
The Figure 5.15 presents the different category of the respondents both private and public under the waste manager group involved in the survey interview.

Figure 5. 15: Different category of waste managers



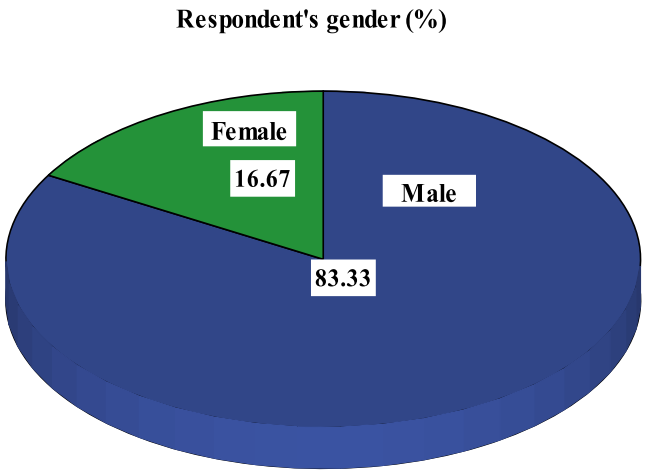
The respondents with qualification level of Bachelor degree and the Master degree finds same counts for waste managers (Figure 5.16)

Figure 5. 16: Qualification level of the respondents for waste manager



The age of the respondents ranged between 22-55 years old for waste managers (Figure 5.17)

Figure 5. 17: % respondents of waste manager group by age



In the waste manager group the respondent is dominated by males (about 83%) as compared to female respondents (17 %) as in the Figure 5.18

Figure 5. 18: Waste manager respondents by gender

	Meaning of waste	Satisfaction level with the waste management service in Thimphu city	Is the management of the waste in the city improving	Most common type of waste found in the city_Pet bottles	Most common type of waste found in the city_Plastics or Polythene
Chi-Square	0.667	2.667	0.000	2.667	2.667
Df	1	1	1	1	1
Asymp. Sig.	0.414	0.102	1.000	0.102	0.102

Table 5. 14: Chi-Square tests

Significant at ($p<.05$)

Table 5.14: The Chi-Square tests (Asymptotic) analysis for meaning of waste deduced no significant association, $\chi 2$ (1) = .667, p < .414 as answer varied, some stated "*Unwanted things that should be get rid of or out of sight*" and others as "*Resources at wrong place and wrong time*". It was indicated in the analyzed frequency description. All other variables also has no significant association, thus it deduced most of the respondent stated that "No they were not satisfied with the waste management service in Thimphu city". Through frequency table it determined that 50% of the respondent said waste management in the city is being improving and other 50% stated not improving. Most of the respondents have said the most common waste in the city were the PET bottles, plastics or other polythene materials.

	Most common type of waste found in the city_Metals &aluminium	Most common type of waste found in the city_E-wastes	Most common type of waste found in the city_Chemicals	Most common type of waste found in the city_Hospital wastes	Most common type of waste found in the city_Food wastes
Chi-Square	0.000	2.667	2.667	2.667	2.667
df	1	1	1	1	1
Asymp. Sig.	1.000	0.102	0.102	0.102	0.102

Table 5. 15: Chi-Square tests

Significant at ($p<.05$)

The Chi-Square tests here also predicted no significant association at significant test level $p<.05$. It was found out through frequency table analysis that some stated "YES" and some "NO" on the asked variable questions such as most common type of waste found in the city are metals and aluminium; E-wastes; city-chemicals; city-hospital wastes; and city-food wastes. The test illustrated mix mode of results.

	Most difficult process in waste management in city_Separation	Most difficult process in waste management in city_Collection	Different coloured of waste bin_Green	Different coloured of waste bin_White	Types of wastes separated_ Plastics
Chi-Square	0.667	0.667	0.000	0.000	0.000
Df	1	1	1	1	1
Asymp. Sig.	0.414	0.414	1.000	1.000	1.000

Table 5. 16: Chi-Square tests

Significant at ($p<.05$)

From the managers' perspective, all have said separation and collection of city wastes were the most difficult task due to which Chi-Square tests did not predicted a significant association for those cited variables. Through analyzed frequency tables, it has been revealed that there has been equal numbers of response for the variable like bin colours, separated wastes like plastics, thus $\chi 2$ tests at significant level $p<.05$ showed none significant association.

	Types of wastes separated_ PET bottles	Types of wastes separated_Organic or biodegradable wastes	Types of wastes separated_ Aluminium	Types of wastes separated_ Chemicals	Types of wastes separated_Glasses
Chi-Square	2.667	0.667	0.667	0.000	0.000
Df	1	1	1	1	1
Asymp. Sig.	0.102	0.414	0.414	1.000	1.000

Table 5. 17: Chi-Square tests

Significant at ($p<.05$)

It was found out through analyzed frequency table that there was equal mix feeling responses (YES or NO) for the asked variables like, types of wastes separated_PET bottles; types of wastes separated_Organic or biodegradable wastes; types of wastes separated_ Aluminium; types of wastes separated_Chemicals; and types of wastes separated_Glasses, due to which, $\chi 2$ tests at significant level $p<.05$ did not deduced any significant association.

	Method of waste disposal being practiced_ Landfill	Method of waste disposal being practiced_Incineration	Method of waste disposal being practiced_Specify_ Sell to dealers	Distance to landfill site from the city_0 to 5 km	Distance to landfill site from the city_6 to 10 km
Chi-Square	0.000	0.000	0.667	0.667	2.667
df	1	1	1	1	1
Asymp. Sig.	1.000	1.000	0.414	0.414	0.102

Table 5. 18: Chi-square Tests

Significant at ($p<.05$)

There was no any significant association determined by the Asymptotic Chi-Square tests at significant level of $p<.05$ for the variables like, method of waste disposal being practiced_ Landfill; method of waste disposal being practiced_Incineration; method of waste disposal being practiced_Specify_Sell to dealers; distance to landfill site from the city_0 to 5 km; and distance to landfill site from the city_6 to 10 km. It is understood through frequency tables that most of the responses were positive against each variables.

	Distance to landfill site from the city_11 to 15 km	Distance to landfill site from the city_16 km and above	Distance to landfill site from the city_ I don't know	Distance to waste treatment plant from the city_0 to 2 km	Distance to waste treatment plant from the city_3 to 5 km
Chi-Square	2.667	0.667	0.667	0.667	0.667
df	1	1	1	1	1
Asymp. Sig.	0.102	0.414	0.414	0.414	0.414

Table 5. 19: Chi-square Tests

Significant at ($p<.05$)

Similar situation was deduced out here too through the tests of asymptotic Chi-Square at significant level of $p<.05$ for the variables like, distance to landfill site from the city_11 to 15 km; distance to landfill site from the city_16 km and above; distance to landfill site from the city_ I don't know; distance to waste treatment plant from the city_0 to 2 km; and distance to waste treatment plant from the city_3 to 5 km. It was revealed through frequency tables that most of the responses were in favour against each variable as cited.

	Distance to waste treatment plant from the city_6 to 8 km	Distance to waste treatment plant from the city_I don't know	First information on recycling wastes through_ leaflets	First information on recycling wastes through_government awareness campaign	First information on recycling wastes through_Movies
Chi-Square	0.667	0.667	2.667	2.000	0.000
df	1	1	1	3	1
Asymp. Sig.	0.414	0.414	0.102	0.572	1.000

Table 5. 20: Chi-square Tests

Significant at ($p<.05$)

The Chi-Square tests did not deduced any significant association at significant test level ($p<.05$) for those variables, such as, distance to waste treatment plant from the city_6 to 8 km; distance to waste treatment plant from the city_I don't know; first information on recycling wastes through_ leaflets; first information on recycling wastes through_government awareness campaign; and First information on recycling wastes through_Movies.

	First information on recycling wastes through_social media	First information on recycling wastes through_others	First information on recycling wastes through_Specify_ friends and family	The waste collected ends up at_Landfill	The waste collected ends up at_Recycling factory and local dealers
Chi-Square	0.667	0.000	0.667	2.667	0.667
df	1	1	1	1	1
Asymp. Sig.	0.414	1.000	0.414	0.102	0.414

Table 5. 21: Chi-square Tests

Significant at ($p<.05$)

The Chi-Square tests did not deduced any significant association at significant test level ($p<.05$) for those variables which are stated in above $\chi 2$ table against each test value.

	The waste collected ends up at_International dealer	The waste collected ends up at_Incinerator	Materials reused most_Papers	Materials reused most_Metals & aluminium	Materials reused most_Chemicals
Chi-Square	0.000	2.667	2.667	0.667	0.667
df	1	1	1	1	1
Asymp. Sig.	1.000	0.102	0.102	0.414	0.414

Table 5. 22: Chi-square Tests

Significant at ($p<.05$)

There is no any significant association determined by Chi-Square tests at significant level ($p<.05$) for the variables viz., waste collected ends up at_International dealer; waste collected ends up at_Incinerator; materials reused most_Papers; materials reused most_Metals & aluminium; and materials reused most_Chemicals.

	Materials reused most_Water	Materials recycled most_ PET bottles	Materials recycled most_Plastics/ Polythene	Materials recycled most_Papers	Materials recycled most_Chemicals
Chi-Square	0.667	0.000	2.667	0.667	2.667
df	1	1	1	1	1
Asymp. Sig.	0.414	1.000	0.102	0.414	0.102

Table 5. 23: Chi-square Tests

Significant at (p<.05)

The Chi-Square tests did not deduced any significant association at significant test level ($p<.05$) for the variables like, materials reused most_Water; materials recycled most_ PET bottles; Materials recycled most_Plastics/ Polythene; Materials recycled most_Papers; and Materials recycled most_Chemicals.

	Materials recycled most_Water	Materials recycled most_Glasses	Materials recycled most_ Specify_Metal	Materials recycled most_Not yet recycled	Materials recycled most_Specify_ Food waste
Chi-Square	0.667	0.667	0.667	0.000	1.000
df	1	1	1	2	2
Asymp. Sig.	0.414	0.414	0.414	1.000	0.607

Table 5. 24: Chi-square Tests

Significant at (p<.05)

There isn't any significant association illustrated by Chi-Square test at significant test level (*p<.05)* for those variables as included in the above table.

	Do you sell any recyclable or reusable materials	Main problems and obstacles being faced by waste managers_segregation problem	Main problems and obstacles being faced by waste managers_collection and transportation problem	Main problems and obstacles being faced by waste managers _higher waste buying price	Main problems and obstacles being faced by waste managers _ lack of funds
Chi-Square	1.000	0.667	0.667	0.667	0.667
df	2	1	1	1	1
Asymp. Sig.	0.607	0.414	0.414	0.414	0.414

Table 5. 25: Chi-square Tests

Significant at (*p<.05*)

No any significant association predicted by Chi-Square tests with a significant test level ($p<.05$) for the variables such as, do you sell any recyclable or reusable materials; main problems and obstacles being faced by waste managers_segregation problem; main problems and obstacles being faced by waste managers_collection and transportation problem; main problems and obstacles being faced by waste managers _higher waste buying price; and main problems and obstacles being faced by waste managers _ lack of funds.

	Main problems and obstacles being faced by waste managers_lack of expertise	Main problems and obstacles being faced by waste managers_lack of infrastructures	Main problems and obstacles being faced by waste managers_lack of laws	Main problems and obstacles being faced by waste managers_illigal dumping
Chi-Square	0.667	0.667	0.667	0.667
Df	1	1	1	1
Asymp. Sig.	0.414	0.414	0.414	0.414

Table 5. 26: Chi-square Tests

Significant at ($p<.05$)

The Chi-Square Tests (Asymp.) did not forecasted any significant association at significant test level ($p<.05$) to those variables like, main problems and obstacles being faced by waste managers_lack of expertise; main problems and obstacles being faced by waste managers_lack of infrastructures; main problems and obstacles being faced by

waste managers_lack of laws; and Main problems and obstacles being faced by waste managers_illegal dumping.

The entire tests for the manager groups predicted that there is no significant level of association or relationship among or between the groups.

Chapter 6: Discussion of findings

This chapter will be discussing results of the data analysis of survey, literatures, and site visit. And it will be discussed under the different sections based on the research questions and objectives. The sections that will be discussed are existing waste management system as seen through the literature review and the site visit; awareness of the people on the current waste management system/ knowledge on the waste and its system; the perception/ satisfaction level of people for the current waste management system; and the attitude of people towards waste and its management.

6.1 Existing waste management system as seen through the literature review and the site visit

In the light of reviewed global waste situation, as well as that of the domestic waste situations; the waste management system in Bhutan has been evolving throughout the history along with the increase in the knowledge and technology about the effective and sustainable waste management. However, there has been a general observation that the solution for the waste problems in the past as well as at present has been temporary which is very much evident from the explosion of the current and the only landfill in the Thimphu city.

Figure 6. 1: Memeylakha Landfill, Thimphu City (site visited)

The landfill at Memeylakha (Figure 6.1) has grown out of its carrying capacity and the leachate (Figure 6.2) can be visible on the road below the landfill which is contaminating the adjacent stream. The authority concerned is not able to manage these waste problems completely even at the landfill. This is due to the fact that the waste management is a complex system that requires an interdisciplinary knowledge and techniques with inter-organizational cooperation which is somehow and some were lacking to certain extent in Thimphu city's waste management system.

Although there were several waste related initiatives in the past in Bhutan such as plastic ban in 1999, all most all have been largely ineffective (BBS, 2013) . Therefore, in Bhutan, the systematic waste management is a not very old. The current waste management doesn't seem to be a fully integrated and sustainable.

Figure 6. 2: Leachate from Memeylakha Landfill

Further, it has been observed during the site visit to the only sewage treatment plant that the quality of the treated water could be improved a lot (Figure 6.3).

Figure 6. 3: Thimphu City's only sewage treatment plant (Lagoon); a-Inlet, b-treatment tanks, c-sludge, d-outlet/ treated water into river

The similar situation has been observed in the only composting plant at Memeylakha as depicted in Figure 6.4. The composting methodology being followed is traditional method and the green house gases such as methane and carbon dioxide is known to be released to greater amount through such methodology.

The figure 6.5 explains the current structure of the waste management system in Thimphu city.

Figure 6. 4: Composting plant at Memeylakha; a-Plant; b &c-organic waste; d-treatement; e & f-final product/package

Figure 6. 5: Current waste management structure of Thimphu City

6.2 Awareness of the people on the current waste management system/ knowledge on the waste and its system

The study suggests the existence of a significant association between the notion of respondent and the waste management (Table 5.1). For instance about 67% of the respondents defined wastes as the "*Unwanted things that should be get rid off or out of sight*" which means that the most of the people do not believe that the waste is the resources that can be further recycled or used. This gives the first impression that the people do not have adequate awareness or knowledge about the value of waste they generate.

Further the high significant association levels (Table 5.1) between variables like Meaning of waste; Is the waste problem growing over time in the city suggests that something is wrong in the current waste management system as people believe that waste problem is growing over time.

And the frequency of waste collections per week is not up-to the mark as expected by the city dwellers (respondents), which means frequency of waste collection per week need to be increased.

.

6.3 The perception/ satisfaction level of people for the current waste management system

The non significant associations from the result showed mixed satisfaction level of the people with the waste management service in Thimphu city (Table 5.1) suggesting the faults in the current waste management service in Thimphu. Further, the

results also show a non significant association between the variables like Satisfaction level for the current frequency of collection in the city and Greater distance discourages to dispose waste to the garbage truck (Table 5.2).

However, the result showed a very strong significant of association in the variables (Table 5.2) like Awareness about the different coloured waste bins, Different coloured bins necessary for separation, and Different coloured bins necessary for awareness, with the tests values of $\chi 2$ (2) = 13.818, $p < .001$, $\chi 2$ (1) = 13.364, $p < .000$, and $\chi 2$ (1) = 16.030, $p < .000$ respectively suggesting that such use of variable items in the waste management will be highly effective.

6.4 The attitude of people towards waste and its management

The variables such as "Do you separate waste types?"; "Importance of waste separation at source" were asked to the respondents and the Chi-Square Tests analysis of such variables showed the high significant association, as for "Different coloured bins_No" as the garbage goes to same truck at the end, $\chi 2$ (1) = 29.121, $p < .000$, Different coloured bins_I don't know, $\chi 2$ (1) = 25.485, $p < .000$, Do you separate waste types, $\chi 2$ (1) = 8.758, $p < .003$, and Importance of waste separation at source, $\chi 2$ (2) = 44.364, $p < .000$ respectively.

The above significances suggest that existence of mix feeling of people on the waste management. People said it is important to segregate waste at source but at the same-time they tend not to separate any waste since the variable like "Types of wastes separated_plastics" deduced no significant relationship, $\chi 2$ (1) = 1.485, $p < .223$.

Further, there is no significant level of association or relationship among or between the groups. In reality there should exsist a strong association within and among the waste managers and with other stakeholders. However, the result data shows that there is no any strong significant of associations suggesting that there is no effective waste management system.

Chapter 6: Conclusion

This section shall discuss about the final deduction of the research which shall also include the challenges, recommendation for possible improvement of waste management in Thimphu city, Bhutan.

The statistical analysis has shown that the in-depth knowledge on waste and its value as the resources, lack in the general population of the Thimphu city which is a vital part of the sustainable/ effective waste management system. Other variables such as the satisfaction level on the current waste management system showed that there is a set of population who are unsatisfied and also an all most equal amount of population who are not able to answer. The attitude of the people towards the waste and waste systems have a very confusing result as people wants to "separate waste at source" and also considered it as very important of the waste management system. However, when they are asked whether if they separate waste at source, most of them said they don't separate waste citing other reasons. This suggests that there is a lack of action in management of waste which is most probably resulting out of the lack of general awareness on waste and its management importance. It is also predicted that the mix feeling of satisfaction by people exists on the current waste management.

Therefore, as a conclusion, the waste management system in Thimphu is not adequately addressing one of the vital aspect of effective waste management system; Social aspects which was deduced through this study based on the knowledge, perception and attitude of people to waste and waste system. It would be necessary to strength this aspect along with other aspects such as more awareness on importance of

waste management, encouragement and incentives to the private sectors to take up the waste related activities and general public participation in the waste management system.

6.1 Challenges and difficulties in sustainable waste management in Thimphu city, Bhutan

There are many challenges identified during the research. The most three important problems identified both through the survey analysis as well as the visits and literature were the segregation of waste, collection and transportation with about 67% each being responded positive by the waste managers alone. And these are very much linked with the people, their knowledge, and their attitude towards waste. Other challenges with 50% of the waste manager responding positive and having considerable impacts on effective waste management system were like the lack of expertise/ technology, lack of infrastructures, lack of adequate laws, illegal dumping and the lack of public participation.

6.2 Further research

Since this research was focussed only on one aspect of the sustainable/ effective waste management system, that is Social; other aspect such as Economical, Environmental, technological or political aspect has to be linked after proper/ adequate research in the respective area. Further, the detailed material flow analysis in the city was not able to conduct which would be more comprehensive for any intervention solutions in the future.

6.3 Recent developments in Thimphu City Waste Management System

Starting 1st January, 2015, the Thimphu City has outsourced the waste management activity to private company, Greenerway. More than 70% of the city is managed by the Greenerway at present while waste from rest of the area is being looked after by the city. However, the plan is underway to completely outsource the waste management activity to private companies. This is a positive development as the need of private participation is very much necessary for the waste management in the city. As per the Greenerway data, as high as 1595 tones of recyclable dry waste and 858 tones of organic waste has been prevented from going to the only landfill; Memeylakha in Thimphu City just in 5 months (January-May, 2015). The culture of waste segregation at source has picked up with the intervention by Greenerway.

Such private participation in the waste management in other cities of Bhutan should be encouraged and the right environment should be created to let people see the waste as resources. The experiences and lessons from Thimphu city further highlight the importance of private participation for the effective management of the waste in Bhutan.

Reference

ADB. (2013, 07). *Nepal Cities: Clean and Healthy Urban Development*. Retrieved 04 2015, from www.adb.org: http://www.adb.org/results/nepal-cities-clean-and-healthy-urban-development

ADB. (2013). *Solid Waste Management in Nepal: Current Status and policy recommendations.* Asian Development Bank.

Bajgain, S. (2008). *Feasibility of a Biogas Programme in Bhutan.* Bangladesh: SNV Netherland Development Organization.

BBP. (2012). *First Annual Progress Repot.* Thimphu: Department of Livestock, MoAF.

BBS. (2013, 01 14). *www.bbs.bt*. Retrieved 03 25, 2015, from www.bbs.bt/news: http://www.bbs.bt/news/?p=22302

Bergmeier, M. (2003). The history of waste energy recovery in Germany since 1920. *Energy 28* , 1359–1374.

Caniato, M., Tudor, T., & Vaccari, M. (2014). Understanding the perceptions, roles and interactions of stakeholder networks managing health-care waste: A case study of Gaza Strip. *Waste Management xxx (2014)* , 1-10.

DRE. (2012). *Bhutan Energy Efficiency Baseline Study-Final Report.* DRE. Thimphu: Department of Renewable Energy & UNDP Bhutan.

Fischer, C. (2013). *Municipal Waste Management in Germany.* European Environment Agency.

FNR. (2013). *Biogas: An introduction.* OT Gulzow, Hofplatz 1: FNR.

Ghimire, P. C. (2009). *Biogas Market Study in Bhutan-Final Report* . SNV/ ADB.

Government of Japan. (2000). *asic Act for Establishing a Sound Material-Cycle Society (.*

Greenerwaybhutan. (2015, 04 01). Thimphu.

Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management , 33* (1), 220-232.

Gyeltshen, P. (2008). Solid Waste Management in Thimphu City. *National Conference on Solid Waste Management August 2008.* Thimphu.

IfaS. (2013). *Zero Emission.* IfaS. Germany: Institute of Applied Material Flow Management(IfaS).

Johnke, B. (1992). Waste Incineration-An important element of the integrated waste management system in Germany. *Waste Management & Research (1992) 10* , 303-315.

Kanus, M. (2013, 09 26). IMFM Lecture No.2: MFM Methodology.

Kawai, K., & Tasaki, T. (2015). Revisiting estimates of municipal solid waste generation per capita and their reliability. *J Matter Cycles Waste Management; DOI 10.1007/s10163-015-0355-1* , DOI 10.1007/s10163-015-0355-1.

Kuenselonline. (2013, 10 21). *25MW of Renewable Energy by 2025*. Retrieved 10 21, 2013, from kuenselonline.com: http://www.kuenselonline.com/25mw-of-renewable-energy-by-2025/#.UmU2ePmVONc

Kuenselonline. (2013, 11 17). *Electricity for all by 2013*. Retrieved 11 17, 2013, from kuenselonline.com: www.kuenselonline.com/electricity-for-all-by2013/#.Uoikh8Q_uwk

Kuenselonline. (2012, 01 30). *Setting trash afire*. Retrieved 12 10, 2013, from www.kuenselonline.com: http://www.kuenselonline.com/setting-trash-afire/#.UqcjDvQW0QE

kuenselonline.com. (2013, 03 01). *Detoxifying the Meymeylakha Landfill*. Retrieved 12 10, 2013, from Kuenselonline: http://www.kuenselonline.com/detoxifying-the-memeylakha-landfill/#.Uqb9QfQW0QE

MoE, Japan. (2006). *Sweeping Policy Reform towards a "Sound Material-Cycle Society".*

MoWHS/RGoB. (2008). *Thimphu City Development Strategy*. Thimphu: Ministry of Work and Human Settlement, Royal Government of Bhutan.

National Statistical Bureau, Asian Development Bank. (2013). *Bhutan Living Standards Survey 2012 Report.* Thimphu & Philippines: NSB & ADB.

NEC. (2013). *National Environment Commission*. Retrieved 12 10, 2013, from http://www.nec.gov.bt: http://www.nec.gov.bt/nec1/?page_id=346

Phuntsho, S., Herat, S., Shon, H., Vigneswaran, S., Dulal, I., Yangden, D., et al. (2009). Studying Municipal Solid Waste generation and Composition in the Urban areas of Bhutan. *SAGE Journals* (545-551), 1.

RGoB. (2013). Alternate Renewable Energy Policy 2013. *Alternate Renewable Energy Policy 2013* .

RGoB. (2012). *National Waste Prevention & Management Regulation.* Thimphu: NEC.

Schreurs, M. A. (2005). *Environmental policy in Japan.* Edward Elgar.

Schübeler, P., Wehrle, K., & Christen, J. (1996). *Working Paper No.9: Conceptual Framework for Municipal Solid Waste Management in Low-Income Countries.* Vadianstrasse 42, CH-9000 St. Gallen: SKAT (Swiss Centre for Development Cooperation in Technology and Management).

Sharma, S. (2013, 11 29). Greenerway Survey 2013. 4. (S. B. Rai, Interviewer)

Thapa, G. B. (1998). Lessons learned form solid waste management in Kathmandu, Nepal. *HABITATITNL., Vol. 22, No. 2* , 97-114.

thimphucity.bt. (2010). *The first bullitin (progress report) 2010.* Thimphu: Thimphu City Corporation.

Tobgay, S. (2011). *Bioenergy Needs Assessment Study in Bhutan-Status, Issues, Concerns and Opportunites.* Thimphu: PPD, MoAF, Bhutan.

Wilson, D. C., Rodic, L., Cowing, M. J., Costas, V. A., Whiteman, A. D., Scheinberg, A., et al. (2014). 'Wasteaware' benchmark indicators for integrated sustainable waste management in cities. *Waste Management 35 (2015)* , 329–342.

www.earth911.com. (2014). *Trash Planet: Germany*. Retrieved 04 07, 2015, from www.earth911.com: http://www.earth911.com/earth-watch/trash-planet-germany/

www.iwar.tu-darmstadt.de. (2014). *Technische Universität Darmstadt*. Retrieved 09 04, 2014, from Technische Universität Darmstadt: http://www.iwar.tu-darmstadt.de/sur/fg_sr/forschung_sr/index.en.jsp

Yuan, H. (2013). Key indicators for assessing the effectiveness of waste management in construction projects. *Ecological Indicators 24* , 476–484.

Zotos, G., Karagiannidis, A., Zampetoglou, I.-S., Kontogianni, S., & Tchobanoglous, G. (2009). Developing a holistic strategy for integrated waste management within municipal planning: Challenges, policies, solutions and perspectives for Hellenic municipalities in the zero-waste, low-cost direction. *Waste Management 29* , 1686–1692.

Appendices

Annexure 1: Survey Questionnaire

The main objective of this survey is to assess effectiveness of the current waste management system in Thimphu City which will help identify the weakness and opportunities for possible intervention for improvements.

The answers from this survey shall be used for research purpose only and the confidentiality of individual respondents shall be maintained. This is a part of Masters' thesis research of Mr. Saha Bir Rai, IMAT Program (2013-2015) at APU, Japan-IfaS, Germany.

ID:

Instructions:

Respondent category (Tick as relevant from the list)

Respondent Category A: Waste Producer	**Respondent Category B: Waste Manager**
Individuals ⦿ Resident ⦿ Shopkeepers ⦿ Civil servants ⦿ Others (specify)..... **Organizations/ Industries/ Offices** ⦿ Food Industry (Agro)	**Government** ⦿ City Office ⦿ Department of Renewable Energy, MoEA ⦿ SNV ⦿ Others (specify)..... **Private Company** ⦿ Greenerway

⦿ Wood Industry: Saw mills &wood crafts ⦿ Workshops ⦿ Hotels ⦿ Institutions (non-waste manger) *Government offices* *Schools* *Hospitals* *Others (specify).....* ⦿ Others (specify).....	⦿ Scrap Dealers ⦿ Others (specify).....

For Respondent Category A (Individuals): please answer General Information, Section A& B only

For Respondent Category A (Organizations): *please answer General Information, Section A & C only*

For Respondent Category B (both Government& Private Company): *please answer Section A& D only*

Recycling *: into new products and value from waste products;*

Reuse *: using waste materials again for same purpose or for different purpose)*

Section A: General Information

P1

Date of interview:

Name of Interviewer: .....

Qualification level of the respondent: .....

Age of the respondent: .....

Sex (Please tick): ☐ Male ☐ Female

No. of family members **(only for Individual respondents**):

Adult: ..... Child: .....

Name of the location/place/ area of the house/ office: .....

Name of the organization/ Office/ company (**only for Organizations and Category B respondents**): .....

Section B: General Awareness about the wastes and waste management system

P2

1. What is the meaning of waste for you? (tick only one)

   - ⦿ Unwanted things that should be get rid of/ out of sight
   - ⦿ Resources at wrong place and wrong time
   - ⦿ Others (specify).....

2. Rate your satisfaction level with the waste management service in Thimphu city on the scale of 1-10 (tick one)

⦿ 1	⦿ 2	⦿ 3	⦿ 4	⦿ 5	⦿ 6	⦿ 7	⦿ 8	9	10

1: Least satisfied;	*10: Most satisfied*

3. Do you think that there is a waste problem in Thimphu City/ in Bhutan?

   ☐ Yes ⟶ Go to Q4

   ☐ No ⟶ Go to Q6

   ☐ I don't know

4. Is the waste problem growing with the passage of the time in the city?

   ☐ Yes ⟶ Go to Q5

   ☐ No ⟶ Go to Q6

   ☐ I don't know

5. What do you think the reason for no improvement of the waste problem management in Thimphu City? (Can tick more than one)

   ⦿ Increasing population 1
   ⦿ Lack of awareness 2
   ⦿ Lack of law enforcement 3
   ⦿ Change in the complexities of wastes types 4
   ⦿ Lack of environmental concern 5
   ⦿ Illegal Dumping
   ⦿ Poor waste collection and disposal system in place
   ⦿ Changing life/living style/ Change in consumption habit
   ⦿ Any other (specify).....

6. What do you think the reason for improvement of the waste problem in Thimphu City?

   ⦿ Adequate awareness/ education
   ⦿ Better law enforcement
   ⦿ Increasing environmental concern
   ⦿ Reduced illegal dumping

⦿ Better waste collection and disposal system in place

⦿ All of the above

7. What specific role do you play in the city waste management?

.....

.....

.....

.....

Waste Collection system

8. Who usually collects your waste? (can tick more than one)

⦿ City Official	⦿ Waste dealers
⦿ Private Enterprises	⦿ Others (specify).....

9. How many times per week the garbage truck come to your place? Please tick appropriate.

⦿ Once

⦿ Twice

⦿ 3-6 times

⦿ Daily

⦿ I don't know

⦿ Truck never come (has link to Q22)

10. Rate your satisfaction level for the current frequency of waste collection in the city?

⦿ 1	⦿ 2	⦿ 3	⦿ 4	⦿ 5	⦿ 6	⦿ 7	⦿ 8	9	10
1: Least satisfied;									*10: Most satisfied*

11. Do you think the greater distance between your house/resident& the stop of garbage truck discourages you to dispose your waste to the truck?

⦿ Yes	⦿ No	⦿ I don't know

Waste Separation System

12. Do you know about the different coloured waste bins?

☐ Yes 1 ⟶ Go to Q13

☐ No 2 ⟶ Go to Q14

☐ I don't know 3

13. What are different colour of waste bin you have seen and what each colour represents? (Can tick more than one)

⦿ Green

⦿ White

⦿ Blue

⦿ Others (specify).....

14. Do you think it is necessary to have different coloured bins for different waste types?

⦿ Yes Why.....	⦿ No Why.....	⦿ I don't know

15. Do you separate waste types?

☐ Yes ⟶ Go to Q16& 17

☐ No ⟶ Go to Q18

☐ I don't know

16. Give your view on the importance of waste separation at source for better waste management?

⦿ Very important

⦿ Not important

⦿ No difference

⦿ I don't know

17. Into how many types of wastes you separate? (tick appropriate)

⦿ Plastics

⦿ Pet bottles

⦿ Organic (biodegradable) wastes

⦿ Non-organic (dry)

⦿ Aluminium

⦿ Papers

⦿ Metals

⦿ Chemicals

⦿ Glasses

⦿ E-wastes

⦿ Others (specify).....

18. Reasons you don't separate waste?

⦿ I don't think it is important

⦿ It is difficult task

⦿ I never tried separating waste

⦿ I never heard of separating wastes

⦿ Others (specify).....

Waste Disposal/ Treatment System

19. Where/how do you dispose your waste? (*Tick more than one*)

⦿ City garbage truck

⦿ Backyard waste bin/ pit

⦿ Into the river

⦿ In the nearby forest

⦿ Burn in the backyard

⦿ Others (specify).....

20. How often do you dispose the waste? Please tick appropriate

⦿ Once a week	⦿ 2 times a week	⦿ 3-6 times a week
⦿ Daily	⦿ Never	

21. Do you pay for disposing your waste?

☐ Yes ⟶ Go to Q22& Q23

☐ No ⟶ Go to Q25

☐ I don't know

22. How much you pay for disposing your waste?

Nu: .....per month or per year

23. Are you satisfied with the fee?

☐ Yes

☐ No ⟶ Go Q24

24. If not satisfied, provide your suggestion for improvement in fee system!

Nu..... ..Suggestion:.....

.....

25. Are you ready to pay for disposing off your waste?

⦿ Yes ⦿ No

26. Which one will you prefer from the following (tick only one).

⦿ Paying for your waste	⦿ Selling your waste	⦿ Neither selling nor paying	⦿ I don't know

27. How far is the nearest waste treatment plant from your house/ quarter?

⦿ .....km

⦿ I don't know

28. Do you have your own compost pit for your organic waste?

☐ Yes ⟶ Go Q29

☐ No

29. For what purpose you use the compost?

Answer.....

.....

.....

Waste recovery/ recycling System

30. When and how did you first hear about recycling of wastes? Tick appropriate (can be more than one)

Time	Medium				
⦿ ..... year (s) ago	⦿ Leaflets	⦿ Awareness campaign by Govt and/ Private companies	⦿ Movies	⦿ Social media	⦿ Others..... ....

31. How important is the reuse and recycling of materials for you? Please rate?

⦿ 1	⦿ 2	⦿ 3	⦿ 4	⦿ 5	⦿ 6	⦿ 7	⦿ 8	⦿ 9	⦿ 10
1: Least important;									*10: Most important*

32. Do you prefer to buy and use recycled material/ product?

⦿ Yes ⟶ Go to Q33, Q34, 35& 36

⦿ No ⟶ If No, Why?

.....

.....

.....

33. Which of the following materials do you reuse most?(Please tick the 3 materials that are reused most)

- ⦿ PET bottles
- ⦿ Plastics
- ⦿ Papers
- ⦿ Chemicals
- ⦿ Water
- ⦿ Glasses
- ⦿ E-wastes
- ⦿ Others (specify).....

34. Which of the following materials do you recycle most? (Please tick the 3 materials that are recycled most)

- ⦿ PET bottles
- ⦿ Plastics
- ⦿ Papers
- ⦿ E-wastes
- ⦿ Chemicals
- ⦿ Water
- ⦿ Glasses
- ⦿ Others (specify).....

35. Which of the following materials would you prefer to reuse? Please tick 3 only

- ⦿ Pet bottles
- ⦿ Polythene bags
- ⦿ Papers
- ⦿ Woods
- ⦿ Glass bottles
- ⦿ Metals & aluminium
- ⦿ Food wastes
- ⦿ E-wastes

36. Which of the following materials would you prefer to recycle? Please tick 3 only

- ⦿ Pet bottles
- ⦿ Glass bottles
- ⦿ Polythene bags
- ⦿ Metals &aluminium
- ⦿ Papers
- ⦿ Food wastes
- ⦿ Woods
- ⦿ E-wastes

37. Do you sell any recyclable/ reusable materials?

- ⦿ Yes⟶ Go to Q38
- ⦿ No

38. If yes, what price you sell the waste material at?

1. Materials.....Nu...../ unit.....
2. Materials.....Nu...../ unit.....
3. Materials.....Nu...../ unit.....
4. Materials.....Nu...../ unit.....

.....

.....

Section C: Organization/ Industry specific questions **P3**

39. What waste materials does your organization produce/generate?

(Mention some of the waste problems in your organization?)

Answer:

Waste materials.....

.....

.....

Waste Problems.....

.....

.....

.....

40. Where you dispose off your waste? (Or who takes your wastes?)

Answer:.....

.....

41. Is your organization undertaking any activities/ projects in support of waste management in the city?

- ⦿ Yes ⟶ Go to Q42
- ⦿ No ⟶ Go to Q43
- ⦿ I don't know

42. List any waste management related activities/ projects.

1.....

2.....

3.....

4.....

43. Do you think your organization can contribute to waste management in the city?

⦿ Yes ⟶ Go to Q44

⦿ No

44. If Yes, in what ways your organization/ office can contribute to waste management in the city?

Answer:.....

.....

.....

.....

.....

.....

45. Do you have any waste related business activities such as recycling, waste collection, selling, projects etc?

Yes ⟶ Go to Q46

No ⟶ Go to Q47

46. If Yes, please list those waste related business activities?

Answer: .....

.....

.....

.....

.....

47. If No, please list some possible area of (business) opportunities by your organization/office/ industry in waste management sector?

Answer:.....

.....

.....

.....

.....

48. Do you have any future plans and programs in support of waste management in the city?

⦿ Yes ⦿ No

If Yes, please list: .....

.....

.....

.....

Section D: For Waste Managers

P4

49. What is the meaning of waste for you? (tick only one)

⦿ Unwanted things that should be get rid of/ out of sight

⦿ Resources at wrong place and wrong time

⦿ Others (specify).....

50. Rate your satisfaction level with the waste management service in Thimphu city on the scale of 1-10 (tick one)

⦿ 1	⦿ 2	⦿ 3	⦿ 4	⦿ 5	⦿ 6	⦿ 7	⦿ 8	9	10
1: Least satisfied;									*10: Most satisfied*

51. Is the management of the waste in the city improving?

⦿ Yes	⦿ No	⦿ I don't know

☐ Yes ⟶ Go to Q52

☐ No ⟶ Go to Q53

☐ I don't know

52. What do you think the reason for improvement of the waste problem management in Thimphu City?

⦿ Adequate awareness/ education

⦿ Better law enforcement

⦿ Increasing environmental concern

⦿ Reduced illegal dumping

⦿ Better waste collection and disposal system in place

⦿ All of the above

53. What do you think the reason for no improvement of the waste problem management in Thimphu City? (Can tick more than one)

⦿ Increasing population

⦿ Lack of awareness

⦿ Lack of law enforcement

⦿ Change in the complexities of wastes types

⦿ Lack of environmental concern

- ⦿ Illegal Dumping
- ⦿ Poor waste collection and disposal system in place
- ⦿ Changing life/living style/ Change in consumption habit
- ⦿ Any other (specify).....

Waste Collection system

54. Are you able to collect the waste from the whole city?

- ⦿ Yes
- ⦿ No ⟶ Go to Q55

55. What is/ are the main problem (s) for not able to collect waste from the whole city? Please provide suggestion/ solution for problems.

1.....

2.....

3.....

56. The most common type of waste found in the city?

- ⦿ Pet bottles
- ⦿ Plastics/ Polythene
- ⦿ Papers
- ⦿ Metals &aluminium
- ⦿ E-wastes
- ⦿ Construction wastes
- ⦿ Chemicals
- ⦿ Hospital wastes
- ⦿ Food wastes
- ⦿ Others (specify).....

57. In which of the following areas you face the problem most during the process of waste management in the City? (Tick only one)

- ⦿ Separation
- ⦿ Collection

⦿ Transportation ⦿ Recycling

⦿ Treatment

Waste Separation System

58. Do you believe in separation of waste at source?

☐ Yes ⟶ Go to Q59 & 60

☐ No ⟶ Go to Q61

59. Give your view on the importance of waste separation at source for better waste management?

⦿ Very important ⦿ No difference

⦿ Not important ⦿ I don't know

60. What different colour of waste bin you have? Please also provide waste type that each bin represents?

⦿ Green: Waste type: .....

⦿ White: Waste type: .....

⦿ Blue: Waste type: .....

⦿ Others (specify).....Waste type: .....

⦿ .....

61. If No, which one of the followings is the reason you don't separate waste at source? (tick only one)

⦿ Waste producers don't separate wastes even if they are provided with bins

- ⦿ It is costly and difficult to separate waste at source
- ⦿ It has been tried and failed
- ⦿ It is still to be tried
- ⦿ It is not important
- ⦿ Others (specify).....

62. Into how many types of wastes you separate? (tick appropriate)

- ⦿ Plastics
- ⦿ Pet bottles
- ⦿ Organic (biodegradable) wastes
- ⦿ Non-organic (dry)
- ⦿ Aluminium
- ⦿ Papers
- ⦿ Metals
- ⦿ Chemicals
- ⦿ Glasses
- ⦿ Others (specify).....

Waste Disposal/ Treatment System

63. What is the method of waste disposal being practiced? (*can tick more than one*)

- ⦿ Landfill
- ⦿ Incineration
- ⦿ Waste to energy plant
- ⦿ Others (specify).....

64. How far is the nearest landfill site from the city?

- ⦿ .....km
- ⦿ I don't know

65. How far is the nearest waste treatment plant from the city?

⦿ .....km

⦿ I don't know

66. What you do with the organic waste from the city?

Landfill

Composting plant ⟶ Go to 67& 68

67. Whom do you sell the compost?

Answer:.....

.....

68. What is the price per kg of compost?

Nu: ...../ kg of compost

Waste recovery/ recycling System

69. When and how did you first start educating mass about recycling of wastes? Tick as appropriate

Time	Medium used				
⦿ ..... year (s) ago	⦿ Leaflets	⦿ Awareness campaign by Govt and/ Private companies	⦿ Movies	⦿ Social media	⦿ Others..... ....

70. How important is the reuse and recycling of materials for you? Please rate

⦿ 1	⦿ 2	⦿ 3	⦿ 4	⦿ 5	⦿ 6	⦿ 7	⦿ 8	⦿ 9	⦿ 10
1: Least important;									*10: Most important*

71. Where does the waste you collected end up? (can be more than one answer)

⦿ Landfill
⦿ Recycling factory
⦿ International dealer
⦿ Incinerator
⦿ Compost plant
⦿ Others
(specify).....

72. Does your office/ organisation buy and use recycled material/ product?

⦿ Yes ⟶ Go to Q73 & Q74
⦿ No ⟶ If No, Why? ....

73. Which of the following waste materials do you reuse most?(Please tick as appropriate)

⦿ PET bottles
⦿ Plastics/ Polythene
⦿ Papers
⦿ Metals &aluminium
⦿ Chemicals
⦿ Water
⦿ Glasses
⦿ Others (specify).....
⦿ Not yet reused

74. Which of the following materials do you recycle most? (Please tick as appropriate)

⦿ PET bottles
⦿ Plastics/ Polythene
⦿ Papers
⦿ Chemicals
⦿ Not yet recycled
⦿ Water
⦿ Glasses
⦿ Others (specify).....

75. Do you sell any recyclable/ reusable materials?

- ⦿ Yes ⟶ Go to Q76
- ⦿ No

76. If yes, what price you sell the waste material at?

1. Materials.....Nu...../ unit.....
2. Materials.....Nu...../ unit.....
3. Materials.....Nu...../ unit.....
4. Materials.....Nu...../ unit.....

77. Mention main problems and obstacles being faced by your organizations/ office in the field of waste management?

! Thank you very much!

.....

.....

..