



**EFFECTIVE MANAGEMENT OF PLASTIC WASTE AND OTHER SOLID WASTE
IN NEPAL (A CASE STUDY OF KATHMANDU VALLEY)**

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Abstract:	
<p>This is the study of effective management of solid waste along with plastic waste in Kathmandu city. This thesis provides user with knowledge how currently waste is managed in Nepal and what steps can be taken for effective management of waste. How recycling and reusing is done in other countries and how can we apply it in our country. This study is based on qualitative as well as quantitative study. Observation method and interview method are taken into account to derive conclusion at the end of the writing.</p> <p>In theoretical part different topics like reusing, recycling, waste shorting methods are discussed. Books, websites, observation and publication of different organization are used as main source of information. Different ways of Finnish waste management which could be applied in Nepal is discussed. This thesis is written with a view to give some good information to Nepalese student studying in various schools and colleges. To find effective waste management technique which can be implemented with small investment to make drastic change in the whole process is the main objective of this thesis.</p>	
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Contents

1	Introduction.....	6
1.1	Statement of the problem.....	6
1.2	Waste management in Kathmandu.....	8
1.3	Common ways of waste management.....	9
1.4	Conceptual framework	11
1.5	Objectives.....	14
1.6	Importance of study.....	14
1.7	Organisation of study.....	16
2	Review of literature.....	18
2.1	Review of previous studies.....	18
3	Research Methodology.....	23
3.1	Rationale of the selection of study area.....	23
3.2	Research design	23
3.3	Nature and sources of data.....	24
3.4	Data collection techniques.....	24
3.5	Data processing and analysis.....	25
3.6	Limitation of the study.....	25
4	Presentation and analysis of data	27
5	Summary conclusion and recomendation	35
6	Questionnaire.....	50
7	Bibliography.....	53

List of Abbreviations

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
CSR	Corporate Social Responsibility
CFL	Compact Fluorescent Lamp
EU	European Union
HDPE	High Density Polyethylene
HH	House Hold
IEA	International Energy Agency
INGO	International Non Government Organisation
KMC	Kathmandu Metropolian City
LDPE	Low Density Polyethylene
MSW	Municipal Solid Waste
NGO	Non Government Organisation
PVC	Poly Vinyl Chloride
PP	PolyPropylene
PET	Polyethylene Terephthalate
RDF	Refuse Derived Fuel
SWMRMC	Solid Waste Management Resource Mobilization Center
SWM	Solid Waste Management

List of figures

Figure 1 Reduce, Reuse and Recycle.....	7
Figure 2 Bucher City Cat 1000	13
Figure 3 Municipal waste containing all form of waste	22
Figure 4 Recycling numbers of Plastic	44
Figure 5 Management of Waste at Household Level.....	47
Figure 6 Management of Community Waste.....	48-49

List of tables

Table 1 Municipal Solid Waste Generation and Collection	27
Table 2 Composition of Household Waste in KMC.....	33
Table 3 Composition of Institutional Waste in KMC.....	33
Table 4 Composition of Commercial Waste in KMC.....	33

CHAPTER I

INTRODUCTION

1.1 STATEMENT OF THE PROBLEM

Everyone likes to be neat and clean. Just like we our surroundings has also to be neat and clean. Many of us especially people from developing and under developed countries are suffering from problem of solid waste management. This problem has become major headache to many policy makers and state authorities. In spite of spending huge amount of their budget in disposing waste they aren't getting fruitful results. This problem has been skyrocketed because of our own behavior. Waste should be shorted in place of generation. Mixing of waste which is the root cause of this problem should be addressed properly by imposing heavy penalty fee. Continuous awareness is needed for educating people about it. More than 70% of the total waste of the city is found to be organic which can be turned into manure and can be converted into gas. This will cut the load of waste that directly goes to the landfill site. This single act of separating waste into organic and inorganic part can solve more than 50% of the problem of waste management. Citizens also have to come in front and help government by obeying the rules and regulation related to waste management.

Major inorganic portion of waste is occupied by papers and plastics. Papers can be recycled to make other paper products. Plastics bags are the cause of blocking of drains in roads. They degrade the beauty of rivers by covering the surface. They can be burnt to release energy. This energy can be used to generate electricity which can be boon for developing and under developed countries. Generally developing countries have power cut problems. So this way of waste treatment can in one hand clean environment and in another hand address the hunger for power to some extent. If possible we can recycle plastic if not at least we can burn them in controlled environment to get energy. It is foolish to dump them uselessly in landfill site waiting for hundreds of years to get rotten and degraded. Metals and cardboard can be recy-

pled and reused comparatively in much easier way than others. It is true that in practice it is difficult to do as stated above because of underdeveloped economy and illiteracy of many people. Even of this bitter reality we cannot divert away from this problem. Among many of us one has surely to come in front and take initiative to solve this. We always have to keep in mind that if we want to live in clean and green environment then it is us who has to act and work. No one will come and make our environment clean and green for us.

We have heard many times about reuse and recycling but in context of under developed countries there is still one term which is more important than recycling which is Reduce.



Figure 1 3R REDUCE, REUSE AND RECYCLE. City of Little Rock (2014)

Unnecessary hoarding of goods, excessive eating habit and availability of cheap materials has increased the amount of waste. If we can reduce the waste production at early stage then it is the best option than reuse and recycling. Habit of buying unnecessary stuff looking others is commonly seen in underdeveloped countries. This has resulted in overconsumption and overproduction of materials resulting in depletion of virgin materials. Most of these things ultimately goes to waste without even passing their normal life which should be corrected.

1.2 WASTE MANAGEMENT IN KATHMANDU

There is lack of proper initiative from government sector in waste management so it can be said that waste is not managed properly. The common practice is mix all the waste and throw it in big bins placed in different places, sometimes in street and in rivers. From private sector there has been something done but that is also not for the purpose of conserving environment but for making some extra money. Bio waste from restaurants and small hotels are sold to farmers who rear pigs. Waste from restaurants and hotels are given as fodder for pigs. Cardboard, HDPE Plastic, newspaper, white office paper, beer bottles are sold to street hawkers who comes to house in different frequencies during the day. Street scavengers who are involved in separating and collecting useful waste from streets and dumping sites also aid in waste management of the street. Metals like zinc, iron, copper, tin, aluminium, bronze and brass are widely collected by them.

Waste collecting centers are owned by individual people and they generally export these items to India or sold it to industries of Nepal. Government hasn't taken any major step in promotion of recycling and reusing of waste. Mixed waste are collected in transfer station and dumped in landfill site without separation. Thanks to those scavengers who has vital role in separation of waste in transfer station and landfill site putting their own health in risk. They are doing this in their own effort to get few earning for living. Construction debris are used for making roads. Generally the common practice is dump waste near bank of river cover it with soil and make road above it. Few awareness programme are run in society promoting women to reuse waste by giving training to them. Except this nothing so much noticeable has been done for separation of waste. In few tourist areas there are small waste bin which are used for separating organic and inorganic waste. Hardly any waste bins were found in streets and bus station where the flow of people is maximum. It was seen that in large shopping malls and department stores cardboard used for packaging things were sold by them directly to street hawkers. Glass bottles of beer were sold from bars and restaurants to such hawkers. So, in general it can be said that whatever can be sold that doesn't goes into mainstream garbage. This is a puzzling aspect of Nepalese waste management scenario. It can be assured

that if we can apply this formula for waste management regarding separation of waste we can surely get success.

1.3 COMMON WAYS OF WASTE MANAGEMENT

OPEN BURNING

This is the unhygienic form of waste management. It creates extensive land, air and water pollution. There is probability of release of toxic gases which damages environment and health of people. Even wastes like dry cells and perfume bottles are burnt which creates explosion and sound pollution. Many do it unknowingly since it isn't possible to search out dry cell and perfume bottles from a heap of wastes. Scientifically waste can be treated by burning known as incineration method. Countries where there is lack of land this method is used. Even in countries where there is availability of land hazardous waste like hospital wastes are treated with this method. If the waste has good proportion of inorganic part and it has higher calorific value then it can be burnt to release energy in controlled environment. In underdeveloped countries this open way of waste treatment is common as it is easy and less expensive. Many catastrophic accidents related to fire has occurred in underdeveloped countries due to this activity especially in dry and windy season.

DUMPING

This is also another common method of waste treatment in underdeveloped countries. In this method wastes are deposited over land and then soil is used for covering it. After that it is compressed with loader. River bank, open spaces and unused land are used for dumping waste. Soil is used for covering waste deposited in river bank which is later compressed to make road used for transportation. This is unscientific because waste aren't separated and many hazardous waste are also there in mixed proportion. This pollutes water table found under land and is very difficult to purify. Leachate may get leaked from dumped wastes if

dumped unscientifically. Sanitary landfill site is good option for dumping waste which cannot be shorted and further treated. In sanitary landfill site necessary precautions are taken so that leachate cannot escape outside from the dumping place. Because of lack of budget and lack of proper technology underdeveloped countries just pile the waste, cover it with mud and name it as sanitary landfill site.

BIO GAS GENERATION AND COMPOSTING

Bio wastes are used in different places for producing gas which is used to cook food. Especially in places where the volume of waste is high there such plants are kept which produces gas. The by-product after gas production can be used as fertilizer which is in slurry form. This way of waste management is limited in small scale and limited to institution and organizations like hotels, canteen and restaurant. Majority of waste which comes from individual houses don't get chance to enter into such process which is the main problem of waste management. In household scale bio wastes are fed to earthworm which turn such wastes into high quality manure which can be used in garden and kitchen yard. This is also limited in small scale and majority household are beyond this technology due to lack of proper awareness. In rural areas where there is availability of land people dug ground put bio waste in it and cover it with mud which later turns into manure. Good proportion of waste is also found to be fed to cattle. Problem of bio waste is greater in cities rather than urban rural areas.

ENERGY RECOVERY BY BURNING

This way of waste management is generally adapted by developed countries and rarely seen in underdeveloped countries. In developed countries wastes are segregated so that there will be only collection of waste which has high calorific value. Burning of high calorific waste is quite important for sustainable running of this project. Underdeveloped countries were waste aren't segregated rarely use this option of energy recovery. What they generally do is unnecessarily burn waste in an open environment and dump it neglecting the energy value of waste. Partially burnt wooden logs gathered from various sources are used as fuel for making brick.

Unwanted weeds are burnt and then later mixed with various material to make briquette which is used as an alternative form of energy for cooking and heating. Other form of waste treatment in institutional level aren't generally found to be done in underdeveloped countries. Though there is lack of energy in underdeveloped countries this form of energy recovery is rarely seen in practice.

1.4 CONCEPTUAL FRAMEWORK

The impact of effective and poor waste management is almost in each and every sector of our daily life. Some are explained as below.

Impact on Business and Industry

Each and every business should be eco-friendly and responsible to preserve nature and environment. For sake of small profit it isn't good to harm nature and pollute environment. This is the basic ethics of business. Each and every one should learn it by heart. Negative words are quite harmful for image of industry. If people become aware that the product they are using is hampering environment they will search for other alternative and boycott that product. Consumers are the biggest asset of any organization so to please them also organization should be keenly interested in waste management. Products manufacture in unhealthy environment and around pile of wastes will be unhealthy and not good for eating. Employees of organization will also become sick working in places full of waste. So waste management has greater impact on business organization and industry.

Impact on Tourism

Tourism is one of the source of earning foreign currency by developing and underdeveloped countries. People come to see beautiful places and healthy environment. No one likes to see places full of dust, waste and garbage. Poor waste management will degrade the beauty of city and it will create a bad impression in the mind of people. They will tell their friends about this and other people who are willing to visit will also cancel their visit. This will stop the source of flow of foreign currency. Tourism is a business which has chain effect. When number of tourist goes down it will not only hit tourism sector but also airline industry and other transportation sector. Similarly hotel and restaurant sector plus many other services which has been opened targeting tourist will also suffer heavily. The number of families depending on tourism sector is directly or indirectly quite large in every country. So negative impact in tourism industry will cut down employment opportunities and lower down living standard of people living in such countries. This will make them even poorer.

Impact on Health sector

Health is wealth this is a popular slogan heard everywhere. A country is judged not only by the number of natural resources it has but also by the economic and health status of people. If people are unhealthy then country has to spend a lot of money in curing them. The required manpower needed to develop country cannot be achieved with sick people. People will die early and average life of people will be below than standard. This isn't good news for any country. We must eat, breath and live in healthy environment to have high life expectancy rate. For healthy environment surrounding should be clean and waste should be properly managed.

Impact on Employment

Effective waste management will create a number of job opportunities. Road pickers and waste shorter who now work individually and in unsafe condition can be drawn into main-stream work under labor law. Machines like road sweeper Bucher city cat 1000 designed to suck garbage can be run in street and people can be trained to run those machines instead of

sweeping in street with broom. This will save time and clean larger area relatively in shorter period of time. The manpower which is now sweeping can be converted into quality checkers who can check area and teach people how to sort waste and keep environment clean. Machines can sweep and suck such waste faster without blowing dust in air. So, large amount of employment opportunities can be generated which will help to lower down unemployment rate of underdeveloped countries. The traditional concept of cleaning has been expanded now to a business strategy. Many countries are spending huge amount of money in this sector and getting return from it creating employment for thousands of people.



Figure 2 Bucher City Cat 1000 (Butcher 2014)

Impact on Economy

Waste if treated carefully and scientifically can aid in changing the economy of country. Underdeveloped countries generally have power problem. They are unable to provide required level of energy needed for their people, factories and industries. Wastes can be used as an alternative form of energy either in the form of electricity, gas or fuel. This will in one hand save the amount of foreign currency that goes in importing energy sources and in other hand saves environment and nature. For underdeveloped countries it is just like killing two birds with one arrow. Underdeveloped countries generally rely on agricultural sector so fertilizer is quite essential for them. They rarely have chemical fertilizer manufacturing plant inside their

territory so import almost all of the fertilizers needed for them. Those chemical fertilizers are degrading the fertility of land and taking away a lot of money away from underdeveloped countries. Compost from Bio waste in one hand can increase the fertility of land and in other hand cut down the flow of currency going out from the country. Composting if cannot be done in large scale can be effective even if can be done in grass level household scale.

1.5 OBJECTIVES

- To find effective waste shorting method in residential area.
- To find effective ways to reuse and recycle collected waste.
- To find effective ways to raise awareness among people about importance of shorting, reusing and recycling.
- To haunt new areas where recycle materials can be used instead of virgin materials.
- To find out effects of plastic that bring to environment.
- To identify benefits of reuse and recycle of waste including plastic.

1.6 IMPORTANCE OF THE STUDY

To do research, to publish an article or book and to write thesis is an important work in itself. To write thesis on hot cake subjects and socially concerned topic is even more important. The problem of waste and the impact it has created in each and every sector of underdeveloped countries has to be addressed in some way to boost their economy and improve the living standard of their people. Many underdeveloped countries has been gifted natural beauty by nature but we people have degraded that beauty with this unscientific management of waste.

Realizing this situation an attempt has been made and importance has been given for this subject once again.

Waste has been dealt with different ways in developed and underdeveloped countries. Developed countries recover valuable resources from it and recover energy from it whereas underdeveloped countries think this as burden and dump it in ground ignoring the energy value which they can get from it. Beauty of city, health and public is directly related with environment of the city. If surrounding is polluted then people get sick frequently and state has to spend a lot of money in curing them. It will degrade the image of city and unscientific management of waste will lead to land pollution, air pollution and water pollution. Animals, fishes, birds and aquatic life will be affected by it which isn't good news for any of us. When population increases volume of waste will also increase we cannot stop this but we can make plan to minimize waste and dispose it scientifically so that minimum harm is done to the nature and environment.

Developing countries and under developed countries are already behind in each and every stage. Further they are constantly bombarded with newly invented products. It has been headache for everyone how to deal with the waste which comes from utilizing such products manufactured in those factories of the world where they haven't been and haven't seen. In this modern world of trade and commerce we cannot prohibit goods entering into our boundary. In other hand it is equally true that we cannot sit peacefully with our eyes closed leaving this problem as it is. We should look towards other countries and try to adopt those ways of management which are suitable for our country. We should seek help for transfer of technology in such cases from other countries.

If land, water and air of underdeveloped countries is polluted then even developed countries will be affected in course of time. Because these problems don't have geographical boundaries which can be stopped nor visual appearance which can be screened and stopped. So it is good for all of us that we must unite with hand in hand and with arm in arm to address and solve this problem. The problems faced by developing countries seems to be interesting to listen and hear but there hasn't been much depth study and action done to solve this. So let us

hope this thesis prepared by taking interview, having face to face chat and observation will be a good reference material for all other concerned people, school students, policy makers, researchers and other common people.

1.6 Organization of the study:

The study of effective ways of waste management in under developed countries (a case study of Kathmandu city) has been divided into 5 chapter viz. Introduction, Review of Literature, research Methodology, Presentation and Analysis of Data, and Summary, Conclusion and Recommendation.

Chapter – I Introduction:

The introduction chapter deals with the general background and the subject matter of the study. It consists of introduction, research study which explains the focus of the study, statement of the problem, objectives of the study and importance of the study.

Chapter – II Review of literature:

In the second chapter, Theoretical review and review of previous studies has been done. For review of previous studies different books, thesis and websites were reviewed according to our necessity.

Chapter – III Research Methodology:

The third chapter briefly explains about the research methodology, which has been used to find out about the effective waste management techniques. This chapter consists of research design, sampling, sources of data and data collection techniques.

Chapter – IV Presentation and Analysis of Data:

In the fourth chapter, data required for the study has been presented, analyzed and interpreted in suitable form and format.

Chapter – V Summary, Conclusion and Recommendations:

Fifth chapter is the final chapter of this study which consists of the summary of the four earlier chapters. This chapter tries to draw out a conclusion of the study and attempts to offer various suggestions and recommendations for the improvement of effective waste management in our country.

CHAPTER II

REVIEW OF LITERATURE

LITERATURE REVIEW AND DATA COLLECTION

Different documents and materials were read to gather information needed for this study. Internet research was done excessively and reference example of other countries was taken into consideration while making conclusion. Pre published data was collected from authorized sources of government agencies where as additional information was taken from interview, observation, questionnaire methods. Questionnaire was made and asked to small scale of respondents to find out the root cause of the problem and the ways to solve it.

Review of literature is basically a stock-taking of available literature in the field of research. The textual constraints would help the researcher to support the area of research in order to explore the relevant and true facts for the reporting purpose. While conducting the research study, previous studies cannot be ignored as those instructions would help to check up the changes of duplication in the present study. Thus one can find what research studies have been conducted and what remains to go with. Review of Previous studies will include the objectives set by different researchers in the similar field of study.

2.1 REVIEW OF PREVIOUS STUDIES

“Improper handling of solid waste and indiscriminate disposal in open spaces, road margins, tank beds etc. give rise to numerous potential risks to the environment and to human health. Direct health risks mainly concern those working in the field without using proper gloves, uniforms, etc. A high percentage of waste workers and individual who live near or on dispos-

al site are infected with gastrointestinal parasites, worms and related organisms” **(Hand in Hand, 2007)**

“The maximum waste generated in Nepal is in the capital city itself. In case of Kathmandu over 90% of the waste is collected. Solid waste management is the growing issue of the country. Composition and quantity of the solid waste is determined by the level of socio economic development of the people. Higher the socio economic status higher the generation of waste. Also the amount of non-bio degradable waste increases with increase in socio economic status” **(Stapit, 2010)**

“ASEAN countries have been practicing open dumping as major management option for municipal solid wastes in contrast to European countries where recycling and composting is major practice. Except some highly developed countries of Asia like Japan still in many countries open dumping and uncontrolled burning is utilized as waste management technique”. **(Ngoc & Schniizer, 2008)**

“Briquetting is the process of converting low density biomass into high density and energy concentrated fuel briquettes. This process increases volumetric calorific value of fuel and makes it easier to transfer in remote areas. As the country’s living standard improves, the consumption trend is inclined towards to processed foods and more plastic derived materials. The urban growth in Nepal shows similar pattern of waste composition. In Kathmandu, the capital city, 17 percentage of total waste is composed of plastic and paper” **(SWMRMC, 2008)**

“Similar trend of composition is seen in other growing cities. Plastic waste mainly polyethylene bags in MSW have high energy content, as much as kerosene. Such a high energy content which is imported from foreign countries should not be dumped in landfill” **(Heejon, et.al, 2006)**

“Briquetting technology is one of the simple technologies practiced for making biomass based fuels including wastes like milled paper, plastic and other combustible wastes. The municipal waste can be best recovered, reused by transformation into solid waste fuel briquettes either in the form of RDF, a compressed form of waste paper, plastics, wood chips and other combustible materials, or in the form of selective fuel, a blend of combustible organic component such as plastics of MSW with low grade coal like lignite.

In this light waste to energy conversion would be an economical and eco-friendly way for addressing both the issue of waste management and energy shortage, both at the same time. Utilization of plastics in briquettes improves fuel efficiency and this makes briquetting option a better option as fuel in industrial boiler, and brick kilns with appropriate control measure. This waste to energy conversion option not only extends the life of landfill but also provides an alternative energy resource by utilizing wastes.” **(Shrestha &Singh, 2011)**

“Rapid population growth and urbanization in developing countries have led to the generation of large quantities of solid wastes and consequential environmental degradation. 90-95% of all waste in the world is landfilled or disposed in open dumps, creating considerable nuisance and environmental problems. Often lack of technical knowledge, finance and human resources coupled with existing policies limit the extent to which landfills can be built, operated and maintained at minimum standards of sanitary practice” **(AIT)**

Landfills are a source of methane and carbon dioxide emissions, which are greenhouse gases and a major threat to nature. The Kyoto protocol shows that landfill, gas will constitute 4% of the total emissions of greenhouse gas in 2010. The protocol, that aims to decrease the emission of greenhouse gases was signed by EU countries and other industrialized countries in 1997. In Asia incineration is traditionally used to get rid of large volumes of waste.

“The development in the Asian countries have resulted in the change of the waste characteristics and the uncontrolled incineration leads to environmental and health problems. Controlled incineration demands expensive technology that is difficult to maintain in developing countries. The rapid population growth and urbanization in developing countries as Nepal constitute a threat to the environment. Along with the development comes the problem with solid waste and the situation in Kathmandu is at the moment precarious. The environmental problem caused by improper solid waste management in the expanding cities is one of the most urgent improvement issues for the government of Nepal.

“Rapid and uncontrolled urbanization, lack of public awareness, and poor management by municipalities have intensified environmental problems in towns in Nepal, including unsanitary waste management and disposal. While solid waste management (SWM) has become a major concern for municipalities and the country as a whole, the status of SWM isn’t fully understood due to lack of SWM baseline data which are also essential for effective planning. The analysis of household waste composition indicated that the highest waste category was organic waste with 66% followed by plastics with 12%, paper and paper products with 9%. The composition analysis of institutional waste revealed 45% paper and paper products 22% organic wastes and 21% plastics. The study found that commercial waste comprised 43% organic waste 23% paper and 22% plastics. In aggregate, MSW is composed of 56% organic waste, 16% plastics and 16% paper and paper products. This indicates great potential for producing compost from organic waste and reusing and recycling other materials, with only about 10% going to final disposal if resource recovery is maximized.” **(ADB)**

Photograph of municipal waste near bank of river and road taken by researcher. Here we can see considerable amount of Plastic bags and plastic pieces which has raised question among state authorities.



Figure 3 Municipal Waste Containing all form of waste

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter describes about the research method employed to obtain relevant data for the study. The section is mainly concerned with the data analysis, how the research design is formulated, how the study area is selected, how the sampling techniques and sources of data were used.

3.1 Rationale of the selection of the study area:

Kathmandu city is the capital of country Nepal and it is the most densely populated municipality of the country. It is like a melting pot where people from various parts of the country come to seek future and make their life better. The rate of waste generation is increasing daily with increasing number of citizen so necessary steps has to be taken in advance to solve this skyrocketing problem. The city is overpopulated and there is lack of scientific waste management system. So this study was carried out hoping that it will be aid in the waste management of the city. If waste management can be effectively done in Kathmandu city then that successful model can be launched in other municipalities of Nepal. The researcher has selected this city because it is the same area where he was born, worked and become familiar with this very problem. This particular problem is almost same for other underdeveloped countries of the world.

3.2 Research design:

This study was conducted to know about the effective ways of waste management in Kathmandu city. As this study area is in our own society and the subject matter is also somehow related to our own society therefore the study will be social in nature. This study was based on explorative and descriptive research design. Descriptive type of research was applied to know about the root cause of the waste disposal problem and the reason of failure in manag-

ing waste successfully. Explorative research design was applied to explore the various possibilities in effective waste management, reuse and recycle of such products suitable for Nepal.

3.3 Nature and sources of data:

This study was conducted mainly on the basis of primary data and secondary data. The collection of primary data was done by the following methods, interview, observation and questionnaire. Secondary data was taken from various sources such as books, magazines, published and unpublished documents, newspaper, magazine and websites related to our study.

3.4 Data Collection Techniques:

We know to make the research fruitful and successful data collection technique plays a very important role. The necessary data for this research were collected by using following techniques.

3.4.1 Interview Method:

Interview is popular and one of the most important oral method of collecting primary data. It is an important process of social interaction with the respondents. By this method we can know the opinion and view of individual person and society as well. The opinion of people about waste management, recycling, and solution methods were collected by having face to face chat with them.

3.4.2 Observation method:

Observation is also one of the important methods of collecting primary data. All the answers told during the interview mightn't be correct as they might have exaggerated and told hypothetical answers. Further they mightn't like to give answers of all the questions we asked. They could be shy, illiterate and chatterbox who like to tell stories rather than realities. The

data which comes into the papers may have been altered dramatically showing something far away from reality. Thus observation helps the researchers to catch all such activities in front of his eyes. Researcher has done intense travelling on foot to cover as much area as possible to capture the real scenario of waste management. Places like temples, shopping complex, bus station, Hospitals, cinema halls, parks, schools, restaurants, small offices, small shops and large periphery of street was covered travelling by foot to collect required information. This is the main data collection technique for this thesis study and researcher has given a lot of time for this.

3.4.3 Key informants:

Identifying key informants and taking information from them can make our research more effective so this method was also used here. Views and opinion of Key informants from different background related to this field like recycling experts, environment specialist, scavengers, and owner of waste recycling center are kept in this thesis work as subject matter.

3.5 Data processing and analysis:

The success of any research depends upon the effective presentation and analysis of collected data. The collected data were classified according to their nature as primary data and secondary data. They were further tabulated and finally presented in suitable form and format.

3.6 Limitation of the study:

To gather data is a very difficult task. There is always a question raised about the validity and reliability of the data taken. Respondent mayn't tell the exact answer and modify their statement resulting in virtual and artificial answers which are far away from reality. Only some people chosen randomly from different places will be taken as sample and it will be assumed that they represent the whole population. In practice this mayn't happen as exactly as we want. Published data from authorized sources are also questionable because past experience has proved that many of them are made sitting in a room of hotel rather going to the exact

spot. These problems and errors are natural and can be minimized but not eliminated. Each and every study has its own boundaries. It isn't possible to compile all the subject materials in one single study. So we try to incorporate and make results. Further this study is for the partial fulfilment required for the degree thesis so it is impossible to keep each and every thing in this work. However care has been given to keep as much as things and cover as much area as possible. These limitations are normal one and further researches, comment, suggestion about this topic will be always welcomed in future.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

Almost 87% of waste produced in Kathmandu city is collected by formal and informal ways. The collection days and frequencies aren't fixed and scheduled in many places. There is carelessness in working. There is also lack of proper vehicles and equipment. Still collecting heap of garbage from Open Street is seen in practice. . The volume of household waste is large in comparison to commercial waste and institutional waste. This is the reason why there is large amount of organic waste in main stream garbage.

Table 1

Municipality	Avg. HH waste (kg/day)	Avg. HH size. Members	Total HH waste (tons/day)	Total commercial waste tons/day	Total institutional waste tons/day	Total MSW tons/day	Estimated Waste collection tons/day	Collection Efficiency %
KMC	1.10	4.74	233.07	203.49	29.58	466.14	405	86.9

Municipal Solid Waste Generation and Collection. ADB (2013)

For primary source of data collection observation and interview method were used. Total 25 respondents were selected for the interview method. The no. of respondents seems to be small because greater priority has been given to observation method in this thesis writing rather than interview method. Previous experience during other research showed researcher that many answers were told in exaggerated form far away from reality. So in this thesis 40 % weight has been given to interview method and 60% weight has been given to observation method to give more accuracy to this thesis writing. Respondents were selected from age group of 16-45 and they had at least 4 members in their family. All of them were permanent residence of Kathmandu city. Some of them were descents of their ancestors living here from long period of time whereas some of them have migrated here for searching opportunities. Majority of them were female because it is the female gender in Nepal who spend most of

their time in kitchen. They are the ones who are directly related towards our study. Profession of respondents varied from student, house wife to office workers. Greater priority was given for selecting students because they are the future pillar of the country and what they know now is going to affect the country and its future.

Out of 25 respondents approached during interview only 5 respondents replied that they short waste. The 5 respondents also separate waste as only bio and non-bio. The bio waste they short were decomposed in free land in controlled way or fed to earthworm to produce high quality fertilizer. They used such fertilizer in garden for flowering plants or used it as manure for vegetables grown in kitchen yard. The 5 respondents came from educated family and slightly familiar with ways of waste treatment.

All of the respondents said that they throw waste in proper place and they said that they know they have to throw waste in proper place. This fact seems to be true inside their own house and within their house periphery. However the same people were seen to be careless while walking in public areas, streets and public places. People often throw packaging wrappers and materials in street or open land. They further complained that everyone does like that and they do it because there is lacking of waste bins in appropriate places.

21 people replied that yes they know about recycling and some of them also showed recycled items which they have made like paper mugs, sitting mat etc. They know about the theoretical concept of recycling but they lack in-depth knowledge about recycling. They have thinking that those waste things which can be sold are recyclable whereas others aren't.

4 out of 25 respondent replied that they know about reusing. It is surprising to know that 21 people know about recycling whereas only 4 people know about reusing. In practice in Nepal once used glass jar, plastic vessel, sacks are extensively used for storing pickles, food stuff and similar other stuffs. Almost in every house this habit is seen in practice. Surprising fact is

that even in those house were this activity is running people don't know that what they are doing is in fact reusing of waste product. This shows there is lack of proper information with-in people. People are recycling and reusing products from their own experience and tradition which has been passed from one generation to another.

All of the respondents 100% replied that waste isn't properly managed in Nepal. When they see clean and green environment of western world via different entertainment means they start blaming government and politicians for all of this. All believe that government of Nepal is corrupt and they are responsible for the ugliness of the city. Each and every people blame others for poor waste management. People blame KMC. KMC blames government for not getting enough budget for this purpose and government in turns blame again people for not obeying rules and regulation. Government says people aren't sensitive and careful towards waste management. However reality is that everyone is equally guilty and they are equally responsible for all of this.

People said that they don't exactly know about the frequency of waste collection in their house because they are outside most of the time. However 10 people replied that it is once a week and 7 people replied that it is twice a week. Others were unknown about it. It looked like according to the nearness of the area to the city frequency of waste collection is determined. In places near to city waste is collected with more frequency than in places far away from city. There is lack of fixed time schedule for collecting waste. Sometimes in the morning and sometimes in the afternoon. In places near to crowded city it is collected in the morning and the collection frequency is almost daily whereas in places far away from city it can be any time and frequency also not fixed.

All of the people said that yes they have faced many problem due to poor waste management. They have to smell the foul smell of rotten garbage when waste isn't collected for many days. They have fallen sick many times and it is difficult to breathe and walk near that area. They

fell scarce to drink water fearing that it might be contaminated or the source of water might have been contaminated.

People were found to be unsatisfied both with government and private sector for not managing waste properly. Private sector takes money from citizens for providing the service but neither the service is regular nor is it satisfactory. They are found burning waste somewhere near banks of river or in some open spaces. They transport waste unscientifically in open containers which they should improve. There is much chance of spreading disease transporting waste in such way.

People are completely unknown with different types of plastic. They only know about the term polyethylene which has become popular due to excessive use of polyethylene bags. Thousands of water bottles made of PET are sold but no one knows that it is made of PET and is a type of plastic. Even food containers which they use actually is a type of plastic. Some plastic products come with international recycling number inside triangle whereas most of them don't. People don't have any ideas what this number inside triangle means. For people polyethylene is plastic and plastic is just polyethylene. All 25 respondents were unfamiliar with various type of plastic. They extensively use PP pipes, PVC pipes and HDPE pipes. They also know the name but don't know they are also a type of plastic and don't have any idea how to recycle it.

All of them said plastic waste is harmful waste because when it burns in open air it gives unpleasant smell and is poisonous. These polyethylene bags get stuck in gutters and creates flooding in cities by blocking drainage system. Frequently there is campaign run from time to time to ban plastic bags and certain areas like temple, zoo have already banned them entering inside their territory. In other words it can be said that the number of plastic prohibited zones have increased. People don't have idea that it is a source of energy and comes from the same source from where oil comes. Burning it in controlled environment can release energy which can be used for different other purposes.

All the plastic waste are put in waste bin and disposed of. There is just mixing of waste but not segregation of waste. People say plastic bags have degraded beauty of city by covering rivers and streams. When wind blows light polyethylene bag blows in the air and moves far away making it more difficult to manage properly.

All of them replied that bio waste is the chief constituent in their household waste which is followed by packaging materials and paper. Most of the respondents who were student replied that yes they have subject matter related to reuse and recycle in their curriculum but it is only theoretical in nature. It says to recycle but how to recycle in cheap and convenient way it doesn't teach us. Practical knowledge about waste management seems to be lacking there. All of the respondents replied that the waste which is taken from their house goes to landfill site for dumping. This is in fact true also because there is no any mechanism to sort waste neither at the time of collection nor at the time of disposal

People weren't found to give priority to use recycled materials because they think that it is contaminated with waste. Products relating directly to health aren't welcomed by them however some objects like handicraft items, sitting mats and decorative items were often kept by people in their home. They were giving much priority to reuse product rather than in recycling products. Empty plastic jar, glass jars and similar other stuff were found to be extremely reused by them which is also good news for effective waste management.

None of the respondents replied that waste of Kathmandu city is properly managed. There is always problem of landfill site and it gets interrupted from time to time. Frequency of waste collection isn't punctual and due to lack of modern equipment the process of waste collection is time consuming and not effective. Though most of the respondents were students none of them said that they have participated in waste management training programme. They said they even don't know when and where it is happening. Some of the respondent's guardians or parents were involved in such programme. So lack of proper mechanism to reach towards

people is seen here. Schools and colleges are appropriate to cover a large mass of people in quick time. Students are going to be tomorrow's effective manpower. So effective plans should be launched targeting such group and focusing educational area.

Handling of waste is almost same in each and every respondent's house which is mixing all of them in same bin. Only 5 respondents sort waste in their home as stated earlier. There weren't consciousness in handling hazardous waste and electronic waste. Fluorescent lamp, CFL lamp, dry cells, spray bottles were also found to be mixed up. Even electronically waste ultimately ends up in landfill site if it isn't get picked by street pickers. Even in the researchers own home the same thing is happening which must be corrected. Cleaning and waste management hasn't been taken seriously in Nepal. It hasn't been established as a business/industry even though a lot of money has been spent in such sector formally and informally. Individual house, schools and industries everywhere there is same problem. People blame KMC and government. KMC blames government. Government in turn blames people and KMC. So fruitful days are just passing blaming each other and we are known as citizen of dirty country in front of the rest of world.

Everyone accepted that plastic has played an important role in their life. In spite of many problems it has given it is still an important aspect of their life. Plastic has made the price of the product cheaper and affordable. People can choose variety of product in cheap price. They are easy to carry and use. They accepted that they cannot imagine a world without plastics even though they had very few and basic knowledge about plastics.

All of the respondents replied that they were unknown about recycling symbol and number printed in plastic bottles, glass bottles and cans. No one has taught them about it. Locally made products don't carry this symbol whereas some products imported from third countries bear this symbol. So, people don't care about these things carefully. People say that if situation improves and there will be proper management of waste then they are willing to pay extra money for making environment clean and green. However they fear that only the price

will be hiked but the management of waste will be same like before. Due to corrupt politics people don't believe anything easily so they want guarantee in each and every step which is very difficult to do. This shows that price isn't the factor for waste management money can be arranged from different sources what we need is actually dedication for effective management of waste.

Table 2

Municipality	Organic	Plastics	Paper & Paper Products	Glass	Metals	Textiles	Rubber & Leather	Others
KMC	64.24	15.96	8.16	3.75	1.72	3.40	1.12	1.15

Composition of Household Waste in Kathmandu Municipality in %. ADB (2013)

Table 3

Municipality	Organic	Plastics	Paper & Paper Products	Glass	Metals	Textiles	Rubber & Leather	Others
KMC	20.29	24.55	44.28	1.37	1.13	3.89	1.14	3.35

Composition of Institutional Waste in Kathmandu Municipality in %. ADB (2013)

Table 4

Municipality	Organic	Plastics	Paper & Paper Products	Glass	Metals	Textiles	Rubber & Leather	Others
KMC	45.44	24.29	23.29	2.86	2.65	1.03	0.00	0.45

Composition of Commercial Waste in Kathmandu Municipality in %. ADB (2013)

Data analysis from ADB report shows that there is considerable amount of plastic and paper waste in overall wastes derived from all sources. Percentage of plastic and paper is higher in institution and commercial waste due to thrown out packaging materials and sheets. Percentage of organic content is higher in household waste because majority of Nepalese eat at home rather than outside. Organic waste, paper waste and plastic waste accounts almost 90% of total waste. Plastic and paper waste can be used as a fuel the easiest and cheapest option whereas bio can be used to generate bio gas and fertilizer by composting. After managing only these 3 items we can lower down the volume of waste from 100% to 10%. This is very interesting .What we are thinking as a mountain of problem is in fact due to our negligence and mismanagement of waste. If we can be a little bit more careful in sorting, reducing, reusing and recycling waste we can make our city clean and green.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATION

BENEFITS OF REUSING AND RECYCLING OF WASTE

There has been no confusion now that reusing and recycling of waste has various benefits to individual and country. From cost recovery to energy recovery there is benefit in each and every move. The major benefits are grouped under economic and environmental benefit.

Environmental benefit.

Burning of waste will release toxic elements in atmosphere and uncontrolled dumping will release leachate in the ground. This will make people sick polluting land, air and water. Littering waste will decrease the beauty of the city. Scattered polyethylene bags are the cause of blocking of drains which cause artificial flood in cities. Decaying of waste brings greater chance of spreading disease. If we carefully manage it then all above listed environmental problems can be solved and we can get benefit everywhere.

Economic benefit.

Effective waste management will create employment opportunities for road pickers. Controlled burning will help to recover energy from waste. By products after waste treatment can be used for different purposes. It will decrease the import of virgin raw materials from foreign countries and make the final cost of product cheaper. Tourism industry is highly benefited by making healthier environment and keeping city clean and green. These are some of the benefit of effective waste management.

PRODUCTS MADE FROM RECYCLED WASTE

In comparison to other waste plastic waste is recycled in wide scale. Extensive survey showed that shredded HDPE plastic is used as raw material for making black HDPE pipes. Benches, tables, partition walls, litter bins and similar other low grade stuffs are made with HDPE waste. Others plastic waste are rarely recycled in comparison to HDPE in Kathmandu. PET bottles are collected, crushed into flakes and exported. Iron and other metallic waste are sent to respective industries outside Kathmandu and to India. Beer glass bottles and other selected bottles are found to be sent to respective industries. PET bottles are first crushed into small size manually then shredded into small pieces by putting in shredder. The shredded pieces are washed with water and soap in a rotating drum and finally the flakes are dried in hot air or sunlight. Thus produced flakes are sent to industries for recycling. Newspaper are collected in wide scale and sent for recycling. Cardboard waste and office paper is also widely collected and sent for recycling to make new products. Among hazardous waste Lead acid cell is sold to shop and recycling center whereas other electronic waste, dry cell and fluorescent lamp which don't have any resale value are just dumped into main stream garbage. Some houses are found to have sorted bio waste and used it to make fertilizer by composting in small bins and some used those bio waste to feed earthworm to make high quality fertilizer. In this way recycled waste are converted into different products.

PRECAUTION WHILE USING RECYCLED PRODUCTS

Though it is good to use recycled products. We also have to be careful in using recycled products. Especially in underdeveloped countries where consciousness isn't given much priority in quality. Excess use of recycled materials can considerably weaken the strength of product. Products like baby toys, food containers shouldn't be made from recycled materials. There should be ethics in such case. For sake of money misusing recycled products can create negative image in the mind of consumers which is a problem often seen in underdeveloped countries. Good concept is being used in bad manner to bring negative results. So, all should

take it seriously and work accordingly. Government should make standard how much to use and where to use recycled materials so that environment is also saved and health of people is also saved.

RECYCLING AND RECOVERY PROCESS OF PLASTIC WASTE

Collection of Plastic Waste

The process of recycling of plastic waste starts from the collection of waste. Since plastic products in underdeveloped countries don't come compulsorily with international recycling codes it is difficult to sort different plastic by a common person. So, collecting all the plastic waste in one place and then later sorting it at recycling units is a good option for effective separation of plastic waste. Plastic waste from houses, industries, business organizations and commercial sources should be aggregated in one place before proceeding to another stage. Collection of as much as possible plastic waste is good for the fruitful running of business.

Sorting of Plastic Waste

After collection of plastic waste the next process is sorting of plastic waste. Different types of plastic like PET, Polyethylene, and Polypropylene are found to be mixed in one place. First of all this has to be separated into different groups so as to keep the quality of recycled products. It can be done manually because the cost of manpower is low in underdeveloped countries. So, instead of using huge costly machines manual sorting is better. However, mechanical sorting can also be done by blowing air, using the difference in density of different plastic products or using similar other relevant technologies to sort it. Since how much automated the system is still we need people to run the equipment. As the waste volume isn't so much in underdeveloped countries after excluding the organic portion it is good to give priority to sorting by

hands rather than machine. So, starting phase can be run with manual shorting which can be later turned into automatic system after the feasibility of the project.

Shredding

After the plastic waste is shorted it is put in shredder where it is converted into small flakes. First the big size of plastic waste has to be cut into small pieces which is done manually by using sharp knife. Then the small size pieces are fed into shredder manually or by means of conveyer belt. The shredder has blades rotating at high speed which cuts the plastic pieces and turns in into flakes. Great care has to be done while doing this because plastic pieces may flow outside and hit in eyes if negligence is done. Further ear should be protected with ear plugs so as to prevent ears from continuous huge sound coming from the shredder. This can damage the hearing capacity of people working nearby. The shredder is operated with motor driven by electricity.

Washing

After the flakes are collected from the shredder they are put in a rotating drum along with water and detergent. The drum is rotating at a high speed by using motors which separates dust grease and oil from the flakes. It is quite important to remove those things from flakes because this will later effect the quality of newly manufactured product. The flakes are then dried either in sunlight or using hot air and finally packed in sacks for further processing.

Pelletizing and End using

After the plastic flakes are dried then they are further proceed in two stages. One is they are directly used along with other materials and virgin materials in the production process. The other is they are put into extruder where they are melted then after they are drawn into strands which is passed over water cooled tank. They are converged toward pelletizer where the

strands are cut into plastic pellets using cutting blade. The pellets are stored in sacks which is used later for other purposes.

Waste has been a hot issue in nowadays world. State authorities of different countries are facing difficulties in addressing this problem. Everyone speaks about recycling but recycling isn't as easy as it looks. It is costly due to high cost of manpower and costly high tech technologies. Still lot of people are engaged in it to make recycling project more profitable and sustainable. Plastic waste can be recycled by two ways mechanical recycling and chemical recycling. Those plastic which cannot be recycled easily due to its nature can be either burnt in controlled environment to release energy or dumped to prevent further problems.

SOURCES OF WASTE

Wastes are separated generally into three categories Municipal waste, Institutional waste and Industrial waste.

Municipal waste

Kathmandu city is the most densely populated city of Nepal. It has an approximate area of about 49.45square km and a population of about 1,003,285 according to 2011 census with an average population density of about 20,289 person per square kilometer. The average household waste produced per day is around 1.10 kg per day .This varies according to places and is less in rural areas where there is low population density and lack of any business activities. In contrast it is higher in urban areas where there is high population density because of easy access to industries, and modern commercial activities. Rural areas are generally less dirty and there is not so much waste management problem because in rural areas large proportion of organic waste is managed locally due to access of cheap excess land and it isn't either bombarded with modern ways of eating and consuming. Kathmandu city is overpopulated and many houses are made without standards. Without easy accessible wide roads it has been difficult to manage municipal waste. In other hand people also are found to be negligence in managing waste. Throwing garbage in streets and lack of habit of sorting waste has made dif-

difficult to manage waste. We have to thank informal sector, road pickers and waste collectors who sort waste for few extra earnings. This has been the only tool to recycle waste.

In Kathmandu KMC is responsible for managing waste. Many informal sectors are also involved in collecting and disposing waste. Road side waste picking is still common. Waste is transferred in open containers and there is no active means of sorting waste. Consuming readymade food and junk food has increased the amount of waste. Plastic bags below 20 micron though banned are still used which is quite difficult and uneconomical to recycle. These bags are the root cause of degrading the beauty of city and are the agent of blockage in gutter and drainage creating artificial flood in cities during heavy shower. In municipal waste bio waste generally comes from house whereas plastic and paper waste generally come from small shop. Since there is lack of collecting bins in streets people throw wrappers and similar stuff in ground which has to be swept to make street clean. Since there is less manpower and cleaning of street is done manually the area of coverage is low and time consuming. This is the reason why in spite of spending so much budget in municipal waste management nothing fruitful result has been achieved up to now.

Due to lack of sufficient municipal drinking water people generally prefer to drink water from bottles made from PET. These bottles are thrown as waste in streets and side of streets. Thanks to several road pickers who collect all recyclable such things in their sack walking all-round the city sweating in the sun. Even after all these hard effort much recyclable things still go to main stream garbage which is a huge loss of energy and money for underdeveloped countries like Nepal.

Institutional waste

Institutional waste comes from organization involved in commercial activities like schools, departmental stores, hotels, restaurants etc. Different combination of waste comes from this area which is stated at the back of this thesis work. To start effective waste management practice this place can be starting point because a lot of people comes to this place. A large vol-

ume of waste will be collected from such places and it will be economically feasible to collect segregated waste from such places in comparison to individual houses affected by unplanned urbanization. It is easier to teach the ways of segregating waste here because the coverage of teaching and passing information about waste management will be large in these areas and from the results derived here further plan can be made how to address and municipal waste problems.

Industrial waste

Industrial waste are generated by industries and factories. In Kathmandu city large industries are established in different industrial state and small cottage industries are established in local periphery. In industrial state strict rules can be made about sorting and disposing of waste. A wide variety of packaging waste (paper and plastic) is thrown out as disposable waste. Large quantity of waste produced in these areas can be properly recycled or reused to save environment and nature.

If selling of waste can be done then reuse and recycle of waste can be successful in dramatic way in developing and under developed countries. If cash can be generated in exchange of trash then we can considerably lower down the amount of garbage that goes to main stream. From our study also it is seen that waste which can be sold are hardly thrown away from houses. As household waste comprises major proportion of waste in Kathmandu valley any programme addressing directly to individual houses if launched can be successful in this aspect. Opening well managed recycling centers which accept waste should be promptly launched into action. Millions of drinking bottles made from PET, carbonated soft drink bottles, and aluminium can are thrown in garbage. If they can be redeemed for cash just like in countries like Finland then it can be quite effective. Imposing plastic and metal tax while selling filled bottle and returning the same amount after returning the used containers is a good example in waste management.

From various studies it is seen that household waste of Kathmandu valley comprises around 70-80 % of organic waste. If we could distribute big bio sulos for big houses and small bio sulos for small houses and collect the waste at least once a week we can dramatically lower down the volume of garbage that goes directly to landfill site. Separation of bio waste at initial level will help to short remaining inorganic waste in transfer station. Bio waste thus collected can be used for generating gas which can be used to generate electricity or as a source of energy for other purpose. Remaining of bio waste can be used as organic manure for agricultural purpose. This will be boon for agricultural country were more than 70% of the people depend upon agriculture for their living and cent percent of chemical fertilizers has to be imported from other countries.

Strict checking and heavy penalty can be a useful weapon for tackling carelessness of people. Starting can be done from government offices, schools, colleges, industries, big shopping complexes and then individual houses. Since sulo is well covered there is no spreading of foul smell. It is easier to carry it in narrow streets because of wheels under it. A compactor lorry can be used weekly to collect all those waste compact it and take it to reuse and recycle station. This will save the transportation cost of carrying waste in comparison to open containers. There is no need of huge investment for this just rising awareness, strict checking, and heavy penalty is needed. As all of we know quite a huge budget of KMC is spent in waste management and the result isn't fruitful up to now this single act of separating waste just into inorganic and organic or decaying and non/decaying can magically solve this problem of waste disposal. All inorganic waste collected in the main stream after separating bio waste can be further separated as burnable waste, metal waste, glass waste or unsorted disposable waste. Burnable waste can be burnt to release energy and disposable unsorted waste can be dumped in landfill site. Separation of organic waste will help to minimize the moisture content in the aggregate waste which will increase the calorification of waste and can be used as a source of fuel.

It has been already stated that from this research it is seen that there were few items found in the main stream garbage which could be easily sold to cash. Even if in cheap price if we can

buy bio waste from people this will lure them and develop the habit of shorting waste. Right now people are seen paying for disposing their mixed waste. If they can get something in return for their separated waste they will surely short it. This will cut down the volume of bio waste that goes to landfill site. Bio waste can be used for making organic fertilizers and bio gas which will make revenue needed for successful operation of this project. Government should aid in such scientific management of waste so as make such projects successful. Later when this separation becomes their habit and people see the result of separating waste they will be ready to short waste even if we don't pay for them. To gain confidence of people this plan can also be launched into action for effective waste management.

It should be made compulsory for people to short waste as at least organic and inorganic in their house. Separation bins can be given free of cost for this purpose. Those houses whose waste aren't sorted shouldn't be provided with basic needs like electricity and water. Such types of severe punishment will compel the people to sort waste. In underdeveloped countries two types of schemes generally work one if people receive money they can do anything and the other if they are imposed with fear of heavy penalty they will rapidly change their habit and follow each and every rule and regulation loyally.

Plastic products should be marked with international symbols which are helpful for recycling like 1 for PET, 2 for HDPE etc. During research many products were found without number in them. If they have numbers printed in them even people who don't know much about plastics can sort it and earn money by selling it. There should be mandatory rules for this and products which don't obey this rule should be prohibited to be sold in market. Right scenario showed that PET bottles and HDPE plastic parts are widely collected and crushed into flakes to be used later in manufacturing process. In comparison to production only a small portion is being recycled so much initiative has to be given in collecting such bottles and cans.

RESIN CODE	POLYMER NAME & ABBREVIATION	ORIGINAL USES	RECYCLED USES
	Polyethylene Terephthalate PETE or PET	Soft Drink Bottles Mouthwash Bottles Peanut Butter Jars	Industrial Strapping Automotive Bumpers Luggage
	High-Density Polyethylene HDPE	Milk Jugs Retail Bags Yogurt Containers	Playground Equipment Mailbox Posts Liquid Laundry Bottles
	Polyvinyl Chloride PVC or V	Shampoo Bottles Medical Tubing Window Cleaner Bottles	Binders/Notebooks Automotive Mudflaps Speed Bumps
	Low-Density Polyethylene LDPE	Squeezable Bottles Dry Cleaning Bags Frozen Food Bags	Garbage Can Liners 6-Pack Rings Shipping Envelopes
	Polypropylene PP	Straws Medicine Bottles Syrup Bottles	Automotive Ice Scrapers Bicycle Racks Lawn Rakes
	Polystyrene PS	Dinnerware Egg Cartons Compact Disc Jackets	Light Switch Plates Cafeteria Trays Video Cassettes
	Acrylic, Nylon, Fiberglass Other or O	3 & 5-Gallon Water Bottles	Plastic Lumber

Figure 4 Recycling numbers of Plastic. Eartheasy.com (2011)

Practical knowledge about waste management like how to effectively manage waste should be taught to children from their school age. This should be put in their curriculum and included in subjects like science, social studies. It was seen from the research that many people know the meaning and importance of waste management but they don't know how to do it practically.

Immediately at least electronic waste collecting bins should be placed in major public places of the city. It was seen during research that many electronic waste also go to the mainstream garbage. Even electronic goods like used mobile phones, radio, wires, were difficult to dispose as there were unavailability of places and bins collecting such waste. Shops which sell such goods should keep bins in their backyard and accept all such goods from customer when they want to dispose it. International companies should also help in managing such waste because such products aren't developed inside our country and it is also their responsibility to manage such waste. They shouldn't concentrate only in making profit from poor country and shut their eyes in addressing such problem. They should transfer their high technology in management of such waste.

Hazardous waste should be compelled to be sent to the country of its origin. Many wastes like insecticides, pesticides, radiographic waste and batteries which cannot be dumped nor treated with low technology should be returned to country of its origin. This should be done by imposing heavy tax at the custom while entering the goods and refunding it at the time of exit of such goods.

Huge lava should be placed in each area once a month to collect big waste except bio waste and mixed waste. Big objects which are difficult to put in bins should be stored in houses for at least one month and should be put in such huge lava. This will help to reuse and recycle waste. Time and places can be informed by means of local ways which can be effective.

Instead of open trucks compactor should be used as much as possible because with compactor we can compact and carry large amount of waste which will result in reduction of transportation cost. Open cart should be discourage because this will spread the foul smell and is unhygienic. The driver of open cart short waste in different sacks tied in his cart. This isn't a scientific solution. People should be taught at least to separate waste as organic and inorganic in their house in separate bins and collect separately. Inorganic waste which doesn't have bio proportion can be shorted later in transfer station and maximum valuable things can be recovered. Mixing of organic and inorganic is the root problem of effective waste management which can be addressed only through public awareness.

Waste bin should be placed in plenty amount in required places. In places like temples, bus station, shopping complex where the flow of people is high there should be plenty of such bins. During research it was found that there was lack of proper number of bins. The bins were also of difficult design and without covering which were difficult to move and empty. This is also one of the reasons why there are so many wastes in the floor and street of Kathmandu city. We can make lot of bins with the recycled plastic which comes from the wastes.

Proper management seems to be lacking there. Waste bins should be emptied in fixed time and fixed date only then the service becomes reliable.

It is unfair to say that adapting this process cent percent of the waste can be effectively managed. Management of waste, recycling and reusing is a challenging work even in developed countries so we cannot expect huge results in under developed countries where level of literacy is quite low and no one has taught about the importance of reuse and recycle to local people up to now. If we can have only 50% success in our mission in initial stage we should think ourselves successful and make plans to get better results in coming days.

We cannot completely change our society quickly and forcefully. It will take definitely time but the important thing is that we must be clear in our vision and direction. There is no need of advanced, latest costly equipment and technologies to deal with work stated above. Just separate inorganic waste and organic waste and treat them. We have seen huge amount of budget and manpower spent in management and collection of waste but neither waste is effectively managed nor are we getting any other benefits. We are just dumping sources of energy in landfill site carelessly and living in energy crisis society

Right now also it is seen in different parts of the city like streets, river bank and open places people are found burning mixed waste in large scale which is polluting environment. If burning has to be done at any cost and it is the easiest option then why not to recover energy by burning it in controlled environment. This will harm environment less than the first way of open burning. There should be at least some incineration machine for this. People who works in street as street pickers can be utilized to separate waste as combustible and non-combustible at transfer station.

This isn't a permanent solution because waste has to be separated at the place of origin rather than at place of disposal for effective waste management. However this can be utilized as a

short term plan for waste management. Remittance should be utilized in such sector rather than spending on unnecessary stuff. It will be wrong to be visualized in front of the world as rich people of poor country. We should be clear in this vision that nobody is coming to make our city clean and green we ourselves have to do some effort for changing it.

Shopping bags which has created negative influence about plastic in peoples mind should be replaced with recyclable plastic bags. This in one hand will decrease the consumption of virgin materials and in other hand helps in the management of plastic waste. Just like here in Finland shopping bags should be made up of either jute, cotton or recyclable plastic material. This doesn't need high tech technologies because now also many plastic bag manufacturing industries are running in Nepal. The only thing needed is will.

At the end it is nice to remember one Nepali proverb where there is wish there is way. So we must be united with hand in hand and work together with arm in arm to make our country clean and green. This is difficult but not impossible.



Figure 4 Management of Waste at Household Level

The above and below diagram shows us how waste can be separated at initial level which will make recycling of waste products effective. If every house manages its waste in such a way then there will not be so much headache about waste management. Wastes are sorted in su-los at household level and specially designed bins at community level. The number of bins can be added or subtracted according to the volume and type of waste generated. There are many public land in Kathmandu city. We can design such bins there and compel people to short waste there. It doesn't cost that much huge amount of money. We can use local technology and locally available materials for this purpose. It will be easier to transport waste and treat them if we can separate it at initial stage. This Finnish model can be applied in Nepal if we really want to solve this problem.





Figure 6 Management of Community Waste

Questionnaire.

General Questionnaire

- Age
- Sex
- Permanent Residence
- Temporary Residence
- Family No.
- Profession

Subject Related Questionnaire

- Do you separate waste in your house? How you manage waste in your house?
- Where do you throw waste? In proper place or street?
- Do you know about the importance of recycling?
- Do you know about the importance of reuse?
- Have you participated in any training programme of recycling of waste?
- Do you reuse waste in your house?
- Do you think waste is properly managed in Nepal by government authorities?
- Do you think waste is properly managed in Nepal by private organizations?
- Frequency of waste collection by concerned authorities in your locality?
- Is waste collected in fixed time and date by concerned authorities? Are you satisfied with their service? Is it free or paid?

- Have you faced any problem due to poor waste management? If so what?
- Do you know about different types of plastic like PET, PVC, HDPE, PP etc.?
- Do you think plastic is really waste and harmful to environment?
- How do you handle plastic waste?
- What are the difficulties in handling plastic waste?
- Do you have any subject material related to recycling, reuse and management of waste in your study curriculum?
- What are the chief constituents in your household waste?
- Do you give priority in using recycled materials? Have you used such materials up to now? If so what?
- Do you know where the waste you produce in house ultimately goes?
- Have you participate in any training, awareness programme about waste management by state authorities or other concerned authorities?
- In your view how waste of Kathmandu valley can be properly managed?
- How do you handle Electronic waste?
- How do you handle Hazardous waste?
- How do you handle Bio waste?
- How do you handle paper waste?
- Besides your home is waste properly managed in your study and working area? How is waste handled there?
- Who is responsible for proper management of waste in Kathmandu valley?
- Do you know about recycling symbol and numbers printed in plastic bottles, aluminium cans and glass waste?
- How do you handle PVC waste?

Do you know about the origin of plastic you use? How much important is plastic in your life?

Are you willing to pay extra amount for managing waste and making environment clean and green?

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