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INSTITUTE OF ENGINEERING

PULCHOWK CAMPUS

THESIS NO: 072/MSU/207

Community Participation for Solid Waste Management

- A case of Traditional Core of Kathmandu City

by

Mita Prajapati

A THESIS

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE AND URBAN PLANNING

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN URBAN PLANNING

DEPARTMENT OF ARCHITECTURE AND URBAN PLANNING

LALITPUR, NEPAL

NOVEMBER, 2017

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CERTIFICATE OF THESIS APPROVAL

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ACKNOWLEDGEMENT

My thesis would not have been completed without the help and support of so many people**.**

First and foremost, I would like to express my heartfelt gratitude to **Associate. Prof. Sangeeta Singh**, my thesis supervisor, for her guidance and support during the preparation of this research report.

I would also **like to thank Prof. Dr. Sudarshan Raj Tiwari, Prof. Sanjay Upreti, Mr. Ajay Chandra Lal, Mr. Kumar Prasad Lohani, Mr. Umesh Bahadur Malla** and **Mr. Deepak Pant** for their appropriate guidance and valuable suggestions.

I am also grateful to **Prof. Dr. Bharat Sharma** and **Prof. Dr. Mahesh Kumar Shrestha** for their precious suggestions and guidance.

To **Mr. Rajesh Dangol**, ward member of ward no 25, **Miss. Nisha Koirala**, Chief Environment Engineer and **Mr. Macha Raja Maharjan** of Environment Management Department**, Mr. Indra Man Singh Suwal**, Chief of Disaster Risk Management Department, (KMC), for providing information, help and support during my filed work.

To Mr. Sanjog Kanyastha, Ms. Milana Prajapati and my mother for their help during my filed survey and many thanks go to all the respondents without whom this study would not have been successful.

I also wish to express my gratitude to all my classmates and seniors and to all those who have directly or indirectly contributed for accomplish of this research paper.

Thank you

ABSTRACT

Urbanization in Nepal is taking place rapidly. Kathmandu is the capital city which is one of the fastest growing metropolis in south Asia. Increasing population puts immense pressure on the services provided my municipality including the solid waste management. Solid waste management in Nepal is one of the major urban issues and unmanaged solid waste has direct impact over people and environment. There is a huge gap between demand and supply of solid waste management and this gap can be filled by active participation from community and public.

Thus this paper focused on the community participation for solid waste management in Kathmandu city. The core areas are the densest place of the city so the waste generation is also high. Most of the core areas are serviced by only KMC for solid waste management and in absence of this service, the waste are disposed in the public arears.

The study area of my research paper is ward no. 27 of KMC which is the historical part of KMC and located in the inner city and divided into different toles. The SWM service is provided by municipality only. There is no other stakeholders like NGO/INGO, private sector or CBOs. Currently the waste is collected by municipal vehicle and street sweeper and street sweeper collect charge for waste collection.

Household questionnaire and interviews were used as the research tools and a total of 100 respondents were interviewed. The paper uses both qualitative and quantitative approach to analyze the information. Waste reduction is generally not practiced in this ward. The major waste that is generated in this ward is organic but very few household practice composting remaining waste is dumped in municipal vehicle. Also the scrap waste are disposed with other waste and not segregated for recycle purpose. Street sweeper plays important role in waste collection and cleaning in this ward and informal sector are important for waste reduction.

The ward office and CBOs plays no role for the solid waste management of the ward. The people of the ward had not received any training programs regarding SWM. If proper assistance is received, people of this ward is willing to participate in waste management which help to reduce the waste that is carried by municipal vehicle to landfill site.

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LIST OF ABBREVIATION

ADB	ASIAN DEVELOPMENT BANK
CEE	CENTER FOR ENVIROMENT EDUCATION
GoN	GOVERNMNET OF NEPAL
ISWM	INTEGRTED SUSTAINABLE WASTE MNAGMENT
SWM	SOLID WASTE MANAGEMNET
UWEP	URBAN WASTE EXPERTISE PROGRAMME
UNEP	UNITED NATION ENVIROMENT PROGRAM
WHO	WORLD HEALTH ORBANIZATION
KMC	KATHMANDU METROPOLITAN CITY
SWMTSC	SOLID WASTE MANATEMNET TECHNICAL SUPPORT CENTER
CBO	COMMUNITY BASED ORGANIZATION
MOUD	MINISTRY OF URBAN DEVELOPMENT
MOFALD	MINISTRY OF FEDRAL AFFAIRS AND LOCAL DEVELOPMENT
NGO	NON GOVERNMENT ORGANIZATION
PPP	PUBLIC PRIVATE PARTNERSHIP
HH	HOUSEHOLD
MSWM	MUNICIPAL SOLID WASTE MANAGMENT

CHAPTER 1: INTRODUCTION

1. BACKGROUND

Urbanization is a form of social transformation from traditional rural societies to modern urban communities which is long term continuous process (Kumar & Rai, October 2014). Urbanization is taking place all over the world in rapid pace especially in developing countries. In context of Nepal the urbanization process is very new phenomena but taking place in rapid pace. Government of Nepal has defined urban areas in the basis of municipality which should have infrastructures such as road, water supply, sewerage and drainage and revenue of 5 million. From 2014 AD to 2016 AD, the number of municipalities have been increased from 16 to 217 which increase urban population from 4.1% to 34%.

Urbanization in Nepal is dominated by few large and medium cities among which the urbanization rate is very high in the capital city, Kathmandu. It is one of the fastest growing metropolitan in South Asia with total population of 2.5 million which is increasing at 4% per year (The World Bank). The major reason behind high population concentration in Kathmandu is rural-urban migration. Urbanization provide better economic and social opportunities but it has its own cost. Unplanned and unmanaged urbanization has result into various economic, social and environmental problems. Due to unplanned urbanization, the demands for different basic services cannot be fulfilled and Solid Waste Management is one of them which create various environmental problems. The urbanization rate is less compared to other developing countries but as the area and the available resources of Nepal is less this small urban population has become an enormous burden for the government in terms of environmental health, sanitation and environmental management. The urbanization in Nepal is rapid and the provision of facilities to the population is lagging behind (D.Pokhrel & T.Viraraghavan, 2005).

Along with increasing urbanization and growing population, problems related to solid waste are also increasing. Since every person is potential generator of waste, the growing population has direct impact on waste generation. Also, rapid urbanization and economic development has changed the consumption pattern of the people which introduced different kinds of materials such as glass, plastic etc. that cannot be degraded. Thus, there is increase in the quantity as well as the complexity of the solid waste generated. The solid wastes of urban cities is more inorganic rather than organic that cannot be degraded. Use of Plastic is

the very reason of environmental pollution and has become one of the major issues of solid waste management of the world. The resulting effect of unlimited waste generation leads to greater demand for Solid Waste Management (SWM) services. Most cities in the developing world face a high level of environmental pollution, partly due to inadequate provision of basic services like waste collection and water supply (United Nations Centre for Human Settlements (Habitate), 2001).

Thus solid wastes are by-product of human activities which tends to increase with rapid urbanization, improved living standards and changing consumption patterns. On the basis of survey conducted by Asian Development Bank (ADB) in 2012, household waste generation rate is 170 grams (g)/capita/day which vary with the economic status and climatic conditions. The amount of waste generation vary according to the use of buildings. For institutional establishments, the average daily waste generation was 4.0 kilograms (kg) per school and 1.4 kg per office. Similarly, the average daily waste generation of commercial establishments was 1.4 kg per shop and 5.7 kg per hotel or restaurant (Asian Development Bank, 2013).

Solid Waste Management (SWM) is one of the major environmental issues and has become a major concern for the municipalities of Nepal. The main purpose of SWM is to collect, transport and treat/dispose the total waste generated without affecting the environment. In context of Kathmandu city, population is increasing at alarming rate putting immense pressure on municipal services particularly in managing solid waste.

Problem regarding waste management has adverse effect on environment as well as on the public health. Environmental problems are mostly related to the effects of pollution due to waste, open landfills, blocked drainage which ultimately result into severe health problems especially in the children. Due to the lack of efficient and effective collection techniques, all the generated wastes is not collected which is dumped along roadside, riverbanks, open spaces around residential and commercial areas etc. Solid wastes are those unwanted materials that result from daily human activities from different areas such as residential, commercial, industrial institutional etc. and management of these wastes is responsibility of government authorities. The collected wastes are carried to Teku Collection Center where segregation of wastes are carried out and then remaining wastes are dumped into landfill sites (Okharpauwa). There is a huge gap between the waste generation and management of these wastes.

The survey study done by ADB uncovered that present collection efficiency of government ranges from 70%-90% in major towns and below 50% in small towns. Many municipalities of the valley do not have sanitary landfill sites and dispose the waste in open areas including river bank, public spaces etc. In total, 37% municipal solid wastes in Nepal is disposed in sanitary landfills, although not necessarily in a sanitary manner (Asian Development Bank, 2013). However, in present context, there are also some private organization which engage in collection and segregation of the waste from society in exchange of money but the remaining wastes get disposed to the landfills. But it is estimated that the Okharpauwa will have life of about 96 years which could be increased to about 27 years if 40% of solid waste are composted (Kathmandu: Regulating Growth, 1994). The resources available within government authorities is not sufficient for sustainable and effective management of total waste generated. Thus the participatory approach is very important to address the problems regarding the solid waste management.

Management of solid waste is a critical problem as it is directly linked with health of general public and environmental sanitation which was practiced from early Malla period. The major occupation was agriculture so the generated wastes are mostly organic and decomposed wastes are again utilized for agricultural purpose. The wastes are collected within enclosed common space which is known as “Saga or Sagal”. Some residential buildings have this space within the residential buildings at ground floor below staircase. Also, there are certain group of people who reside along riverside responsible for cleaning the society and collection of wastes. These are generally lowermost caste *“Kuchikar”* of the society living at the outskirt of the city. Thus the collection and management of waste is consider as inferior job in traditional society. There is also a festival “Sithinakha” which is devoted to cleaning of the houses and the nearby water sources. The community people clean and worship the water resources such as pond, well and other water resources.

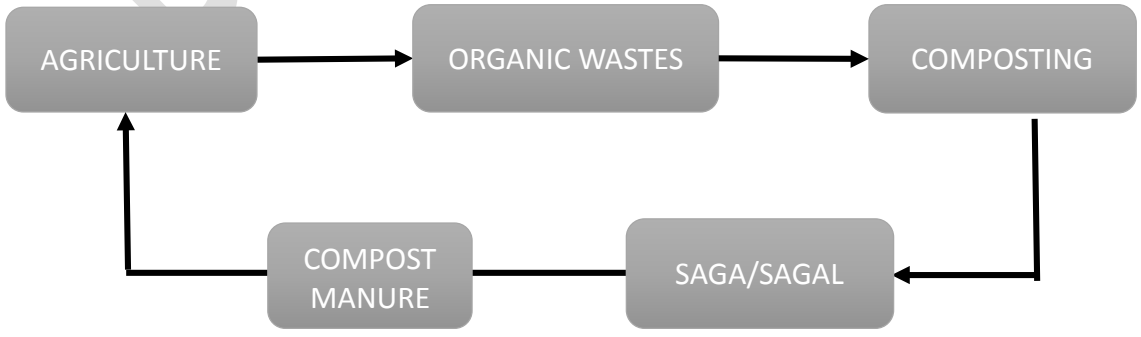


Figure 1: Organic Waste Cycle in Traditional Society

The traditional community was also homogenous in nature. The communities are divided on the basis of their caste and city is layered on the basis of their status. The population of the community were involved in same type of occupation, culture and festival. Every community has the social organizations called "Guthi" which is further categorized according to their function. There are different Guthi for different purpose such as Siguthi for death ritual, festival Guthi to organize feast and festivals and so on. The people were socially close, they knew each other and help each other in time of need. The traditional society worked in groups either for agriculture or for festival so they had the feeling of "We". Also, there is a kind of social and emotional bonding between the place and people so they also work for the welfare of that place which include cleaning of the community for festivals and jatras.

But as the population increases, the people from outside reside among these community which result into heterogeneity in community which result into multicultural communities with different ideas and thoughts. In present context, the most of the communities of traditional towns has been degenerated. The migrated people stay within the area as tenant and the original people left the place. As the tenant change their place time and again, migrated people barely have any attachment to the society where they are living. Thus, public participation in modern community is for development and welfare is comparatively less. Also, many of the traditional settlements has been influenced with modernization which result into mixed settlements. Most of the traditional buildings has been converted into modern buildings which do not possess any traditional characteristic including *Saga or Sagal.* The size of the buildings has increased vertically and also the used has been shifted from residential to commercial which has impacted the nature as well as the amount of the waste generation.

Solid Waste Management (SWM) is an important aspect of urban governance as it reflects the consequences of the authorities dealing with waste and also the responses of the society on the performance of the system used by these authorities. Success of these authorities defines good governance and thus the gains trust from general public whereas failure of these authorities result into loss of hope from people.

Most of the developing countries mostly practice two systems of waste handling. The first one is a formal system that is managed by government authorities. Generally it involves the municipalities where municipality has the responsibility to ensure safe, reliable and cost

effective collection and final disposal of the solid waste. This process requires large financial resources and in most cases it is allocated on the public budget. This system is generally characterized as an inefficient and expensive. Municipal solid waste management includes collection, sorting, recycling and selling of wastes. The next system engage mainly private dealers such as scavengers' communities and private association. They represent a significant part of economy as they recognize the potential part of certain materials such as plastic, bottles, paper, and cans. These systems however have very little or no interference and cooperation in all aspect of handling wastes.

1.2 NEED OF RESEARCH

The solid waste generation varies according to the use of building, economic condition and climatic condition. The survey study done by ADB uncovered that the solid waste segregation and composting are not practiced in urban areas. It also analyzed that the present system of solid waste management is not sufficient to address the total waste generated in most of the towns. Many municipalities of the valley do not have sanitary landfill sites and dispose the waste in open areas including river bank, public spaces etc. In total, 37% municipal solid wastes in Nepal is disposed in sanitary landfills, although not necessarily in a sanitary manner. (Asian Development Bank, 2013). So in order to increase the life of landfill sites wastes carried to landfill sites needs to be reduced.

The solid wastes are generated due to the activities of people within the community and unmanaged wastes affects the health of community people and their environment. So it is the responsibility of community people to participate in waste management. It also plays an important role for the sustainable solid waste management that help in reduction of wastes carried to landfill. So there is need to study the different ways so that the local people actively participate in efficient solid waste management of their area.

1.3 IMPORTANCE OF RESEARCH

The Solid waste management is one the major issues of developing countries like Nepal. The people migrate from rural to urban areas in search of opportunity, security and better facilities. Kathmandu is the densest urban center, with highest population. The traditional settlement of the town has converted into commercial areas and houses are mostly occupied by tenants. Since the population density is very high, more wastes are generated even from small area which is more inorganic.

If somehow, the municipality fails to collect the waste daily or the vehicle did not arrive regularly, then the wastes get piled up along the roadsides which has adverse effect on public health and environment of community. This also affect the people who travelled through the community. Thus, this research is importance for the local authority, environmentalist as well as local people so as to develop the place which is independent of municipality or any other private organization for the waste management. The research in community participation is also important for the country like Nepal which has very limited resources for development.

1.4 PROBLEM STATEMNET

Many traditional core of Kathmandu has been degenerated due to change in lifestyle, diverse economic activities and increased population density. Many residential areas has been converted into commercial areas but still it has some residential buildings, traditional markets/ squares and historic monuments. The community of traditional core is mostly occupied by migrants and the indigenous residents has migrated from the core to other place. All of these results into increased and complex wastes generation and the available resources for solid waste management is far behind from being effective.

But still the population of these core areas completely depend upon government authorities for waste management service. As a result of which, people of the community is facing various problems related to health and environment. Thus for the protection of public health and natural ecosystem, effective waste management is very essential. The SWM can be practices at local level which decrease the dependency upon municipality. But however the people are not willing to participate in this solid waste management program. If the local people actively and willingly participate in Solid Waste Management, then the issue of wastes can be decreased.

1.5 RESEARCH PURPOSE

Main Objectives:

- To study the composition and nature of modern community
- To find out the responsibility and function of the present social organization
- To study the current practice of SWM in community and their attitude towards community participation in solid waste management system.

- To find the different ways for the community to participate in SWM actively, effectively and willingly.

1.6 RESEARCH QUESTION

- What are the reasons that holds back the community to participate solid waste management in traditional core?

1.7 VALIDITY OF RESEARCH

Solid waste management is major issues of developing urban areas. The nature and complexity of the solid waste has changed with the change in lifestyle of the people. The community has the potential to reduce and reuse/recycle the solid waste significantly. There has been many researches regarding SWM and responsibility of the local people. But the research has not been carried out in the traditional settlement of the Kathmandu city. Thus from the perspective of the case study area, the research has not been researched before.

1.8 SCOPE AND LIMITATION

The scope of the research is limited to the study area of the traditional core especially the case area i.e. ward no. 22. The study is focused on the community composition, their responsibility towards the community and their willingness to participate. The research is limited on management of solid wastes only. The survey is conducted in sample population for required information only. The data for the literature will be based on secondary sources.

1.9 EXPECTED OUTPUT

Through this research, the existing community is studied along with the existing social organization. The attitude of the local people regarding SWM and community participation is expected to be understand and analyzed in such a way that effectives ways are developed for the community people to participate in SWM on their own will. Thus the solid waste carried to the landfill sites is expected to be reduced significantly. This increase the life span of landfill sites which is very important for the city like Kathmandu where availability of land is less.

CHAPETR 2: METHODOLOGY

The objectives of this research is to identify the reason that hold back the community from participating in Solid Waste Management and also to explore the ways to make them participate effectively. The research is based upon Post positivism paradigm as the reality obtained from research gives single truth which may not be 100%. There could be various reasons behind unwillingness of community people which can be collected through sample survey and result is obtained through data analysis. The research will focus on what are the reasons that people do not participate in SWM and why the government authority is not able to manage solid wastes completely and properly. The valid tool to obtain reality is empirical observation and measurement. In my research, the proposition for the ontology could be the various factors that hold back the community from being participate in SWM. In this research, there is need of knowledge sharing among the researcher and research area. The object cannot be treated as 100% subjectively.

The methodology of the research is quantitative which is based on data collection and analysis of that data. It is also based case study which is carried out in specific ward i.e. Ward no. 27 of core area of Kathmandu municipality.

The literature review is done on the basis of study related article and books through internet, library, teacher, lecture notes, magazines, media etc. on solid waste management and community participation. Also, the various legislation such as SWM Act 2011, National policy on SWM 1996 and SWM Rules2070 are reviewed in order to regulate appropriate strategies to overcome the problem. In literature review, different case areas will be studies which are the successful example of the community involvement in SWM in different areas. Since the concept of Smart city is also rising, case area study of smart city will be done to find out the level of SWM in that particular country.

The primary data required for the research can be obtained through closed- ended questionnaire survey, interview and from direct observation. Questionnaire survey is conducted to understand the people's attitude and perception towards the community level solid waste management system. People of this ward is interviewed with the set of closed-ended questionnaire in which questions are provided with set of answers that can be coded with some number or symbol which represent a response. The questionnaire consist of multiple choice on the basis of which the respondents responds. The knowledge and awareness regarding the solid waste management process can be also known from this field

survey. The questionnaire survey is also done to know the physical and socio-cultural and economic condition of the ward. Also the community representatives and the local bodies are interviewed with the set of open questionnaire.

The research is based on Case Study approach as the Kathmandu City itself is very large municipality and SWM is common environmental issue. The questions and queries related to government authorities and the formal/informal workers through open questionnaire. The set of questionnaire is prepared to generate the answer regarding amount of total waste generated and managed, the process and schedule followed for collection of wastes etc.

For the data such as population composition and household, secondary source of data Is more relevant like national census. The census data is also the valid source to know and understand the existing composition of the community. On the basis of this total population and household number, sample amount is calculated. The survey is carried out on the sample population only and survey include every tole/ area of the ward so as to have overall information

The behavioral pattern regarding wastes disposal by community people can be known through observation during different time period which also help to confirm the result of interviews.

Beside direct interviews and observation, there are secondary data from different NGOs and INGOs which was done before which further validate the obtained data. These observed and provided data from primary and secondary source are analyzed which help to understand the existing condition of the community people and community representatives. On the basis of these analysis, different method is developed which make the community people to participate in the SWM process

The variables that has been obtained from the questionnaire is analyzed and result is obtained. On the basis of these variable and information form interviews, key stakeholders related to SWM is identified who has importance we well as influence over SWM. Thus the final analysis of the research is based upon the role and responsibility of stakeholders.

From the finding of analysis suitable recommendation will be provided for effective involvement of stakeholders in efficient SWM in this particular ward.

CHAPTER 3: LITERATURE REVIEW

3.1 WASTE

Waste or Garbage is unwanted or undesired materials or substance that need to be disposed. Wastes are byproducts or left-overs from manufacturing process, community and household activities. These materials may be discarded or accumulated, stored or treated prior to being discarded or recycled. Presence of wastes indicate overconsumption and that the materials are not being used efficiently. It also shows that the natural capacity of nature to absorb and process these materials is under stress.

According to *Basel Convention*, Wastes are substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provision of national law (UNEP, 2011).

According to *Environment Protection Act, 2053 (1997)* "Wastes" means the liquid, solid, gas, slurry, smoke, dust, radiated element or substance or similar other materials disposed in a manner to degrade the environment.

Broadly, wastes can be categorized into two types:

- Liquid wastes:

  Wastes that come in non-solid form is liquid wastes but some solid wastes can also be converted into liquid form for disposal. It includes point source and non-point source discharges such as storm water and waste water from homes, industries etc.
- Solid wastes:

  Solid wastes are non-liquid wastes but sludge of certain kind falls under the scope of solid waste management. It is predominantly any garbage, reuse or rubbish that is produced from household and others.

3.1.1 Hierarchy of Waste

Waste Hierarchy can be define as the evaluation process that protect the environment along with resources and energy consumption to most favorable to least favorable action. The waste hierarchy established preferred program priorities base on sustainability which indicate an order of preference for action to reduce and manage waste and presented diagrammatically in the form of pyramid. The aim of waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.

The waste hierarchy is now used globally as a communication tool to remind those who generate waste and those who manage it that preventing waste through efficient use of resources and raw materials is the best option. Re-using discarded goods without reprocessing or remanufacture is assumed to provide greater savings in resource consumption and is given priority over recycling (Wolsink, 2010).

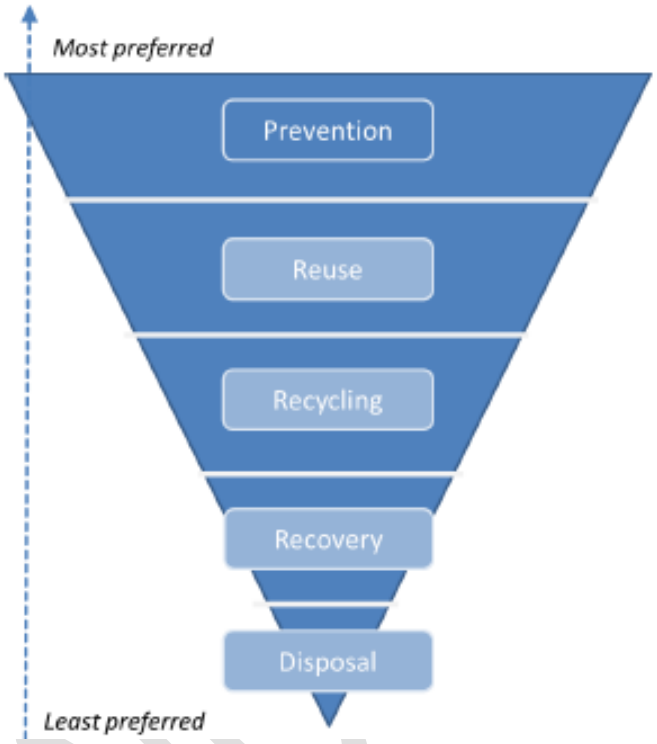


Figure 2: Waste Management Hierarchy (UNEP, 2011)

The waste hierarchy identifies five waste management activities in descending order of preference. The preferred activity is waste reduction; the least desirable is landfill disposal.

- **Reduce**

  Reducing waste is the most important part of waste minimization. Waste reduction avoids the unnecessary use of resources such as materials, energy and water and means there is less waste to manage. The aim of waste reduction is to eliminate waste before it is produced and to reduce both the quantity and toxicity of waste.

- **Reuse**

  The next most cost effective means of minimizing waste is to reuse waste material in its same form. Reusing an item means it doesn't go in the rubbish and end up in the landfill. In reusing any stuff, a new product is not bought and the energy and the resources which would have been used to make the new product is saved.

- **Recycle**

  Recycling is a process to convert waste materials into reusable material to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, air pollution (from incineration) and water pollution (from landfilling) by reducing the need for "conventional" waste disposal and lower greenhouse gas emissions as compared to plastic production. Recyclable materials include many kinds of glass, paper, metal, plastic, tires, textiles and electronics. The composting or other reuse of biodegradable waste such as food or garden waste is also considered recycling. Materials to be recycled after collection are sorted, cleaned and reprocessed into new materials destined for manufacturing.

- **Recover**

  This is the recovery of materials or energy content of a waste without any pre-processing. For example, waste oils that cannot be refined for reuse in vehicles are used for energy recovery. Source reduction, reusing and recycling wastes are the first steps that should be taken for managing solid waste. But even with our best efforts we may still need means of getting rid of some waste. Recovery is a means of recovering energy or materials, without any preprocessing, from wastes that cannot be used for something

- **Reject**

  Rejecting is one of the newer 'Rs' and is also called pre-cycling. In terms of smart waste management, this is the simple act of rejecting excessive or unnecessary packaging. When shopping, it means saying "no thanks" to a bag for small purchases that can be easily carried in our hands. Foods, beverages, or other products in fancy, multilayer packaging that needs to be thrown into the trash as soon as they are opened, can also be rejected.

- **Respond/React/Reward**

  This R goes by several different names, but they all mean letting the manufacturers and businesses know what we think about their waste management practices. This may include contacting them with a letter, an e-mail or by calling the tol- free number listed on the package to voice concerns about excessive packaging; or, showing appreciation when they are doing something positive for the earth.

- **Residual Management**

  Residual management is the final treatment and/or disposal of a waste that cannot be used in any other way.

3.2 SOLID WASTES

Solid waste can be define as the non-liquid discarded or useless materials which refer to garbage, refuse, sludge from different treatment plants generated from combined industrial, commercial and residential activities within an area. Solid waste is defined as discarded material that arise from human activities and are not free flowing (WHO, 1971).

According to Solid Waste Management Act 2011, "Solid Waste" means domestic waste, industrial waste, chemical waste, health institution related waste or harmful waste and also the materials which cannot be used presently, thrown away or in rotten stage or in solid, liquid, gaseous, thick liquid, smoke, or dust form emitted out damaging the environment or materials and equipment used for electrical or information technology or any other materials of such nature or posters, pamphlets posted unauthorized at public places.

Solid waste refers to all sort of garbage arising from animals and human activities that are discarded as unwanted and useless (LeBlanc, 2014). Solid wastes are generated from different areas such as household, industry, institution etc. and on the basis of their origin, the material content, nature and the effect on the surrounding vary.

3.2.1 Classification of Solid Wastes

On the basis of source and nature, solid wastes can be classified into following categories:

- **Municipal Wastes**

  Household waste is also termed as municipal solid wastes that mostly consist of household waste, sanitation waste, waste from streets, and demolition debris from construction activities. With increase in urbanization and population growth, municipal waste in forming the bulk part of solid wastes. Municipal solid wastes are non-hazardous wastes which require collection and transport to a processing or disposal site.

- **Industrial Wastes**

  Industrial waste is quite dangerous to all living beings and environment as is consist of toxic substances that are of chemical nature. An improper disposal of these waste may lead to death, disease and environmental damage that may continue for generation. These wastes consist of oil spill, poisonous gases, chemicals etc.

- **Hazardous Wastes**

  Those wastes are termed as hazardous waste which possess the properties such as toxicity, reactivity, ignitability and corrosively. These wastes are generated from

chemical manufacturing companies, petroleum refineries, paper mills, smelters and other industries. If these wastes are treated in improper way, they can become health hazards.

- **Bio-medical Wastes**

  Bio medical wastes are the hospital wastes that is being generated from hospitals, clinics, research centers, pharmaceuticals companies and health care centers. These wastes are most infectious and can spread disease and other types of viral and bacterial infections among humans and animals if not managed properly. Thus the hospitals wastes are equally dangerous like hazardous wastes.

3.3 SOLID WASTE MANAGEMNET (SWM)

University of West of England states that 'waste management is broader than just the disposal of waste. It includes the generation, collection, processing, transport, minimization of the production, the re-conceptualizing of waste as an economic resource, mobilizing the communities in the process, and protection of human health and environment (Nyachhyon, 2006). Municipal Solid Waste Management refers to the control of generation, storage, collection, transportation, processing and disposal of municipal solid waste. This is done to maintain public health and sanitary condition in an urban area (Rwegasira, et al., 1996).

Solid Waste Management is a mechanism associated with the control of generation, storage, collection, transport, processing and disposal of solid wastes in way that favors the best interest of public health and also consider the environmental aspects. The main objectives of SWM in to ensure that the solid wastes are handled efficiently, economically and with minimum environmental impacts. The main purpose of SWM is to provide hygienic, efficient and economic collection, transportation, treatment and disposal of solid wastes without polluting the atmosphere, soil or water resources.

Solid Wastes Management is multi-disciplinary mechanism which should be carried out within the existing legal and social guidelines that protect the public health and environment and are aesthetically and economically acceptable. For a successful solid waste management plan, it is necessary that all these disciplines communicate and interest with each other in a positive interdisciplinary relationship (Baral, 2014). Since solid wastes management is a very important aspect of urban environment hygiene, its needs to be incorporated with our environmental planning.

Proper management of solid waste reduces or eliminate adverse impact on the environment and human health and also supports economic development and improved quality of life. In its scope, Municipal Solid Waste management should therefore focus on all administrative, financial, legal and processing of functions that lead to finding solutions to all problems of solid wastes (Tchobanoglous, et al., 1993)

3.4 EXISTING SOLID WASTE MANAGEMNT SYSTEM IN NEPAL

Generally, there is no particular approach for solid waste management that deal with the problems of solid waste management. Every area has its own profile regarding solid waste generation and the attitude of people vary regarding waste management practices. Every municipality has its own strategy to deal with solid waste management. Generally SWM include following steps:

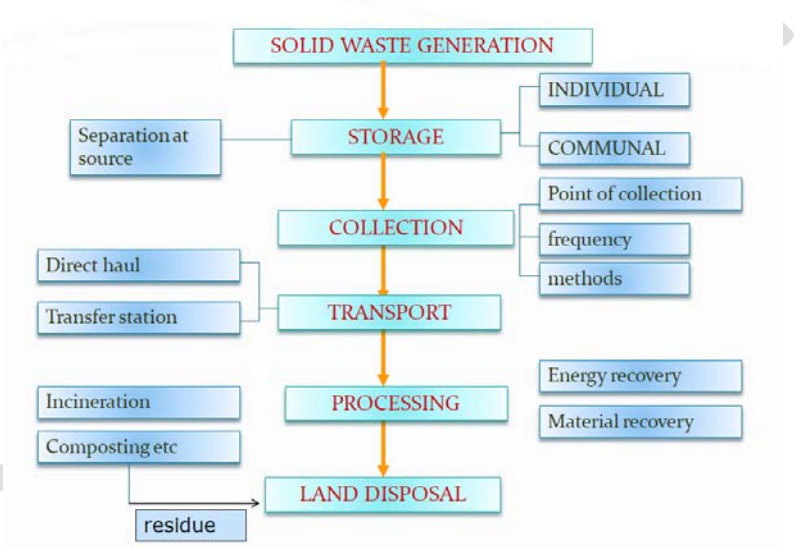


Figure 3: Steps of solid waste management

The common approaches in Nepal is reviewed as follows (Asian Development Bank, 2013).

i. Collection and Segregation

According to the survey done by ADB in 58 municipalities it is found that waste generated from 70% of the households goes to the main stream for collection and disposal without segregation. The remaining 30% were mostly from rural wards who practiced segregation of kitchen wastes for their own purpose. Effective and large scale segregation programs are yet to be implemented by many municipalities.

It is also report that segregated waste in sometime mixed again during collection and transport due to lack of separate collection and treatment method.

The average collection efficiency is estimated to be 62% which may not be exact due to lack of scientific recording system. Container service, door-to-door collection and roadside pickup from garbage piles are other types of collection services.

Figure 4: Waste Collected from Street (Source: Internet)

Average household waste (kg/day)	Average HH size (Number of members)	Average per capita HH waste (g/capita/day)	Total HH waste (tons/day)	Total commercial waste (tons/day)	Total institutional waste (tons/day)	Average per capita MSW (g/capita/day)	Total MSW generation (g/capita/day)	Estimated waste collection (tons/day)	Collection efficiency (%)
1.10	4.74	232.31	233.07	203.49	29.58	464.61	466.14	405	86.90

Table 1: Solid Waste Generation and collection efficiency in KMC (Source: (Asian Development Bank, 2013)

ii. Transport and Final Disposal

The vehicle and equipment available for waste collection and transport in each municipality varies widely. Vehicle commonly used for collection are rickshaw, carts, tractors, dump trucks etc. which are then transport to disposal sites. The facilities and equipment available in municipality affects the efficiency of waste transfer from primary collection to processing center or final disposal sites. The transfer sites are not available for other municipalities except for KMC, Lalitpur and Madhyapur Thimi.

Sites for treatment facilities and sanitary landfills are yet to be identified by many municipalities and the wastes is currently being disposed without treatment. According to the survey, it is found that open dumping is practiced in most of the municipalities and very few has sanitary landfills.

The KMC has operated one transfer center in Teku having a capacity of 5000 metric ton in open space surrounded by residential area. But the accumulated wastes at transfer center is more than 15,000 metric tons. In transfer center vehicles collecting waste from the sources unload onto the ground and then it is scooped up again by using excavators and placed into a large vehicle and transported to Sisdol landfill. The transfer center was originally constructed with infrastructure for segregating various wastes and composting organic waste.

Figure 5: Teku Collection Center (Source: Internet)

Figure 6: Energy Plant at Teku Collection Center (Source: Internet)

Recently, the Transfer center has established Energy Plant which can consume 3Ton of Wastes/day and can produce 14KW of electricity. KMC plans to produce 300 kg of fertilizer, 300 cubic meter of bio gas and 1500 liters of treated water (The Himalayan Times, 06-2016). The organic waste for this plant is collected from Vegetable market as it does not require much segregation. The machinery plants can be damaged by small piece of metal. The energy generated from this plant is utilized for the operation of this plant and also provide electricity to the transfer station areas.

About 37% of total municipal waste is disposed of at sanitary landfill sites. But KMC and Lalitpur are facing problems regarding landfill sites due to frequent local protest, lack of proper management and necessary equipment which lead into unsanitary method of disposal.

Figure 7: Sisdol Dumping Site for Kathmandu Municipality at Okharpauwa

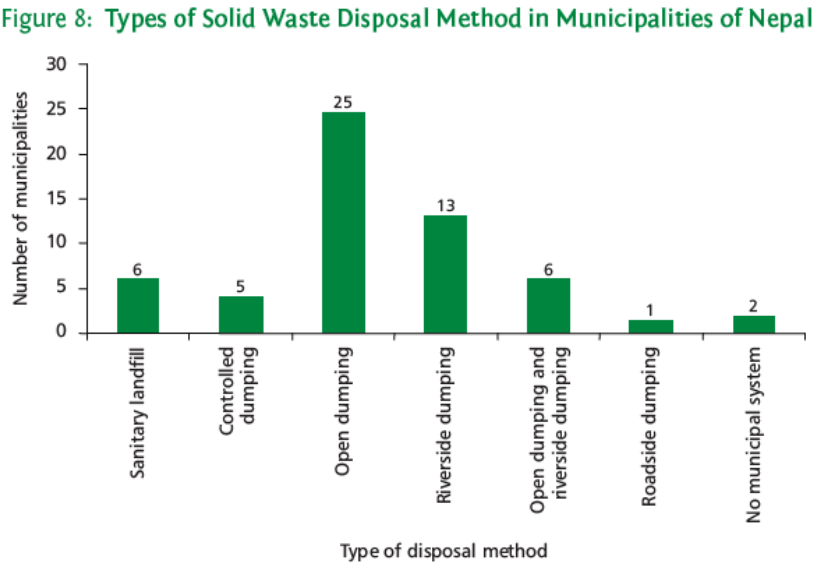


Figure 8: Type of Solid Waste Disposal Method (Source: Asian Development Bank)

iii. Resource Recovery Method

Due to lack of resources, solid waste management has become environmental, financial and social burden to the municipalities. These burdens could be reduced through management of the municipal solid waste and it can even generate the revenue. But minimal resource recovery activities are being conducted in municipalities.

Recycling: waste composition shows that more than 25% of household waste and higher proportion of institutional and commercial waste could be either reused or recycled. People are encouraged to recover the recyclable materials at source and sell them to formal/informal sectors but still large recyclable materials are continue to be disposed of on the street which ultimately ends up at dumping grounds. But however there is no formal system for reuse and recycle in many areas.

Composting: on average 66% of households wastes are organic that could be used for producing compost. But the municipalities of rural areas are practicing composting using traditional methods and urban households' area not generally practicing composting.

iv. Public Awareness and Community Mobilization

Public awareness plays an important role in management of solid wastes. The survey data shows that only 10% of the municipalities conduct awareness programs collaborating with other stakeholders such as SWMTSC, NGOs. Survey also shows that more than 65% of household are not aware of SWM program implemented by municipalities.

v. Special Waste Management

Special waste management include those categories of wastes such as dead animals, construction/ industrial wastes, hazardous or infectious wastes. These wastes need different management system than other municipal wastes. In many municipalities, these wastes are mixed with municipal wastes and in some cases these are burned or crudely dumped. Also, there is no proper slaughterhouse in any municipalities. Dead animals are buried or dumped near riverbank, jungle areas and dump sites.

3.4.1 Problems and Challenges in Current SWM System

Currently, the solid waste management has become one of the greatest challenge in developing countries which has been increasing with increasing rate of urbanization and

population growth. The general problems and challenges of current SWM can be listed as below which has been discussed in different literatures by various scholars.

- Inadequate services provided by the government authorities
- Lack of sufficient and effective resources
- Attitude of throw and forget by public
- Limitation of landfill site and transfer station
- Management of solid waste on
- Lack of appropriate laws/policies and its implementation
- Less knowledge and awareness in public
- Public and political intervention

3.5 COMMUNITY PATICIPATION

According to the Oxford Dictionary, Community is a group of people living in the same place or having a particular characteristic in common.

The term 'Community Participation' can be defined as the active voluntary engagement of individuals/group of people to change problematic conditions and to influence policies and programs that affect the quality of their life and the life of others (Gamble & Weil, 1995.p.483). Generally, community participation can be defines as the involvement of people in a community in projects in order to solve their problems. People can be encourage but cannot be forced to participate in projects which affects their lives.

Thus, the community participation must be voluntary in nature that people are willingly supposed to participate in development processes. The community should be educated and have awareness on the importance of their participation in development of their wellbeing. The community participation must be active involvement of local community and not mere presence. The local community members must be involved from designing, implementation, monitoring, evaluating and maintain development projects.

Waste (1996) defines community and community participation as – "A community consists of people living together in some form of social organization and cohesion. Its member share in varying degrees of political, economic, social and cultural characteristic as well as interest. Community Participation - is the process by which individuals and families assume responsibility for their own health and welfare and for those of community and develop the capacity to contribute to theirs and the community development. According to Anschutz

(1996) community participation is taken as a crucial aspect of solid waste management. Community participation in solid waste management is always required because solid waste management is a continuous maintenance system.

3.5.1 Benefit of Community Participation

Many local authorities in developing countries suffer from insufficient financial, technical and human resources. Thus they are not capable to deliver and maintain the urban basic services and community participation plays a major role. The possible benefit of community participation for any projects are as follows (A.Subash, 2017).

- Community involvement in design of project help to integrate its needs and constraints in the objectives of the project which helps in effective implementation of project
- Community involvement increase local ownership of project and enhance a sense of responsibility for maintaining services provided by project which is essential for durability and continuity of project.
- Community participation may be used to enhance the understanding and agreement of cost sharing (physical and financial contribution) which improve project efficiency
- Community participation can be used to prevent conflicts and to stimulate cooperation and agreement between different actors that reduce delay in project.
- Community participation may increase awareness of knowledge and capacities which improve the ability to negotiate as equals with authorities/ stakeholders to promote common objectives
- Community involvement in decision making ensure the different needs and problems of community
- Community participation may give people the opportunity to devise and initiate strategies to improve their situation.

3.5.2 Community Participation in SWM

According to Anschutz (1996) community participation is taken as a crucial aspect of solid waste management. Since solid waste management is a continuous process, community participation is very important. In community management, community members or their representatives decide on what to do and how to do. However, communities are concerned with the collection and transport of solid waste from neighborhood to dumping side. And

transport of waste to final disposal site and operation of this site is usually carried out by municipality.

Craig and Mayo (1995) argue that community participation and empowerment are the widely advocated topic both in North and South when there is poverty, polarization and social exclusion. World Bank sees community participation as a means for ensuring that third world development projects reach the poorest in the most efficient and cost effective way sharing costs as well as the benefits through the promotion of self- help (Paul 1987, cited in Craig and Mayo, 1995). NGOs (Non-governmental Organizations) are historically identified with community participation and empowerment. It is believed that NGOs are committed to support the communities and empower them towards development.

The community as a whole can exercise power through participation and empowerment but without any negative effects upon the powerful. They can help themselves in the development and gain tools for self-reliance (Thomas 1992, cited in Craig and Mayo, 1995). But increase in power of a certain group may lead to the decrease in power of the other group. Empowerment may have different meaning depending upon different ideologies.

The success of community participation in solid waste management depends upon other actors such as municipality, community based organizations (CBOs), microenterprises and local leaders. During community participation, special attention should be paid to the role of women as they are the first to be affected by depleted environment and are willing to participate in projects to improve their life. Also, local leaders plays another important role in community participation. The local leaders are responsible for encouraging people to subscribe different activities regarding solid waste management. They even act as negotiator for local authorities.

Kathmandu Municipality has established the community mobilization unit under environment department with a motive to improve the degrading environmental condition. The main focus of this unit is to encourage the people to contribute in the better environment of Kathmandu. The aims of this unit are as follows:

- To encourage the students and the local community to participate in different environmental activities.
- To encourage people to reuse the things to minimize the waste.
- To form groups in the schools to perform different environmental works

- To make the people aware about the different local, national and international environmental problems.
- To provide the necessary information, trainings and technological help to the community that has been actively involved in protecting the environment.

According to SWM Act 2011, nobody is allowed to carry out activities related to solid waste management without obtaining license from the local body. Any national or foreign company, body or organization wishing to carry out solid waste management shall have to apply to the local body for license enclosing following particulars:

- Solid waste management plan
- Detail of manpower and technology related to solid waste management
- Other matters as prescribed

3.6 POLICY AND ACTS

Among the various acts and rules, Solid waste Management Act 2011, National Policy on SWM 1996 and Solid Waste Management Rules, 2070 are particularly relevant.

2.6.1 Solid waste Management Act 2011

Solid Waste Management Act was introduced in 2011 which describes the duties and function of Center called as Solid Waste Technical Cooperation Center (SWTCC). The head office of SWTCC is situated in Lalitpur. This Act came into force all over the country.

The preamble of this Act is to make the management of solid waste in a systematic and effective way by reducing at its source, re-use, processing or discharge and for maintaining a clean and healthy environment through the reduction of adverse effects that may be caused to the public health and environment by amending and consolidating the laws relating to the management of solid waste like most essential services laws.

On the basis of section 50 of Solid Waste Management Act 2011, The Solid Waste Management Rules 2070 has been issued by Government of Nepal (GoN).

This Act describes the responsibility of local body as:

- To manage solid waste by construction and operation of infrastructure like transfer station, landfill sites, processing plant, compost plant, bio-gas plant and also collection of waste to final disposal and processing.
- To prescribe to segregate solid waste into least organic and inorganic at its source.
- To determine time, place and manner for discharge of solid waste.

- To make arrangement of necessary collection container by prescribing collection center
- To encourage reduction, reuse and recycling of SW
- To forge a partnership with private sector, community and NGOs

This act also describe the role of any individual, organization as they should as far as possible reduce the production of SW. According to this Act, to manage the health institution waste and chemical/industrial waste is responsibility of individual themselves. This Act also state that while making management of solid waste in case of private sector company all and in case of community sector and NGO or agency, these works should be carried out

- Enhancement of public awareness in the reduction of solid waste
- Collection of solid waste
- Transportation of solid waste
- Use, reuse recycled use or processing of solid waste
- Disposal of solid waste
- Management after closure

3.6.2 National Policy on SWM 1996

The National Policy on SWM was formulated in 1996 to address the emerging SWM problems due to urbanization. The main objectives are:

- To make management work of the solid wastes simple and effective.
- To minimize environmental pollution caused by the solid wastes and adverse effect thereof to the public health.
- To mobilize the solid wastes as resources.
- To privatize the management work of the solid wastes.
- To obtain public support by increasing public awareness in the sanitation works.

The strategy of this policy are as follows:

- Public participation: To gather huge public participation by promoting public awareness among students, women, youth and other groups in the field of sanitation.
- Technology: To develop concept of solid wastes management having minimized environmental pollution on the basis of appropriate technology which shall be suitable to the local environment and economic conditions.

- Mobilization Sources: To involve the governmental and private sector for mobilizing the solid wastes as resources and to produce organic manure and energy there from.
- Privatization: To privatize as per necessity, management works of the solid wastes for simple and effective operation.

3.7 STAKEHOLDER ANALYSIS

Stakeholder Analysis is the process of symmetrical gathering and analyzing qualitative information to determine where interest should be taken into account when developing and /or implementing a policy or program **(Schmeer)**.

Stakeholders are those actors (people/ organization), who are interested in the policy being promoted.

3.7.1 Importance of Stakeholder Analysis

- to identify the key actors and to assess their knowledge, interest, position, alliance and importance
- to interact more effectively with these key stakeholders and increase support for given policy
- to prevent potential misunderstanding about opposition to the policy or program

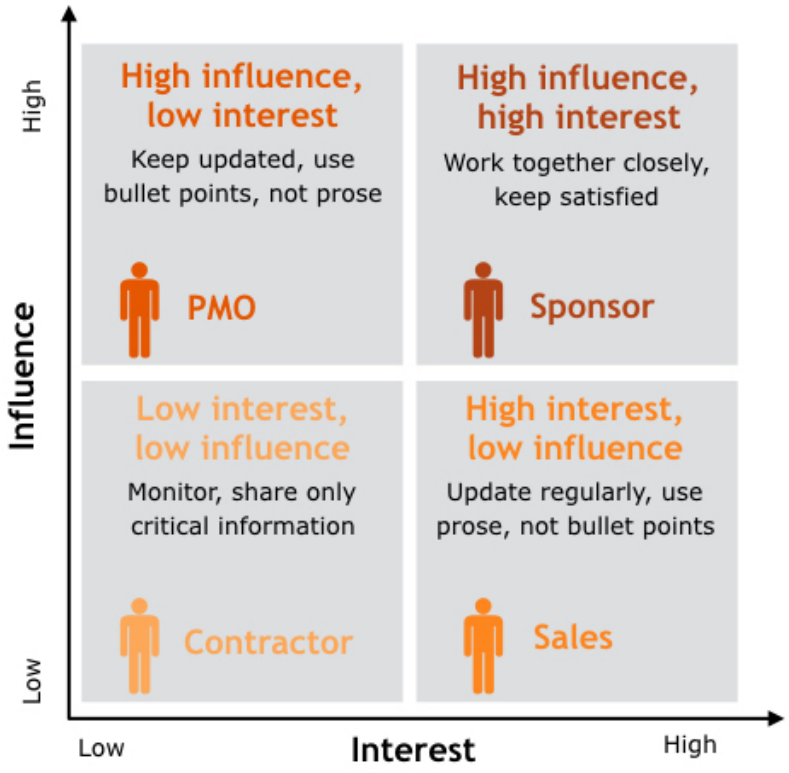


Figure 9: Stakeholder Analysis Matrix (Source: Internet)

3.7.2 Category of Stakeholders

The stakeholders can be broadly divided into three categories. They are as follows:

Primary Stakeholder

They are directly affected by implementation of SWM project either negatively or positively which include householders and citizens receiving services.

Secondary Stakeholder

They play intermediary role and may have an important effect on project/program outcome which include municipalities and their employee, other government departments, NGOs, CBOs, donor agencies, waste pickers, private sweepers, small entrepreneur and contractors.

External Stakeholder

They are not directly involved but may nevertheless be affected by a specific project. In SWM this is important group and there are many potential actors which include residents of neighboring communities, itinerant waste buyers, middle men in waste recycling trade, waste re-processor.

3.7.3 Steps in Stakeholder Analysis

This analysis yields useful and accurate information that can be used to provide input for other analysis, to develop action plans, to support policy and its reformation and to guide participatory process. The detail process of Stakeholder Analysis are:

- Planning the Process
- Selecting and defining Policy
- Identify Key stakeholder
- Adapting Tools
- Collecting and Recording Information
- Filling in Stakeholder Table
- Analyzing Stakeholder Table
- Using the Information

3.8 STAKEHOLDERS IN SOLID WASTE MANAGMNET

3.8.1 Public/ People

John Dewey defined (Dewey 1927) public as a group of people who is facing similar problem, recognized it and organize themselves to address it. In any plan or project, public

plays a vital role as they are the first one who will be affected by positive and negative impact of any development of projects. Every people is generator of waste which directly/ indirectly affect the health and environment if not managed properly. Unmanaged waste not only affect the people living in particular area but also the user of that area.

Traditionally, public plays the role as waste disposal service recipient. But with time people are becoming service provider through participation at different level like waste reduction, source separation and composting. Awareness, willingness and concern of people in participation plays significant role in waste reduction. Participation of individual especially (youth and women) has lots of potential in sustainable solid waste management.

Public participation in SWM can significantly reduce the cost of collection and need for landfill areas through waste recycle/ resource recovery. For the sustainable waste management, public participation plays an important role. Segregation of waste is first step to the sustainable solid waste management which can be practiced at the source (where waste is generated) by individual people. But the degree and nature of public participation is different for every case.

Public participation may be the whole population or specific interest group. But there are many factors that affect the process of public participation which depend upon the method as well as the characteristic of the people in particular location. People living in particular location have different knowledge base which automatically differ their attitude. The information, knowledge and awareness gaps among the people make their involvement more challenging (Shinge, Nabegu, Shenpam, Yakubu, & Giwa, 2015).

3.8.2 Government Authorities

In most of the developing countries, waste management is carried out by the local government body. In context of Kathmandu city, solid wastes have been increasing gradually with the urbanization. The Kathmandu Metropolitan City (KMC) has the main responsibility for managing solid waste in Kathmandu Metropolitan area. According to SWM Act 2011, local body is responsible for solid waste management by construction and operation of infrastructure. After restructuring of the country, every local body has given more power.

Besides KMC, the Government of Nepal, other concerned Ministries such as Ministry of Urban Development (MOUD), Ministry of Federal Affairs and Local Development

(MOFALD) also have direct and indirect responsibilities regarding solid waste management in Kathmandu.

SWMTSC (Solid Waste Management Technical Support Centre) is responsible for providing technical support to manage solid waste properly and environment-friendly throughout the country. It support the local bodies of the country to establish landfill sites, providing training, distributing dustbins, compost plants and so on. Restructuring of state has provide more power to local body (municipality) thus many responsibility of SWMTSC has decreased.

The KMC was established as "Cleaning Office" in 1919 AD. Since its establishment the KMC has been managing solid waste and sanitation activities within municipal territory. It manages street sweeping, waste collection, transportation and final disposal

3.8.3 Community Based Organization (CBOs)

The community and its representatives have a direct interest in waste management, as residents, service users and tax payers. Communities in the low income areas generally receive marginal or no service in terms of public transport, electricity, drinking water, sanitation, drainage and waste removal.

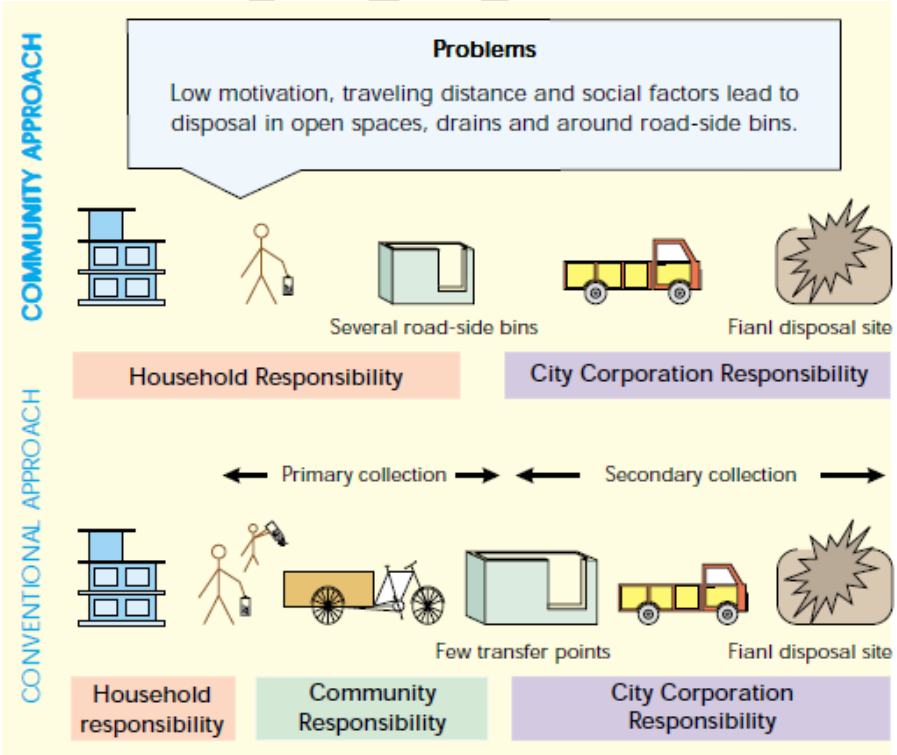


Figure 10: Schematic diagram showing the conventional and community based approach to solid waste management (Source: (Community Based Pilot Project on Solid Waste Management in Khulna City: General Project Description)

CBOs with the direct goal of self-help and improving their living condition. Such CBOs may receive external assistance in the form of technical or financial aid from different agencies. Sometimes these activities may also take the form of direct participation in waste management, such as feeding organic material directly to their stock. Usable materials, like bottles, often reused by the members of the low income community themselves.

Group of citizen, including those from middle and high-income areas, may start CBOs aimed at improving the waste situation in their neighborhood. They may hire informal or formal waste collector, make arrangements for waste transfer points, may start waste separation and so on.

CBOs also take as role in actual provision of services, including operations and maintenance and even in the construction of facilities. Thus CBOs play an important role in waste management system and social development process. Organized community have stringer voice than individual and can bring about improvement more easily.

3.8.4 Non Government Organization (NGO)

The number of NGOs has increased in size, scope and number in the last few decades and has become important in the social, political an economical aspects. Establishments of NGOs were very slow during 1961 to 1990s (Dhakal, 2007). The number of registered NGOs in Nepal has reached from 220 in 1990 to somewhere between 10,000 and 15,000 today (Montgomery, 2002). Nepal is ranked among the poorest countries so roles of NGOs are considered as important and compulsory for the grass root level development. The government of Nepal too has maintained favorable conditions for the NGO sector so the numbers of NGOs in Nepal have increased. Most of NGOs in Nepal are foreign aided while some have been established and supported by the local community. NGOs have contributed a lot in the development of the socioeconomic structure of the country

According to Klundert and Lardinois (1995) NGO have worked in waste management but these organizations have promoted either environmental health (e.g. the need for clean cities), social goals (such as the involvement of street children or working conditions of women and children in particular, generally considered as the most vulnerable group), or a combination of these two.

3.8.5 Informal Sector in SWM

In sustainable waste management system, waste recycle and resource recovery is effective ways that reduce the need for landfill areas and saves the natural resources which generally involve participation from informal sector.

The informal sector refers to small-scale, labor-intensive, largely unregulated and unregistered, low-technology manufacturers or service providers (Wilson, Whiteman, & Tormin, 2001). Informal sector in SWM is advantageous in terms of cost control and reliability. Significance of informal sector in SWM is self-developed by income earning motivation and its performance is not stable under market driven mechanism (Amin, 2000). It is generally carried out by poor and marginalized social groups who extract recyclable and reusable materials from mixed waste.

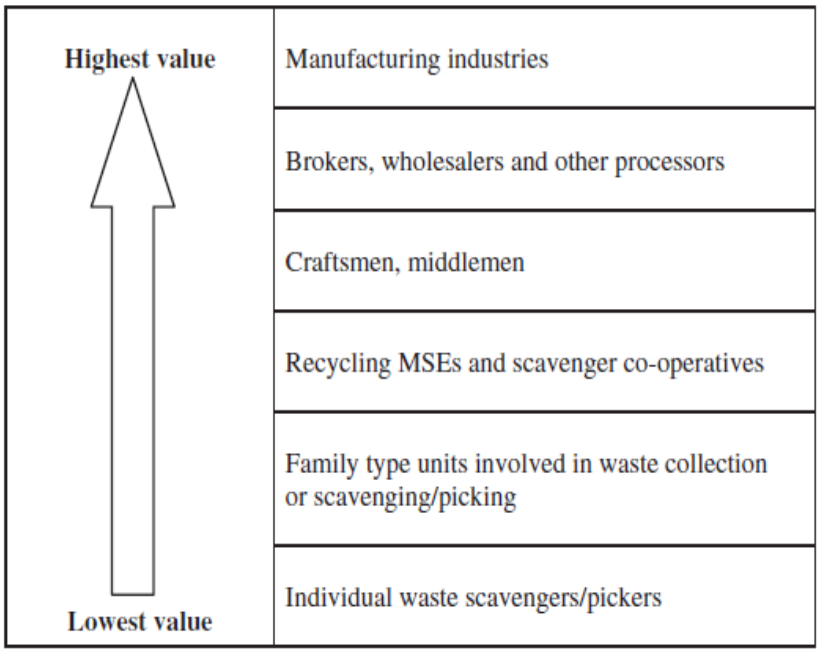


Figure 11: Hierarchy of informal sector recycling (Source: (Wilson, Velis, & Cheeseman, 2006))

Insufficient collection by government body, uncontrolled street collection points and improper disposal in open dumps allow refuse to be readily available for informal waste recycling through scavenging and waste picking. Informal sector approach in urban waste is viewed as an economic resource which reveal multiple results like reduction of waste, saving in public expenditure for waste management and employment generation (Poerbo, 1996).

Informal Sector provide human resource and innovative ideas which provide efficient SWM. Informal collectors are tricyclist, street scavengers, pickup traders, collection crew

and landfill scavengers. They play major role in collecting the recyclable materials directly from various source or sort the recyclable before the waste get dumped in landfill sites.

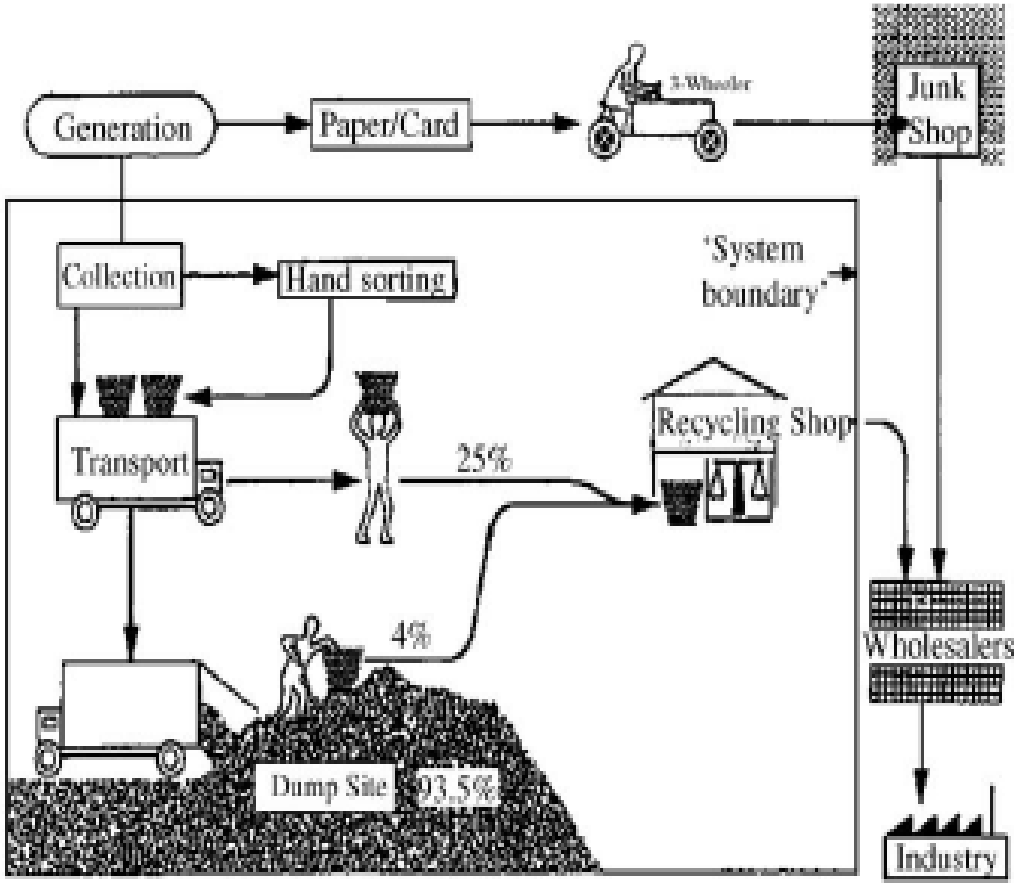


Figure 12: Flowchart of informal recycling system (Source: (Wilson, Velis, & Cheeseman, 2006)

The categories of informal waste picking are as follows:

- **Street waste picking:**

  In street waste picking secondary raw materials are recovered from mixed waste thrown on the streets or from communal bins and dumps spots on the streets before collection by waste management authority or their agents. In context of Nepal, these street waste pickers are generally termed as "Khate". In context of Kathmandu valley, these street scavengers collect 12% of scrap waste which consist of plastic, iron, paper etc. **(Luitel & Khanal, March 2010)** from different areas.

- **Municipal waste collection crew:**

  Municipal waste collection crew recovers secondary raw materials from vehicles transporting MSW to disposal sites which is practiced widely. In context of KMC, municipal waste collector sort the materials such as plastic bottles, cans, etc. which is dumped in the vehicle.

Category	Method of Work	Material
Street pickers	Recovery	Bottles, cans
Landfill scavengers	Recovery	Bottles, paper, plastic bags, cans, other valuables
Collection crews	Recovery (en route)	Bottles, cardboard, cans, valuables
Itinerant buyers	Door to door buying (announced collector)	Paper, cardboard, plastic bottles, glass bottles, aluminum cans
Dealers, neighborhood dealers or buyers	Buying (retail)	Metal, iron, steel, paper, cardboard, plastic bottles, glass bottles, miscellaneous
Small-scale entrepreneurs	Buying , trading	
Large-scale entrepreneurs	Buying and large-scale processing technology	

Modified and supplemented on the basis of Romaos and Chifos, 1996

Figure 13: Role of Informal Sector in SWM (Source: (P., Trankler, K., & W, 2003)

- **Waste picking from dumps:**

  Waste pickers/scavengers sort through wastes prior to being covered. This is often associated with communities that live in shacks, built from waste construction materials, on or near the dump. Scavenging at dumps occurs in cities throughout the economically developing world such as Mexico City, Cape Town, and Bangalore etc.

- **Itinerant waste buyers:**

  They are individual waste collectors who often go from door to door, collecting sorted dry recyclable materials from householders or domestic servants, which they buy or barter and then transport to a recycling shop of some kind.

  They are generally termed as 'Kabadiwala or Khalisisi'. They buy the recyclable and reusable materials such as metal, glass, paper cardboards, plastics etc. from individual households. Apart from their labor, they invest capital to acquire and run a vehicle. This activity is widespread all over the world. From this field study, Most of the scrap waste was found collected by door to door collection system, which consists of 41 %.

3.8.6 Waste Buyers

Waste buyer are the people or organization buying scrap waste i.e. recyclable or reusable wastes (metal, glass, paper cardboards, plastics etc.) which could be formal or informal. Informal sector do not pay taxes and have no trading license but the formal sector enjoys enjoy official recognition, protection and support as they are registered and have license by local government. These waste buyers play major part in reduction of solid waste that is

carried to the landfill sites. Formal waste buyers are formal enterprises which buy scrap wastes from street scavengers, pick up traders, collection crews or organization whereas the informal waste buyers buy wastes from households, street scavengers, pick up traders or collection crews . Involvement of these formal/informal sectors fills the gaps of the SWM program and application of municipalities.

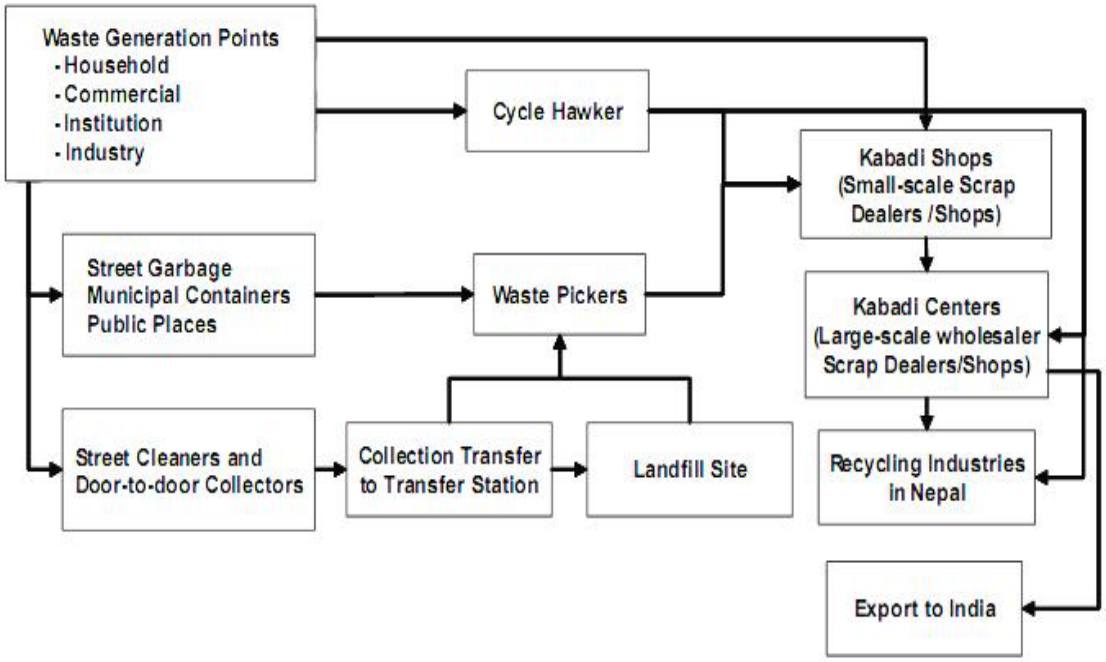


Figure 14: Scrap Waste flow in Kathmandu Valley (Source: Nippon Koie, 2005 (Luitel & Khanal, March 2010))

Scrape wastes generally termed as "Kabadi Wastes" are parts of solid wastes which could be segregated and taken for reuse and recycle. In the Kathmandu valley there are total 178 scrap shops. Scape wastes consist of 32.49% glass, 23.89% paper, 22.65% plastic and 20.97% metals, textiles, leather and rubber. Among these scrap wastes, 38.96% is reusable and 44.77% recyclable and 16.27% could be either recyclable or reusable (Luitel & Khanal, March 2010).

Most of the household and industrial scrap wastes are generally bought by itinerant buyer. The scrap wastes that in generated and collected at different point is generally bought or collected by informal sector which is then sold to small scale scrap dealers and shops. These wastes are further sold to large scale wholesaler scrape dealers/ shops which is then bought by recycling industries and finally export to India.

In present context, there are some organization which has been providing convenient and digital platform for waste buying. The main objectives of these organizations is to convert **"trash into cash"** rather than dumping into landfill site.

Khaalisisi.com

Itinerant waste buyer plays important role in managing scarp waste but due to the lack of their proper organization they are not regulated properly. In some areas these buyers looks for the scarp waste whereas in some areas the people wait for them so that they could sell the scrap wastes. Thus there is a gap between the service provided by these buyers and the one who use it. Due to this gap, most of the scrap wastes that could be recycled end up at landfill sites. This gap is filled by **Khaalisisi.com.**

This organization act as a bridge between waste generator and itinerant waste buyer (termed as Khaalisisi friends by organization) for effective mobilization of recyclable wastes and the service is available within the ring road. It is established on 5th June 2017 on the day of World Environment Day by Aayushi K.C (Founder, CEO). This organization makes it easier for waste seller to sell/donate the recyclables wastes which also increase the business of Khaalisisi friends.

Before the establishment of this organization, itinerant waste buyer roam around the city to collect waste and on other hand people had to wait for them. Sometimes this waiting leads the recyclable waste to the municipal container. It helps to manage the time for both waste buyer and generator and people can either sell or give away their waste. People who are willing to sell or donate the waste can schedule the pickup time and date through online service. After that the waste buyer will come and collect the waste at the doorstep.

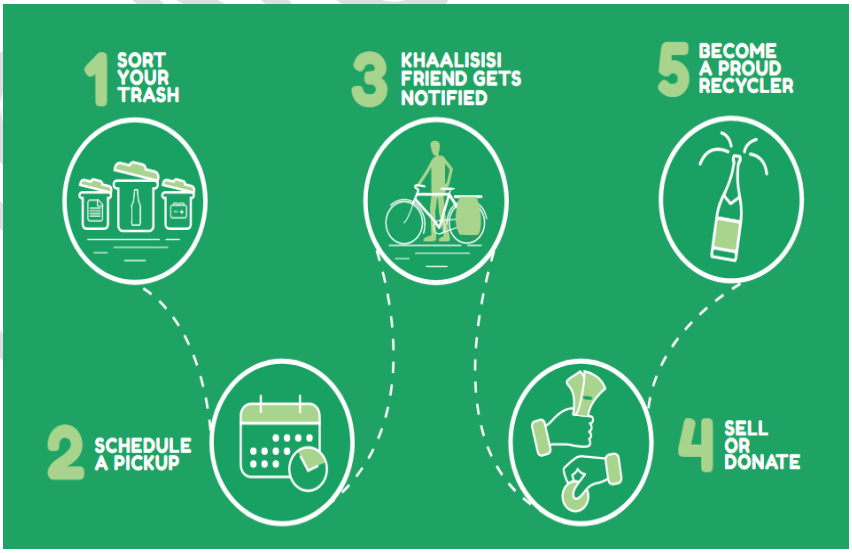


Figure 15: Working Procedure of Khaalisisi.com (Source: (Khaalisisi.com, 2017))

In order to sell/donate trash people need to sort the waste that could be recycled. When enough waste is collected, one can schedule the pickup time through the website of this

organization. One could confirm date and time of waste collection as per the convenience of people. The listed itinerant waste buyer of this organization get notified about the schedule and address of pickup. The khaalisis friend collect the waste which is then transferred to recycling company.

Many restaurants and few households are in regular contact with this organization from where recyclable wastes are collected regularly.. Till today, the collected waste comprise of:

- 1500 pcs of glass bottles
- 1500 kg of paper
- 200kg of plastic
- 20 pcs of E-wastes (Khaalisisi.com, 2017)

Doko Recyclers

Doko Recyclers was established to manage the tall garbage heaps and overflowing landfills of Kathmandu. It is the first social venture which aims to solve ever-growing waste problem of Nepal by streamlining the informal recycling industry and bring innovative solutions to make recycling significantly more efficient for everyone. As a result of which there will be hassle free services for managing waste, as well as increased recycling rates and lower carbon emissions for the planet. The main objective of Doko Recyclers is to make sure that generated waste doesn't end up on the streets or landfills but instead positively impacts our environment and economy. Trash for one person could be treasure for other.

The team of Doko Recyclers consist of six expert member:

- Ashma Basnyat (Waste Guru, Masters of Urban Planning)
- Kushal Harjani (Waste Manager, Master Degree in Development Economics)
- Neha Puri (Waste Wizard, Bachelors of Engineering)
- Raghavendra Mahto (Waste Minimizer, MBA in Strategic & Technology Management)
- Runit Saria (Waste Investigator, Bachelor in Compute Engineering)
- Shivani Saria (Relationship Manager, Social Work on Public Health)

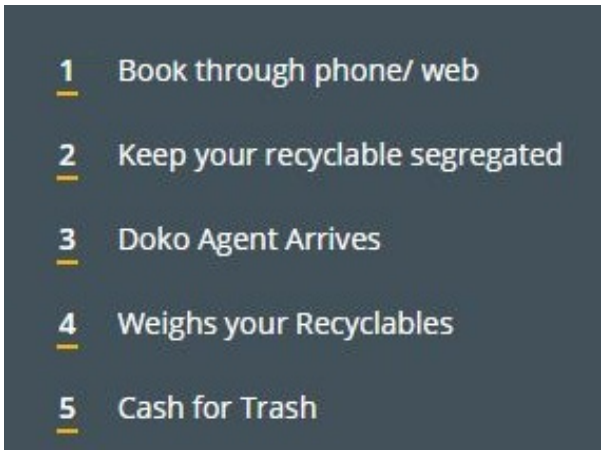


Figure 16: Working Procedure of Doko Recyclers (Source: (Doko Recyclers , 2017))

Since it is a digital platform, people can schedule waste pickup time and date either through online or phone as per their convenience. The segregated waste that are recyclable are then collected by Doko Agents. The price of each trash is provided on their website and the people receive money in exchange of their recyclable wastes.

The main objective of this organization is to make sure that the waste created doesn't end up on the streets or landfills and has positive impacts on environment and economy. This organization also accept paper, glass, plastic, metal and e-wastes. It is the first digital platform which provide recyclable digital platform for individual households, housing communities and corporate agencies.

In is the first digital recyclable waste pickup platform for households. It also provide customized recycling services for larger household societies. It also ensure that all solid waste generated at corporate organization is recycled in a responsible and sustainable manner. Household and corporate services of Doko Recyclers are:

- seamless pickup-scheduled, hassle-free, convenient, doorstep pick up and
- doko bins-dustbins for collecting all recyclable waste in one place so that the tiniest piece of trash is recycled instead of dumping it in landfill. These are durable dustbins that are available at affordable price.

3.9 SWM IN SMART CITY

There is no universally accepted definition for *'Smart City'*. The concept of Smart City varies from city to city and from country to country which depend upon the level of development, willingness to change and reform, resources and aspiration of the city residents. A smart city uses digital technologies to enhance performance and wellbeing, to reduce costs and resource consumption, and to engage more effectively and actively with its citizens.

The most important thing which makes the city smarter is **Design and Technology**.

- **Design** that is sustainable, efficient and livable.
- **Technology** that saves the time, money, effort, energy and environment.

According to Boyd Cohen, a famed urban and climate strategist, there are six indicator of Smart City. They are:

i. Smart economy
ii. Smart environment
iii. Smart government
iv. Smart mobility
v. Smart living
vi. Smart people

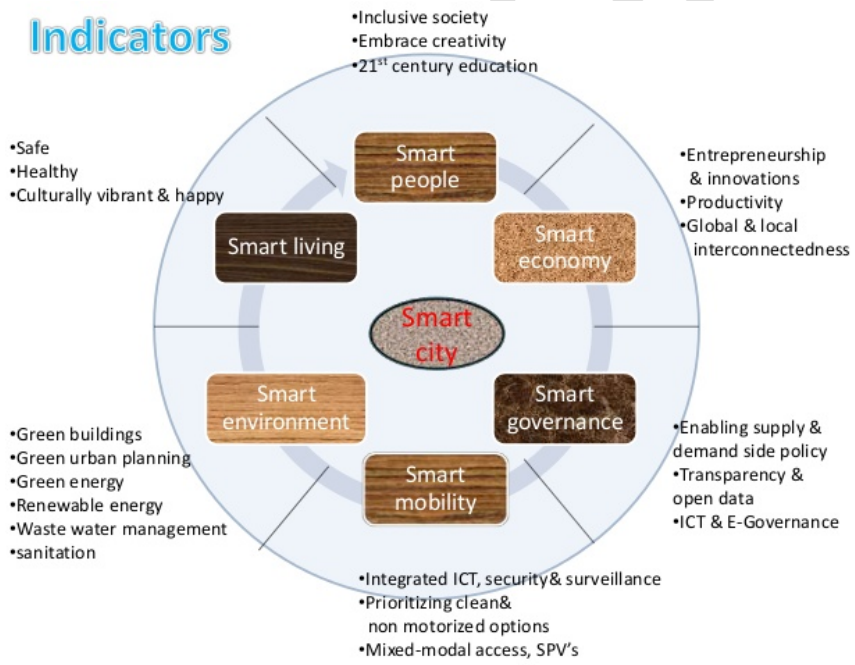


Figure 17: Indicators of Smart City (Source: Internet)

Among these six indicators of smart city, **smart environment, smart living** and **smart people** can be linked with the solid waste management, its impact on health/ environment and responsibility of people/ community towards SWM.

- Smart environment: concern with green/ renewable energy and waste management
- Smart living: safe and healthy living
- Smart people: inclusive society

The objectives of Smart City mission is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment,

sustainable and inclusive development and application of 'Smart' Solutions. the purpose of the Smart Cities Mission is to drive economic growth and improve the quality of life of people by enabling local area development and harnessing technology that leads to Smart outcomes The illustrative list of Smart solutions are given below:

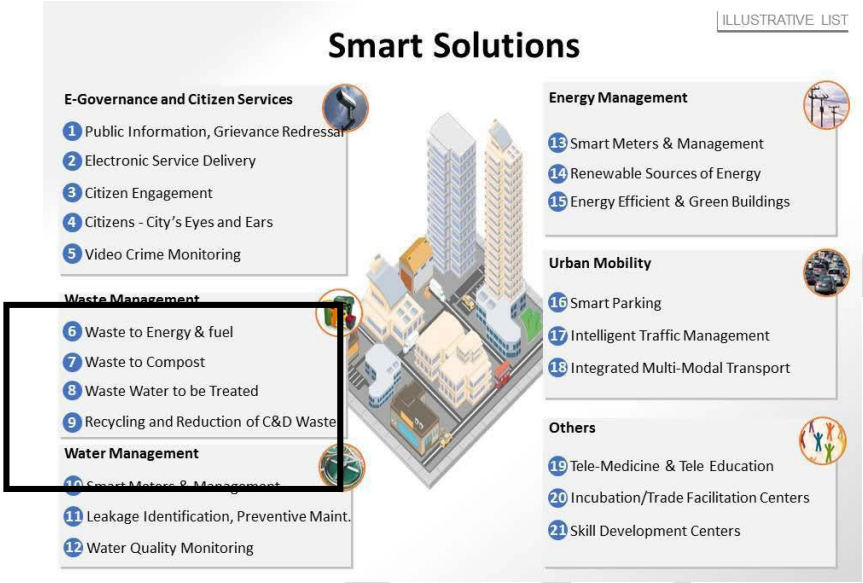


Figure 18: Smart solutions for Smart City (Source: (What is Smart City, 2017))

Smart Solutions will enable cities to use technology, information and data to improve infrastructure and services. Development in this way will improve quality of life, create employment and enhance incomes for all leading to inclusive Cities. The smart solutions for the waste management are:

- Waste to energy and fuel
- Waste to compost
- Waste water to be treated
- Recycling and reduction of construction and demolition wastes

3.10 PUBLIC PRIVATE PARTNERSHIP (PPP)

Public-Private Partnership (PPP) is one of the popular schemes which involve both public and private institutions for the development. According to United Nations Public-Private Partnership for Urban Environment (UNPPPUE), Public Private Partnership (PPP) refers to tri-partite form of contractual agreement between the public sector (government and municipality) and the private sector (formal and informal enterprises) for provision of basic services based on a combination of commercial viability, sustainability, environmental awareness, social responsibility, public accountability (fairness, competitiveness and

transparency) with effective involvement of the civil societies (communities, NGO, research groups) as beneficiary target groups (Nyachhyon, 2006).

Thus PPP can be define as the alternative for full privatization where government and private companies assume so-responsibility and co-ownership to deliver the services. But however, the concept of PPP is not easy in real case. Environment for the public and private sectors to work together is a pre requisite for the PPP to foster the trust and working relationship. PPP is more than the public sector merely offering co-operation to the private sector to facilitate the profitability of local firms. Some enabling conditions that are required to form successful PPPs are:

- A positive culture that encourages leadership and citizen participation, and that is related to the long-term development concerns of the community.
- A realistic commonly accepted vision among the public sector, private sector and the community members that is based on the area's strengths and weaknesses as well as on a common understanding of the potential for the area.
- A participatory ethos in concerned organizations that can blend the self-interest of members with the broader interest of the community.

3.11 EXAMPLE OF EFFECTIVE COMMUNITY PARTICIPATION IN SWM

3.11.1 Solid Waste Management at Bhaktapur Municipality

Bhaktapur municipality is a historical town which spreads over an area of nearly 7sqkm and a popular tourist destination. This municipality is divide into 17 wards and 75% of land is used for agriculture. The population projected for 2008 is 85,000 with population growth rate 1.7 (CBS 2001).

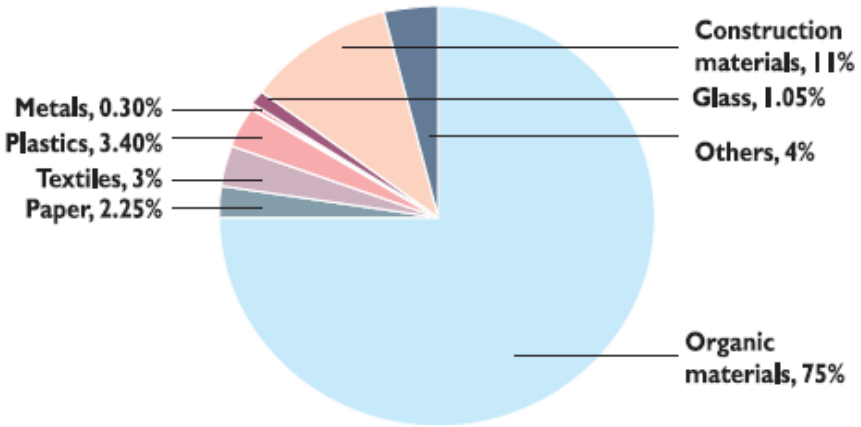


Figure 19: Waste Composition in at source, Bhaktapur Municipality (Source: (Nepal, November 2008)

The Waste Management Program was introduce to address the complaints from local communities about the ineffective collection system, and haphazard dumping of wastes by municipality. Thus the main objectives of this program is to provide effective waste collection, safe transport to disposal site by Local community Group Contractors. With the support from GTZ, Bhaktapur composting was commissioned in 1984. Local Community Groups provide waste management services to municipality in 12 wards and remaining 5 wards are services by Community Development Section. The SWM service provide by Local Community Groups includes waste collection and street sweeping. This system not only provide income source to local residents but also made it easier to control and complain to the group workers as they are part of same community. But the collection of these waste and final disposal of wastes is handled by municipality.

This group is also actively engaged in waste minimization and segregation of wastes. It has distributed almost 500 composting bins of 50kg capacity. The average per capita household waste generation rate in 0.3Kg/capita/day with total waste generation in 25 tons/day (Bhaktapur municipality, 2008 data). Waste consist of 75% organic waste, 2.25% paper, 3% textiles, 3.4% plastic, 0.3% metal, 1.05% glass, 11% construction debris and 4% other materials.

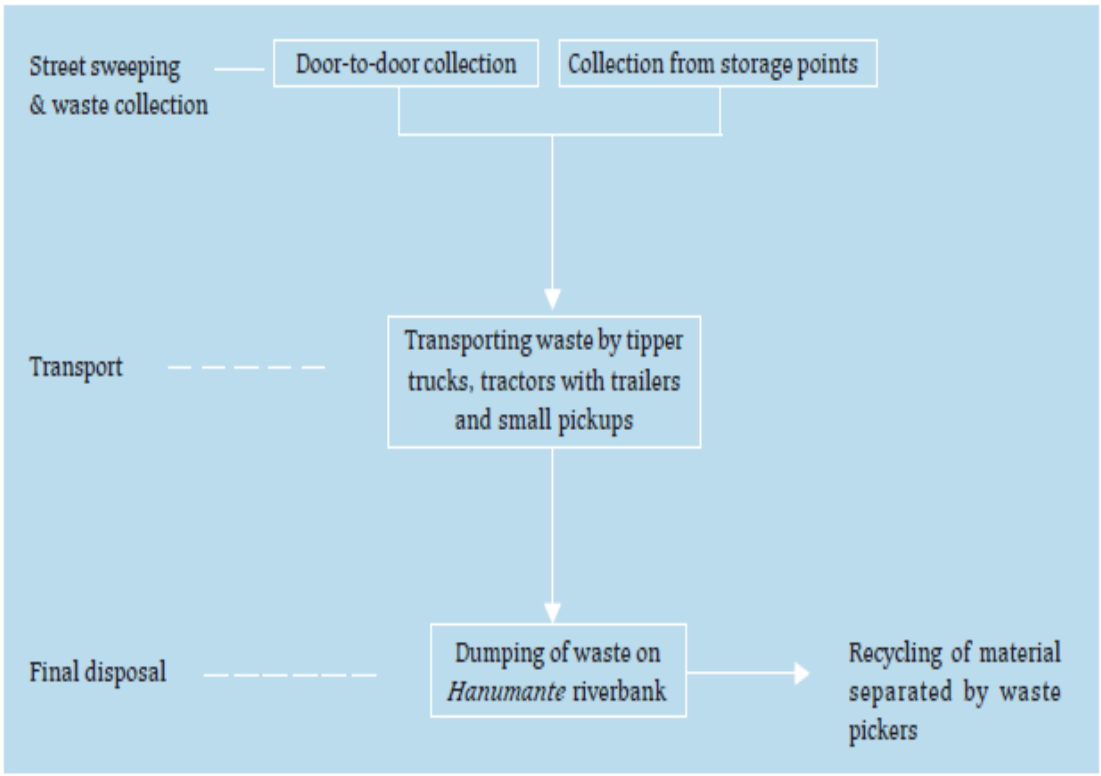


Figure 20: Solid Waste Management System at Bhaktapur (Source: (Nepal, November 2008)

After the implementation of the program, Bhaktapur municipality has been working systematically. Everyday waste is collected and streets are swept according to definite schedule. This program is effective as staff work in the area where they live. It is estimated that 20% by weight of waste is recycled by municipality and private waste recyclers collect the recyclable waste in different points. The municipality, disposed the waste on the bank of Hanumante River which is 25tons/day.

Problems of SWM Program

- Poor responses for efforts to encourage waste minimization at source
- Too small waste management workforce to achieve vision of municipality
- Since charges for waste management is nominal, find needed for investments is not sufficient
- Lack of authority of Community Development Section in making financial and administrative decisions results into poor cooperation between public and private sectors

3.11.2 Solid Waste Management in Bharatpur

Bharatpur Municipality is regarded as middle sized municipality and the commercial center of Narayani zone. It has 14 wards with total area of 162.16 sqkm with 19,910 HH in year 2001. The total population in 2007 was 134,803 with population density was 1433.58.sqkm (Bharatpur Municipality, 2007 data). The population growth rate is high as a result of migration as it is surrounded by fertile land and its proximity to the Indian border. SWM in Bharatpur is an example of private sector participation in MSWM and waste recycling.

Before this project, municipality was struggling to provide door-to door collection, especially in core areas of the city and to dispose the waste in sanitary way as the wastes was dumped on the bank of Narayani River. Bharatpur has initiated a public private partnership in order to manage the solid waste. A private contractor has been engaged to provide door-to door waste collection and to collect waste from unofficial collection points which was brought to the official transfer station which are located in two areas of municipality. The main objectives of this system is to maintain a clean and healthy environment by involving the private sector.

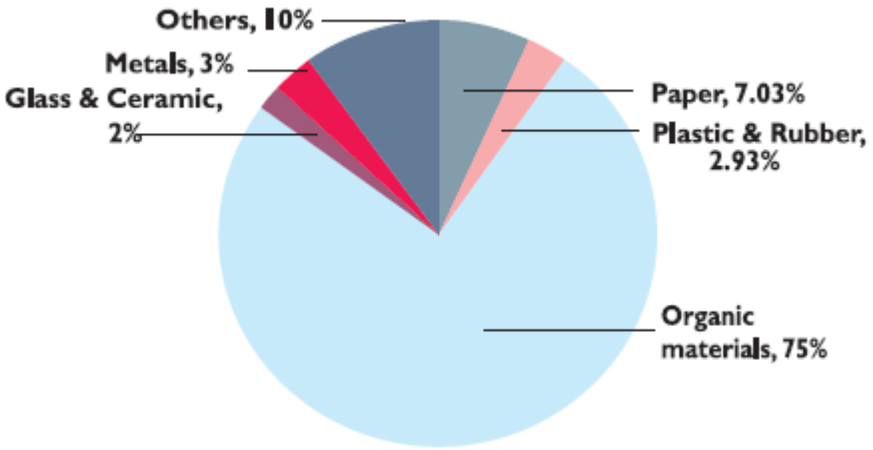


Figure 21: Waste Composition in at source, Bharatpur Municipality (Source: (Nepal, November 2008)

On the basis of municipal data and survey conducted in 2008, the average HH waste generation rate in 0.276kg/capita/day. The total waste collected by the municipality is 37 tons (Bharatpur Muniicplaity, 2008 data). But only 54% of the generated wastes is collected and dumped by municipality. Although the healthcare waste is supposed to be managed by hospitals/nursing homes itself, but it is found that they are not serious about managing infectious wastes.

Waste is collected from unofficial collecting points in almost 71% of areas in urban wards and the contractors is responsible for collecting waste from various stations to disposal sites every day at definite schedule. In order to encourage waste reduction at source, HH compost and segregation of plastic using *suiro* hooks for storage have been promoted in some wards. With the help of Lumanti, Practical Action Nepal and local NGOs, a 40metercube biogas plant is under construction in ward 5.

In Bharatpur, it is estimated that 15% of the MSW is recycled and almost 50% of the domestic waste and 25% of institutional waste is collected at source each day. A total of 530 compost bins (capacity 50 kg), 550 plastic buckets (capacity 10 kg) and 1200 *suiro* hooks have been distributed by Practical Action throughout *Bharatpur* municipality.

Since 2006, the municipality has been dumping waste at Ramnagar Dumping site and the municipal record shows that 15 tons of waste are dumped at this site every day. Municipality has sometimes sprayed pesticides after dumping of wastes in attempt to minimize health risks.

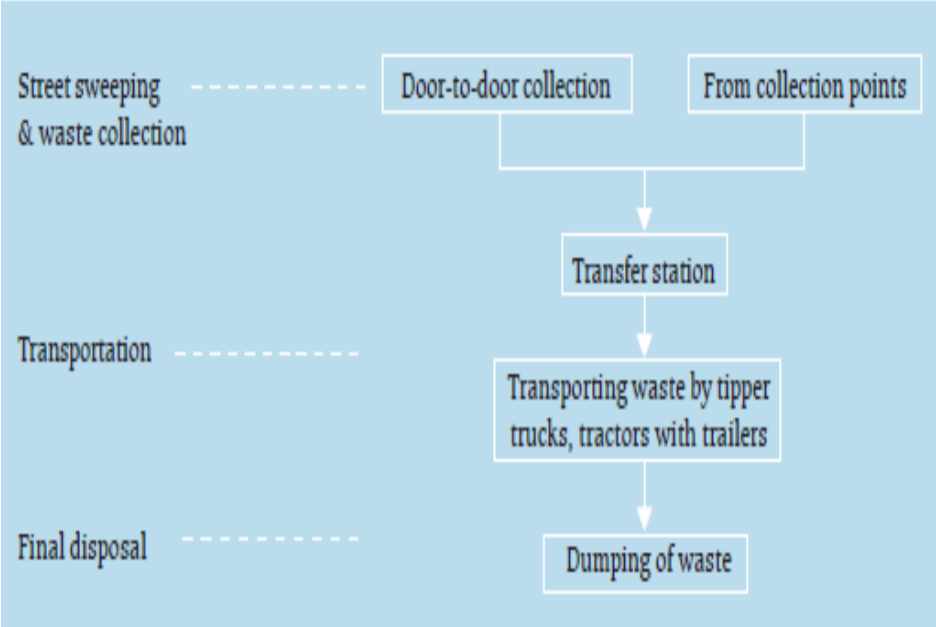


Figure 22: Solid Waste Management System at Bharatpur (Source: (Nepal, November 2008))

Problems of SWM Program

- Poor response of residents to calls for waste minimization
- shortage of waste management staffs and financial limitation
- Lack of authority in making financial and administrative decisions
- Lack of trained personnel, standardized vehicles and frequent breakdown of vehicles
- Uncontrolled squatter settlement and poor cooperation from public as well as private sector and inadequate stakeholder co ordination
- Transfer station cause problems to the local people

3.11.3 Community Based SWM in Bangalore, India

The different intentions regarding community participation in waste management refer to a major distinction, which has both practical and policy implications. The distinction refers to community participation as an instrument to make waste management more efficient, and community participation as an objective in which waste management is an important instrument to achieve social development.

Community-based solid waste management in Nagpura, ward -14 is one of the pilot projects of UWEP in Bangalore that address specific problem in waste management. The project is designed by local partner organization in consultation with stakeholders in waste management, applying general ISWM guidelines developed by UWEP.

In case of Bangalore, the city council is responsible for waste collection and disposal. The Bangalore city council is interested in supporting private and NGO initiatives as a way of expanding its own waste services throughout the city, as demanded by law.

Nagpur, ward-14 of Bangalore has total population of 60000 residents and is comprise of middle and upper class area with about 8000 households and low income area with about 800 households. The ward is mostly residential with some major commercial centers which are the major water generator (about 15-20 tons/day). Several private entrepreneurs carry out waste collection, each in their own sector of the ward. The ward councilor is greatly interested in improving waste collection. The CEE (Centre for Environmental Education) has also been involved in small waste-composting projects in Nagapura Ward since 1994. However, there is no coordination between all these different waste activities in the ward.

The UWEP pilot project is in a sector comprising 3,000 households with the aim to establish a solid waste management system in the whole Nagapura Ward, through community involvement in cooperation with the city authorities. A group of about 20 residents (mainly women) endorsed these objectives at a meeting.

Figure 23: Map of Nagpur City (Source: Internet)

The central components of integrated solid waste system were the collection of separated waste and the composting of organic waste. The project team started a new composting pit and, at the same time, tried to establish a commercially viable link with a private composting enterprise. Project strategies included:

- education and training of waste generators and service providers
- identification of a landfill site for safe disposal of waste collected from the ward
- Involvement of citizens as well as the local ward councilor in monitoring the new waste collection service.

For this project, CEE has defined the participation as:

- the daily action of handing over separated waste at a particular time to the waste collector
- The payment of service charges, i.e. a monthly payment based upon what the community is able and willing to pay.
- participation in a committee that plans and manages the program in its entirety
- a resident or a commercial establishment providing space to park vehicles or make financial contributions for equipment and carts; and
- membership of a monitoring committee to monitor the service

Achievements of Pilot Project

The major outcome of the pilot project is that a new door-to-door service has been established in several sectors of Nagapura Ward which is managed by the waste management committee. Waste collectors transporting organic waste to the compost pits in the neighborhood or handing it over directly to the council trucks after retrieving recyclable dry waste. There is a fixed time to hand over waste rather than depositing it in and around the street containers whenever residents find it convenient to do so. There is an increase of about 15 per cent in the number of participating households after each round of awareness raising. As a result, the streets are looking cleaner, with less garbage being thrown out indiscriminately. The removal of street containers as the first step towards a door-to door collection service, the separation of waste and composting is example of project achievements.

Problems of Pilot Project

- The members of waste management committee are not able to involve themselves in entire range of management issues and to motivate people with NGO.
- wet and dry garbage being collected separately in one neighborhood while all garbage is put together in the next neighborhood
- Payment conditions and degree of supervision of waste collectors also vary

- the joint use of facilities such as compost pits or transfer stations by different groups of waste collectors leads to conflict and requires careful discussion and coordination
- linking up the variety of neighborhood-based primary services to the city's waste system
- The pilot project has not yet found a suitable approach to coordinating the waste entrepreneurs and organizations in the ward.

3.11.4 Community Based Pilot Project on SWM in Khulna City, Bangladesh

Khulna is third largest city of Bangladesh with industrial activity in and around the city. The city core cover 1/4 of total city area which is densely populated with multistoried residential and commercial building. The rest of the city is a mixture of urban and peri-urban areas. Khulna City Corporation (KCC) is responsible for operation and maintenance of municipal services which also include solid waste management. Among the eight functional department of KCC, the conservancy department is assigned for SWM which include street sweeping, cleaning of public latrines and drains etc. This department collect waste from approximately 1200 city corporation masonry bins located on roadside throughout the city which is then transported to final disposal site.

KCC collects the waste from roadside bins only but the wastes get disposed in open drains, free land and around the bins which remain uncollected. It is estimated that 200 tons of waste get generated daily which is not collected completely. These uncollected waste blocks drains, causes water logging and spills over on to roads resulting in traffic congestion and pollution.

The pilot project for community based SWM in Khulna city was launched in March 1997 (scheduled completion date of December 2000) and estimated cost of this project is US$315,500. This project is operated in 6 wards of the city and the local NGO, Prodipan was selected to lead the project activities. The local NGO worked closely with communities and KCC which is supported by Water and Sanitation Program (WSP) and Swiss agency for Development and Cooperation (SDC).

The objectives of the pilot project were:

- To gain a strategic understanding of the urban waste and sanitation situation and to identify a range of appropriate options suitable for communities who are willing to share costs and participate in the management process

- To make an assessment of social and economic prerequisites and institutional changes needed to incorporate the partnership approach in municipal service delivery
- To identify ways in which municipal authorities can link up with community management of solid waste
- To identify the potential to scale up from the pilot project to a larger investment in urban waste management.

THE PROJECT PARTNERS	
Communities (in the project areas)	Management of the Primary collection system and contribution towards its' cost.
Khulna City Corporation (KCC)	Collaboration, institutional support and onward links to municipal systems.
Prodipan (NGO)	Lead agency to implement the project activities.
Swiss Agency for Development and Cooperation (SDC)	Management and project funding.
Water and Sanitation Program (WSP)	Strategic supervision and technical support.

Figure 24: The Project Partners of the Pilot Project (Source: (Community Based Pilot Project on Solid Waste Management in Khulna City: General Project Description)

The strategies of the project are as follows:

- **Responsive**: balancing local needs with wider institutional, technical and environmental constraints
- **Equitable**: addressing the needs of all sectors of the community
- **Empowering**: motivating and organizing local people to help them to find solutions to problems at the local level
- **Decentralized**: into small managerial units or blocks over the whole city
- **Diverse**: experimenting with a range of technologies or processes rather than attempting to find one single solution applicable to all situations
- **Flexible**: to allow for developments and modifications in approaches and activities

The main project activity is to establish community based approach to SWM where responsibility is shared between household and city authorities. For this purpose, project is divide in to three phase.

i. Project Initiation

The local NGO. Prodipan was allowed to carry out primary waste collection and to receive payment for these services. There was active collaboration at city level and local ward level whereas Functional Departments of the City Corporation provided technical and logistic support. Two local partner NGOs, Nabarun Shanga and Rastik were selected and trained by Prodipan and WSP provided assistance in preparing an operational framework to implement the project activities.

ii. Community Organization

Over the first few months, communities were organized to take over the operation and maintenance of the primary collection system which require behavioral change among local people. Participatory Urban Appraisal sessions was conducted to determine householder's perception of SW problems, possible solutions and their willingness to share costs. Participatory awareness and motivational workshops were also organized to manage the collection operation for each primary collection block. WPS provided guidance of the design of the collection system and procurement of equipment whereas Prodipan recruited driver and assistant for rickshaw van and trained them in collection methods, hygiene, routine of vans, interaction with households and routine maintenance of equipment.

iii. Operation of Primary Collection System

Waste collection in the 6 project wards was divided into 26 primary waste collection block and each collection blocks consist of 500 households served by one collection van. The primary waste collection system consist of daily house to house collection by rickshaw van. Households gather their waste in plastic bags/ container which is handed over to van driver who takes the waste to local transfer point. Form this point, waste is transport to final disposal site by KCC. The project also provide plastic bins to multistoried apartment and this has increased the operating efficiency of primary collection. These bins are also provided in slum area where several households share one bin.

The primary collection operation is managed by Waste Management Committee with support from Prodipan. This committee will be able to operate and maintain themselves when project completed. Prodipan receives monthly fee

from each households for waste collection and the fee varies according to income and household which is decide by committee. The committee is planning to increase the rate so that it cover the total operation and maintenance cost and generate profit. Then primary collection would be financially viable for operating by CBOs.

The other activities of the project are:

- Appropriate transfer point and secondary transportation that integrate well with primary collection system
- Feasibility of waste recycling and composting initiatives
- Link with private sector
- Initiation of hospital waste management

3.11.5 Solid Waste Management in Smart City Barcelona

Barcelona is the capital city of the autonomous community of Catalonia in the Kingdom of Spain. It is second most populous municipality of Spain with population of 1.6 million within city limits but the urban area extends beyond administrative city limits. It the largest metropolis on the Mediterranean Sea, located on the coast between the mouths of river and bounded by mountains to the west.

It is one of the world's leading tourist, economic, trade fair and cultural centers, and its influence in commerce, education, entertainment, media, fashion, science, and the arts all contribute to its status as one of the world's major global cities

Figure 25: Map of Barcelona (Source: Internet)

Barcelona as Smart City

Barcelona is the first city in the Spanish state coined "Smart City" and is named the fifth overall in Europe in 2013. Smart city model of Barcelona is formed by about 122 projects classified into 22 major programs which identifies 12 areas under which the smart city projects are initiated. They are:

i. Environmental
ii. ICT (information, communication and technology)
iii. mobility (transportation)
iv. water
v. energy
vi. waste
vii. nature
viii. built domain
ix. public space
x. open government
xi. information flow
xii. services

Smart technologies used in public transit, parking, street lightning and waste management, cost saving and improved quality of life of residents all indicate smart way of life of Barcelona. Barcelona harnessed the technology to transform itself into model of data driven, sensing, smart urban system. Xavier Trias, Mayor of Barcelona (from 2011 to 2015) ran on the platform of technological innovation in city services. Launching of IoT (Internet of things) program took advantage of 500km of fiber optical cable within the city which was initiated 30 years ago. This fiber network serve as backbone for integrated city systems and the city draws on the fiber infrastructure to provide citywide WiFi. This fiber network is also used to build out individual IoT systems across urban services. The city installed 19,500 smart meters that monitors and optimizes energy consumption in targeted areas of the city.

The few things that makes Barcelona as Smart city are:

- Its stellar bus transit system.
- Its bicycle sharing system, Bicing
- Its installation of smart parking spaces
- **Its pneumatic waste management system**
- Its installation of smart lighting
- Its use of renewable and more effective energy systems
- It's the Mobile World Capital
- Its urban mobility through apps
- Participatory citizens and transparent government

- 22@ (vint-i-dos arroba), Barcelona's Innovation District

Waste management is one of the important indicator of city being smart. In context of waste management, Barcelona has pneumatic waste management system. People don't have to see and smell overflowing and oversized trash bins. They had provided compact drop-off containers that have subterranean vacuum network through pipes, sucking up trash below the ground. This is automated waste collection system that decreases noise pollution made by trash trucks and keeps the public space and stench clear. In the Poblenou and Sant Cugat neighborhoods, sensors on rubbish and recycling bins have also been tested.

Figure 26: Drop-off bins on Gran Via de Les Corts Catalanes (Source: Internet)

Through radiofrequency and WiFi, the sensor gives data to a central system, detecting the trash level. Sanitation workers can then plan the optimal route and times to collect it. The pneumatic and selective waste collection system minimizes noise pollution from the traditional waste collection methods and improves quality of urban spaces as waste containers disappear from the streets. And, mostly, there's no need of garbage trucks which is a particular advantage in the old historic city, where narrow, curvy streets can't accommodate large trucks, but where a lot of garbage is produced since the residential density is high. And at the market, where a lot of organic waste is generated, it's wonderfully appropriate.

The system consists of a network of fixed collection points strategically distributed, where the users deposit their waste allowing the separation of waste fractions. The drop-off points are connected via a vacuum network through the pipes installed under the streets and

transported to the collection plant. This plant is made up of an incinerator and an MBT facility. At the MBT plant organic waste (food and garden waste) produces methane, while paper, metals, etc. are removed from the waste and recycled. Barcelona residents produce about 500 kg per year per capita, and pay about 75 Euro per household. Landfills used to be prevalent, over 1000 uncontrolled landfills in Catalunia in 1991, all closed since 2000; 30 are left, all regulated. Since 2000, landfilled portion shrank from 70% to 30% in 2008; source separation increased from 12% to 32% in the same period.

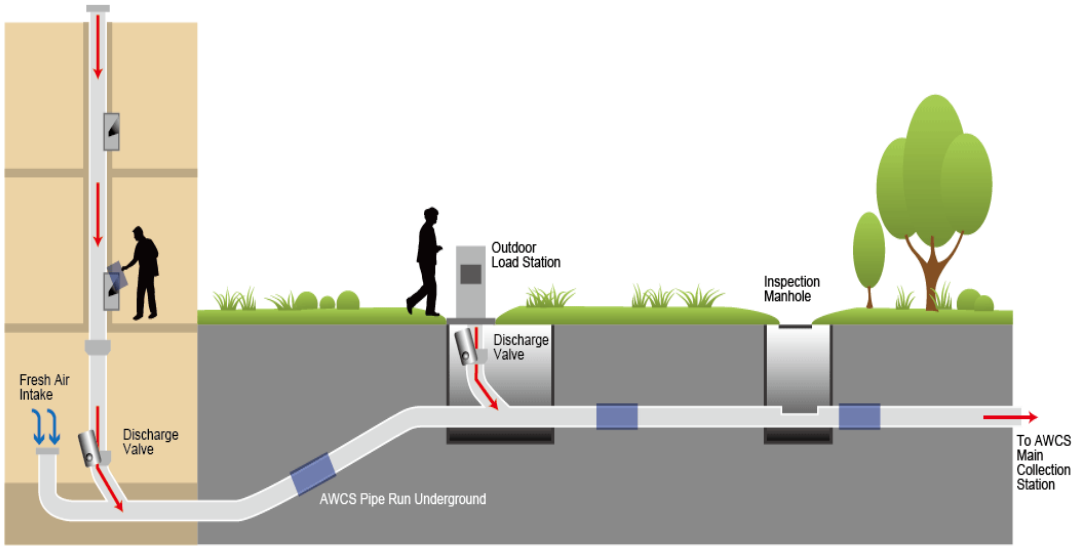


Figure 27: Pneumatic Solid Waste Management Network (Source: Internet)

CHAPTER 4: STUDY AREA

4.1 INTRODUCTION

Kathmandu is the capital city of Nepal and is one of the ancient city of Kathmandu valley. Kathmandu city itself is the largest metropolis which is growing in the rapid pace. It is an urban hub of the country but the city is also famous for its historical and traditional monuments, arts and artifacts, festivals and cultures. Kathmandu metropolitan was divided into 35 administrative wards. But today, some of the small wards has been merged to form single wards to meet the requirement according to the new constitution which result into formation of 32 administrative wards.

Among these wards, ward no. 27 (now merged with ward no. 28 to form new ward no. 25) is a historical part of Kathmandu metropolis located in the inner city. This ward is bounded by ward no. 30 in east, ward no. 24 and 28 in south, ward no. 27 and 29 in north, ward no. 17, 18, 25, 26 and 28 in west.

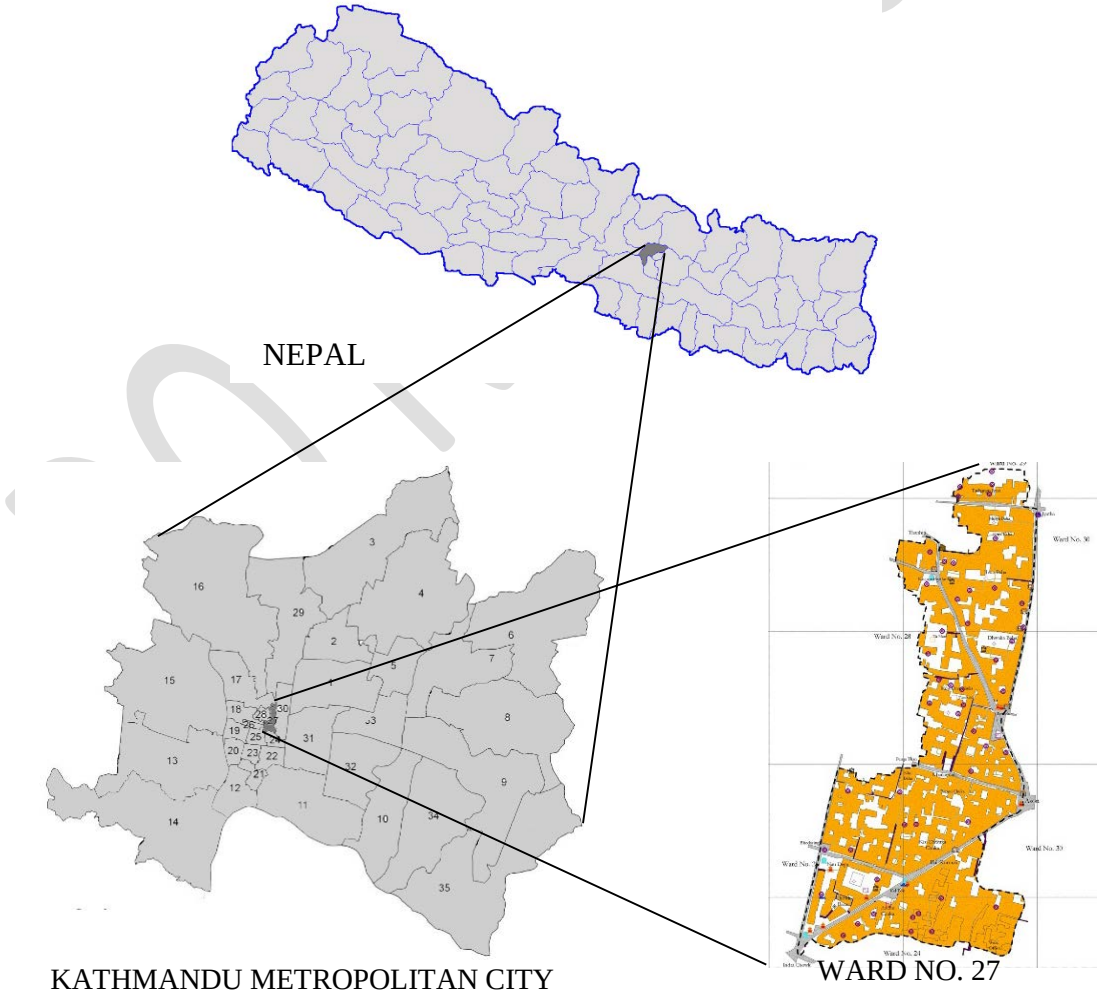


Figure 28: Location of Ward No. 27, KMC (Source: Internet & Ward Profile)

Masang Galli

Bal Kumari

Jhwa Bahal

Ason Chowk

Jyatha Tole

Tyauda Market

Figure 29: Images of Study Areas

This ward of the Kathmandu metropolis lies almost at the center of the city and the traditional settlement, historic monuments, festivals and culture are the main importance of this place. It is the traditional core of Kathmandu city with majority of Newar. There are many historically important bahas (bahals) such as Mussya Baha, Jana Baha, Khya Baha, Dhwakha Baha and Jhwa Baha. The traditional market areas such as Tyauda, Ason and

Indrachowk are also the part of these ward which are still active commercial areas of this ward. This ward is divide into different small toles which comprise of different Newar community.

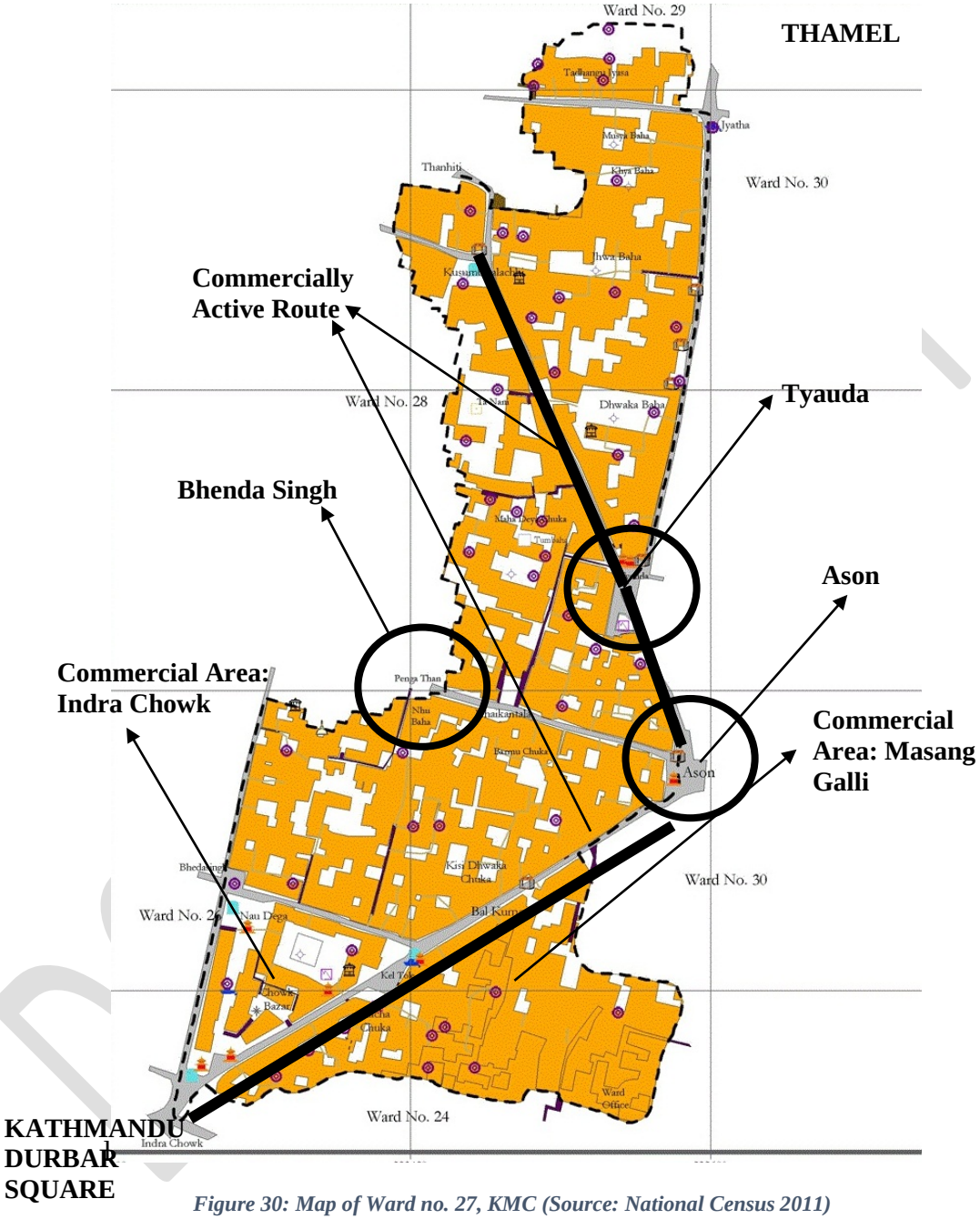


Figure 30: Map of Ward no. 27, KMC (Source: National Census 2011)

But in present context, the traditional settlement of this ward has been gentrified as most of the residential buildings and chowks has been commercialized. Many indigenous people had moved out whereas the number of tenants (migrated from outside) are increasing. As a result of modern technology, load-bearing buildings are converted into multi-storied modern buildings which also increase the population. Since this ward is located in between

the famous tourist destinations i.e. Thamel and Kathmandu Durbar Square, residential buildings are being commercialized. Some areas of this ward such as Masangalli and Balkumari are completely commercial area and buildings are used as storage and shops. Some areas like Jyatha, Ason, Tyauda, and inner chowks have mixed used buildings (residential and commercial or store/go downs). Especially the buildings along the route Indrachowk-Ason-Tyauda-Thaity, were more commercial than residential.

Many load- bearing residential buildings were damaged during Gorkha Earthquake and those located within the chowks or inner chowks are abandoned by the owner and left vacant till today.

4.2 POPULATION DATA

There is no database for current population and waste generation in this ward. According to ward profile 2058, the total area of the ward is 76,000sq.m (7.6 hectare). On the basis of National Population Census 2011, the population data of ward 27 is given in table below.

Total Household	1888
Total Population	7592
Male Population	4058
Female Population	3534

Table 2: Population data of ward 27 (Source: National Population Census 2011)

The total population of the ward is 7592 with population density 999 people per hectare. The sex ratio of the ward according to 2011 census is 1.15 i.e. 115 male for 100 female. On the basis of annual growth rate of Kathmandu Valley, the current population of the ward is estimated as:

Population of 2011 census=7592

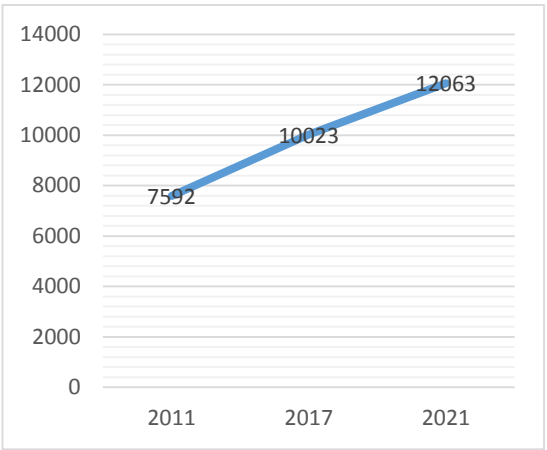
Population growth rate of valley= 4.63%

(Source: Kathmandu Valley Development Authority, KVDA, http://kvda.gov.np/Kathmandu-Valley.aspx)

Current Population of 2017= 10,023

Population Density =1319 people per hectare.

Projected population for 2021= 12,063



4.3 INSTITUITIONAL STRUCTURE OF WARD

The On the basis of local level election held on 14th May 2017, the new institutional structure of the ward is as follows.

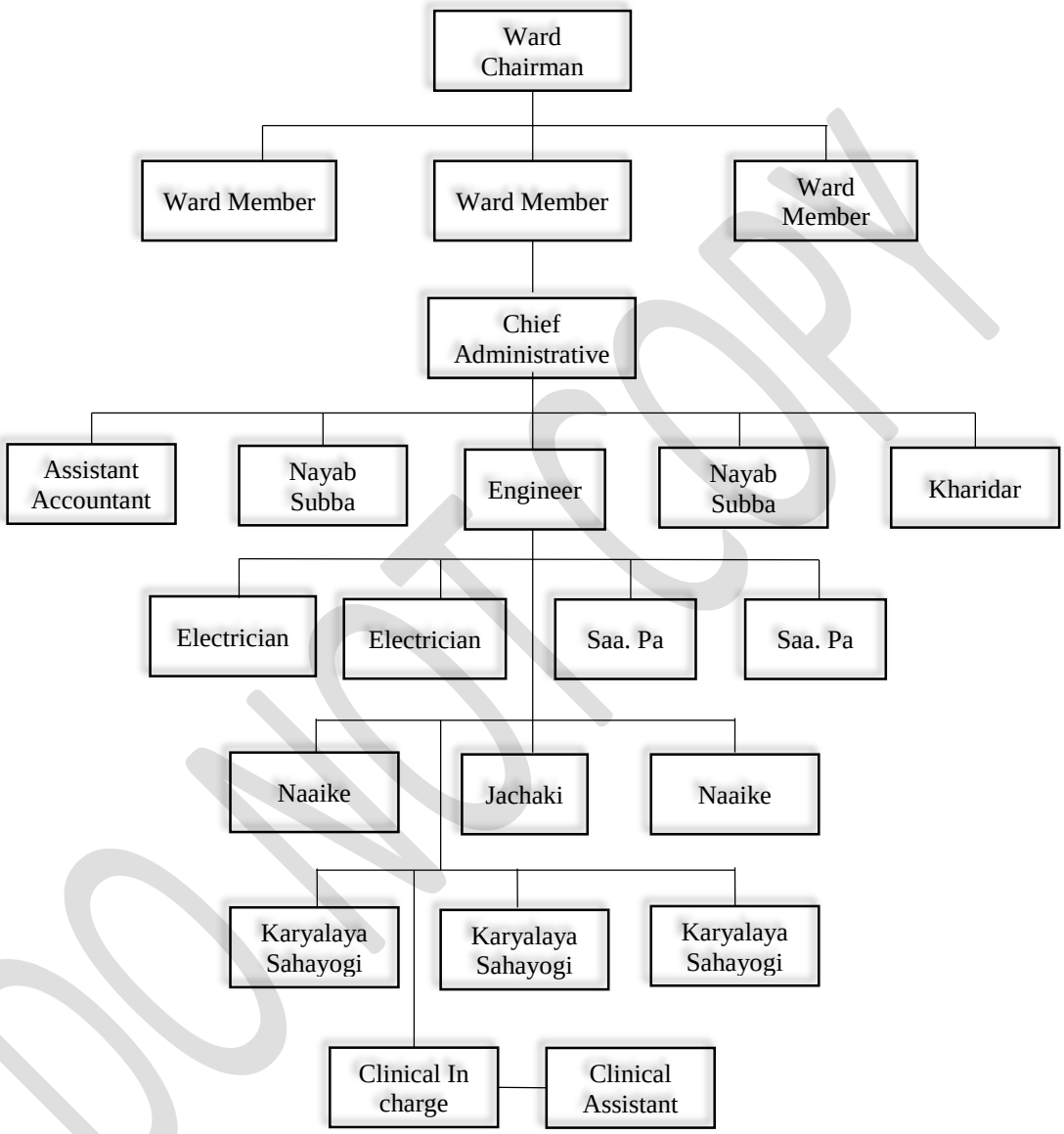


Figure 31: Institutional Arrangement of Ward Office (Source: Ward Office)

The new constitution of Nepal has defined certain power of local level. Among which the power related to SWM or that include waste management are:

- Management of local services
- Basic Health and Sanitation
- Local Market Management, Environment Protection and Bio-diversity

According to ward member, Rajesh Dangol, these powers are limited to paper only and these powers/responsibilities will come into force after the central election that will held on Poush. In present context, the SWM is completely handled by Municipality only. But however, the ward level is responsible for cleaning and sweeping of streets and public space for street festival and jatras. Ward level is also responsible for providing training programs related to SWM with the help of SWMTSC. But this ward office does not provide these training programs. Thus in present context, SWM of whole ward is handled by municipality.

4.4 CURRENT SOLID WASTE MANAGEMENT TREND

Unmanaged solid waste is one of the major issues of KMC. Ward no. 22 of Kathmandu Municipality is one of the major solid waste generator which is comprise of different residential communities, traditional market (informal) like Ason, Tyauda, BhedaSingh and commercial hub like MasangGalli, Indrwchowk and Balkumari. In absence of municipal vehicle, these commercial areas and traditional market squares get covered under waste piles. This statement is evident from the scenario of Kathmandu core areas few months back (during Indrajatra, one of the most important festival of Kathmandu) when there was strike in landfill site area as shown in image.

Figure 32: Wastes at Bhendasingh

Figure 33: Wastes at Tyauda

Waste collection is done by municipal vehicle which could be tripper, container or tricycle. Similarly waste collection service is also different according to the location and use of areas. In residential areas, those along the main road or near to main road are served by municipal vehicle at certain interval for waste collection whereas the residence within the chowks, nani or baha are provided with door to door collection system. People left their

waste outside the house which is then picked by sweeper who clean/ sweep these open spaces. But in commercial areas, the wastes are left outside the shop which is then collected by sweeper in the morning. The wastes thus collected by street sweeper is transported to municipal vehicle in tricycle. The wastes that are left outside for the whole night are sorted by street scavengers or rag picker for reusable/ recyclable wastes.

Figure 34: Collection of waste from roadside

Figure 35: Communal collection of waste

In case of traditional market squares, the wastes are collected at certain point by street sweepers which is then cleaned early morning by municipal vehicle. During collection also, municipal staff further sort the waste for reusable and recyclable materials. The wastes are not collected separately for organic and inorganic waste. According to ADB, 70% of urban areas practice composting but according to field survey, the amount of organic waste is quite high. There is no other community groups or private organizations or NGOs that are involved in SWM in this ward.

These collected wastes are carries to Teku Transfer Station and from there transported to landfill site, Okharpauwa.

4.5 SOLID WASTE COMPOSITION AND GENERATION

Municipality doesn't have ward wise data for the composition of waste generated. Composition of waste depend on the activities that take place in that particular area. According to the survey done by ADB, in municipalities with a large daytime influx of population due to economic and commercial activities or with major tourist destinations, household waste contributes to a smaller degree. From filed survey also, it is found that area with more residential buildings generate more organic waste which is then followed by plastics and papers.

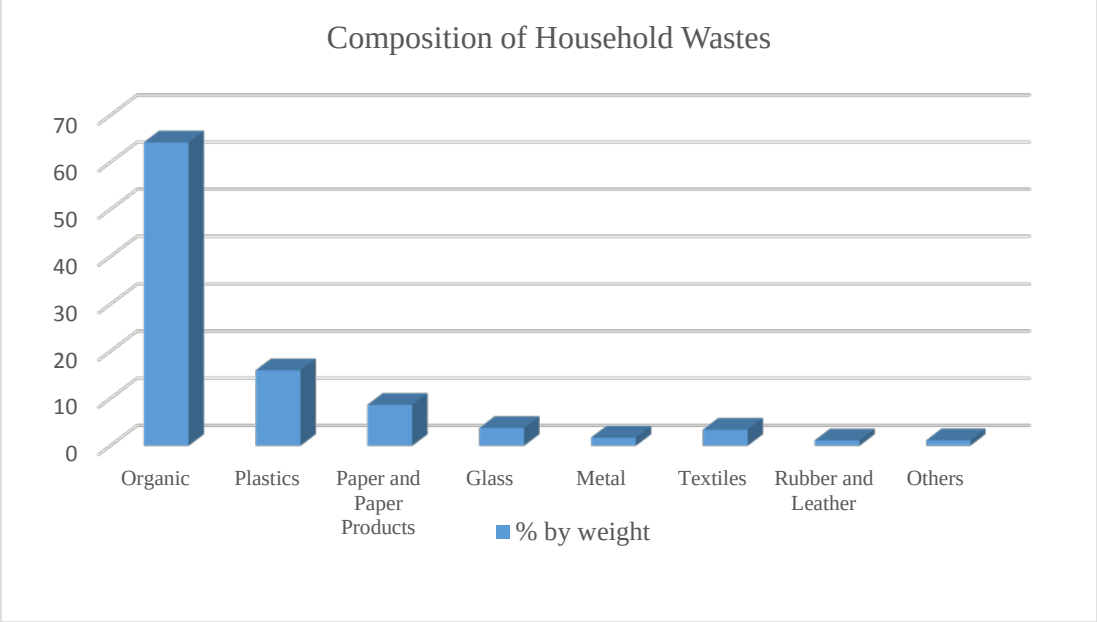


Figure 36: Composition of Household Wastes (Source: (Asian Development Bank, 2013)

But in case of commercial areas, waste composition depend upon the type of commercial activities. Hotels and restaurant produce more organic wastes wheras the clothing store, and other fancy shops generate more plastics and papers in comparision to other wastes. The traditional market squares like Ason and Bhendasingh generate organic waste as they are famous for fruit and vegetable market. But the commercial hub like Masangalli and Indrachowks generate more plastics and paper as there are comparatively few restaurants and hotels.

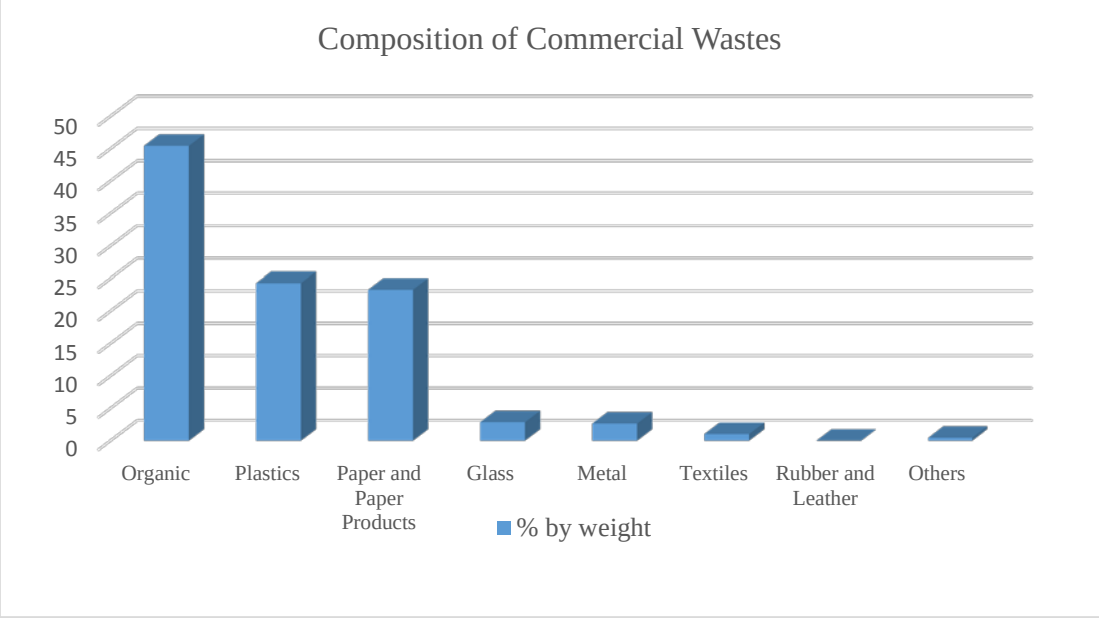


Figure 37: Composition of Commercial Wastes (Source: (Asian Development Bank, 2013)

Year	Waste generation	Waste collection	Collection efficiency
2001	**949cum/day**	**521 cum/day**	**55%** *(Source: SWM in Kathmandu Metropolitan City)*
2004	**300tons/day**	**250tons/day**	**83%** *(Source: Generation, Storage, Collection & transport of MSW: A case study in the city of Kathmandu)*
2012	**553tons/day**	**498tons/day**	**86.90%** *(Source: Asian Development bank, 2013)*

Table 3: Comparison of Collection Efficiency of Solid Waste

According to field survey performed by ADB, the average amount of municipal waste generation is 317g/capita/day (Asian Development Bank, 2013). But this waste doesnot include other wastes such as wastes from street and parks. It is estimated that generally household wastes contribute to 50%-75% of total municipal solid wastes. Considering the population of ward no. 27 to be 10,023 (projected for 2017 with growth rate= 4.63%) and waste generation rate and collection capacity of municipality to be same as that of Asian Development Bank, 2013, Thus

Total waste generated in present context = 317X10023= 3177291g/ day

= 3177.29 kg/day

The collection efficiency of municipality is increasing with increase in population and resouces but still waste has not been managed 100% till today. The collection efficiency of major town ranges between 70%-90% (Asian Development Bank, 2013). Since KMC is major metropolis, the collection efficiency as per Asian Development Bank =86.90%

Total waste collected = 275.47X10023 g/day

= 2761035.81g/kg = 2761.04kg/ day

Uncollected waste = (3177.29-2761.04)kg/day

= 416.25 kg/day= 12487.50 kg/ month

Thus, approximately 12,500kg of waste remained uncollected within this ward which is the huge gap between waste management demand and supply.

The gap between demand and supply of SWM can be filled with active participation of community and public which can decrese the waste that should be collected by municipality.

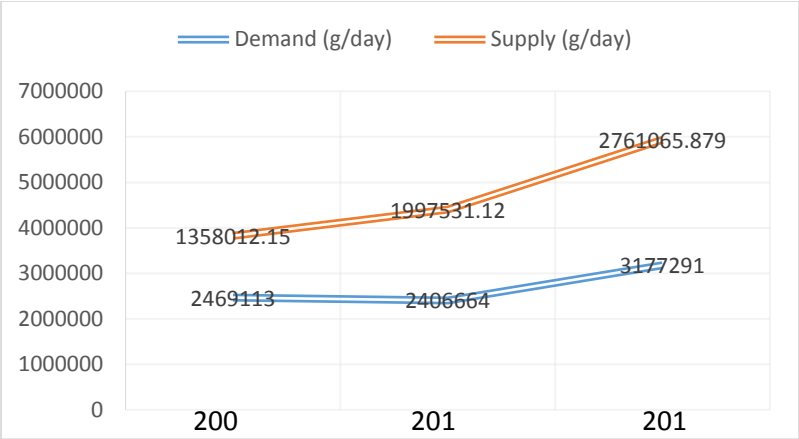


Figure 38: Figure 31: Gap between generation and collection of Solid Waste Management

4.6 DATA COLLECTION

The data collection was done from the field survey through close ended questionnaire. The main purpose of this questionnaire is to collect general household information, current trend of waste generation, storage, collection and disposal of wastes. The questionnaire also provide general perception of people living/ using space and about the solid waste management and community/ public participation.

Form 2011 census, there were total 1888 households in ward no. 22. Out of which 100 (approx. 5%) survey questionnaires were administered among the household of ward 22. One member from each household was selected to provide the answers of questionnaire.

The survey questionnaire covers different areas/ toles of the ward so that overall information of this particular ward could be received.

S.N	Address	No. of Respondent
1	Ason tole	7
2	Balkumari	6
3	Dhwakha Bahal	7
4	Indra Chowk	8
5	Jana Bahal	6
6	Jyasal	6
7	Jyatha tole	8
8	Jhwa Bahal	6
9	Kel tole	7
10	Khya Bahal	6
11	Masan Galli	7
12	Nhyakantala	7
13	Suchikar Galli	6
14	Ta Nani	6
15	Tyauda	7
		100

Table 4: No. of Respondent in different areas

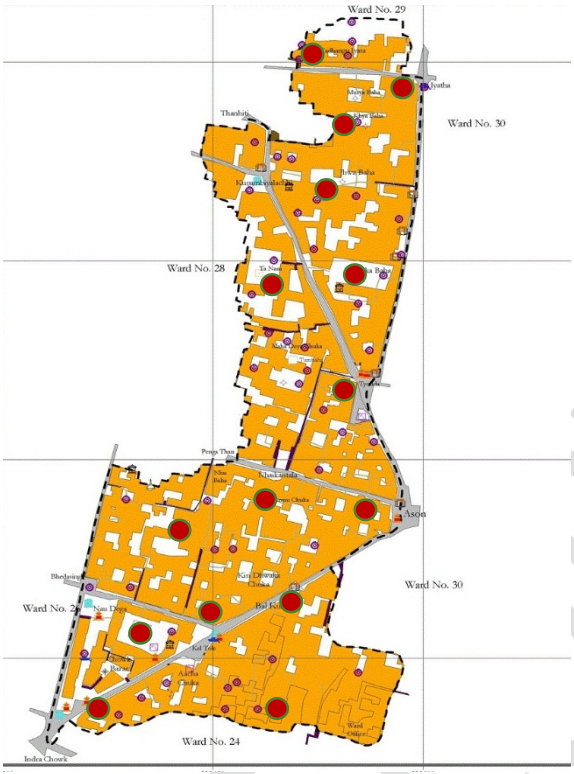


Figure 39: Map of Ward 27 showing Survey Areas

4.6.1 General Household information

This section of questionnaire include general information of household such as name, age, sex, caste, education level, occupation, family detail etc. of the respondent. Although the traditional settlement has been disintegrated, but still majority of households are owned by Newars. In filed survey also, out of 100 respondents, 76% household belongs to Newar family. But in present context, every building has certain number of tenant migrated from outside which is the major cause for the disintegration of traditional society.

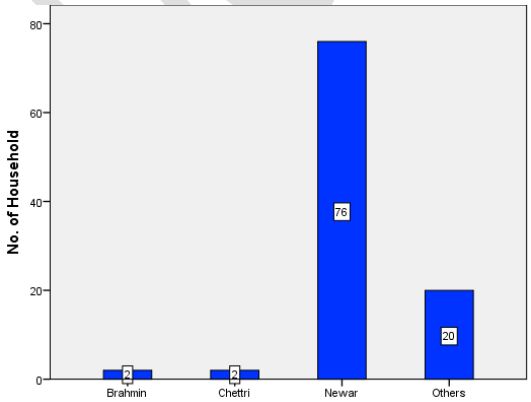


Figure 40: Caste of Respondent

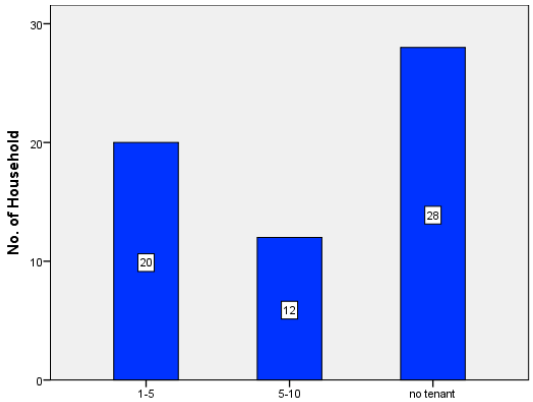


Figure 41: No. of Tenant

Since the research is about the community participation, respondent was inquire about their linkage with social organization. According to field survey, there are very few household which is associate with social organizations such as Guthi, Women committee and Youth Club. From the survey it is found that 60% of respondents are indigenous to the community.

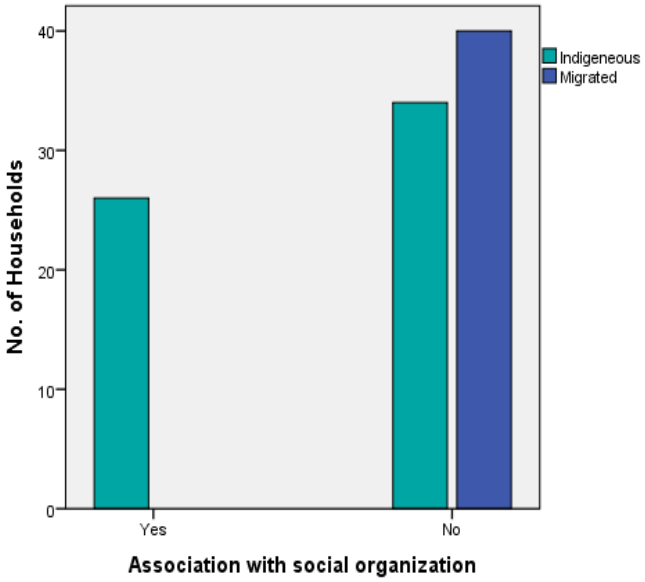


Figure 42: Association of people with Social Organization

As shown in graph (Figure 41), out of 60 indigenous people, only 26 people are associated with social organization.

These social organizations are active where there is homogeneity is community in terms of caste and people. Migrated people are not linked with any kind of social organization. Although there is majority of Newar residents, there are few social organization.

4.6.2 Solid Waste Information

The second section includes the questionnaire related to solid waste generation, storage and collection.

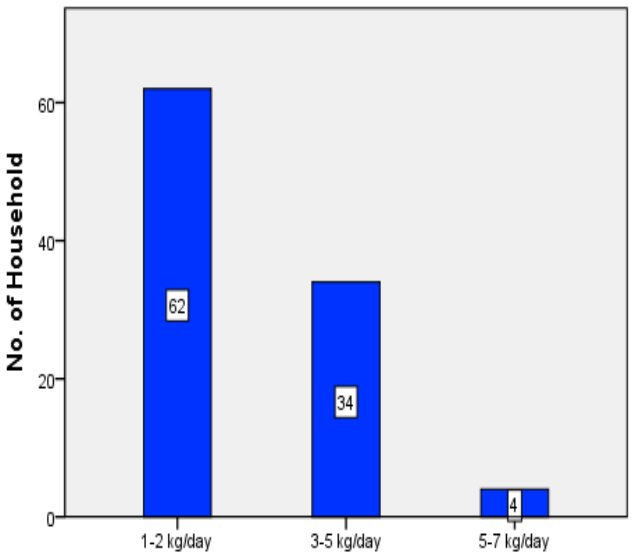


Figure 43: Amount of waste generation

According to field survey, it is found that 62% of households generate 1-2 kg of waste per day where as 34% of households generate 3-5kg of wastes per day. Since the family size is decreasing, waste generation from each household is also decreasing but this is not total waste generated by building.

It is total waste from respondent's family only and it does not include waste from tenant and other commercial activities that occur within the building.

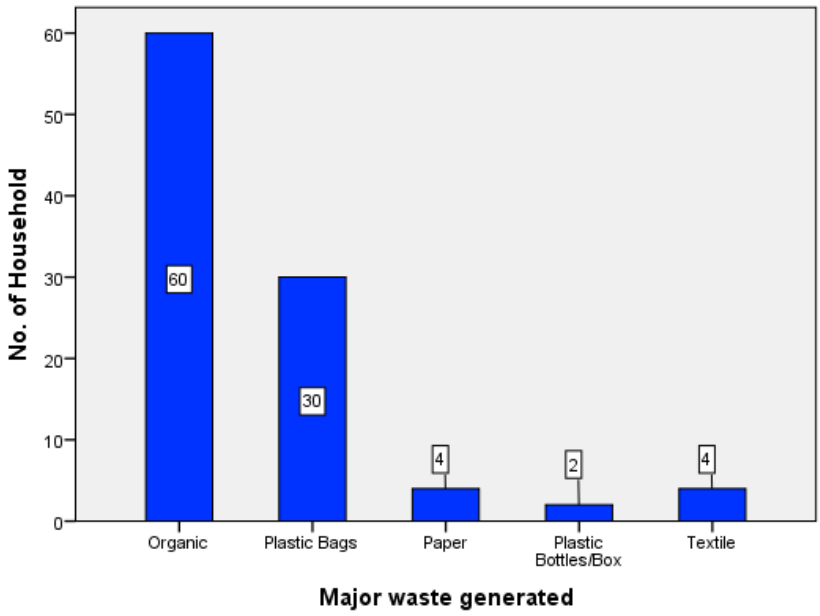


Figure 44: Major waste generated

This ward is has more residential areas than commercial. As in traditional settlement, there are different interconnected chowks and nani (small and big) which is not suitable for commercial purpose. Thus, majority of waste produced is organic which is then followed by plastic bags, paper, plastic boxes and textiles respectively.

The generated wastes are collected in bin or bags. People find it easy to collect waste in bags thus in field survey also 52% households store the wastes in plastic bags. While storing waste, many household do not segregate waste. Both organic and inorganic wastes are stored together.

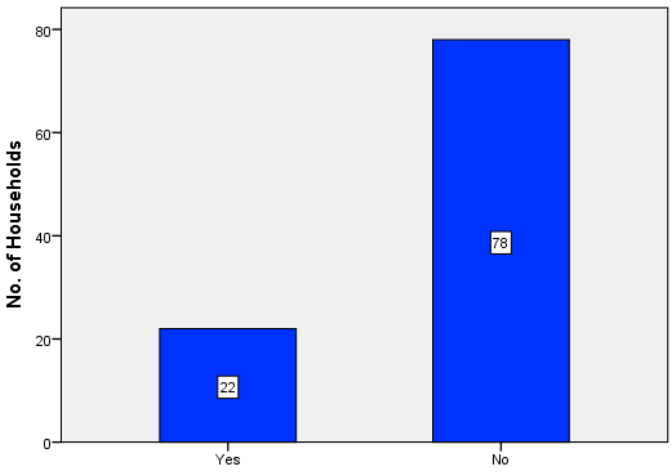


Figure 45: Segregation of Wastes

On the basis of field survey, it is seen that only 22 % of household segregate waste while storing whereas 78% do not segregate wastes. While asking about the reason behind not segregating the wastes, majority of people answers that:

- Space is not available for storing separately
- Inorganic waste are generated in less amount and it's easy to store together
- Although waste is segregated while storing, it is collected together by municipality

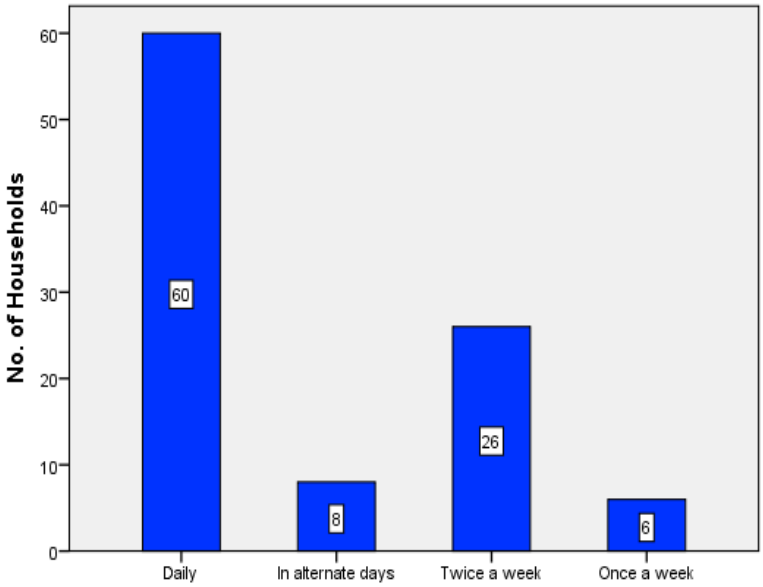


Figure 46: Frequency of Waste Collection

The wastes are collected in the morning but the collection frequency is different in different areas. The collection frequency depend upon the amount of waste generated and human activities of that area. But many areas, waste is collected daily.

In this ward, waste is collected by municipal vehicle but type and size of vehicle depend upon the location of waste generation. Survey results shows that tricycle is used in 48 households which include commercial shops and inners chowks and nani. Those areas which is facilitate by wide road, tripper, container and tractor is provided for waste collection. Mostly used large vehicle for waste collection is container which is then followed by tripper. Tractors are very rarely used.

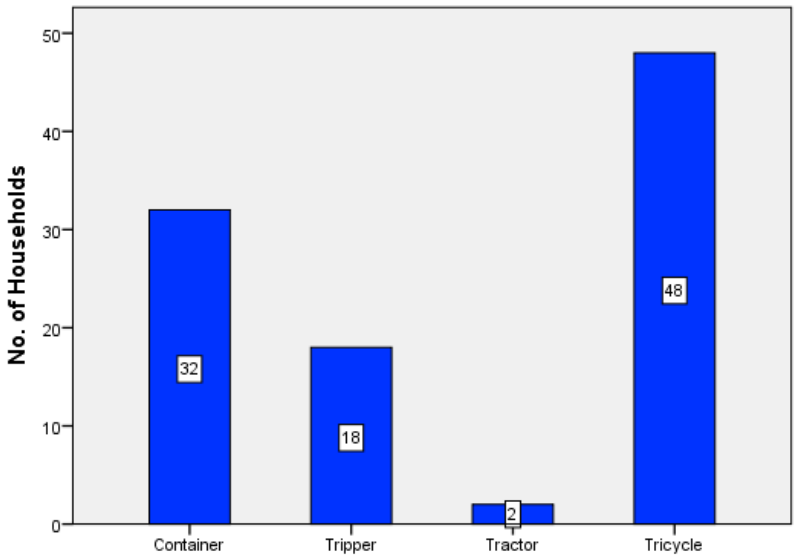
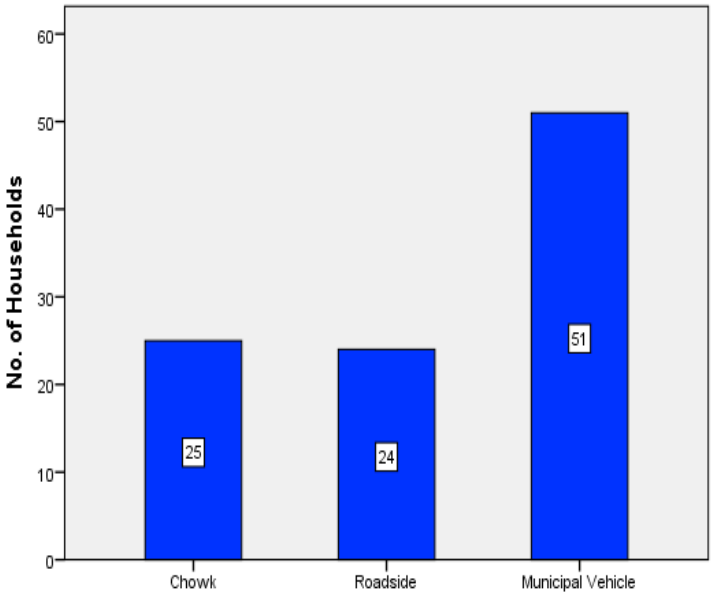


Figure 47: Vehicle for Waste Collection



Areas which is served by tricycle left their waste outside the house or shops along roadside or chowks which is then collected by municipal sweeper in tricycle to container.

For this service, people have to pay money to the sweeper whereas those people who dump their waste directly in municipal vehicle don't pay for waste collection.

Figure 48: Point of Waste collection

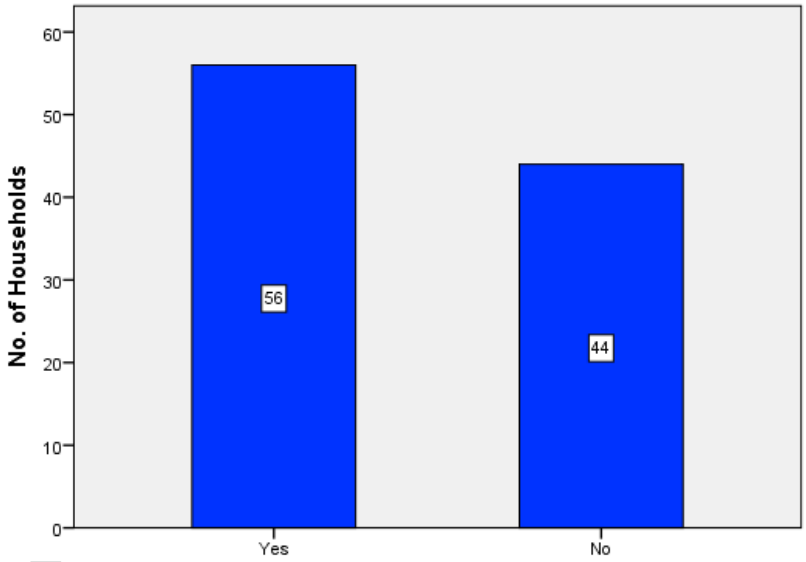


Figure 49: Households paying for Waste Collection

After generation, storage and collection of wastes, peoples were enquired about the waste reduction practice. Form the field survey it is found that, most of the people have knowledge about composting of organic waste. But during field survey, it is found that only 22% of total household practice composting.

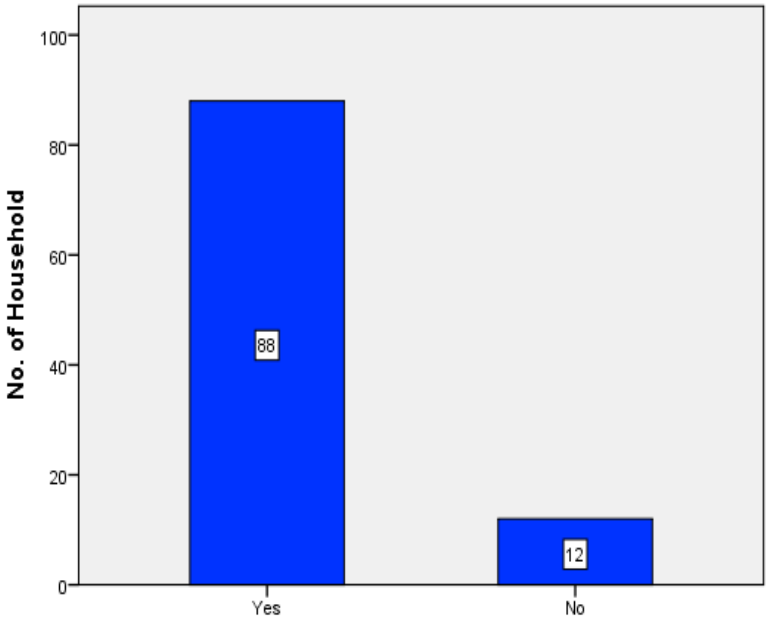


Figure 50: Knowledge about composting

Composting is generally practice by those who own terrace garden. From the field survey it is found that, out of 22 households who practice composting, 18 households own terrace garden. Below chart shows that, 78 % of households do not practice composting. These mixed waste goes directly to municipal vehicle and end up at landfill site. According to ADB 2013 also, only 30% of municipalities with rural background practice composting and urban areas generally do not practice composting of organic waste.

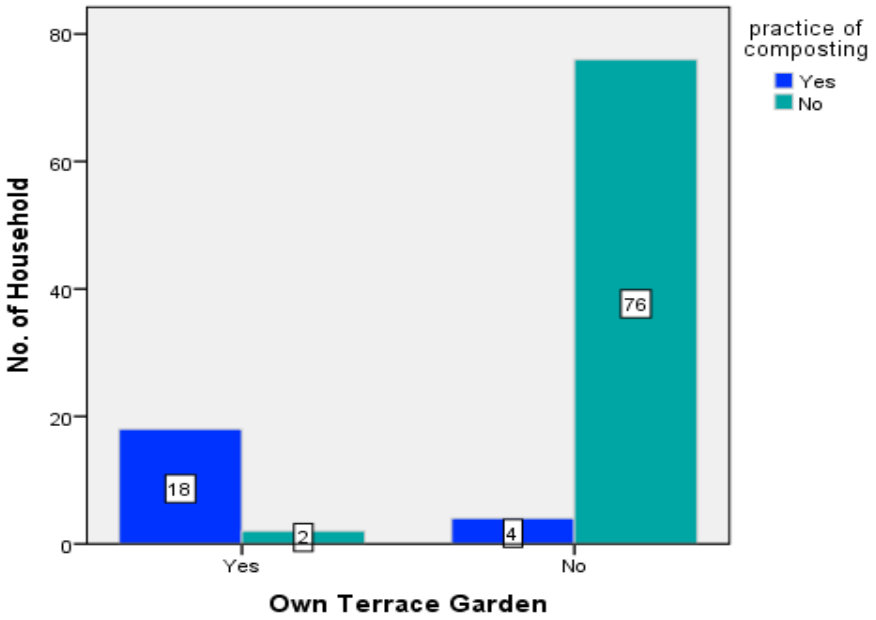


Figure 51: Household with terrace garden and practicing composting

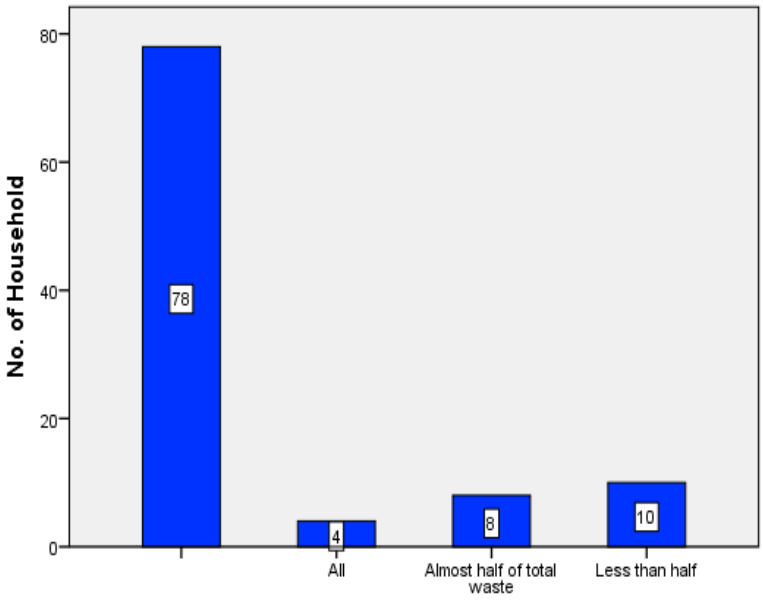


Figure 52: Amount of Composting

Those who practice composting, do not use all the organic waste that is generated. Out of 100 households, only 4 households convert all organic waste into compost manure. Amount of composing depend upon the requirement of household.

Generally people of this ward do not practice composting as all the residential building has been modernized and people are engage in other occupation rather than agriculture. During field survey also, people answer that

- There is no space available for composting
- There is no place to use compost manure

Beside organic wastes, there are also different reusable and recyclable waste. These wastes can generate money if stored properly but people prefer to dispose it off along with other waste. Upon filed survey also, it is found that 70 out of 100 households dispose these waste to municipal vehicle whereas 24 households sell it to scrapper.

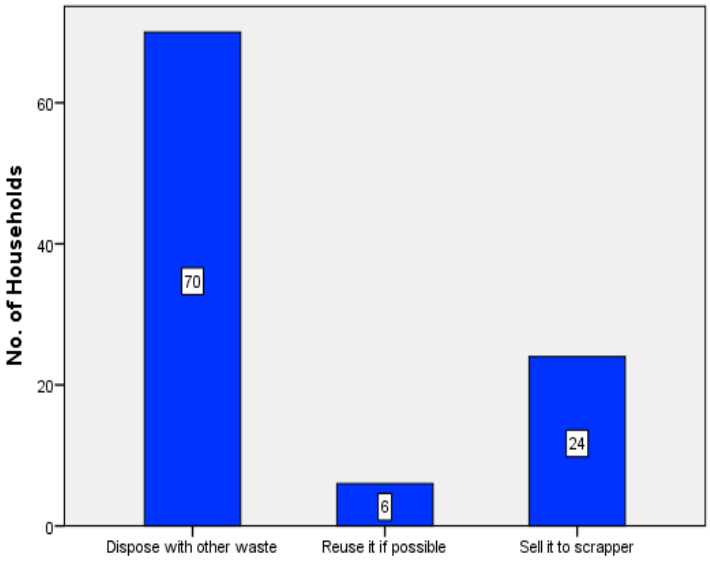
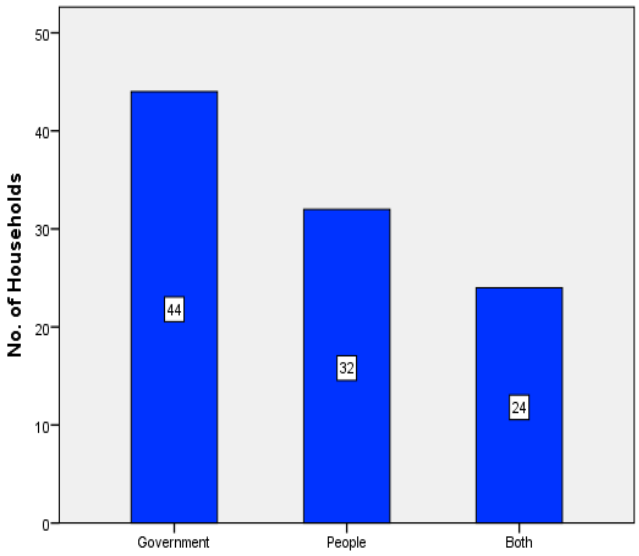


Figure 53: Reusable and Recyclable waste treatment

Today there are some online organization which has made scrap selling easy and convenient but the core areas are unaware about these new technology and medium. They know about the informal waste buyer but prefer to throw the scrap rather than storing them to sell.



All people are aware of harmful effect of haphazard solid waste management but depend upon municipality for proper and complete waste management. Out of 100 households, 44 % think that SWM is solely responsibility of government But 32% of household consider it as their own responsibility as they generate the wastes.

Figure 54: Responsibility of Solid Waste Management

Education plays an important role in making public aware about their responsibility and rights. From the survey it is found that, many people who are illiterate consider SWM as responsibility of government whereas the educated people consider SWM as responsibility of people or both.

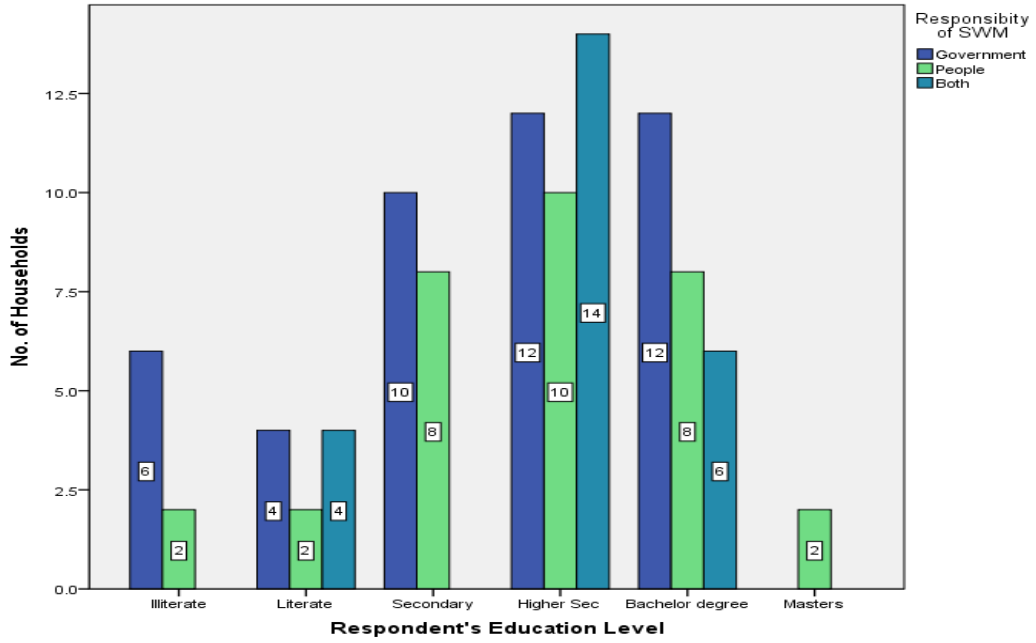


Figure 55: Education level of Respondent and SWM responsibility

4.6.3 Willingness of Public in SWM

For sustainable waste management, public participation plays an important role. Cooperation form people and community is necessary in terms of changing their practice, their attitude and making them realize their responsibility can considerably improve the effectiveness of system. Almost all people are aware about the degrading environment due to haphazard waste disposal but this cannot be associated with their willingness to participate.

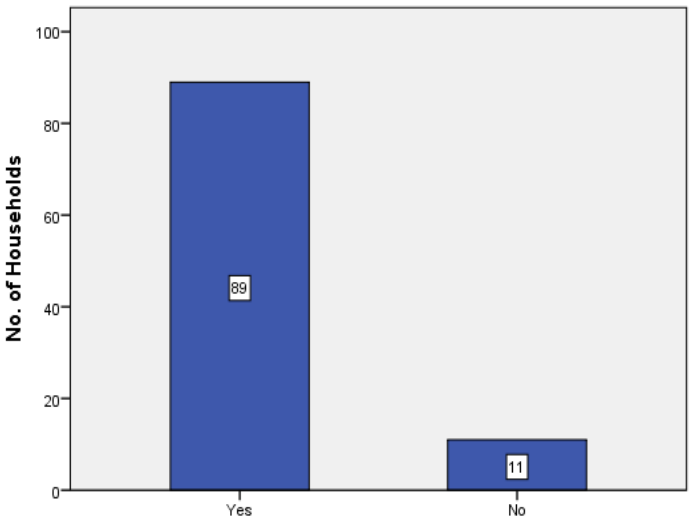


Figure 56: Willingness to segregate wastes

Separation of waste at source not only decrease the cost for municipality, but also help to manage the waste properly. From the field survey it is found that almost 90% of total households are willing to segregate waste if they are provided with separated bins for waste separation.

According to ADB 2013, total wastes generated consist of 70% of organic waste and in urban areas, people do not practice composting. All the organic wastes that can be used as resources are dumped into landfill site. This also decrease the lifespan of landfill sites.

In field survey, out of 100 only 32 households are willing to practice composting if there is arrangement for selling compost. Despite that people are not willing to practice composting as it require space and produce foul smell.

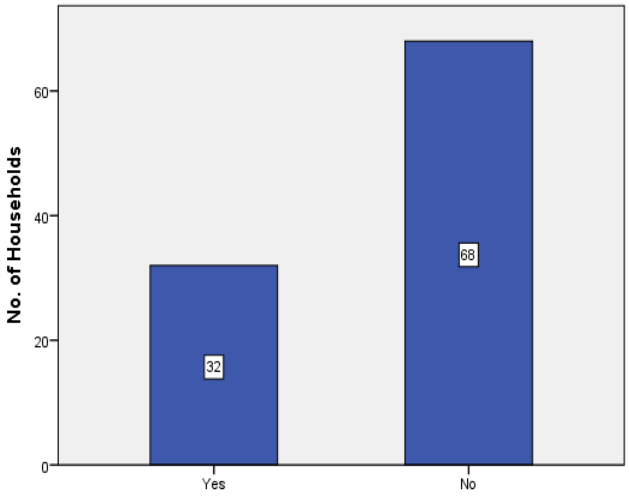


Figure 57: willingness to practice composting

Beside composting and segregation of waste, training programs are important to manage solid waste at ward level. From the survey, it is found that people prefer to take training related to terrace gardening rather than composting and making artifacts. But many people are not interested in training programs provided as they have to dedicate more time for this.

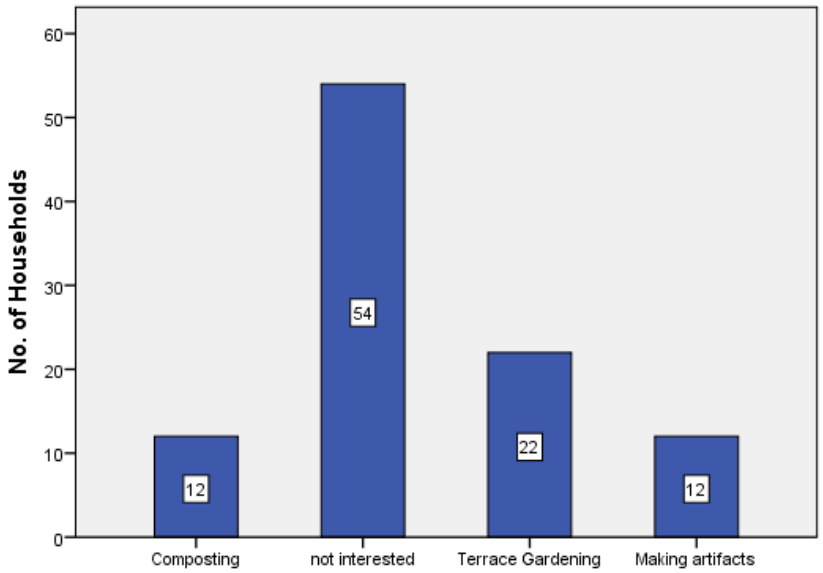


Figure 58: Willingness to participate in different training program

Also, the survey results shows that women are more interested in participating in training programs. Out of 32 female respondent, only 4 are not willing to participate whereas 50 out of 68 male respondent are not interested in training programs.

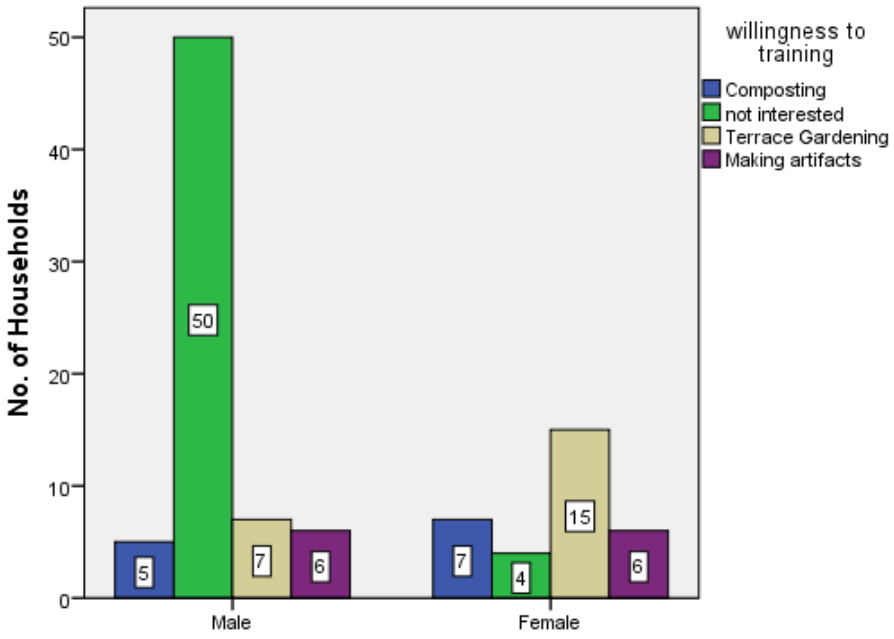


Figure 59: Gender of Respondent and their willingness to participate

4.7 ANALYSIS

4.7.1 Key Stakeholder for SWM

The analysis of this research is based upon stakeholder analysis as stakeholders are important for solid waste management services. The stakeholders of ward no. 27 for SWM are as follows:

Primary Stakeholder	Secondary Stakeholders	External Stakeholders
1. Public (Householders & Citizen)	1. Environment Management Department & their employees(KMC) 2. SWMTSC 3. CBOs (Guthi & Tole Sudhar Samiti, Youth or Women Org) 4. Waste Picker	1. Neighboring Communities 2. Itinerant waste buyers 3. Middleman in waste recycling trade (like Khalisis.com & Dokorecyclers)

Table 5: Key Stakeholders in SWM of Ward no. 27

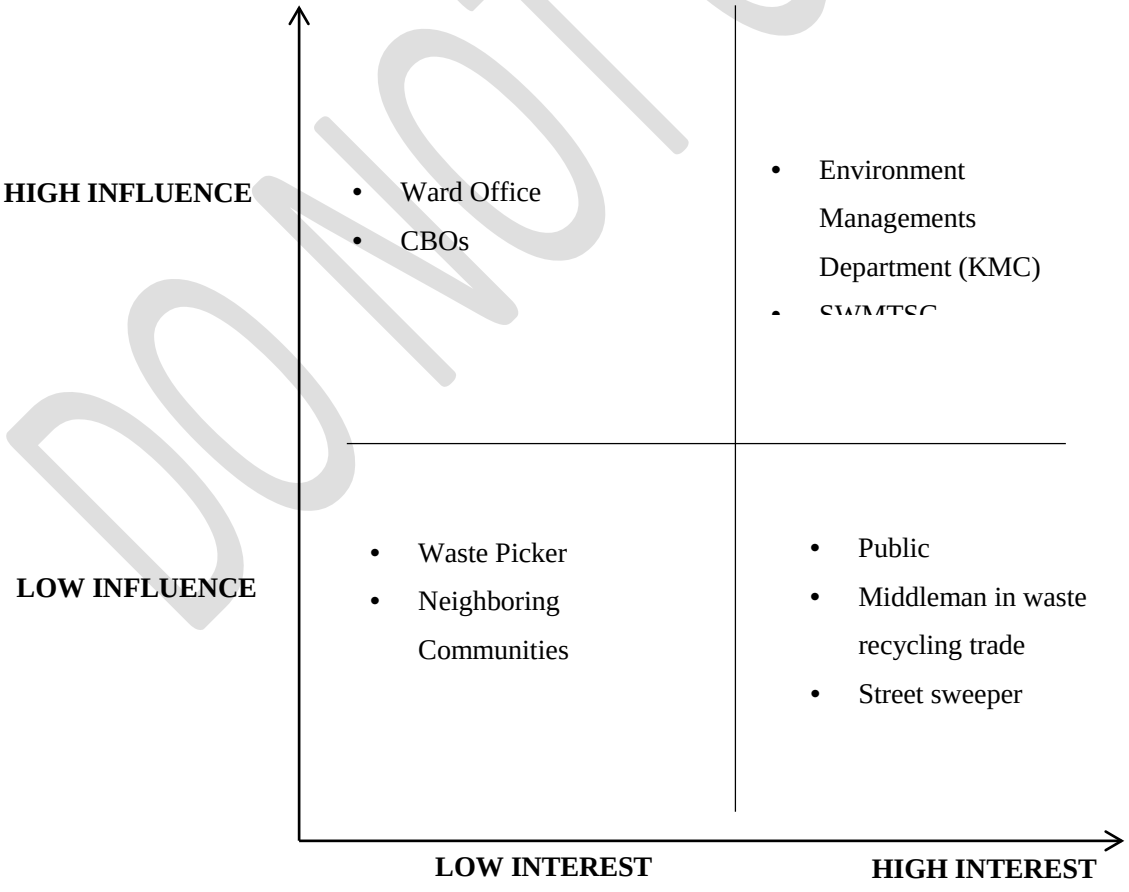


Figure 60: Stakeholders Analysis Chart for Interest and Influence of Ward no.27

4.7.2 Role of different Stakeholder

i. Environment Management Department (KMC)

It is department of KMC which is sole responsible for solid waste management of ward no. 27. It is responsible for collection, segregation, transportation and final disposal of solid waste from whole ward. It is also responsible for sweeping and collecting wastes from street and open spaces of this ward. It has direct interest and influence on SWM.

ii. Solid Waste Management and Technical Support Center (SWMTSC)

SWMTSC provide technical support for SWM. In ward level it provide training programs, distribution of dustbins, compost plant and so on but require collaboration with ward office. It also has direct interest on SWM but in context of this ward, the role of this organization is yet to explore.

iii. Ward Office

Wards offices are responsible for overall management and functioning of particular ward. In any wards, trainings and programs related to SWM is carried through ward office. But in present context, SWM is carried by KMC and ward level does not play any role. Ward office of this ward has not performed any training or programs till today. But during festival, ward office is responsible for cleaning of public spaces like streets, chowks and nani. Thus ward office has major importance in managing solid waste of the ward but has no power. After the central election, powers of ward office will be implemented but it will operated under municipality.

iv. CBOs

In ward no. 22, there are many community based organizations such as Guthi, Tole Sudhar Samiti, Woman's committee and Youth club. These organizations are more active in residential areas rather than commercial areas.

Guthi is traditional community organization which is homogenous in context of caste of people. In many areas, Guthi has been collapsed as indigenous people are moving away from the core. From the field survey also it is found that out of 100, only 26 are associated with social organization. There are different Guthi in different tole and there are more than one Guthi in each tole. The Guthi is responsible for performing puja, feast and festivals and but does not play any role in SWM of the community.

Tole Sudhar Samiti is modern community organization which is heterogeneous in nature. Each tole has one Tole Sudhar Samiti that has been established for welfare of the society. In most of the cases, these tole Samiti are not that actively involved in SWM

except in Dhwakha Bahal. In Dhwakha Bahal, this Samiti is actively involved in SWM like cleaning of open space and collection of cleaning fee. In commercial area, there is no such organization whereas in some tole, residents are unaware about presence of these organization.

Similarly there are some women organizations and youth club in some of the toles but they don't participate in waste management program.

v. Public

Public of this ward refer to the householders and citizens who are the waste generator in this ward. Public could be permanent resident, tenant or shopkeeper, street vendors or street walker who are responsible for generation of wastes. Public are also responsible for reduction of wastes to be collected by municipality. But there are only 22% of household who segregate the waste during storage. Also some public participate in waste management by paying for the collection of waste. Generally, these public are those living in inner chowks and shopkeepers. From the survey about 56% of respondent pay for the waste collection to the municipal sweeper

vi. Middleman in waste recycling trade

Waste recycling traders are main stakeholders for waste reduction in any wards. These traders could be street hawker or formal/informal waste buyer who are active in every wards. Especially, the itinerant waste buyers who exchange reusable waste with money. But the influence of these waste traders depend upon the interest of residents.

There has been innovation in waste buying by establishment of online portals for easy and convenient waste recycle but traditional residents are unaware about these organizations.

vii. Waste Picker

Waste picker are informal stakeholder responsible for reduction of reusable and recyclable waste who roam around these wards. These waste picker are active in commercial areas during or after closing of commercial activities. They restore the waste from dumped wastes or waste piles. These stakeholders are of high importance but have less power.

viii. Neighboring communities

Neighboring communities are different wards that surrounds this wards. The SWM programs in neighboring communities has little influence and the neighboring communities has low interest over SWM of this ward

ix. Street Sweeper

Street sweeper are staffs of municipality (Environment Management Department) who are responsible for cleaning of streets and open space of the wards. They also collect waste from the households where there is no provision for municipal vehicle.

१	सु.भा.	माधव सुवेदी
२	नाइके	प्रविन्द्र पोडे
३	२५४/७९	ज्ञानलाल पोडे
४	स ३६	मदन पोडे
५	३०० मध्ये	चाकला पोडे
६	कूचिकार	बबिता पोडे
७	पा १९	किशोर पोडे
८	१२/४	बिना पोडे
९	३०० मध्ये	माया पोडे
१०	३०० मध्ये	शंखर पोडे
११	३०० मध्ये	कान्छी पोडे
१२	२५४/१६१	दिलशोभा पोडे
१३	पा ४९	गोपिलाल पोडे
१४	पा १५४	प्रकाश पोडे
१५	कूचिकार	मैया च्यामीनी
१६	कूचिकार	सरिता पोडे
१७	पा ३५	निलशोभा पोडे

Figure 61: List of Street Sweeper for Ward no. 27 (Source: Environment Management Department)

These street sweeper transfer these waste to the collection point or municipal vehicle. These street sweeper are recruited by municipality. In present context, there are 17 street sweeper assigned for cleaning of whole ward and they are all from lower caste. They are important stakeholder for SWM

4.8 FINDINGS

- Population of the capital city is increasing every day. As the growth rate of Kathmandu is 4.63%, it seems that population of this ward will increase so will the solid wastes generation. If the municipal collection rate is same as today then there will be huge gap between demand and supply of SWM.
- Kathmandu metropolitan city is the sole stakeholder for the management of waste in this ward. Although ward office is responsible for waste reduction (by providing training and awareness campaign) in the ward, it has not conducted any trainings till today. And after central election, ward office will have more power
- Most of the waste generated in this ward is organic and people don't practice composting of these wastes. Almost everyone has knowledge about composting of organic waste but very few practice composting. Those household who owns terrace garden generally practice composting. Due to the lack of space and use, composting is not generally practiced by people. From survey also it is found that, out of 100 only 4 household completely compost the organic waste.

- Population growth is result of migration from rural areas. This ward of KMC also has many migrants either as tenant, shop holder or street vendor. But still there are majority of Newar families residing in this ward. Upon field survey, it is found that 32 out of 100 household has tenant (1- 10 tenant per house). Although there is majority of Newar, the social organization "Guthi" has collapsed thus very few people are associated with Guthi. Guthi is active in those tole where society is homogenous in terms of caste.
- Guthi does not play any role on SWM of community. Similarly, the youth club and Woman committee also has no role towards SWM. But Tole Sudhar Samiti is modern heterogeneous organization of community and every people of tole is member to this Samiti. In many tole these samiti actively participate in SWM of community whereas in some tole people does not have any knowledge about these samiti.
- Many household of this ward do not segregate organic/ inorganic waste and municipality also does not have any provision to collect segregated waste separately. All the wastes are mixed up in same vehicle and dumped into landfill site. Also the recyclable and reusable waste are disposed along with other waste as these waste are less in amount and people find it inconvenient to store these wastes rather than exchanging with waste buyer.
- There is innovation in waste buying through online portal but the residents of this ward are unknown to these kind of services. Thus service of these waste buyer are limited and could not reach to core areas of Kathmandu city.
- In many tole of ward, waste is collected daily by municipal vehicle or street sweeper either in tripper, tractor or container. Waste gets collected either in municipal vehicle or collected from chowks or roadside by street sweeper. Thus street sweeper plays an important role in SWM of this ward. People has to pay for the service provided by street sweeper. From field survey, it is found that 56 out of 100 household pay for the waste collection in this ward.
- All people are very much aware about the harmful impact of haphazard disposal of solid waste but many people think it as sole responsibility of government to manage solid wastes. Educational background plays an important role to make people realize their responsibility towards SWM.
- In support from ward office, people of this ward is willing to participate in waste reduction program such as segregation of waste, composting, training for terrace garden etc. But people still does not prefer composting and making artifacts from waste.

4.9 CONCLUSION

Managing solid waste has become a major urban problem of Kathmandu municipality. Increasing population concentration, increasing rate of waste generation, limited resources of municipality has result into unmanaged solid waste. Case area studies in different cities during literature showed that SWM is global issues which has been addressed in different ways in different countries which include participation from community and public. In early Malla period, people were capable of managing generated solid waste on their own way. Thus the same participation from people can fill the gap between demand and supply for SWM that existed within ward no. 27 of municipality.

Ward no.27 of KMC is major waste generator due to its compact settlement, different market squares, commercial areas and tourist centers. In present context, waste management is handled by municipality only. The waste generation amount is increasing whereas the resources of municipality is not sufficient to handle the complete waste management of the ward.

As it is already mentioned above, in absence of municipal service, waste is thrown haphazardly in public spaces such as chowks and roadside. During municipal service also approximately 12.50 ton of waste per month is remain uncollected. People of this ward are aware about the negative impact of haphazard disposal of waste. But still they prefer to throw waste outside instead of managing within their premises. Field survey results shows that, people of this ward neither practice composting of organic waste nor they recycle the scrap waste. All of these wastes are collected by municipality and finally disposed into landfill sites.

Waste disposal into landfill at this rate is decreasing life of landfill at rapid pace. And the municipality has limited land resources for new landfill site. Thus it is very important to reduce waste that is carried to landfill through composting and 7R concept. Filed survey shows that educated people think SWM as responsibility of people whereas illiterate people think it as sole responsibility of government. But it is responsibility of both government and people to manage solid waste. Resident of this ward are interested to participate in training programs related to SWM especially women are more interested than men.

Thus if assistance is provided through ward office or SWMTSC, resident are interested to manage generated solid waste through composting, waste segregation, waste recycle and reuse and recovery.

4.10 RECOMMENDATIONS

From the above analysis it is found that in ward no. 27 solid waste management is carried out by municipality only. The ward office as well as CBO also plays active role in functioning and management of the ward but has not initiated any programs regarding SWM. There are very few residents who participate in waste reduction. Thus on the basis of stakeholder analysis, following recommendations has been proposed:

i. Environment Management Department (KMC)

In present context, KMC is sole responsible for managing solid waste in this ward, thus the environment management department plays important role in SWM.

- Municipality should develop those human resources that has knowledge about proper SWM.
- It should also develop the plan and policies so that private sector and CBO could participate in SWM which not only facilitate the management efficiency of solid waste but also decrease the burden of municipality.
- The segregated waste is collected in same day and same vehicle by municipality thus sorting of dry and wet waste at source is not beneficial. So KMC should also develop the concept of source segregation through separate collection for dry and wet waste either in different vehicle or in different days.
- Waste collection point and frequency should be systematic and regular so that people do not dispose the waste haphazardly in public/ open space.
- The municipal office should tie up with company like **Biocomp Nepal** that collect organic waste for large scale composting. Since the large part of solid waste is organic, this will not only decrease the waste that is carried to landfill but also decrease the use and import of chemical fertilizer in agricultural production.
- KMC should implement strict rules, regulation and fine system for the people so that they practice proper segregation, reduction and disposal of solid waste.

ii. Ward Office

People of this ward are aware about harmful effect of solid waste but they need to be aware about their responsibility towards managing solid waste. Awareness plays an important role for effective waste management and education plays an important role in raising awareness. Thus ward office is responsible for awareness and training programs related to SWM.

- Ward office should conduct various awareness campaign so that people of this ward realize their responsibility towards managing solid waste.
- From survey it is found that if aid is provided, residents are willing to participate in different trainings thus ward office should coordinate with SWMTSC to provide trainings related to SWM.
- The compact settlement of the ward makes it impossible for establishment of compost plant, thus vermi-composting and vessel composting can be practiced within the buildings. So these compost bins should be made available at minimum cost to local residents by ward office.
- In urban areas, composting is practiced by those who own terrace garden which is also found during field survey. Thus to motivate composting, training regarding proper terrace gardening should be provided. 1 kg organic waste produce 0.25 kg of compost which can be utilized in terrace garden. This will not only decrease the organic waste carried to the municipal vehicle but also help to produce healthy organic vegetables on their own.
- Those people without terrace garden should encourage for composting of organic waste by collection of compost in exchange of money by ward office that can be utilized in agricultural sector.
- To encourage waste segregation, segregation bins should be provided to the residents at free of cost or at minimum cost. Also the waste that is not sorted should not be collected by municipal vehicle.
- Regular cleaning of public space and regular waste collection should be supervised by ward office.
- Ward office should be responsible for the placement of waste bins in public space at certain interval so that the waste such as food wrappers, cans, papers etc. are not thrown haphazardly by those who walk along the roads.

iii. CBOs

For community participation in SWM, CBOs plays an important role. Providing training or awareness to few personnel from community is easier than providing training to every individual. For this CBOs are important as they are the representative of the community and to communicate with individual is easy and effective through these social and community organizations.

- Guthi organization, Tole Sudhar Samiti, Women organizations and Youth organizations should generate understanding of solid waste among the member of their organization which further help to convey the knowledge to other people of the community.
- Women are more responsible for managing of household waste and filed survey also shows that women are more interested to participate in training programs. Thus women and women organizations should be empowered and encouraged to participate in various training programs.
- The women organizations should collect the recyclable waste from every member on weekly or monthly basis as a routine and sell them to the waste buyer in combine form which is beneficial to both organization and the waste buyer.
- All the open spaces of this ward are public spaces where establishment of compost plant is not possible but communal storage for scrap waste should be made by Tole Sudhar Samiti or Guthi organizations which could be sold to large scale recycle traders.
- CBOs should coordinate with local bodies for different plans and program related to SWM and they should also follow up and monitor the implementation of these plans and programs related to SWM.

iv. Public

- Compact settlement, high population density, different market squares and tourist centers make it a high waste generator and it is responsibility of every individual to store the waste properly within the premises before disposing into agreed time and place.
- Public can participate in waste management by segregating organic and inorganic waste in separate bins during waste storage.
- According to SWM Act 2011, every individual should participate in waste reduction which can be practiced through 7R concept of SWM such as
    - More reuse of materials within household rather than dumping in municipal vehicle
    - Recycle of scrap materials either by selling it to scrap waste collector or by making artifacts

- Rejection of materials that cannot be recycled such as plastic bags, use and throw plates glass etc.
- Reduction of waste by composting of organic waste at home through vermin composting or vessel composting which could be either used or sell.
- Respond if the people throw the waste haphazardly so that people do not dispose the waste in public or open space.

v. Middleman in Waste Recycling Trade

Waste recycling is important step for waste reduction. Itinerant waste buyer and formal/informal waste trader collect scrap waste and convert trash into cash.

- Most of the waste buyer are informal sector but these buyer should be organized and regulated according to the amount of scarp waste generated so that these waste does not end at landfill.
- There are digital platform for waste buying so that people can sell their waste in easy way but the people of this ward are not aware about this. So these stakeholders should make residents aware about their existence and the convenient method of selling waste through these organization.

vi. Street Sweeper

Street sweepers are main stakeholders for SWM from innermost chowks and nani where accessibility of large public vehicle is not possible.

- Street sweeper should clean the public spaces and streets daily and collect the household solid waste in regular basis.
- There should be uniformity in collection and cleaning services provided by street sweeper.

ANNEX

QUESTIONNAIRE FOR INDIVIDUAL PEOPLE

HOUSEHOLD INFORMATIONS

SURVEY No. ……

1. **Tole: ……...**
2. **Name of Respondent**: ……
3. **Gender:** i. Male ii. Female iii. Others
4. **Age:** ……..
5. **Caste**: ……
6. **Education Level**
   i. Uneducated ii. Educated iii. Primary iv. Secondary
   v. Higher secondary vi. Bachelor vii. Masters
7. **Occupation**
   i. Agriculture ii. Business iii. Government Service iv. Private Service
   v. Housewife vi. Student vii. Retired vii. Unemployment vii. Others
8. **No. of family members**: ……
9. **Are you associate with some social groups or Guthi within this community?**
   i. Yes ii. No
10. **If yes-**

Name	Purpose

11. **Are you indigenous to this community (tole)?**
    i. Yes ii. No
12. **If migrated- from where? …….**
13. **Is the respondent**
    i. Owner ii. Tenant
14. **If Owner- how many tenants are there?**

i. 1-5 ii. 5-10 ii. 10-15 iii. 15-20

15. If Tenant, how long (in years) they have been living in this place

i. < 1 ii. 1-3 iii. 3-5 iv.5-10 v. >10

16. Building type:

i. Load bearing ii. Frame Structure

17. Building Storey

……

18. Purpose of the Building

i. Residential ii. Commercial iii. Go down iv. Mixed

19. If commercial or go down, specify the type ……..

SOLID WASTE INFORMATION

A. GENERATION

1. How much waste is generated?

i. 1-2kg ii. 3-5kg iii. 5-7 kg iv. >7 kg

2. What is the major waste generated?

i. Degradable ii. Paper iii. Plastic bags iv. Plastic Bottles

v. Metal vi. Glass vii. Textile viii. E-waste ix. Others

B. STORAGE

1. Where the wastes are stored before disposal?

i. Bags ii. Bins iii. Both

2. Do you segregate the organic and dry waste during storage?

i. Yes ii. No

3. If No- Why?

……

C. COLLECTION

1. Time of waste collection

i. Morning ii. Daytime iii. Evening

2. Frequency of waste collection

i. Daily ii. In Alternate Days iii. Twice a week iv. Once in a week

3. Vehicle for waste collection

i. Container ii. Tripper iii. Tractor iv. Tricycle

4. **Point of waste collection**

   i. Chowk ii. Roadside iii. Municipal Container iv.Private Sector

5. **Do you pay for the collection of waste?**

   i. Yes ii. No

6. **If Yes- How much do you pay?** ……

7. **Is there any problem in waste collection system?**

   ……

D. REDUCTION OF WASTE

1. **Do you have knowledge about composting of organic waste?**

   i. Yes ii. No

2. **Do you own Terrace Garden**

   ii. Yes ii. No

3. **Do you practice composting of organic waste?**

   iii. Yes ii. No

4. **If yes- how much of organic waste do you compost?**

   i. All ii. Half of the waste iii. Less than half

5. **If no- reason.**

   ……..

6. **How do you treat the reusable/recyclable waste?**

   i. Dispose with other waste

   ii. Reuse it

   iii. Sell in to scrapper

7. **Do you have knowledge about online services for selling wastes (reusable/recyclable)?**

   i. Yes ii. No

8. **What will you do if municipal vehicle do not arrive regularly?**

   i. Store the waste properly within the house

   ii. Burn the waste

   iii. Throw the waste outside and forget

9. **Solid Waste Management- whose responsibility is this?**

   i. Government ii. People

10. **Do you know about harmful effect on your health and surrounding due to haphazard waste disposal?**

    i. Yes ii. No

11. **If ward office/ other organization buy the compost manure from you, are you willing to practice composting of organic waste?**

    i. Yes ii. No

12. **If ward office provide different dustbins foe segregation of organic and inorganic waste, are you willing to segregate waste?**

    i. Yes ii. No

13. **If SWM training is provided, which training would you like to take?**

    i. Terrace Gardening ii. Composting iii. Making artifacts from wastes iv. Not interested in training

14. **What do you think the current waste management problem/issues?**

    ……..

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