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INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS

**Stakeholder Participation in Managing Municipal Solid Waste at The Point
of Generation: A Case of Kirtipur**

by

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A THESIS REPORT

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THE DEGREE OF MASTER OF SCIENCE IN URBAN PLANNING**

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DECLARATION

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ABSTRACT

This study aims to explore how MSW can be efficiently managed at the generation point, through stakeholder participation to reduce the waste load in the landfill site by doing qualitative analysis. Ward 2 of Kirtipur, was selected as a growing urban settlement. It lies in the south of the Kathmandu. The urbanization in the modern age has had a huge impact on the environment, among the various causes solid waste is the one. Managing solid waste had become a big challenge in developed and developing cities. As the populations increased, efforts were made to transport waste farther out from the cities to landfill sites. Landfill may not be a sustainable solution for waste management. Household source reduction may be one of the sustainable solutions for waste management. Various methods of waste reduction were determined based on the standard data from literature. In this study role of stakeholders in the management of solid waste at source was evaluated. In addition, whether the current policy adequately address the problem of waste reduction at the source was evaluated. The study also examined case studies with success stories which reflects improved scenario through waste segregation. Moreover, social perspective from community, government institutions and people involved in source reduction were analysed. Based on the qualitative analysis, behaviour, level of knowledge, practices and willingness of people on source reduction was determined.

Keywords: Source reduction, Stakeholder's, Policy, Willingness

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076Msurp007

LIST OF ACRONYMS

DUDBC: Department of Urban Development and Building Construction

GoN: Government of Nepal

SWM: Solid Waste Management

3R: Reuse, Recycle, Repair

IOE: Institute of Engineering

KII: Key Informant's Interview

KMC: Kathmandu Metropolitan City

KVDA: Kathmandu Valley Development Authority

MOUD: Ministry of Urban Development

NGO: Non-Governmental Organization

NUDS: National Urban Development Strategy

TU: Tribhuvan University

UEMS: Urban Environment Management Society

WEPCO: Women's Environment Preservation Committee

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CHAPTER 1: INTRODUCTION

1.1 Background

Solid waste is defined as non-recyclable and sometimes hazardous material with low liquid content. They include municipal garbage, industrial and commercial waste, sewage sludge, wastes resulting from agricultural and animal husbandry, demolition wastes, and mining residues. They are classified as bio-degradable and non-biodegradable waste. Types of solid waste generated in residential areas include food waste, packaging, papers, and miscellaneous items that have been used up or broken and are thrown out as waste.

Solid waste management is always a challenging part of an urban area either in a developed or developing country. In ancient cities waste was thrown onto unpaved streets and roadways, where it accumulated. Open holes outside the city walls served as extremely primitive disposal options. As populations increased, efforts were made to transport waste farther out from the cities to landfill sites (Jerry A. Nathanson, n.d.). Landfilling may not be a sustainable solution for waste management. Household source reduction may be one of the sustainable solutions for waste management. The term "waste reduction" refers to the technique of reducing waste creation at the source and, when wastes cannot be prevented, using environmentally sound on-site or off-site reuse and recycling. Waste reduction is necessary to reduce waste to landfills and decreasing the need of landfill area.

Currently 54% of the world's population lives in urban areas which are expected to increase to 66% by 2050 (Hannah Ritchie and Max Roser, 2018). Around the world 1.3 billion tons of solid waste are generated per year, amounting to a footprint of 1.2 kg/per/day. It is expected to rise to 2.2 billion tons and generate waste of about 1.42 kg/per/day in 2025 (Maharjan et al., 2019).

Nepal is also expanding quickly. The amount of organic waste fell and the amount of inorganic waste increased with the shift from the agriculture sector to the service sector. In municipalities of Nepal, waste generation is about 3023 tons per day and the average per capita waste generation is 0.223 kg/person/day. On average, the waste composition is primarily decomposable about 60%, and about 25% is recyclables such as plastics, papers, and metals (Pokhrel & Viraraghavan, 2005). The Kathmandu Valley's major urban areas produce the most municipal waste which is about 620 tons/day (441.61 gm/capita/day) (Maharjan et al., 2019). The organic waste composition was highest (54.0%) in 2075/76 compared to the inorganic waste (33.3%) and other wastes (12.7%) (CBS, 2020a). Among the metropolitan cities, the

quantity of daily waste collection was highest in the household (15900 kg/day), followed by the business complex (7700 kg/day) and the educational institutes (4680 kg/day). Similarly, households remained the major sources of waste generation in the sub-metropolitan cities (3300 kg/day) and municipalities (1440 kg/day) (CBS, 2020b). Thus, waste needs to be managed from the generation point.

1.2 Problem Statement

The urban population of Nepal increases from 14% to 17% from 2001 to 2011 (Khandelwal et al., 2019). This growing urbanization creates various problems. A CBS survey in 1997 shows that solid waste (59%) is one of the major environmental problems in Nepal followed by sewerage (25%), air pollution (7%), and water pollution (5%) (Pokhrel & Viraraghavan, 2005). Kirtipur is also a growing city and is also suffering from this problem. According to CBS/2009, the maximum waste generated in Kirtipur is organic and is about 74% in 2000, 75% in 2005, and 74.2% in 2006, and other waste such as paper, plastic, etc. (Khandelwal et al., 2019) The probable problem statement for this research can be: Increasing population generates a huge amount of waste and its management became a big challenge. Thus, managing waste properly from the source itself could be a suitable solution.

1.3 Need of the Research

Over the past decades, there is an increase in the percentage of people living in urban areas. Rapid urbanization and industrialisation have improved socioeconomic situations and consumption habits among urban inhabitants. Development in resource and wealth create high per capita waste generation. The disposal of waste has raised concerns about a resource, health, and environmental issues. Thus solid waste management has become one of the major problems for many urban areas in Nepal.

It was found that 497.3 gm/capita/day of solid waste was generated from households and 48.5, 113.3, and 26.1 kg/day of waste was generated from restaurants, hotels, and schools, respectively (Jerin et al., 2022). And the waste generated is disposed of at landfill sites. Among the total municipalities surveyed, 114 (42.0%) municipalities were using the landfilling practices, 117 (43.2%) municipalities were not practicing the approaches, and the remaining 40 (14.8%) municipalities did not respond about the landfill sites (CBS, 2020b).

Disposal at landfill sites may not be an appropriate solution so source reduction could be one of the suitable methods for solid waste management. As such, this research shall examine the methods used at the generation point to reduce waste, the stakeholders involved, the existing policies, the challenges they are facing in the management of waste, and possible strategies for their proper management.

1.4 Importance of the Research

Solid waste management became the great challenge in the Kathmandu Valley not only with the management system but also in gaining public awareness and participation of the people. The importance of waste management is being considered and realized by the people. Proper waste management contributes to good health and the environment. Literature has been carried out regarding the need for waste management in city and urban areas along with its benefits. But there is a gap in understanding why the issue of waste is not being addressed in our context regarding its management and policy formation. Solid waste management in cities is a global issue that requires immediate attention and research to limit its consequences. There has been researched on different methods and techniques of waste management on a different scale. But, the proper working framework on an individual basis is the need for the source control of waste. This research can be used by responsible agencies as a credible reference to address the existing problems regarding management issues and ways to address them.

1.5 Research question

The research question for this thesis can be:

- a) How can municipal solid waste be efficiently managed at the point of generation to reduce waste loads at landfills?
- b) What role could stakeholders play in the management of solid waste at the source?
- c) Do current policies adequately address the problem of waste reduction at the source?

1.6 Research Objective

The main objective of the research is to explore how MSW can be efficiently managed at the generation point, through stakeholder participation to reduce the waste load in the landfill site, taking the case of Kirtipur. The specific objective for the thesis are;

- a) To explore the current scenario in managing MSW at the point of generation.

- b) To identify the role of stakeholders in the management of solid waste at the source.
- c) To identify the policy gaps in the proper management of MSW at the point of generation.

1.7 Limitations of the Research

Despite acknowledging the importance of the context and boundary conditions, there were several limitations in the study. The research is limited to ward 2 of Kirtipur and the findings obtained will be entirely context based. As a result, the findings may not be applicable in other areas. Also, the research is focused on the household level so doesn't talk about the community level waste management and others.

CHAPTER 2: CONCEPTUAL FRAMEWORK AND RESEARCH METHODOLOGY

This chapter deals with the research framework and philosophical perspective of research process to carry out the research objectives. It explains the study's context, sample design, measurement tool, data collection procedure, and data analysis techniques utilized to arrive at the research conclusions.

2.1 Research paradigm

A paradigm offers a theoretical framework for understanding and perceiving the social world. A paradigm is a fundamental theoretical framework and belief system that makes assumptions regarding ontology, epistemology, methodology, and procedures. It is the way of understanding the reality of the world (Rehman & Alharthi, 2016). There is no foundation for further decisions on technique, methods, literature, or research design without initially proposing a paradigm. Positivists, Post-positivists, Interpretivists, Transformative, and Pragmatics are the most common paradigm classifications.

Positive thinking holds that reality exists apart from people. It is not subject to human senses and is guided by unchanging laws. According to positivists, there are rules regulating social processes, and by using scientific procedures, these laws can be developed and presented as factual assertions. While objective and scientific methods are appropriate for studying natural objects, they are not as successful when they are applied to social phenomena (Rehman & Alharthi, 2016). Since my research is mainly based on social phenomena which are more of a subjective approach. So, this is not the paradigm of my research.

Post positivism believes that a context is needed and context-free experimental design is insufficient. This paradigm fits my problem. According to the post-positivist viewpoint, not everything can be fully known (Krauss, 2015). Post-positivists are in favour of the premise that social scientists and natural scientists pursue similar research objectives and use comparable methodologies (Abdullah Kamal, 2019). Post positivists argue that the ideas, and even the particular identity, of a researcher influence what they observe and therefore impact what they conclude. Post-positivism seeks to identify and account for these biases in the ideas and body of knowledge that theorists produce. This post-positivist paradigm is well suited for my research objective.

Interpretivism is a “response to the over-dominance of positivism”(Elshafie, 2013). The idea that there is a single, independently existing reality that cannot be verified by our senses is rejected by Interpretivism. Interpretive ontology is anti-foundationalist. Interpretivism, on the other hand, thinks that various realities are socially produced. Interpretive research aims to comprehend how people see the social phenomena they engage with, rather than to find knowledge and truth that are universal, context- and value-free(Rehman & Alharthi, 2016). This paradigm is more likely to rely on qualitative data and analysis. The research approach for the Interpretivism paradigm includes an interview, questionnaire, and observations.

Positivists and post-positivist usually adopt the deductive approach. A deductive approach can also be called “Top-Down” research. A deductive method focuses on "creating a hypothesis based on the theory already in existence and then building a research strategy to test the hypothesis" (Wilson, 2010). The deductive approach can explain a causal relationship between concepts and variables. The theory for my research is solid waste management which generates a hypothesis that source reduction as a solution for solid waste management. As a result, observation and primary data could be used to validate the solution.

Methodology

Ontology: Ontology refers to the nature of reality. Your ontological assumptions shape how you see and study your research object, although this may seem abstract and far removed from your intended research project (Saunders et al., 2015). The ontological claim for my research is Rapid Urbanization is generating huge amounts of waste creating various problems which can be managed by reducing waste from the source.

Epistemology: Epistemology is the assumptions about knowledge, what constitutes acceptable, valid and legitimate knowledge, and how we can communicate knowledge to others(Rehman & Alharthi, 2016). The epistemology claim for my research is that household source reduction can be validly identified in a real scenario from the literature review, case study, or survey.

2.2 Data Collection Techniques

The data collection techniques that shall be used are direct on-site observations/ checklists/ photographs where what is seen, heard, or encountered is recorded in detailed field notes. Semi-structured and open-ended interviews shall be conducted by personally asking people questions and respective authorities in one-on-one conversations and also in focus groups.

Surveys shall be conducted by distributing questionnaires with open-ended questions to understand the perspective of people on the nature and management of waste. All the above-mentioned techniques are the primary data sources.

For secondary data, the collection of existing data in the form of texts, images, audio or video recordings, etc. shall be carried out. Policy documents related to waste management shall also be reviewed. The case study can also be an important source of information for the research. Relevant international cases shall be identified and reviewed which could provide insights to address the research problem.

2.3 Methods

2.3.1. Literature Review

Literature reviews will be done to find the history of waste reduction, about what kind of waste was used to generate and how it was managed. Also, the parameters for management and the policy documents shall be reviewed.

2.3.2. Observation

In participant observation, the researcher has to immerse themselves in the setting where the respondents are while taking notes and/or recording. A checklist shall be prepared related to the site, surrounding, dispose of waste, etc. Photography, video recording, and sketches can also be done in the study areas. Observation also helps to analyse the actual condition and problems in the study areas.

2.3.3. Sample survey

In the selected households, a random sampling technique will be used for the survey. And the respondents chose shall represent a diverse range of ages, genders, occupations, income, building use, etc. Their viewpoint regarding waste reduction and management issues shall be derived. The questionnaire shall help understand the users' perceptions of waste reduction at the generation point.

2.3.4. Key Informant Interviews

Key informant interviews are in-depth interviews with people who know what is going on in the community (UCLA, 2016). The semi-structured questionnaire shall be conducted for the key informants of the area. Interviews shall also be conducted for users, corresponding

stakeholders, and responsible agencies/ organizations related to the management and challenges faced by them for implementation and execution in the study areas.

2.3.5. Case Study

For this research, a case study method is chosen and the selected case is Ward 2 of Kirtipur municipality. It will aid in the collection of more precise data about existing practices, problems, and issues.

2.3.6. Data Analysis

Various methods would be used to analyse the data such as graphs, bars, and charts. For verification and validity of the research outputs, triangulation would be used and later discussed in the findings of this research. The research report would be prepared as a result of these procedures.

CHAPTER 3: LITERATURE REVIEW

3.1 Various dimensions of Solid waste reduction at the point of generation

Source reduction, commonly referred to as waste avoidance, is a strategy that comes before waste management and focuses on how products are made and acquired. A rational strategy to cut expenses, conserve natural resources, and protect the local environment is to reduce trash before it is formed. By focusing on inefficient processes and goods, waste reduction, for instance, lowers the municipal and commercial expenses associated with garbage collection and disposal while increasing production.(Babasaheb Bhimrao Ambedkar University, 1996)

However, because the objectives and practices of the local waste management system are particular to the region, the source reduction program will only be implemented successfully with the cooperation of all stakeholders (such as enterprises, industries, consumers, and state and local governments). Programs for source reduction must to be included in a community waste management strategy. Several aspects need to be considered while assessing source reduction attempts.

3.1.1. Purpose

Source reduction can have several purposes, including the following: (Babasaheb Bhimrao Ambedkar University, 1996)

- a) **Product reuse:** The quantity of materials that need to be handled as waste is decreased when reusable items are used in place of their disposal counterparts.
- b) **Material volume reduction:** If the volume of material used is reduced then it controls the amount of waste generated and its disposal.
- c) **Toxicity reduction:** Source reduction lessens the quantity of harmful components in items that enter the trash stream as well as the damaging effects that recycling or other waste management practices have on the environment.
- d) **Increased product lifetime:** Source reduction makes it easier to use items with longer lifespans. It promotes a design for a product that favours repair and continuous use over disposal.
- e) **Decreased consumption:** Source reduction reduces the consumption of materials that are not reusable.

3.1.2. Implementation

At the local level, a number of steps may be taken to promote source reduction, including;

a) Education and research:

- Forming stakeholder council to develop a source reduction message to the public.
- Creating media campaigns for public outreach, such as conferences, forums, and posters about source reduction.
- Creating academic programs for colleges and institutions as well as assembling a team of experts in source reduction.

b) Financial incentives and disincentives:

- Implementation of source reduction activities with an economic benefit encourage source reduction. For example;
- Companies and institutions who adhere to source reduction methods may receive a tax credit or exemption.
- Based on the quantity of trash cans utilized, the quantity of bags collected, or the frequency of collection, fines or payments may apply.

c) Regulation: Local governments have the ability to take part in legislative actions that result in the development of laws, even though most rules are developed at the national and state levels. Regulatory options for source reduction can include the following:

- Quantity control regulation
- Product design regulation

3.1.3. Planning of recycling program

The factors involved in the planning process include the following(Act, 2019);

- a) Build local expertise:** Small programs reduce the issues brought on by bad planning and help develop local recycling knowledge.
- b) Understand and develop a recycling market:** It's crucial to identify a market for recyclable materials while making plans for a recycling program.
- c) Foster public education and involvement:** It's crucial to identify a market for recyclable materials while making plans for a recycling program.
- d) Assess local waste stream:** The local waste stream must be taken into account in the recycling program.

- e) **Augment existing program:** Recycling should build on the success that other organizations running recycling initiatives have already had. Planning and success depend heavily on it.
- f) **Set goals and objectives**
- g) **Coordinate the program**
- h) **Evaluate the program**

3.1.4. Waste reduction system and process

Recycling and reuse of waste materials are also included in the waste minimization strategy, which is used to reduce waste, typically by reducing it at the source. Minimizing waste has cost-saving and ecologically beneficial advantages. Source reduction, on-site storage, collection and transport, processing, and disposal are some of the variables that must be considered in order to carry out appropriate waste management.

Households may reduce residual trash and improve the amount of recyclable materials by improving waste sorting and altering their shopping habits. Informational tactics could enlighten individuals about the benefits of reducing waste as well as the best ways to do it. Households can minimize residual waste and increase the volume of materials recycled by improving waste separation and changing purchasing behaviour. Informational strategies may provide people with information on reasons to minimize waste and information on how to minimize waste. The two main ways that households can minimize their negative environmental effects are 1) by reducing their overall consumption of MW and 2) by improving the way they separate their waste into different streams that are collected separately (for example, plastic, organic, glass, paper, and cardboard waste). The decrease and better sorting of MW can also be facilitated by changes in consumer behaviour in the home. (Van der Werff et al., 2019)

3.1.5. Ways to promote waste minimization

a) Informational intervention strategy

In order to encourage sustainable waste behaviour, it seeks to alter people's knowledge, attitudes, incentives, or conventions. Informational techniques can educate individuals on where and how to recycle, with the goal of increasing recycling behaviour. It was discovered, specifically, that educating individuals on the value of recycling and how to recycle has a minor to medium impact on recycling behaviour. Recycling rates, for instance, have increased as a result of distributing fliers or brochures to houses that explain why and how to recycle. (Van der Werff et al., 2019)



Figure 1: The norm activation model

Behaviour is impacted by one's norm, claims the norm activation hypothesis. Personal norms are described as the degree to which people feel ethically obligated to engage in a behaviour, in this example, minimizing waste. In other words, how much people believe their behaviour can help solve issues, or outcome efficacy, has an impact on personal norms. And last, when there is a high level of knowledge of the ramifications, the result is more successful. The degree to which individuals are aware of the issues their behaviour might create can be characterized as their awareness of consequences; in this context, it refers to how much of them are aware that garbage can cause environmental issues. A research by Dai et al. (2015) found that people were visited in their homes and informed about the environmental harm that occurs from not recycling food trash, which increased the amount of food waste that was recycled.

Case of Netherland

The purpose of the current study is to evaluate how an informative approach may affect waste minimization and the underlying process. The research was a component of an intervention plan created by publicly traded ROVA, a Dutch rubbish collecting firm. On January 1st, 2015, the intervention got underway with the goal of getting 100 homes to live waste-free for 100 days. 100% waste-free here refers to the absence of any leftover garbage. The study focuses on two Dutch small towns with fewer than 150 residents. The program was described at an informational session that ROVA planned prior to the intervention's start. Four weeks before

to the commencement of the intervention, a questionnaire was delivered to each participating family as well as all the houses in the control group in order to create a baseline.

Overall, it was discovered that an inventive informative strategy based on active participation was successful in encouraging home waste conservation even after the intervention was stopped. The method had an impact on waste reduction, especially by raising awareness of the effects and effectiveness of the results.

b) Clean Technology

By using products, procedures, or practices that prevent, minimize, or otherwise lessen the production of pollutants or wastes, clean technology seeks to prevent environmental harm at its source. These incorporate a theoretical or methodical approach to manufacturing that mandates that all stages of a product's or a process's life cycle be handled with the elimination of risks to the environment and human health as both a short- and long-term aim.

In order to produce a clean environment that doesn't use up already limited resources or obliterate the flora and fauna by dumping harmful chemicals, clean technology must thus take a multidisciplinary approach, bringing together engineers and scientists from many fields. The ultimate goal of clean technology is to lessen environmental pollution and environmental impact. (Iyyanki V. Muralikrishna, 2017)

The following are the attributes clean technologies must gain to achieve their goals:

- Raw material conservation
- Optimal use of raw materials and other materials
- Optimal use of other valuable ingredients, namely, energy and water
- Optimization of production processes
- Safe disposal of unwanted waste
- Maximum possible recycling of unavoidable waste
- Prevention of accidents
- Prevention of pollution by risk management.

There are three broad categories of clean technologies:

- Low and non-waste technologies (LNWT) of production, which reduce waste at all stages of the production cycle by modifications to the manufacturing process, excellent housekeeping, recycling, and reuse, as well as equipment design and product compositions;

- Utilizing recycling methods for end-of-pipe treatment, which recover by-products, energy, water, and raw materials,
- Technologies for recycling trash and turning it into products with a multitude of uses. Waste reduction requires the employment of more judicious, ecologically friendly methods.

3.1.6. Composting & recycling rate

Recycling is merely common sense, and before the "modern period," it was a typical household task. 70% of American communities had recycling initiatives in place for certain materials prior to the 1920s. About 25% of the waste stream in industry during World War II was recycled and utilized again. Due to environmental concerns, recycling is once more becoming more popular. From 7.7% in 1960 to 17% in 1990, the nation's waste stream had a higher proportion of composted and recycled materials. Approximately 30% of it is now available. California is at around 48%.(Waste Statics and Overall Recycling, n.d.).

Recycling is a component of the resource-efficient philosophy of making the most of products. Natural resources and energy are preserved when recycled material is employed in place of raw material to create a new product. This is because recycled materials have already undergone some level of processing and refinement, making the second production process considerably cleaner and less energy-intensive than the first. For instance, producing aluminium using recycled cans requires 95% less energy than producing the same quantity of aluminium using bauxite. Stanford decreased its waste by 62% through recycling, composting, and other methods, while also reducing landfill use by 35%. As a result, there is improved air and water quality, less pollution, more open space and forested area, and a decrease in greenhouse gas emissions.

Municipalities in Nepal do not currently have any official programs for recovering and recycling municipal waste. However, there are a sizable number of informal garbage pickers and scrap businesses in Nepal, the bulk of which are located in populated areas like the Kathmandu Valley where reusable and recyclable materials are abundant. According to estimates, there are between 10000 and 15000 of them in the Kathmandu Valley alone (Pathak, 2013; PRISM, 2013). These informal waste workers mostly collect paper, plastic utensils, metals, and glass from sources like homes, businesses, and institutions to sell to nearby scrap yards for a living(Waste Statics and Overall Recycling, n.d.).

3.1.7. Waste statics and Overall recycling

As per the data published by the National Environment Agency waste static and recycling data are as follows;(Waste Statics and Overall Recycling, n.d.)

Table 1:Waste statics and overall Recycling

Waste Type	Total Generated ('000 tonnes)	Total Recycled ('000 tonnes)	Recycling Rate	Total Disposed ('000 tonnes)
Ferrous metal	1,312	1,306	99%	6
Paper/Cardboard	1,136	437	39%	699
Construction & Demolition	1,013	1,011	99%	2
Plastics	982	58	6%	924
Food	817	154	19%	663
Horticultural	332	277	83%	55
Wood	310	234	76%	76
Wood	310	234	76%	76
Ash & sludge	249	22	9%	227
Textile/Leather	189	7	4%	182
Used slag	182	181	99%	1
Non-ferrous metal	88	87	98%	1
Glass	74	9	13%	65
Scrap tyres	27	26	95%	1
Others (stones, ceramics, etc.)	233	18	8%	214
Overall	6,944	3,826	55%	3,118

International good practices: (Babasaheb Bhimrao Ambedkar University, 1996)

- As part of its Resource Conservation Challenge, the USA has established a national goal of 35% recycling of municipal solid trash.
- Ireland has set goals to be met by 2013, including diverting 50% of home trash from landfills, reducing biodegradable waste by at least 65%, recycling 35% of municipal garbage, and recycling 85% of waste from building and demolition.
- Japan has set a goal to reduce the amount of trash generated by houses per person daily by 20% by the year 2020.

3.2 Stakeholders in Waste Management

The goals of solid waste management can be fully realized with the participation of all stakeholders such as household communities, non-governmental organizations, the private sector, educational institutions, industries, and rag-pickers as the municipalities operate under certain inherent limitations, i.e., operational hurdles, scarcity of manpower, low productivity of staff, inadequate supervision and unsatisfactory equipment's. Waste management projects involve multiple stakeholders with different goals and roles. Stakeholder analysis allows for the knowledge of stakeholders' goals and the state of their connections in regard to decision-making while investigating topics like SWM.

The creation of decision support systems has a solid foundation thanks to stakeholder analysis. (Chung, 2020). Stakeholder Management Models have so been used to assess the possible influence that a particular stakeholder group may have on the decision-making process. Some of the often used SMM in organizational and project contexts are the Power against Interest Grid, Power versus Influence Grid, Interest vs Influence Grid, Salient Model, and Attitude and Knowledge Stakeholder Map.(Tennakoon & Kulatunga, 2021)

3.2.1. Stakeholders mapping

The Power Versus Interest Grid is a popular way of categorizing stakeholders in stakeholder analysis. It divides stakeholders into four categories based on their relative power and interest, or their interest and influence/relevance over the topic under discussion.

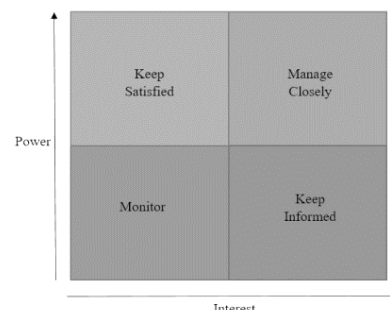


Figure 2: Power Versus Interest Grid

3.2.2. Role of stakeholder

Roles of Stakeholders as per Solid waste management national policy,2079(Office of PM and Council of Minister, 2079)

- a) **Central Government:** The role of the central government in waste management is the formation of SWM plans and policies, investigation, research, new technology and innovation, etc.
- b) **Provincial government:** The role of the provincial government is the development of infrastructure, and help in the coordination of local governments.

- c) **Local government:** The role of local government is the collection, treatment, and disposal of solid waste.
- d) **Public:** The role of the public is to follow the rules and regulations made by the government.
- e) **NGO's/INGO:** The role of NGO's/INGO is to conduct various awareness programs and training.
- f) **Tole lane organization:** Their role is to know the issues and problems of the public and solve them through collaboration with local government.

3.2.3. Managerial and institutional setup of waste reduction in Nepal

In Nepal ministry of Federal Affairs and General Administration is the nodal Ministry to guide all the activities and operations at a local level. Thus, solid waste management, being a local level function, comes under the purview of this ministry. Also, the ministry of Forest and environment is responsible for maintaining environmental quality by drafting policies, norms, standards, monitoring mechanisms, etc. Along with these, the Investment Board of Nepal supports the local level governments in developing projects on a public-private partnership basis following the Public Private Partnership Act, 2019.

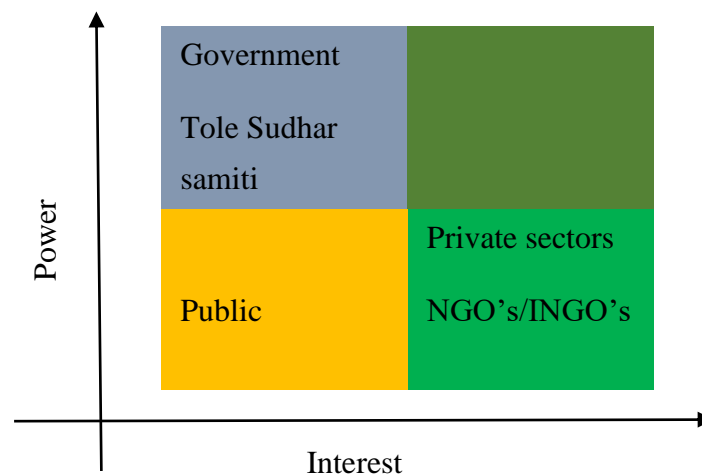


Figure 3: Stakeholders mapping

Also, there is the Alternative Energy Promotion Centre (AEPC), established under the Ministry of Energy, Water Resources, and Irrigation to protect the environment, and promote renewable or commercially viable alternative energy. This organization supports the urban local level governments to develop bio-methanation plants on a PPP basis to utilize the organic waste

generated within the city limit. (CRISIL, 2020) Although the Local Government Operations Act of 2015 governs local government operations, the Solid Waste Management Act of 2011 (SWM Act) and the Solid Waste Management Rules of 2013 oversee SWM activities (SWM Rules). Environment Protection Act, 2019 (“EPA Act”) provides necessary guidance for pollution control to maintain the environment and general public health. The Inter-Governmental Fiscal Arrangement Act, 2017 guides revenue-sharing modalities between different tiers of governments, devolution, transfers of funds, etc. Along with these, Public Private Partnership Act, 2019 (PPP Act) identifies waste treatment plants and sanitary landfills which can be executed on a PPP basis.

3.3 Policy Review

3.3.1. National

a) Solid waste management Act,2068(2011 AD)

Solid waste creation, collection, and disposal are governed under the Solid Waste Management Act of 2068. It discusses how local governments are responsible for reducing waste creation, sorting garbage, and safely disposing of hazardous waste. Additionally, it specifies the use of transfer stations, clean landfills, and official licensing of private parties and local governments to participate in waste management. Local government entities are required by the Act to take the appropriate actions to advance 3R, including the source-level separation of MSW. Additionally, a technological cooperation centre for solid waste management is suggested. The Centre was recently disbanded. The law also included provisions for fines and fees for failing to comply and using services, respectively.(Office of PM and Council of Minister, 2079)

Role of central, provincial, and local government:

- **Central:** To form acts, rules, and bye-laws and develop new technology.
- **Provincial government:** Development of infrastructure related to waste management
- **Local government:** Develop required infrastructure for collection, disposal, and recycling of solid waste.

b) Solid waste management Rules,2070(2013 AD)

This rule is according to SWM Act, 2068

Segregation and management of solid waste(*Solid Waste Management Rule,2070, n.d.*)

- The Local Body must handle and segregate hazardous or chemical waste separately while enforcing at least the separation of organic and non-organic solid waste at the source as required by Section 6.
- The Local Body shall implement initiatives to increase public knowledge of the application of suitable technology for segregation via reduction of creation of solid waste at its source and management pursuant to Sub-Rule (1).
- Service charges are based on the size, type, and environmental impact of solid waste. Discounts shall be provided for the “underprivileged group” and the households involved in the reduction of solid waste at the source of generation.

Responsibilities, duties, and power of the council

- To make policy decisions
- To create the required mechanism and structure

Responsibilities, duties, and power of the Centre

- To recommend local bodies by making appropriate plans.
- To cause participation of the private sector in the SWM.
- To provide technical assistance to the local body.
- To suggest that imports of products that produce greater waste be reduced to the Nepali government and local organizations.
- To conduct awareness programs and training.
- To monitor the SWM condition of local bodies

Functions, duty, and power of the board

- To accept the Centre’s yearly report.
- In order to provide the Centre with the guidance it needs about the import of SWM technology, in order to adopt the Centre’s rules and recommendations.

Monitoring

- A committee at the central level will be in charge of overseeing solid waste segregation, processing, discharge, and final disposal.
- The Ministry of Local Development and Federal Affairs is the coordinator for this project.
- Local body: Keep an eye on whether or not the technologies and measures for solid waste at its source are being used, as well as whether or not the solid waste has been segregated at the source.

c) NUDS

The NUDS claims that improper collection of solid waste and open dumping are the two main problems with waste management. Moreover, there is a lack of a long-term, viable solution to SWM. According to NUDS, the ideal circumstance for SWM is (MoUD, 2017);

- 100% HH waste collection in urban areas:** Encourage community-led waste segregation and collection.
- Sanitary landfill site provisioned by the municipality or cluster of municipalities:** Adopt landfill as a transitional strategy to reach the condition of 3R
- 3R system practiced in all municipalities:** At the community and family levels, encourage or require 3R. Utilizing the right technologies, encourage garbage recycling and reuse in the private sector.
- SWM unit in municipalities:** Establish dedicated and capacitated SWM units in all municipalities.

d) Local Government Operations Act,2074(2015AD)

LGOA helps for the institutionalization of legislative, executive, and judiciary practices in the local governments. It classifies municipalities and the requirements for the operation of the municipalities. Provisioned for municipality's function, duties, and rights such as municipal police, cooperative institutions, local service management, local development plans and projects, health and education, local market management, environment protection and biodiversity, local records management, disaster management, etc. (www.Lawcommission.Gov.Np, n.d.)

e) Fifteen five-year plans

The strategy of the fifteen five-year plan is to adopt new technologies with participation from the private sector for waste management. Working policies for the strategy are as follows;(National Planning Commission, 2019)

- Environmentally friendly action plans will be created at all municipal levels, and public-private partnerships will be established to build and run bioenergy, organic fertilizer, waste treatment, and incineration plants.
- Waste disposal will be fully forbidden in wetland areas, places of worship, highways, streets, toles, and other public spaces. The garbage management system will be improved via the employment of machines based on contemporary technology (that may help, for instance, in converting disposable organic matter into organic manure).
- Both natural and man-made disasters will create rubbish, which will be addressed.

3.3.2. International

i.Policy of India

In 2006, the Indian government announced the National Environment Policy (NEP), which included various trash management and reduction methods. The NEP of 2006 specifically stated that industrial and municipal waste is a significant contributor to soil degradation and presented an action plan that included, among other things, the following:

- Increase the local government's ability to segregate, recycle, and reuse municipal solid waste.
- Promote biodegradable and recyclable substitutes for non-biodegradable materials, and develop and implement strategies for recycling, reuse, and final environmentally benign disposal, including through the promotion of relevant technologies, and the use of incentive-based instruments.
- Promote the adoption of clean technologies by industry, in particular in the small and medium sector, through regulatory and fiscal measures, and standards setting.

ii.3R's principle(Conference, 2008)

- a. **Denmark:** When it comes to preferred methods of waste management, Denmark adheres to Lansink's ladder: prevention, design for prevention and design for beneficial use, product recycling (reuse), material recycling, recovery for use as fuel, disposal by incineration, and disposal to landfill.



Figure 4:Waste Hierarchy

- b. In **Japan**, garbage is viewed as a useful resource rather than just something to be discarded. To combat waste issues, Japan has enhanced its "3R" (recycle, reduce, and reuse) framework and legislative measures.
- c. **Korea's** waste management policy seeks to provide a clean environment to people and the natural ecosystem by minimizing waste generation, optimizing waste recycling, and treating waste generated in an environmentally sound manner and the strategic approach to promote the '3 Rs' (reduce, reuse and recycle) is the core measure.
- d. **South Africa's** waste management policy seeks "to reduce the amount of waste that is generated and, where waste is generated, to ensure that waste is recycled, reused or recovered in an environmentally sound manner before being safely treated and disposed of.
- e. **Ireland's** policy is the "integrated waste management" approach, based on the internationally adopted hierarchy of options which places the greatest emphasis on waste prevention, followed by minimization, reuse, recycling, energy recovery, and, finally, the environmentally sustainable disposal of residual waste.
- f. **The Philippines** waste management policy promotes a systematic, comprehensive, and ecological solid waste management program, which ensures the protection of public

health and the environment, utilizes environmentally sound methods that maximize the utilization of valuable resources, and encourages resource conservation and recovery.

- g. Finland's** waste legislation outlined waste management activities in the following order of importance: preventing wastes and lessening their negative effects; recovering wastes, including recovering wastes' material content and energy content; and, finally, safely treating wastes and repairing any damage that may have resulted.

Other methods, including eco audit, life cycle analysis, extended producer responsibility, product stewardship, etc., were becoming more widely employed globally, particularly to cut down on waste produced by consumer and home items.

- Eco audit:
- Life cycle analysis
- Extended producer responsibility(EPR)
- Product stewardship



Figure 5:Life cycle analysis

iii. USA

The USA has implemented policies such as the Jobs Through Recycling program, which gives grants to support recycling initiatives, the pay as You Throw policy, which charges customers more for collection and disposal services if they put more solid waste at the curb, and the Resource Conservation Challenge, which aims to increase the rate of municipal solid waste recycling and assist the nation in reaching a national goal of 35%.It also specifies the waste streams that are to be targeted, suggests goals for each of those streams for 2008, and provides a set of standards for choosing projects that will aid in achieving the targets.

iv.New Zealand

It uses strategies like Design for the Environment, which involves creating waste-reducing product design tools and techniques, Clean Production, which emphasizes production processes rather than the finished product to improve resource efficiency and reduce waste generated during production, and Extended Producer Responsibility, which encourages companies to prevent wastes at source and establish Take back and recycling programs.

v.Korea's

To reduce the amount of waste, strategies include the Volume-Based Waste Fee System, which charges individual waste generators for the cost of waste disposal, the Waste Charge System, which levies fees on products that are difficult to recycle or contain hazardous chemicals, and Regulations on Packaging Material, which prohibits the use of certain materials in packaging, such as PVC and polystyrene. Additionally, it encourages the gathering and reusing of used containers as well as the use of ecologically friendly packaging materials, as well as the Deposit Refund System for Glass Bottles and the Packaging Container Reuse System.

3.3.3. Agenda 21

According to Agenda 21, governments should "promote waste prevention and minimization as the primary objective of national waste management programs" and "create and implement national strategies for waste management that take advantage of, and give priority to waste reuse and recycling.".(Conference, 2008). Agenda 21 of the World Commission on Sustainable Development states that "environmentally sound waste management should focus on;

- a. Minimizing wastes
- b. Maximizing environmentally sound waste reuse and recycling
- c. Promoting environmentally sound waste disposal and treatment and
- d. Extending waste service coverage

The waste sector must build waste management systems, make the required investments, and do it in accordance with a clear, simple, and consistent policy. Therefore, effective waste management depends greatly on a well-established and backed the waste policy. A waste hierarchy is one aspect of waste policy that most people have in common, according to UNEP. The waste pyramid below serves as an example of how this hierarchy, which is a step-by-step method to waste management, ranks various waste management solutions according to their environmental priority. Many researchers strongly advocate that the reliable quantification of the MSW generation rate and characterization of its composition are the foremost steps essential toward achieving an effective MSWM system. However, these data are lacking in developing countries(Pathak et al., 2020)

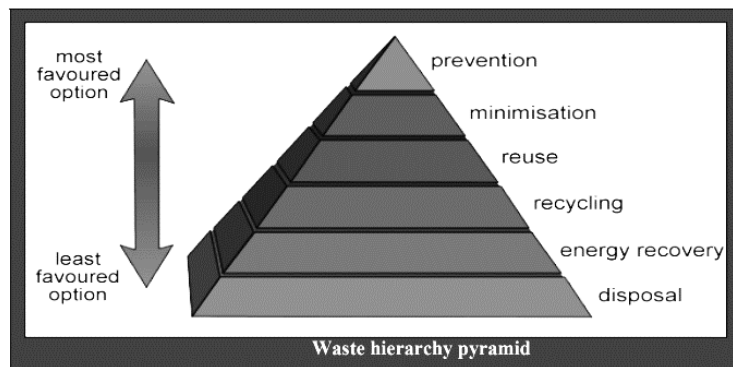


Figure 6: Waste hierarchy pyramid

The Solid Waste Management Technical Support Centre undertook a systematic and thorough analysis of the quantification of MSW, its composition, and the MSWM system for 58 old municipalities in 2012 with financial and technical support from the Asian Development Bank (ADB, 2013). However, no study has been undertaken for the newly created municipalities to estimate the waste quantity and understand the waste stream characteristics. Many researchers (Gallardo et al., 2018) advocate that to define a selective collection system, the waste generation pattern should be firstly determined, and these factors should be analysed in depth.

CHAPTER 4: CASE STUDY

Of Nepal's 753 local level government units, 293 are urban (i.e. metropolitan/ sub-metropolitan cities or municipalities) and the rest are rural local level governments. It is estimated that 16.5 million people reside in urban areas in Nepal with the south-eastern Terai region (plains) housing ~10.5 million people and the north-western hills the remainder. It is estimated that urban Nepal generates ~4,900 tons of solid waste daily and ~1.8 million tons per annum. Of which 63% of waste is generated in the Terai region and 37% in the hills. It is estimated that only 50% of the generated waste is being collected. A study on Nepal's SWM demonstrated that of the 58 municipalities surveyed, only 6 had developed landfill facilities, and the remaining were resorting to disposal of waste on other open land or along the river side or a combination of such disposal locations(CBS, 2020a).

As per a study by ADB (2013), it has been found that in 2011 the waste generated was 170 gm/capita/day. And as per a study by (CBS, 2020a)in 271 municipalities, it has been found that organic waste was 54%, inorganic waste was 33.3% and other was 12.7%. Among the collected waste, 48.6% of waste was disposed in a landfill site,32.1% was incinerated and 27.4% of waste was dumped by the side of the river(Office of PM and Council of Minister, 2079).

Around 4900 tons of solid waste is being generated by urban cities of Nepal every day which is about 1.8 million tons per annum. Among the 293 urban local bodies around 6 bodies have constructed landfill sites (600 tons of plastic) and the rest are dumped in open areas. According to the report published by CRISIL risk and infrastructure solutions limited,35 hectares of land are needed for landfilling every year if waste is disposed of without segregation and treatment. It has been calculated that organic waste can potentially produce 188,203 cu. m. biogas, besides 12,796 kWh electricity, per day. In the present scenario around 200 TPD, bio-methanation plants are under construction which caters to 7% of the 2700 TPD organic waste generated(CRISIL, 2020).

4.1 National Case Study

a. Ghorahi municipality

Waste collection is performed daily, except Saturdays, through the door-to-door collection. Waste collectors use compactor vehicles (modified cycle rickshaws similar to ones used in Kathmandu) for door-to-door collection. Additionally, the Ghorahi Municipality has set up segregation and compost bins. These bins are offered to families by the Municipality at a

discounted rate of 50%. One hundred and twenty families utilize compost bins, while one thousand use segregation bins. Households don't need to keep these bins. As a result of community activity, bin usage has increased. This has been accomplished by residents pooling their funds to purchase a community trash can and by engaging in public lobbying. There is no formal recycling system in Ghorahi. The municipality carries out some sorting of paper, glass, plastics, and metal at the landfill site. The Municipality is also promoting the segregation of plastics at source through the use of Suiro hooks.² A Suiro hook is used to hold a bunch of used plastic bags together before they are collected for recycling (CRISIL, 2020).

b. UEMS for household composting

By working with local government agencies and organizing volunteers, the Urban Environment Management Society (UEMS) was founded in 2002 with the goal of providing clean, safe drinking water, appropriate sanitation, and reducing the amount of residential solid waste. The major goals of UEMS are to improve solid waste management at the HH level by mobilizing neighbourhood resources, encourage collaboration between relevant institutions, and fortify UEMS's organizational capabilities. By enlisting housewives in particular locations, UEMS launched its household-based solid waste management program. Additionally, it carried out awareness-raising efforts through instruction, orientation, exhibits, community organizing, and education. UEMS organized and took part in meetings and seminars about solid waste management in order to build the skills of local volunteers. It also provided the necessary training, orientation, and observation tours. UEMS is preparing to expand its operations to other central regions of Lalitpur after adopting HH composting with success in the LSMC's Saugal neighbourhood.

Waste disposal and recycling Each participating HH separates its organic waste and deposits it in the compost bin, which has a 50kg waste capacity. Residents are allowed to sell compost to UEMS for NRs.6 per kg in order to promote composting and help with marketing. Following this, UEMS purifies, packages, and distributes the compost to adjacent flower nurseries and other customers for NRs. 10–12 per kg. According to UEMS, 900 kg of compost are collected each month. The commencement of the HH composting program has increased awareness to the point that people have begun to request compost bins and are anxious to learn how to utilize them. Similar to this, UEMS found that locals were more conscious of the health risks posed by negligent trash disposal, particularly organic waste.

Working in a central region, as opposed to a suburban one, is more productive, in UEMS's opinion, since individuals of similar ethnic backgrounds may share knowledge extremely efficiently there. UEMS statistics indicate that it spends NRs. 5400 every month on compost procurement.(CRISIL, 2020).

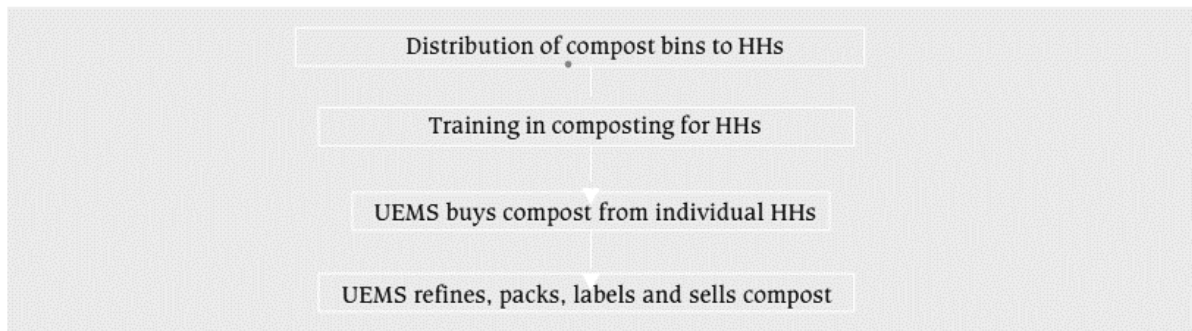


Figure 7: Process followed by UEMS

c. Suiro Abhiyan, Hetauda Municipality

Suiro Abhiyan is a municipal initiative in Hetauda that focuses on collecting household hazardous waste and recycling plastic bags. Members of each Tole Lane group now actively urge HHs to separate plastic garbage from other types of trash and to attach it onto a Suiro hook. One of the key objectives of this effort in the municipality of Hetauda is the successful recovery of plastic from HH wastes. It should be noted that 20.3 percent of the municipality's female population belongs to such TLOs (Government of Nepal, 2008). They participate in activities that advance their capacity for enhancing the environment. The sale of plastic garbage for recycling and money from a saving and credit scheme have both benefitted women's organizations.

Suiro hooks were formerly provided by women's organizations from TLOs to each member HH in Wards 3 and 6 in order to collect plastics twice a month. Recovering plastic garbage is currently under the control of the Hetauda municipality's Community Development Section(Government of Nepal, 2008). The principal organizations supporting this initiative are Clean Nepal, Yug Prabhat Youth Club, Tole Bikas Sanstha, Sri Krishna Pranami, Hetauda municipality, Drinking Water Corporation, and Nava Jeevan Jyoti Club. The price per kilogram of collected plastic is NRs.6. It is expected that each month in 2007, over 1.5 tons of plastic garbage was collected.(Government of Nepal, 2008).

Each month, 800-900 kg of material were sold for recycling. As a result, Suiro Abhiyan in Hetauda municipality earned a total of NRs. 5,000 per month from the sale of recycled plastic.

Hetauda municipality gave away Suiro hooks without charge at first, along with some operating training, to improve the amount of plastic recovered from HH garbage. (Practical Action Nepal, 2008)

d. The women' environment preservation committee(WEPCO)

WEPCO's major goal is to empower women to handle solid waste concerns in their communities by working with local communities. They offer training in leadership, capacity building, gender problems, vermicomposting, paper recycling, and composting. WEPCO has provided red and green bins for the collecting of paper and plastic. Organic and inorganic waste reduction and segregation have become more popular because to its "Give Plastic and Take Compost" campaign. At a transfer point, trash is discarded after pickup. In addition, WEPCO runs a composting facility and a paper recycling facility.

WEPCO operates on a self-sustaining business model. It can meet its operating expenses with the money it makes from composting and recycling. Poor institutional design and insufficient legal support for government organizations limit their activities and expansion plans, which is similar to the structural issues other NGOs confront.

4.2 International Case study

a. Sweden

The five Rs: Refuse, Reduce, Reuse, Recycle, and Rot are the principles underlying zero waste living as defined by those who support this movement. Refuse what you do not require. Make less of what you do need. Utilize recyclables to reuse. Recycle whatever you can't refuse, reduce, or use again. Rot the rest. The objective is to never send garbage to a landfill or an incinerator. The movement is expanding quickly. The hashtag zero-waste was used in 376,669 posts on Instagram(Pedersen & Manhice, 2020). The same search in November 2019 produced 4,106,993 posts.

Blogs, YouTube, and Instagram are the main social media channels that the zero-waste movement uses to spread its message. There aren't many blogs about waste minimization and zero waste in Sweden, at least not as many as in other countries. Only three Swedish blogs with a zero waste emphasis were located in this study, despite a large number of zero waste blogs being published in the USA, Canada, UK, France, and Australia, to name a few, in a Google search for the term². Pedersen and an investigation by Emelie Oldensjö (2018)

concentrate on how zero waste is shown on social media platforms like Facebook, Instagram, and YouTube. According to these research, social media is used to raise awareness among others, for engagement and learning, but it is also used to create a collective frame that encourages and stimulates followers to keep doing tiny actions in everyday life.

Theory of practice

Many theorists have recognized the theory of practice as being helpful for the study of consumption. The definition of practice, according to Andreas Reckwitz, is "a routinized type of behaviour which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, "things" and their use, a background knowledge in the form of understanding, know-how, states of emotion, and motivational knowledge"(Warde, 2005). Using Reckwitz's concept of practice as a guide, Shove, Pantzar, and Watson (2012) developed it. According to their definition, the components of practice include meaning competence and resources. People use energy and materials, and this conduct results in this consumption. This implies that to decrease demand, people must adopt new attitudes, alter their behaviour, and make wiser decisions. This is the so-called ABC model, according to which behaviour will change if attitudes change.

Methods of waste reduction

Practice changes the behaviour of the person. People need to change their consumption pattern for that people need to change attitudes, behave differently and make better choices (Attitude, Behaviour by choice- ABC model) (Practiced in Sweden; through blogs, Facebook, Instagram)

- Three Swedish blogs conceptualize themselves as zero-waste blogs.
- An extreme effort is made by the blogger during this experiment to create zero waste for a full month.
- Households that took part in a waste minimization competition initiated by a governmental institution. The primary purpose of these blogs was to contribute to an internal debate within the competition. This gave in-depth accounts of the struggles people had trying to prevent waste daily. Waste will unavoidably emerge from living in a late-modern culture and maintaining everyday routines.

Ways to reduce waste are:

- Replacement of objects. For example, when replacing disposable objects with reusable ones.

- To prevent replacing disposables. She states that there is no issue with carrying her containers because groceries like fish, coffee, and tea may easily be purchased in bulk.
- The practice of second-hand clothes (circular wardrobe).

b. Japan, Yokohama City

- The city switched from waste management (incineration of garbage) in 1970 to a 3Rs-based system in 2000, by which time the city had generated the maximum amount of rubbish.
- The Yokohama Municipal Solid Trash Management Master Plan (2002-2010), commonly known as the Yokohama G30 Plan, sought to reduce waste generation by 30% by 2010 through the implementation of obligatory source separation.

Expertise of the city of Yokohama

- By collaborating with its residents and business community, Yokohama continually improves its trash reduction programs. Significant waste reduction was accomplished through the "Yokohama G30 Plan". The "Yokohama 3R Dream Plan," the next program, aims to cut down on waste output.
- The 4 Recyclable Resources Separation Centers in Yokohama not only separate recyclable garbage, but also give facility tours, teach recycling lessons, and engage the community in recycling-related activities.
- Waste that can't be recycled is handled in the waste to Energy facility (WtE). Incineration facilities, which further reduce waste volume while emitting the fewest amount of emissions, are used to efficiently create energy from waste.

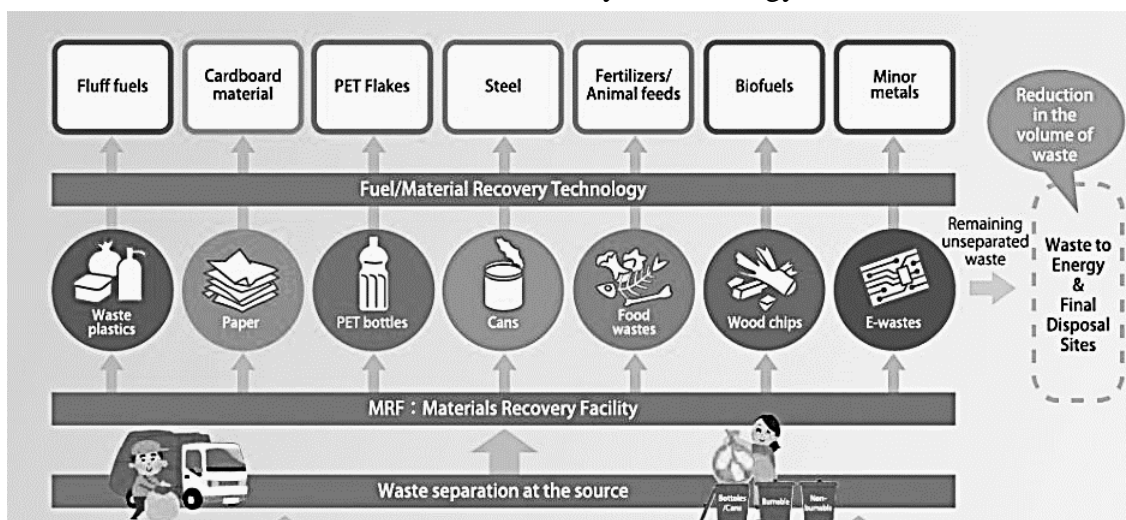


Figure 8: Yokohama city, Japan(src:(Jones, 2015))

Table-2:Technologies/Products/Service of Private Firms in Yokohama

Target	Examples of technologies/products/service
Waste plastics	Crushers, conveyors, washers, wastewater treatment equipment.
Paper/Cardboards	Pulpers, screens, mixers, flotators, papermaking machines
PETs	Bale breakers, conveyors, crushers, washers, dehydrators
Bottles/Cans	Crushers, conveyors, magnetic separators, pressing machines
Food wastes	Biomass boilers/ energy generators, methane fermentation systems/biodiesel generators, composts.
Wood chips	Incinerators(Stoker, fluidised bed, gasification and melting furnaces), dioxin thermal decompositions, energy generators, heat recovery systems.

CHAPTER 5: STUDY AREA

5.1 Introduction to Kirtipur

Kirtipur is an ancient city of Nepal that lies in the Kathmandu valley 5 km southwest of the city of Kathmandu. It covers an area of 14.76 sq. km. with an altitude ranging from 1,248 to 1,524m above mean sea level. Comparing the population counts from 2001 and 2011 reveals a significant rise in population (61%) in Kirtipur Municipality. According to the census of 2011 AD, the total population is 65602 in 19441 households. Male is (50.37 percent) and women are (49.63 percent). The municipality with an average number of 3.7 family size has a population density of 4444.58/ Sq. Km.

“Kirtipur” means “City of Honor”, and a row of old houses built with adobe brick and old Newar temples are still creating the quiet town, where the people are living with traditional Newar culture life. Surrounding the town area, agricultural lands are spreading in the Southern part of the municipality. As a percentage of the overall land area in the municipality, agricultural land is found to have decreased from 55% to 25% while urban land has expanded from 10% to 41%. Kirtipur Municipality is recently the hub of the restaurant and tourism business. In Kirtipur it has been found that the renter population is 11009 (56.63%), the owner is 8165(42%) and the organization is 185(0.95%)(Central Bureau of Statistics, 2018).

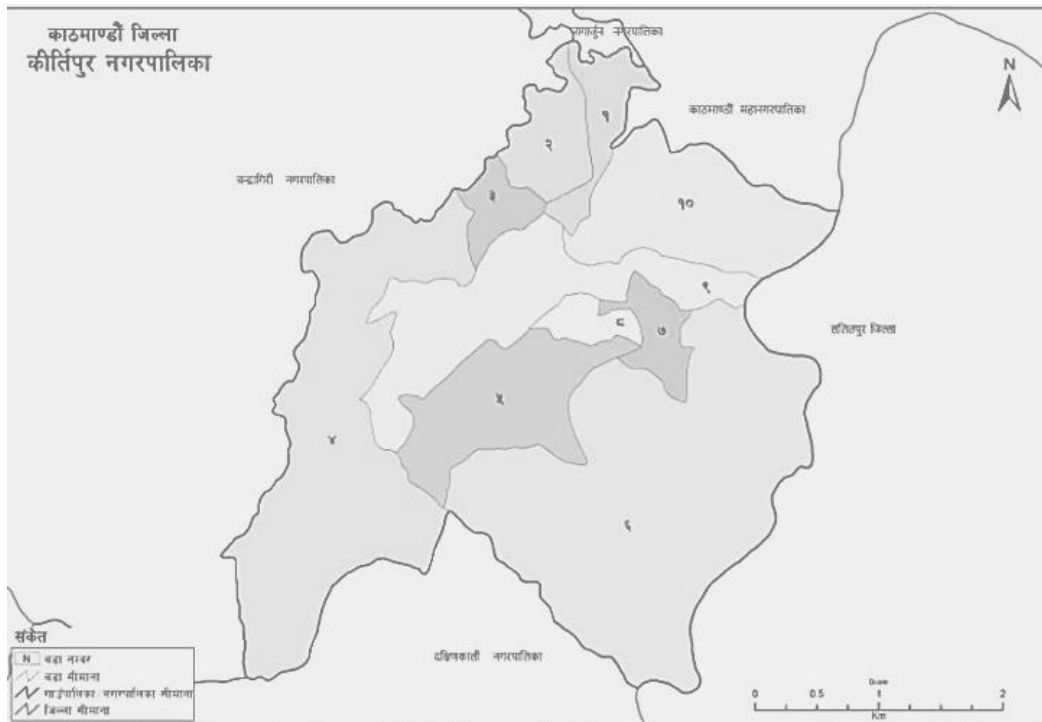


Figure 9:Map of Kirtipur Municipality

Table 3: Demographic information of Kirtipur municipality

Ward No.	Household	Male	Female	Total Population	Area/ha
1	1915	3674	3034	6708	43.11
2	1863	3610	3118	6728	71.89
3	1414	2738	2382	5120	50.27
4	1426	3079	3079	6158	640.42
5	2027	3821	2937	6758	158.64
6	1678	3586	3696	7282	464.85
7	1722	2934	1727	4661	34.52
8	1359	2447	1759	4206	17.19
9	2845	4911	3331	8242	143.78
10	3192	5676	4063	9736	176.68
Total	19441	36476	29126	65602	1801.35
Total (2001 Census)	9487			40835	
Family size (2011 census)	4.3				
Family size (2021 census)	3.7				

Source: Nepal Census 2011 AD.

5.2 Solid waste management in Kirtipur

The municipality has four registered private service providers for solid waste management, namely; Kirtipur Waste Management Service Pvt. Ltd., Nepal Swachchha Batabaran Sirjana Kendra, Clean Nepal Pvt. Ltd., Swachchha Batabaran Samrakshan Samiti at different clusters of the municipality. According to the IUWM report, these four SWM entrepreneurs provide services to 8100 HHs and an average of 7416 tons of waste per year. For 3 years, 4 private sectors are providing 2 % of the collected tariff is paid as revenue to Kirtipur Municipality. In 4 private sector operating transfer stations, a shed was constructed in 2 ropani lands.

Among 19,441 households, 7938 HHs are in access to services from solid waste management operating organizations. That means the majority, 11503 numbers of households are disposing or managing waste by themselves accordingly. Currently, only Kirtipur Waste Management Service Pvt. Ltd segregates the organic waste. Approximately, 15% and 30% of organic and recyclable waste are segregated for composting and recycling. It has been estimated that about 10 percent of collected organic waste is treated and composted whereas the remaining organic waste is transported to the Sisdole landfill site located at Okharpauwa, Nuwakot district. The annual transaction from compost was only NPR 10,000 at the rate of NPR 45 per kg. At present, the service charges are collected by community mobilizers in each community with a minimum charge of 150 households.

5.2.1. Waste quantity

The waste generation rate of municipal waste is 307.4gm/capita/day and 207.97gm/capita/day (Household waste) in Kirtipur municipality which results in a total waste generation to be 20.17tons/day. Around 6.53 tons/day of solid waste is generated from the commercial market and 13.6 tons/day from households. Approximately 10% of readily bio-degradable waste is recovered and 30% of bio-degradable and non-bio degradable waste is sold by a private operator. Around 5.4 tons of waste is transported by private operators to dumping sites per day.

5.2.2. Waste quality

According to the IUWM report, these four SWM entrepreneurs provide services to 8100 HHs and an average of 7416 tons of waste per year. Households waste, followed by commercial waste and institutional waste are the disintegrated source of waste in the municipality, where 74% organic waste and 15% plastic waste has been reported in the municipality. For 3 years, 4 private sectors are providing 2 % of the collected tariff is paid as revenue to Kirtipur Municipality.

Table 4: Waste Quality in KRM

Items	Households			Commercial**	
	KRM data	Study		Dry Season	Wet Season
		Dry Season	Wet Season		
Kitchen waste	74.24%	86.7% (77.4%)	79.2% (82.7%)	74.2% (86.5%)	73.1% (79.4%)
Paper	5.72%	3.3% (3.2%)	5.2% (6.9%)	6.5% (9.0%)	15.4% (11.0%)
Textile	1.92%	3.3% (6.5%)	1.6% (1.3%)	0.8% (0%)	0.8% (3.0%)
Wood/leaves	0.09%	0% (3.2%)	2.8% (0.6%)	7.3% (0%)	0.4% (0.0%)
Plastic	8.83%	6.7% (9.7%)	6.6% (5.3%)	8.9% (3.7%)	9.6% (4.7%)
Rubber/leather	0.96%	0% (0%)	0.0% (0.0%)	0% (0%)	0.1% (0.0%)
Metal	1.94%	0% (0%)	0.4% (0.5%)	0.8% (0.2%)	0.5% (0.3%)
Glass	2.91%	0% (0%)	3.8% (2.7%)	1.6% (0.5%)	0.0% (0.0%)
Ceramics	-	0% (0%)	0.0% (0.0%)	0% (0%)	0.0% (0.0%)
Others	3.39%*	0% (0%)	1.2% (0.0%)	0% (0%)	0.0% (1.6%)
Bulk density	225 g/L	215 g/L (205 g/L)	182 g/L (187 g/L)	143 g/L (269 g/L)	116g/L (243g/L)
Water content	-	57% (65%)	65% (65%)	59% (71%)	52 % (64%)

Note: Lower numerical value in parenthesis is data on weekends and upper on weekdays
 Total value of each composition is not always 100% because each one was rounded off.
 * Includes batteries
 ** Commercial data in dry season is only from hotels and restaurants
 Source: JICA Study Team, May 2004 for Dry Season, June 2005 for Wet Season

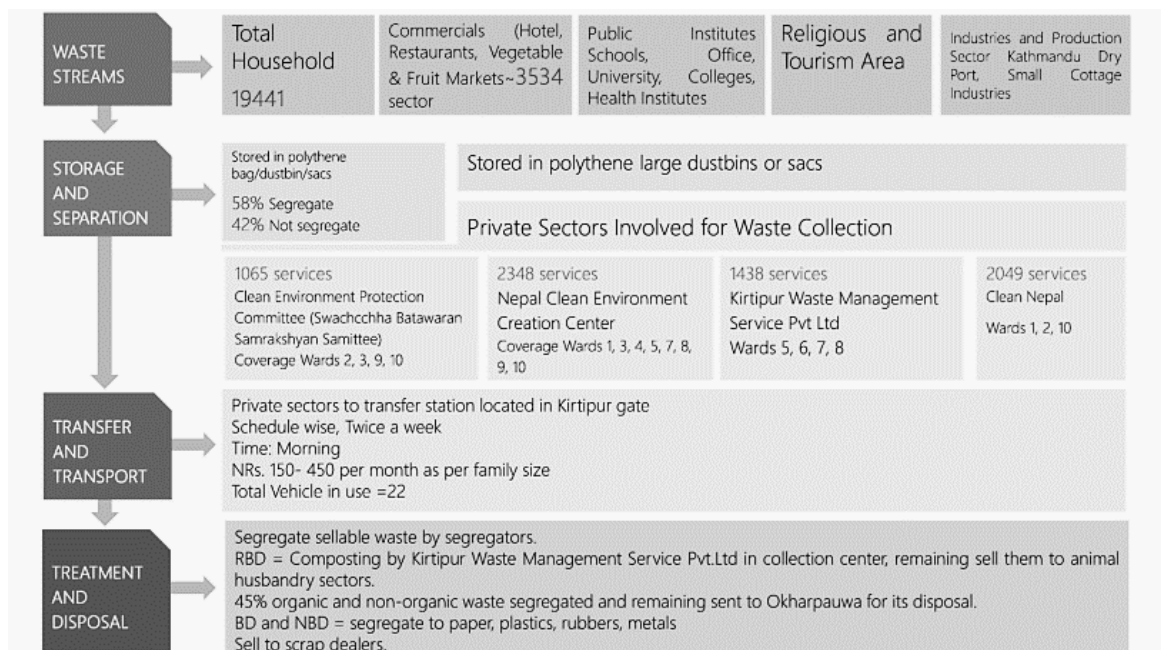
5.2.3. Collection and transportation

Among 19,441 households, 9100 HHs are in access to services from solid waste management operating organizations. That means the majority, 10,341 numbers of households are disposing or managing waste by themselves accordingly. Currently, only Kirtipur Waste Management Service Pvt. Ltd segregates the organic waste. Approximately, 15% and 30% of organic and recyclable waste are segregated for composting and recycling. It has been estimated that about 10% of collected organic waste is treated and composted whereas the remaining organic waste is transported to the Sisdole landfill site located at Okharpauwa, Nuwakot district.

5.2.4. Existing practice of Solid waste management in the Kirtipur municipality

There are 1944 households in the whole municipality of Kirtipur. According to the literature, 58% of the garbage that is collected is separated by individuals. Four private organizations, including Clean Nepal, Kirtipur Rubbish Management Service Pvt. Ltd, Nepal Clean Environment Creation Center, and Clean Environment Protection Committee, are also active in waste collecting in Kirtipur. According to estimates, 45% of organic and non-organic garbage is separated, with the remainder being disposed of in Okharpauwa. (World Bank, 2021).

Table 5: Existing practice in Kirtipur Municipality



5.3 Site selection

The site chosen for the study is ward 2 of the Kirtipur Municipality, which has a total population of 6728 people—3610 males and 3118 women—and a land area of 71.89 hectares, which was selected as the study's site. 1863 dwellings can be found nearby. Waste management has grown to be a significant concern because ward number 2 is a fast-expanding new development in Kirtipur. Following my visit to the municipality and KII with the senior officer of the environment and solid waste management department, I learned that, out of the 10 wards, waste management in ward number 2 is significantly more challenging than in the other wards. I chose ward 2 to learn more about the solid waste situation there.

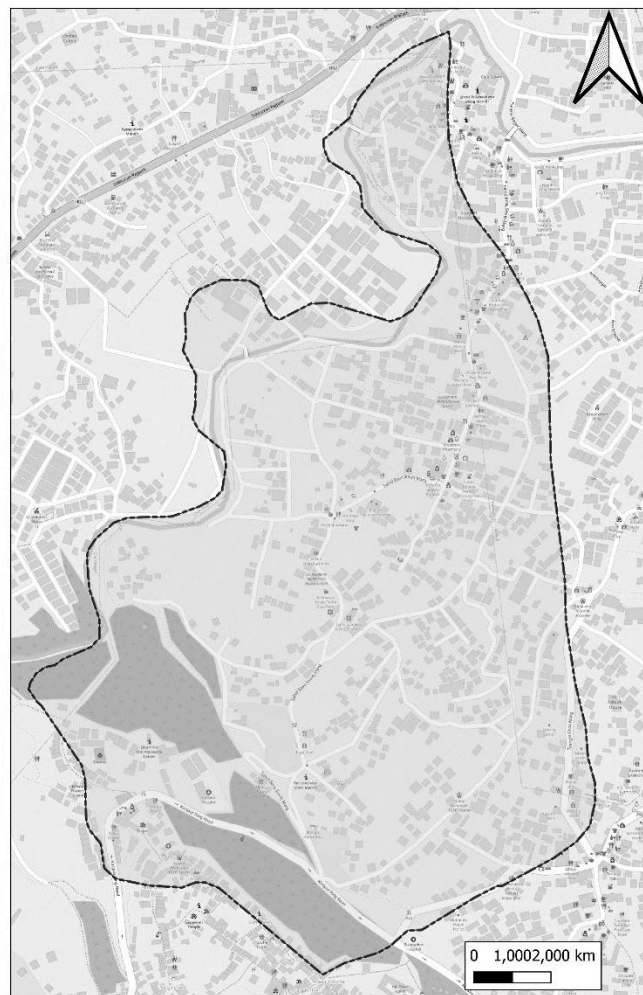


Figure 10: Map of Ward 2 of Kirtipur municipality

5.4 Methodology for data collection

5.4.1. Preparation of questionnaire

Questionnaire for the three categories of people, i.e. for the household people, the key people related to solid waste management, and for the municipality. The question included both closed and open-ended questions. Questions were designed to know the behaviour, attitude, and knowledge of the people. Many questions were referred from relevant literature and also designed according to the site context and research question. (Questionnaires are attached in the annex section)

5.4.2. Determining Sample population and Sample size

First, the sample population was identified to calculate the sample size for the study. The research study used random sampling techniques, with a sample size of approximately 50 respondents. The following classifications were used to determine the sample size: Age, gender, class, type of use for the building, height of the building, Tole, and renters. Since the saturation level was reached after the 50 respondents, I am limiting my survey to 50. Both open and closed questionnaire were included. And due to time and resource constraints, the survey is done to this limit.

5.4.3. Framework for data collection

First, the research questions were identified from the main and specific objective and with the questions, various parameters were defined. Thus after determining parameters data were collected from various sources such as KII, HH's survey, observation, Literature, case study, etc.

Table 6: Framework for data collection

Main objective	Specific objective	Research questions	Parameters	Source
To explore how MSW can be efficiently managed at the point of generation through stakeholder participation to reduce the waste load in the landfill site, taking the case of Kirtipur, ward 2.	To explore the current scenario in managing MSW at the point of generation in Kirtipur.	What is the nature of waste generated in Kirtipur?	Waste generation rate	KII
			Waste sources	HH survey
			Waste composition	HH survey
			Waste characteristics	Observation
			Waste load to the landfill site	KII
		How is the waste currently managed?	Waste storage methods	HH survey
			Waste segregation	HH survey
			Waste reuse and recycling practices	HH survey
			Waste collection	HH survey
			Waste reduction practices or training by municipality/ Kirtipur/ Saugal	KII/HH survey
			Challenges of waste segregation	HH survey
		What are some of the methods of household waste reduction at the source?	Methods of waste reduction/Rate	Literature/Case study
			Institutional setup	KII/Literature
Financial mechanisms	KII/Literature			
Incentives, training, and participatory approaches	KII/HH survey			

	To identify the role of stakeholders in the management of solid waste at the source.	Who are some of the key stakeholders and their roles in waste reduction?	Stakeholders	KII
			Stakeholders role	KII
			Stakeholder mapping,	Literature/KII
		What is the level of participation?	Willingness to participate in waste reduction	HH survey
			Awareness level	HH survey
			Literacy	HH survey
			Gender, etc.	HH survey
		What are some of the challenges in stakeholder participation?	Challenges in storing waste	HH survey
			Challenges in reuse, recycle, etc.	HH survey
	Challenges in co-operation of various stakeholders.		KII	
	To identify the policy gaps in the proper management of MSW at the point of generation	Do the current policies adequately address the MSW source reduction?	Existing policies, acts, and regulations	Literature
			Gaps in the policies	Literature
		What are some of the policies in the international context that have led to the reduction of waste?	Good examples /good practices	Literature, case study
Incentives			HH Survey	

5.5 Result

As per the survey done among 50 respondents the demographic data are as follows;

a. Gender of respondents

Among the 50 respondent majority were males with 68% and the rest were female respondents with 32%. The study includes both males and females.

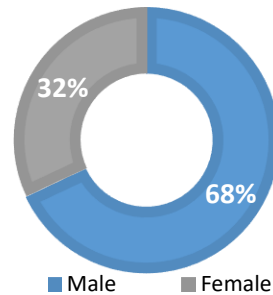


Figure 11:Percentage of male and female

b. Age

Among the 50 respondents, the age group of 25-64 years was the majority with 84%, age above 65 was 14% and age between 15-24 was 2%. The study includes responses from varied age groups such as young, adult, and old people.

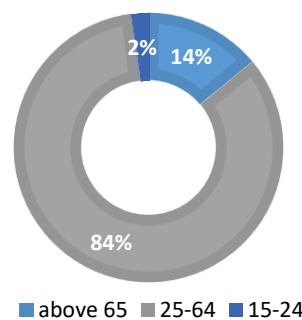


Figure 12:Age of respondent

c. Marital status

Among the 50 respondents, 92% were married and 8% were unmarried. The study includes responses from varied groups.

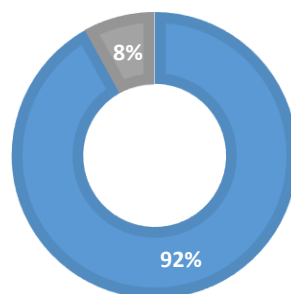


Figure 13:Marital status of Respondent

d. Occupation

The occupation of the respondents included in the survey is being recorded here. In the sample survey, it was found that the majority of the respondents i.e. 16% had their own business and 16% were involved in the services. Following this 9% of respondents were housewives, 7% were student and 2% were from other categories. The knowledge and awareness of the respondents are easily influenced by their field of employment and in most cases the waste management practices within workplaces influence people to be more concerned about waste within households as well. Here, respondents employed in various fields are part of the study.

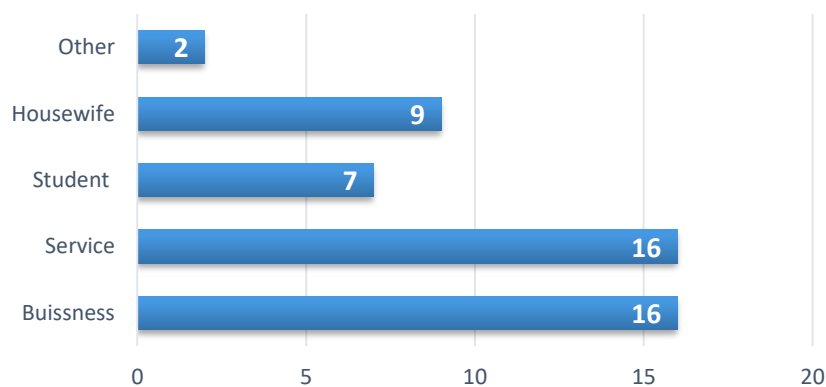


Figure 14: Occupation of respondent

e. Household Ownership

Among the 50 respondents, 72% of the house were rented and 28% owned a house by the residing families. During the study, respondent was selected as per ownership.

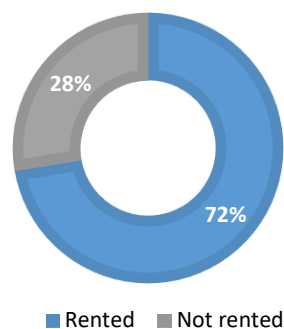


Figure 15: Renters


f. Family size


The important variable was the total number of members in the households. This was analysed to know the consumption and waste generation pattern of households. Generally, the households consist of members between 3 to 6. The average household size was calculated as 4.26.

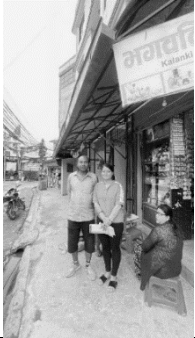

5.6 Key Informant Interview

<p>1. Kirtipur fohor byabasthapan (Private sector)</p> <ul style="list-style-type: none"> • Kirtipur fohor byabasthapan has been collecting waste of around 2.5ton/day from the different wards of Kirtipur. Various waste such as organic, medical, plastic, and paper was collected from residential, commercial, medical, school, etc. • The waste is collected in segregated form but in the same vehicle. The segregated organic waste is used to make compost fertilizer and other recyclable goods and is sold to Kabariwala. • Various trainings were provided for composting and distribution of compost bins, and reuse and recycle programs were also conducted. • Challenges in reuse, recycle: mix waste and difficult to reuse and recycle/ less money in recyclable products. • Waste load to the landfill: 2.5 tonne-3 tons / 2 days. 	<p style="text-align: center;">Jenson Maharjan Manager at Kirtipur fohor byabasthapan Established date: 2069 Covered area: wards 5,6,7,8 Supported by Blue Waste</p>
<p>2. Blue waste to value (Private sector)</p> <ul style="list-style-type: none"> • Blue waste to value has been collecting waste of around 2 tons/day from the various places of Kathmandu. Various waste such as organic, plastic, paper, etc. were collected from the hotel, embassy, etc. • Segregated organic waste was taken to pig farms directly from hotels and inorganic waste is segregated and reusable and recyclable waste is separated. • Waste reduction training is provided twice a year on how to segregate waste to the Municipality, Indian embassy, etc. • Financial mechanism: Monthly membership fee, report for the municipality by consultancy, recyclable products. • The willingness of people to participate in waste reduction: Peoples are aware/ around 20-25% of people are still mixing waste. • Challenges in reuse, recycle: No factories to reuse, recycle. Profit is also less (recycled product is not that much in use). • Waste load to the landfill: 20-30% of total waste. <p>Initiative/programs:</p> <ol style="list-style-type: none"> a. Clean-up campaign (pick up) b. Consultancy services to the municipality (kanchanpur, paach pokhari) c. Health care waste management d. HRDC 	<div data-bbox="1042 1048 1374 1462" style="border: 1px solid black; padding: 5px;"> <p>The infographic features the 'blue Waste To Value' logo at the top left and a circular logo with an infinity symbol at the top right. The main text reads: 'Thinking of Safely Disposing your E-waste? You can easily Drop-off your E-waste at any of the CG/LG official outlets'. Below this is a map of Kathmandu with three location pins. The first pin is labeled 'CG DIGITAL STORE' and the second is labeled 'LG LIFESTYLE SHOPPE'. At the bottom of the infographic, it says 'Contact Information'.</p> </div> <p style="text-align: center;">Ronish Shakya Event Manager Established date: 2014 Covered area: Hotels in Kathmandu (Soaltee, hiate, yak and yeti), Indian embassy, shankharapur, Kirtipur</p>

<p>e. Waste Database</p> <p>What must be done?</p> <ol style="list-style-type: none"> Provision of subsidy Tax-free Ownership by government Capital investment (vehicles, machines, manpower) Agreement for long term (20+ years) then only some changes may occur The local government must take the responsibility 	
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<p>3. Clean Nepal (Private sector)</p>	
<ul style="list-style-type: none"> Waste is collected in mixed form and is segregated in a transfer station near Tinkune and transported to Sisdole. Waste reduction training such as composting is provided in collaboration with the municipality. Financial mechanism: Charge of the waste collection according to family size from Rs.250-500/ month 	 <p>Kalpana Khadka Manager Established date: 2067 Covered area: ward 1,2,10</p>

<p>4. Kirtipur Municipality</p>	
<ul style="list-style-type: none"> Rented population:15000-16000 Waste composition: organic:74%, plastic:15%, clothes:8% Waste generation rate: 300gm/per/day (65% of waste is collected) <p>Role of the municipality:</p> <ol style="list-style-type: none"> Aware public to be a member of the waste collection sector Monitoring Provide sanitation facilities to the people involved in waste management Provide training on composting: Mahila samuha: generate 10kg/day compost, 6/5 ward: biogas, ecosan <p>Challenges with private sectors:</p> <ol style="list-style-type: none"> Hesitate to collect footpath waste, dustbin waste Profit-based: concerned with the number of members and amount of waste not with the reduction of waste 	 <p>Gyan Bajra Maharjan Officer at Batabaran and fohor maila Sakha</p>

<p>What steps need to be taken for effective waste management?</p> <ol style="list-style-type: none"> Space for composting Reuse of plastic Integrated waste management <p>Initiatives</p> <ol style="list-style-type: none"> Awareness program at the community level “ek bidhalaya, ek sampada, sarsafai abhiyan: every Saturday from different schools 25 student’s clean temples and public places Ward-wise plastic collection 	
<p>5. Hariyali Upabhokta samiti</p>	
<ul style="list-style-type: none"> Name of interviewer: Bishnu Bahadur GC(Chairman) 7 members Works on the sewer management, waste management Recently 28 dustbins were kept in the Maitri Nagar area of Kirtipur, ward 2 	
<p>2. Lok Adarsha School</p>	
<ul style="list-style-type: none"> Kamal Tamang(founder) 1 to 10(400 students) Segregation of waste: Decomposable waste is decomposed in a pit and another remaining waste is collected by clean Nepal. Waste amount:30kg/week Resident: 9 Junk food is prohibited Initiatives have been done with tole sudhar Samiti to replace the plastic bags with jute bags. 	

CHAPTER 6: FINDING AND ANALYSIS

6.1 Various Dimension of solid waste reduction at the point of generation

The waste generation rate of municipal waste in Kirtipur is 307.4gm/capita/day and household waste is 207.97gm/capita/day. Waste composition of the Kirtipur municipality is paper(6%), kitchen waste(74%),Textile(2%),Plastic(9%),etc. as shown in chart 6.3-1(World Bank, 2021). From the survey of 50 households,36 houses were for rent. The total population of the surveyed building is 209 (owner=149 and rent=60). Thus the average household size is calculated as 4.18. As per the survey, the total waste generated by 50 households is 261kg/week thus waste generation rate of household waste is calculated as 178.4gm/capita/day.

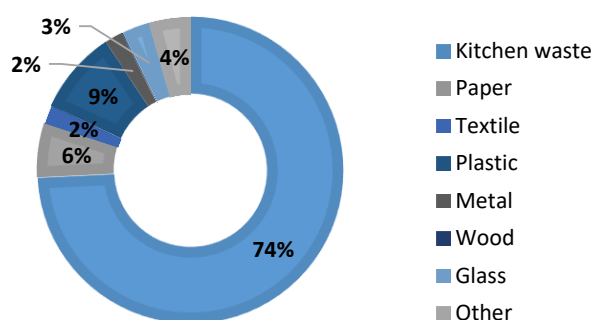


Chart 1: Waste composition in Kirtipur Municipality

In ward 2 of Kirtipur, municipal waste is composed of the waste from residential, commercial, mixed-use, school, cottage industry, etc. Households waste, followed by commercial waste and institutional waste is the disintegrated source of waste in the municipality, where 74% organic waste,15% plastic waste and 8% of clothes has been reported in the municipality(City, 2005).

Among 19,441 households, 9100 HHs (46.8%) are in access to services from solid waste management operating organizations. That means the majority, 10,341 numbers of households (53.19%) are disposing or managing waste by themselves accordingly. Whereas in the case of the study area among 1863 HHs, 1297 HHs are in access to service from Clean Nepal which means, 566 HHs (30%) are disposing or managing waste by themselves. (src-KII: Clean Nepal)

The waste generation rate as per the literature is 307gm/capita/day(World Bank, 2021), and the population of the study area is 209 thus waste collected is 64.163kg/day. It has been estimated that about 15% and 30% of organic and recyclable waste are segregated for

composting and recycling whereas the remaining waste is transported to the Sisdoile landfill site located at Okharpauwa, Nuwakot district.

As per the survey around 96% of household store their waste in plastic bag and only 4% of household use dustbins as shown in the chart. From the observation, I came to know that there is no provision for a dustbin in the community which is one of the reasons for the undamaged waste disposal.

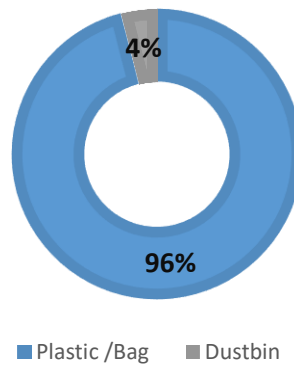


Chart 2:Storage method of ward 2

According to the respondent the barrier to waste segregation is no provision of separate collection vehicles for segregated waste (30%), foul smell (5%), not enough space (11%), and others (6%).

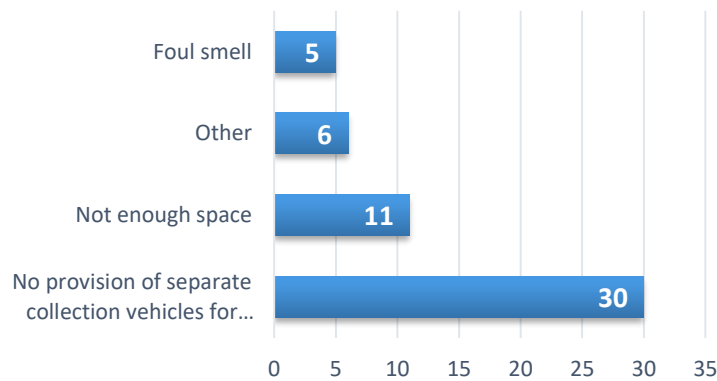


Chart 3:Barriers for waste segregation in ward 2

In the study area, 60%(21) of people are taking steps for waste reduction such as composting (42%), minimum food waste (36%), carry own bag (24%), reuse bottles (8%), and other such as recycle carton, feed food waste to pets.

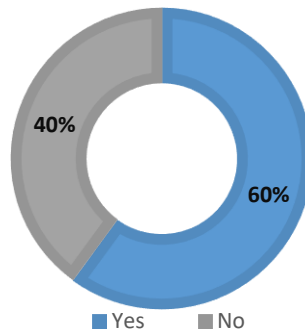


Chart 4: Waste reduction Initiatives in ward 2

As per the KII with Clean Nepal, it has been found that training was provided for composting in collaboration with the municipality. Also according to the officer of the municipality of environment and the SWM department, the municipality has been doing an awareness programs at the community level, ward wise plastic collection. But as per the respondent, no one attends any kind of training and programs provided by the municipality and ward.

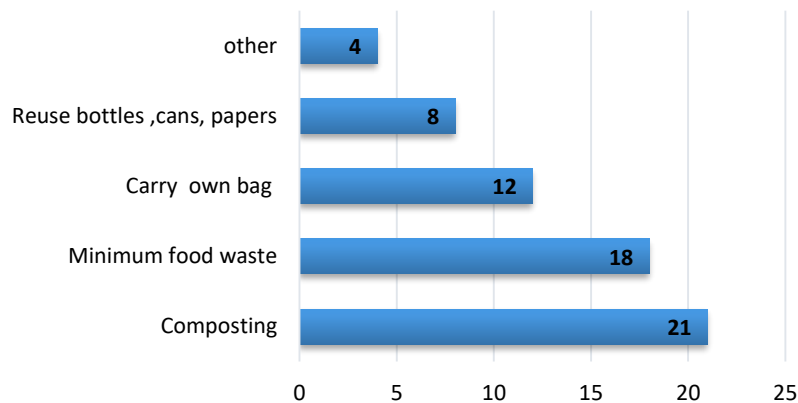


Chart 5: Waste segregation in ward 2

It has been found that among the 50 respondents, 53% of people segregate waste and 47% of people mix their waste.

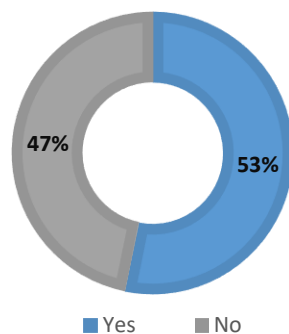


Chart 6: Waste segregation practices in ward 2

“Kirtipur fohor byabasthapan has been collecting waste around 2.5ton/day from the different wards of Kirtipur. The segregated organic waste is used to make compost fertilizer and other recyclable goods are sold to Kabariwala.” **Jenson Maharjan**

“Blue waste to value has been collecting waste around 2 tons/day from the various places of Kathmandu. Segregated organic waste was taken to pig farm directly from hotels and inorganic waste is segregated and reusable and recyclable waste is separated.” **Ronish Shakya**

“ek bidhalaya, ek sampada, sarsafai abhiyan: every Saturday from different schools 25 student’s clean temples and public places/Ward wise plastic collection” **Gyan Bajra Maharjan**

“28 dustbins were kept in the maitrinagar area of Kirtipur, ward 2” **Bishnu bahadur GC(Chairman)**

As per the survey, 29% of respondents thought that recycling and composting is the best method for waste management and 5 % thought that disposing of in landfill is the best method as shown in the chart.

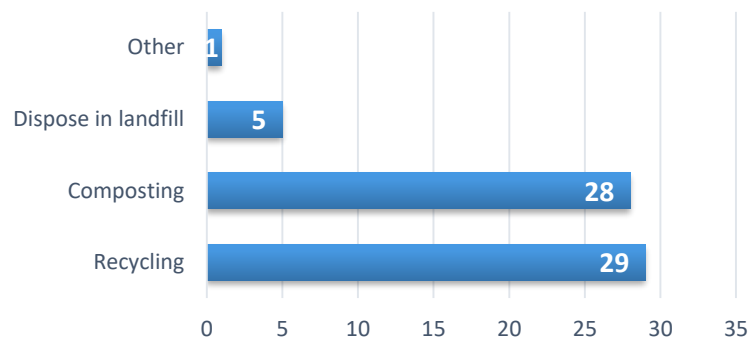


Chart 7: Method suitable for waste management

Education of the surveyed respondents is an important variable to understand consumer awareness and different practices they adopt in waste reduction. In the survey it was found that the majority of the respondents i.e. 19% were intermediate, 15% were graduates, 7% were secondary, 3% were master’s degrees and 6% were none. Various categories of people were surveyed to know their level of knowledge.

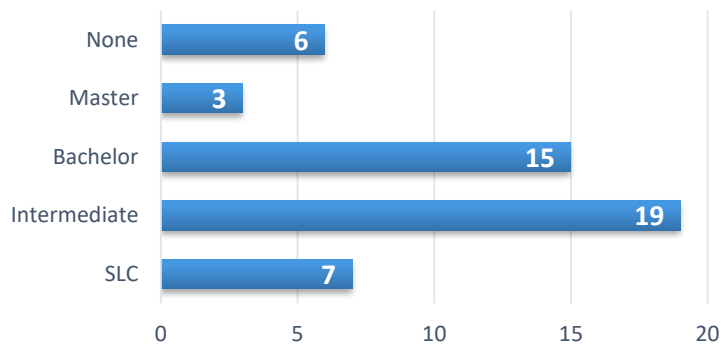


Chart 8: Level of Education

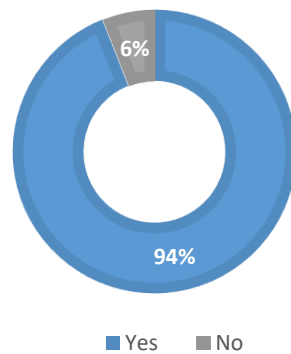


Chart 9: Willingness to participate

6.2 Stakeholders in waste management

Stakeholders involved in ward 2, Kirtipur were a municipality, the public, Hariyali Upabhokta Samiti, Tole sudhar Samiti, Clean Nepal, and NGOs. Currently clean Nepal is collecting waste from ward 2, Tole sudhar samiti and Hariyali Upabhokta samiti were doing few campaigns on cleanliness, the role of public is just in giving waste.; From the KII and survey it was found that municipality, clean Nepal, NGO's/INGO's and private sector have power but don't show much interest on waste management. Whereas tole sudhar samiti, Hariyali Upabhokta samiti are interested but don't have power and public are less interested and have less power as shown in below stakeholder map of power vs interest.

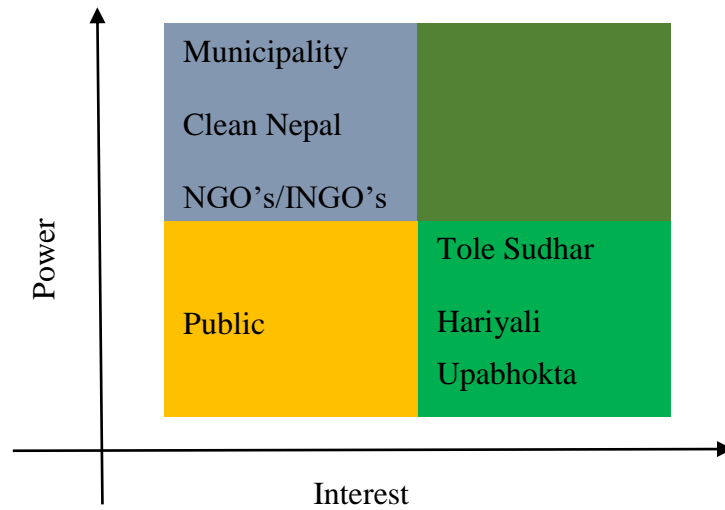


Figure 16: current stakeholder map of ward 2

As per the literature and KII roles of the stakeholders are;

- **Municipality:** Monitoring of private sectors, providing infrastructure, etc.
- **Household:** Waste segregation and minimal waste generation.
- **Clean Nepal:** Collection, segregation, and disposal
- **Tole sudhar:** Conduct awareness programs
- **Hariyali Upabhokta samiti:** Conduct awareness programs
- **NGO's/INGO:** Provide training on composting, and waste reduction techniques

6.3 Policy review

Policy related to source reduction were reviewed and the inferences from the policy is found out as shown in the table below;

Table 7: Policy of Source reduction in Nepal and its gap

Policy	Source reduction	Inference
SWM Act,2068(2011 AD)	<ul style="list-style-type: none"> • Explains the responsibilities of local governments in minimizing waste generation, segregation of waste, and safe disposal of harmful waste. • Mandates local bodies to take the necessary steps to promote 3R (Reduce, Reuse, Recycle), including the segregation of MSW at the source 	<p>These policies include source reduction to some extent but the detailed policy on how to do is not mentioned so the policy must be revised.</p>
SWM Rule,2070(2013AD)	According to Section 6, the local bodies must establish minimum organic and non-organic solid waste segregation at the source.	<p>Also as per the survey, training and programs mentioned in the municipality were not provided. So, there is a gap in policy formation and implementation</p>
NUDS	3R system practiced in all municipalities	
15th five-year plan	At all local levels, environmentally friendly action plans will be created, and PPPs will be used to establish and run bioenergy, organic fertilizer, waste treatment, and incineration facilities.	

CHAPTER 7: DISCUSSION

Kirtipur ward 2 has been rapidly urbanizing. The issue in controlling the created waste is that waste creation per capita is rising along with the population. Waste management cannot be accomplished sustainably using the conventional waste collection approach of collection, transport, and disposal. Since the collection and disposal of waste only move problems from one location to another, waste management is more than crisis management related to these activities. Therefore, it is necessary to stop waste at the source.

7.1.1. Various Dimension of solid waste reduction at the point of generation

According to a survey conducted in Ward 2, kitchen garbage accounts for the majority of household waste production. Since organic waste makes up the majority of created waste, it is simple to control it at the source by composting, feeding animals, etc. Additionally, ward 2's estimated renter population of more than 50% is causing issues with garbage management. Therefore, the homeowner must assume responsibility for the trash that tenants produce. The landlord must instruct the tenants on how to separate trash and where to put it. In ward 2, the majority (30%) of residents dispose of or manage their waste. 15% of organic trash and 30% of recyclable waste are reportedly separated for composting and recycling. Waste is transported in large quantities to the dump. It is taking place as a result of the collection of domestic waste that has not been separated. 53% of the persons in the sample who were surveyed separate their garbage, while the other 47% are unaware of it.

According to the responder, obstacles to waste segregation include a lack of dustbins, the absence of separate vehicles, a bad odor, etc. Thus, it is necessary to have distinct vehicles for the collection of different types of waste. Additionally, there is no dustbin provision; as a result, the municipality must provide one. 60% of the respondents in the research area are pursuing some waste reduction measures—composting, minimizing food waste, etc. but not properly. Although people in Nepal are aware of the repercussions of rubbish, waste is not controlled since the dominant mentality in the country has not changed. Modifying people's beliefs, knowledge, motivations, or customs to promote sustainable waste management (Messick and Brewer, 1983; Steg and Vlek, 2009). Few efforts have been made, such as composting and segregation, according to the KII and study, but they have not been very effective.

As a result, extensive training, research, financial incentives, and disincentives, as well as strict control, are all necessary (Babasaheb Bhimrao Ambedkar University, 1996). Additionally, the poll found that 80% of respondents had a college degree, but the norm activation model claims that source reduction is not happening because of people's actions and norms (Van der Werff et al., 2019). Source reduction is aided by promoting recyclable and biodegradable materials as alternatives to non-biodegradable ones. One effective waste management technique is source reduction. Additionally, it is necessary to improve the MSW sorting, recycling, and reuse capabilities of local groups. Additionally, developing and implementing strategies for garbage output reduction, recycling, and reusing.

7.1.2. Stakeholders in waste management

The municipality, the general public, Hariyali Upabhokta Samiti, Tole sudhar Samiti, Clean Nepal, and NGOs were among the stakeholders in Kirtipur Ward 2. Each person has a certain function, yet Ward 2 lagged. Therefore, power and interest must be appropriately defined to solve the waste management challenge. It is necessary to specify the duties and obligations of the federal, state, and local governments as well as their ambitious objectives and timetables. In addition, the municipality needs to use rewards, punishments, encouragement, and incentives to encourage proactive participation from all parties (community, businesses in the private sector, women, youth, and other stakeholders). Clean Nepal is the primary organization in charge of managing rubbish in ward 2, thus it must have a lot of influence and motivation.

Municipalities and NGO/INGOs must also be moved to the right because they have significant power but little motivation. Sudhar Samiti and Hariyali Upabhokta Samiti must also be hauled up because they have enormous interests but little influence. Therefore, every stakeholder may work effectively in this manner, and problems can be reduced. Stakeholder management models are necessary to assess the possible influence that a particular stakeholder group may have on the decision-making process. Poor decision-making and a lack of citizen involvement in the strategy have made it difficult to provide an effective waste management service.

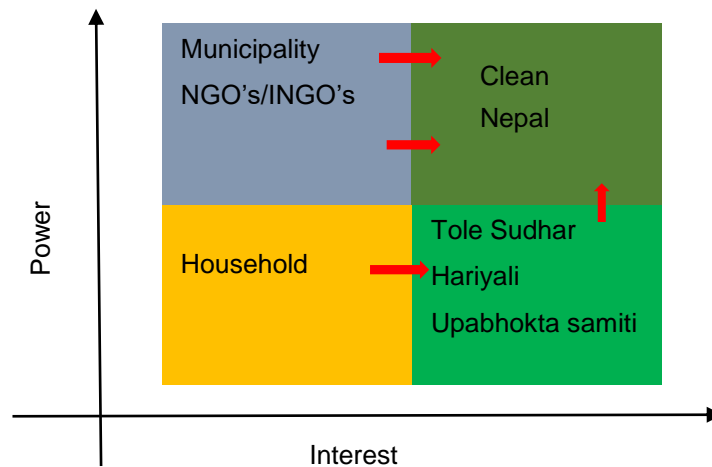


Figure 17: Recommended stakeholder map of ward 2

7.1.3. Policy review

There are numerous policies that discuss waste management. The SWM Act, 2068 outlines the duty of local governments to reduce waste output. Additionally, order local organizations to take the required actions to support the 3Rs, including segregation. Similar to this, NUDS advises using the 3R approach in all municipalities. Source reduction is covered in these policies to some extent, however since it is not covered in detail, the policy has to be amended. Training and programs stated in the municipality were not offered, according to the poll as well. Thus, there is a gap between the creation and application of policies. For the three tiers of government, including the federal, provincial, and local, an appropriate legislative provision must be drafted. This provision must also include a policy and strategic framework. People's conduct must be strictly regulated, all stakeholders' capacities must be built, 3R activities must be promoted, and SWM infrastructures for treatment, recycling, and recovery must be invested so that very little trash needs to be disposed of in landfills.

Municipalities merely give preference for collecting and disposing of rubbish. The municipalities do not place a high priority on the 3R (reduce, reuse, and recycle) approach for efficient sustainable trash management. Although municipalities were primarily in charge of managing solid waste (SWM), there is no Solid Waste Management Technical Support Center (SWMTSC) to offer technical assistance for municipal SWM-related policy, planning, capacity building, and technical issues. There is currently no specialized institution at the federal or provincial levels to offer technical assistance to local governments in all areas of SWM that

must be established, particularly for policy formation, creating SWM standards and guidelines, and increasing local government capacity.

CHAPTER 8: CONCLUSION AND RECOMMENDATION

Waste management is a concern in Ward 2 because of unplanned development, a rapidly expanding population, a lack of basic facilities for integrated solid trash management, and a pervasive misconception about waste management. Source segregation is the first step in source reduction, according to many studies. Without people starting to think about how their causes affect other people, source reduction is impossible. The study finds that increasing awareness can be accomplished in other ways besides education. Individual norms, attitudes, and behaviour are also very important elements. Similar to this, residents of ward 2 are aware of the effects of trash but do not view waste management as a serious issue as a result of the inhabitants' actions. Clean technology can be used to reduce sources, and consumer behaviour can also be modified.

Several stakeholders are involved in the management of solid waste as a source, and their role has become essential. Everyone has responsibilities to fulfil, including their tasks and obligations as well as those of the government in planning and providing infrastructure, NGOs in educating the public, and the government itself. Every stakeholder does not participate equally in the planning and decision-making processes. Each person needs to have a specific amount of ability and motivation to address the issue. The municipality in Ward 2 has power but is uninterested, therefore the issue is not resolved. Municipalities are primarily responsible for providing infrastructure, providing training, and monitoring, but they are falling short. Similar to this, the general population must appropriately separate garbage. The responsibilities and functions of each need to be defined.

In our current policy, source reduction isn't discussed much. Therefore, appropriate source reduction strategies must be addressed, and stringent regulations must be implemented. The first step in source reduction may be adopting guiding laws and strict regulations; this is the government's job. The provision of appropriate infrastructure, such as separated trash bins, recycling facilities, and other training and source reduction programs, is the responsibility of the government, NGOs, and INGOs. The third is the enforcement of laws by people acting under the control of the local government. The source can be diminished at the point of generation based on this. However, significant efforts should be made to implement soft interventions, such as programs to change people's behaviour, build the capacity of all stakeholders, promote 3R initiatives, and invest in SWM infrastructures for treatment, recycling, and recovery, so that very little waste needs to be disposed of in landfills.

8.1. Specific Recommendation

- i. The majority of respondents were aware of segregation but did not engage in it. The sectors involved in waste management must publicly release information on trash segregation in order to encourage it.
- ii. The survey revealed that the lack of separate trucks to collect segregated garbage is the primary cause of waste not being separated. Therefore, the relevant sectors must provide separate cars.
- iii. According to the respondent, just a few individuals are aware of composting, and municipal authorities have not even offered composting training. Therefore, composting must be encouraged in homes who can afford it.
- iv. It was discovered during the inspection that there are no dustbins or compost bins available. Therefore, the municipality is accountable for that.
- v. Municipality must provide incentives and disincentives to change consumer's behaviour such as reduce plastic packaging.
- vi. Equally, the public must be responsible towards their duty as; proper segregation and follow 3R principle.

8.2. Policy Recommendation

- i. Although source segregation and the 3R techniques are stated in our current solid waste management act and solid waste management rules, they do not specify how to implement them. As a result, these methods must be described in depth and strong restrictions must be put in place.
- ii. Strict regulation on source segregation and recovery methods which needs to be addressed such as fine, incentives, punishment, etc.
- iii. Also limiting the use of landfill site may be one of the solution such that people starts reducing waste at household level.

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ANNEXURES

ANNEX 1: LIST OF KEY INFORMANTS

1. Jenson Maharjan: Manager at Kirtipur Fohor Byabasthapan
2. Ronish Shakya: Event Manager at Blue Waste to Value
3. Kalpana Khadka: Manager at Clean Nepal
4. Gyan Bajra Maharjan: Officer at Environment and Solid Waste Department.
5. Bishnu Bahadur GC: Chairman of Hariyali Upabhokta Samiti
6. Kamal Tamang: Founder of Lok Adarsha School

ANNEX 2: QUESTIONNAIRE

Questionnaire for Interview of the Respective Authorities of Study Areas

This questionnaire has been developed as a requirement during the master's thesis study in Urban Planning under Department of Architecture, Pulchowk Campus, Lalitpur, I.O.E., T.U.

Questionnaire for Respondents

Respondents detail

Name of Respondent

Education level

Family member

Rented or not

Total no. of renters

Gender

Occupation

Age of respondent

- i. What is the source of waste generated?
 - a. Residential
 - b. Industrial
 - c. School
 - d. Shops/Restaurant
 - e. Mixed-use

- ii. Generally, what includes your waste?
 - a. Compostable waste (kitchen waste)
 - b. Recyclable waste (Paper, plastic, glass, metal)
 - c. Medical waste (expired medicines, bandages, ointments)
 - d. Domestic hazardous waste
 - e. Electronics waste

- iii. Weight of waste/week?

- iv. Who is responsible for waste collection in your ward?
 - a. Municipality
 - b. Private contractor
 - c. Tole lane organization

d. Any other, please specify

v. How do you store waste at your home?

a. Plastic bag/container

b. Metallic container

c. Both

d. Any other, please specify

vi. Do you use separate bins for different kinds of waste?

a. yes

b. no

If yes, how do you manage segregated waste?

a. Dispose of in landfill

b. Reuse

c. Recycle

d. Composting

e. Incinerate

If no, Don't you think segregation is important?

a. Yes

b. No

vii. Is there any provision from the municipality to collect segregated waste?

a. Yes

b. No

viii. Which of these methods of waste disposal would you like to adopt?

a. Recycling

b. Composting

c. Dispose of in landfill

d. Other

ix. What are the barriers for the waste segregation?

a. Not enough space

b. Dirty smell

c. No provision of separate collection vehicles for segregated waste

d. Other

x. Do you take steps for waste reduction?

a. Yes

b. No

If yes, what steps do you take for waste reduction?

- a. Carry my bag for grocery shopping
 - b. Reuse of paper
 - c. Composting
 - d. Any other, please specify
- xi. What is the frequency of waste collection?
- a. Daily
 - b. Per week
 - c. 2 times a week
- xii. Is community composting practiced in your locality?
- a. yes
 - b. No
- xiii. Have you received guidelines from the municipality to practice composting at your house?
- a. yes
 - b. no
- If yes, how are you applying it?
- xiv. Are you willing to participate in waste reduction practices?
- a. yes
 - b. no
- xv. Is there any incentive or training provided for waste reduction at the household level?
- a. yes
 - b. no
- xvi. What are the challenges in storing waste?
- a. Less space
 - b. Bad smell
 - c. Any other
- xvii. What are the challenges in reusing & recycling waste?
- xviii. Do you attend programs/training for waste reduction?
- a. Yes
 - b. No
- xix. How solid waste can be managed properly?

Questionnaire for Key Informant Interview(KII)

- a. Name of Interviewer
- b. Name of organization
- c. Established date
- d. Covered area
- e. Waste collection/day
- f. Waste composition
- g. Waste source
- h. Waste load to the landfill site(residue)
- i. Waste collection method
- j. Waste storage method
- k. Waste segregation methods
- l. Waste reuse/recycling practices
- m. Waste reduction training provided at the household level or incentives provided?
- n. Institutional setup
- o. Financial mechanism
- p. Stakeholders involved
- q. Stakeholders role
- r. The willingness of people to participate in waste reduction
- s. Awareness level
- t. Challenges in storing waste
- u. Challenges in reuse, recycle
- v. Challenges in co-operation of various stakeholders
- w. Waste recycle/day
- x. Initiatives/program

ANNEX 3: IOE GC