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**Public Private Partnership in Sustainable Solid Waste  
Management: A case of Madhyapur Thimi**

**by**

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**A THESIS REPORT**

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**LALITPUR, NEPAL**

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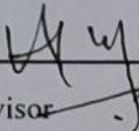
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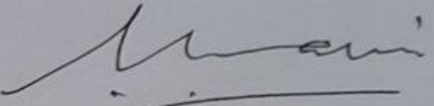
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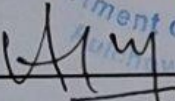
  
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## **ABSTRACT**

Sustainable solid waste management through Public Private Partnership (PPP) projects have been initiated in the municipalities of Nepal in recent years. PPPs combine the skills, knowledge and resources of both the public and private sectors through appropriate sharing of risks, rewards and responsibilities. This research explores roles and responsibilities of the major stakeholders of PPP and how they are working collaboratively to manage solid waste sustainably in Ward 4 of Madhyapur Thimi Municipality. The municipality has initiated best practice of waste management through composting done at Rikishi Compost Pvt. Ltd.

This research emphasizes on private sector participation for sustainable practices in waste sector to reduce waste to landfills and create opportunities. Resource recovery has the capacity to reduce financial, environmental and social burdens on the municipality and even unlock new revenue streams. The various enabling and constraints factors for the successful operation of the project were studied through perception of local government, private party and affected households. In addition, the study examined case studies with good practices of SWM through PPP model, reviewed PPP policies and SWM policies focusing on private sector participation for turning waste to valuable resource. The study finds that peoples' participation, monitoring, training and awareness program for segregation at source is not conducted on regular basis. The service user lack awareness about benefits of waste recovery projects. The local government lacks proper monitoring and feedback mechanism, financial investment and land for the expansion of the project to larger scale. The private company faces difficulty to compete in the market in absence of subsidy to the recovered product, inadequate supply of segregated waste and lacks continued political support. Based on the analysis, strategies for improving enabling environment for successful implementation of PPP in sustainable SWM have been explored.

### **Key words**

Sustainable Waste Management, PPP, segregation at source, policy

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078MSUrP011

## **LIST OF ACRONYMS**

IOE: Institute of Engineering

KII: Key Informant Interview

MTM: Madhyapur Thimi Municipality

MSW: Municipal Solid Waste

MSWM: Municipal Solid Waste Management

PPP: Public Private Partnership

SWM: Solid Waste Management

TLO: Tole Lane Organization

TU: Tribhuvan University

WM: Waste Management

W-t-E: Waste to energy

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## **CHAPTER 1 : INTRODUCTION**

### **1.1 Background**

The management of solid waste is a major environmental issue in most of cities of developing countries. The primary causes for the increasing generation of MSW is urban population growth and economic development and is certainly the case with Kathmandu Valley. Nepal is one of the top 10 nations in the world for the fastest rate of urbanization(United Nations, Department of economic and Social Affairs, 2014). The city's waste management has been extremely problematic for decades in terms of landfill placement, where space is becoming increasingly limited for urban planning. Inadequate scientific disposal have resulted to issues with public health and the environment (Shrestha, 2018). Managing the final disposal of solid waste has become one of the biggest challenges faced by society (Barles, 2014).

By 2050, the amount of waste produced worldwide is predicted to increase from the current 2.01 billion tonnes to 3.4 billion tonnes. If improvements are not made in this sector, it is projected that emissions related to solid waste will reach 2.38 billion tonnes of CO<sub>2</sub>-equivalent annually by 2050 (Kaza et al., 2018). In Nepal, the total amount of waste generated from the municipalities across the country is approximately one million mt/year, of which 3,86,690 mt/year is contributed by households, 2,45,884 mt/year by business houses, 1,03,244 mt/year by educational institutes, 94,392 mt/year by industries, 1,01,507 mt/year by health institutions and 66,220 mt/year by other sectors. The largest use sector was landfill with 3,89,983 mt of waste being dumped annually in the landfill sites. The second largest use sector was the environment (3,15,069 mt/year), followed by burning (22,075 mt/year). Recycling represented the use sector with the lowest quantity of waste flow annually (8,690 mt/ year). The waste types under the recycling sector were plastics, paper and paper products, and metals (CBS, 2022).

Developments and research in the waste sector of the country are strongly influenced by the private sector involvement through competitive bidding, International Non-Government Organization (INGO's) due to the low budget that the Nepalese government allot for solid waste management. The solid waste management has never been prioritized as the demand for other public services is much higher in municipalities across Nepal (Asian Development Bank, 2013b). Municipal governments in Nepal were wholly responsible for all waste management activities prior to the initiation of

the Public-Private Partnership (PPP) model in solid waste management. These activities included; street sweeping, household waste collection and waste disposal. The private sector's involvement in Solid Waste Management was introduced in the city of Biratnagar in 1997. It is the first city in Nepal to successfully use the model of public-private partnership. Its successful development of a sustainable system for managing municipal waste serves as a model for similar public-private partnerships (PPPs) in waste management across Nepal (PPSD).

In recent years, government has made policies to enhance private sector participation for waste management by adopting new technologies. Public-private partnership is encouraged to build and run bioenergy, organic fertilizer, incineration plants and waste treatment. Hence, public sector need to establish partnerships with private sector to reduce waste and create opportunities. Developing sustainable industries will reduce the effects of waste as well as create opportunities for new jobs, compost for crops and building materials. The municipalities need to adopt circular approaches to waste (composting, profitable re-purposing, recycling) in order to achieve sustainable waste management to overcome obstacles and capitalize on opportunities. Resource recovery can reduce the financial, social, and environmental burdens on the municipality and potentially open up new revenue streams from the MSW management perspective (Shrestha, 2018). The concept of circularity in waste management can be strengthened by improving existing system and practices utilized by both public and private sectors to eradicate waste through post-utilization of valuable discharged material and maintaining the value of materials throughout their life cycles. Integrating waste management treatment technologies develops the best structure for waste treatment and recovery which minimizes negative effects on several sustainable dimensions, such as social, economic and environment (Wilson et al., 2014).

## **1.2 Problem Statement**

There is growing need for improved management of municipal solid waste in Asia as it is experiencing rapid urbanization with high population density. Numerous governments have come to the realization that reducing waste volume and minimizing its negative effects on the environment and society can be achieved through waste material recovery and energy conversion. These initiatives may reduce the local government's expenses related to MSW management. It also aids in risk management, industry technology development, and increased operational efficiency. However, these

facilities need huge capital investment and highly skilled professionals for operation and maintenance (Liu et al., 2019). Only the government's investment and involvement is not adequate emphasizing the need for a greater role of the private sector. It is necessary to attract private sector for development activities to be efficient and successful. Public Private Partnership (PPP) can be a tool to mobilize the resources, knowledge, skills and technologies available in private sector. PPP is the tool that aids in mobilization of resources of private sector for public benefit. The private sector will show interest when the enabling environment for the PPP is adequate.

The current waste management practices in Kathmandu Valley are based on a “collect and dump” approach that neglects potential for turning waste into valuable resources. Thus, there is an opportunity to shift from a waste management to a resource management approach (NFEJ, 2020). Improper MSW management and treatment also contributes to environmental pollution. A major factor for climate change and global warming is the mismanagement and accumulation of overwhelming amount of solid waste. Missed opportunities in the resource management of the various waste types accumulated are another important impact that poor MSWM has on society. If we move toward recyclability and optimal material utilization, MSW can be a valuable resource (Shrestha, 2018). In the case of Kathmandu, almost all of the parties that adopted the concept and practice of MSW repurposing and regeneration are non-governmental organizations, commercial businesses, informal waste collectors and recyclers. Most of the waste ends up at Sisdol landfill emphasizing a lack of formal reutilization and recycling facilities in the waste sector. There is need of formal system for resource recovery within the city. In recent years, few municipalities have started composting and waste to energy facilities in partnership with private sector. However, these SWM related enterprises are not being able to operate on a large, commercial scale. It is important to understand the issues and challenges to improve PPP enabling environment and successful implementation of waste recovery projects.

### **1.3 Need of the research**

MSW is not properly managed in most developing countries. The disposal of MSW is primarily dependent on open dumpsites and landfills that are inadequately designed and sanitary, with collection rates between 60% and 90%. Such traditional disposal methods (like open dumpsites or sanitary landfills) require a large area, which is extremely valuable but not always available in dense urban areas. Due to pollution and possible



health risks, local communities also often oppose landfills. Achieving sustainable development requires controlling waste volumes and minimizing these adverse effects (Huang et al., 2018).

Solid waste management is becoming one of the major challenges for local bodies in countries like Nepal, where resources are limited and lack skilled manpower. The majority of local governments handle these tasks internally using their own resources, but some manage them externally by contracting out to a private company. Solid waste management will undoubtedly become more difficult in the near future due to the current population growth, increasing urbanization, and lack of suitable landfill facilities. So, it is necessary to recognize this challenge and prepare for the future (Office Of the Investment Board, 2019). Huge investment is needed for improving Solid Waste Management system. Local bodies are unable to meet this requirement with their internal resources. Collaboration between the public and private sectors is now crucial for providing SWM services, building the necessary infrastructure for the treatment and disposal of waste in local government entities, and maintaining the services in an economical and efficient manner. Private sector may contribute finance, technology and innovation to accelerate the infrastructure development to deliver quality, faster and cost effective and efficient public services. In mutually beneficial circumstances, it is advantageous to have both the public and private sectors actively involved in order to maximize the strengths of each sector. This research shall identify the role, responsibility, strength, constraints and potential of public/private sector and service user in the waste recovery projects. This research will explore good practices in sustainable waste management, the existing policies of PPP, the challenges for successful implementation of PPP and recommend strategies to enhance PPP in solid waste management.

#### **1.4 Importance of the research**

It is possible to reduce the amount of waste reaching landfills and gain value from the waste by developing necessary infrastructure for environmentally sustainable and cost effective collection and transportation, processing and scientific disposal.

The significance of this research is to review recent practices of PPP model in sustainable SWM, emphasize lessons learned, add knowledge in this field and identify critical gaps that need to be addressed. The recommendations of this study will assist

the communities, private enterprises, governments and non-government organizations dealing with waste management issues in developing appropriate strategies to solve the problem. This research will be valuable for planners, researchers and managers of SWM systems. The findings of the study will be helpful resource for the Madhyapur Thimi Municipality to enhance private sector participation in waste sector.

### **1.5 Objective**

The main objective of this study is to assess the role of Public Private Partnership for effective service delivery in sustainable management of municipal solid waste.

The specific objectives include:

- To explore how PPP model is working in solid waste management value chain.
- To analyze the impact of the involvement of private sector on municipal SWM.
- To analyze the factors for success and failure of PPP.
- To recommend strategy for effective PPP in SWM.

### **1.6 Limitations of the Research**

This research tries to study the effectiveness of private sector participation in solid waste management sector. The study focusses on the partnership for turning waste to valuable resource through public private partnership(PPP) in solid waste management as a potential alternative solution to address the waste management issues. The study will be based on primary and secondary data and the findings of the study will be completely context-based.

### **1.7 Expected output**

This study will explore practice of Public Private Partnership model in sustainable solid waste management in Nepal and assess about the importance of private sector participation in municipal waste management. The private sector can play a role in accelerating infrastructure development through technology, finance, and innovation to deliver high-quality public services more quickly, affordably, and efficiently. The expected output of this research is to find out how local government, private company and community is working collaboratively to effectively manage solid waste from the point of waste generation to the final disposal as well as to identify problems and challenges that occur during this phase. This study will explore strategies to improve PPP enabling environment in SWM for effective service delivery.

## **CHAPTER 2 : RESEARCH METHODOLOGY**

### **2.1 Research paradigm**

The term 'paradigm' refer to the consensus among scientists regarding how issues should be understood, how we see the world and how we approach conducting research (Creswell, 2003). These paradigms therefore comprise a fundamental set of presumptions or beliefs that direct our investigations for a specific research project (Lincoln & Guba, 2005). In other words, it is our way of understanding the reality of the world and studying it. Positivists, Post-positivists, Interpretivists, Transformative and Pragmatics are the most common paradigm classifications.

The worldview that the positivist paradigm defines for research is based on what is referred to as the scientific method of investigation. According to this paradigm, experimentation and observation are the best ways to gain true knowledge. When it comes to studying social phenomena, objective and scientific methods are less effective than when they are applied to natural objects (Rehman & Alharthi, 2016). Since, this research is based on social science and cannot be done in a controlled setting, this paradigm is not applicable. Similarly, Post-positivist paradigm is the modified scientific method for the social sciences. The objective of this approach is to generate unbiased and broadly applicable insights into social patterns by validating the existence of universal laws in the correlations between predetermined variables. This research does not adopt any scientific methods, this is not suitable paradigm.

Pragmatism is not associated to any system or philosophy. Researchers are free to employ both qualitative and quantitative methods; what matters most is determining the most effective research procedures and techniques to address the given problem statement. When two or more paradigms are applied in a research, it is known as pragmatic paradigm. This research does not adopt multiple paradigms to address research objectives.

Interpretive approach aims to comprehend how people see the social phenomena they engage with, rather than to find knowledge and truth that are universal, context-free and value-free. Interpretivists believe that each interpret their view of the world based on one's perception. This paradigm is well suited for my research objective. Public Private Partnership in sustainable solid waste management is subjective and has social dimension. Multiple stakeholders which includes local government authorities, private

sector and service users are involved for the data collection and each one interprets the same context differently.

The ontological position for the research is that solid waste can be managed efficiently through private sector participation in waste sector. Ontology is a branch of philosophy based on our beliefs about what constitutes truth or reality as well as the characteristics or essence of the social phenomenon we are studying (Scotland, 2012). Similarly, the study of epistemology in research focuses on how knowledge is obtained, how we know what is true or real, and what is considered knowledge in the real world. It focuses on the foundations of knowledge, including its nature, forms, acquisition methods, and means of communication with other people (Kivunja & Kuyini, 2017). The epistemological position for the study is that issues and challenges and role of various stakeholders in the waste management can be obtained through interaction with the local government authorities of Madhyapur Thimi, private company of the project and affected households. Interaction with them is essential to gain a comprehensive understanding of the situation and its context. The valid knowledge can be attained through observation, interviews and interpretation of secondary data.

## **Methodology**

Methodology deals with how and what procedure can be used to acquire the knowledge. It includes the data collection, analysis and evaluation techniques.

### **2.2 Data Collection Techniques**

The data collection techniques that were used are direct on site observation/checklists/photographs where what is seen, heard or encountered is recorded. Semi-structured and open-ended interviews were conducted by personally asking people questions and respective authorities in one-on-one conversations. Surveys were conducted with questions to understand the perspective of people on the performance of private sector for waste management. All the above mentioned techniques are the primary data sources.

For secondary data, collection of existing data in the form of texts, images was carried out. Policy documents, journals, and past researches related to the study were reviewed. Relevant international cases were identified and reviewed which provide insights to address the problem.

## **2.3 Methods**

### **2.3.1 Literature Review**

Literature reviews were done to find the importance of Public Private Partnership to manage the waste sustainably, their critical success factors and failure factors. The concept of sustainable waste management practices and policy documents were 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. Observation also helps to analyze the actual condition and problems in the study area. A checklist were prepared related to site, surrounding, waste disposal etc. and photographs were taken.

### **2.3.3 Sample survey**

In the selected households, a random sampling technique were used for the survey such that the respondents represent a diverse range of ages, genders, occupations, building use etc. Their viewpoint regarding the waste collection services provided by the private company and waste management issues was derived. The questionnaire helped understand users' perception of waste management by the private sector participation.

### **2.3.4 Key Informant Interview**

Key informant interviews (KII) are in-depth discussion with individuals who are aware of community issues (UCLA, 2016). The semi-structured questionnaire were used for the key informants of the area. Interviews were conducted for responsible agencies/organization related to management and challenges faced by them for the implementation and execution in the study area.

### **2.3.5 Case study**

For this research, case study method was chosen and the selected case is Ward 4 of Madhyapur Thimi Municipality which has initiated good practices of solid waste management. It will aid in the collection of more precise data about existing practices, problems, and issues.

### 2.3.6 Framework for Data Collection

Data were collected from various sources such as KII, HH's survey, Literature, case study so that the objective of study is fulfilled.

*Table 1: Framework for data collection*

MAIN OBJECTIVE	SPECIFIC OBJECTIVES	VARIABLES	DATA SOURCES
To assess the role of Public Private Partnership for effective service delivery in sustainable management of municipal solid waste.	To explore how PPP model is working in solid waste management value chain	<ul style="list-style-type: none"> <li>• Role of local government, private company and households.</li> <li>• Issues and challenges in waste management chain</li> </ul>	KII; Service user survey, Site observation
	To analyze the impact of the involvement of private sector on municipal SWM.	<ul style="list-style-type: none"> <li>• Health and environmental impacts.</li> <li>• Social impacts</li> <li>• Cost, finances and economics</li> <li>• Organization and institutional support</li> </ul>	KII; Service user survey, Site observation, Literature review on good practices of SWM
	To analyze the factors for success and failure of PPP and then recommend strategy for effective PPP in SWM.	<ul style="list-style-type: none"> <li>• Enabling and constraint factors of PPP</li> <li>• PPP project in national and international context</li> <li>• National PPP and SWM policy</li> <li>• Strategies for improving PPP enabling environment</li> </ul>	Literature review, Site study, Policy review

## **CHAPTER 3 : LITERATURE REVIEW**

### **3.1 Sustainable Solid waste management**

Solid waste refers to discarded non-liquid material as a by-products of daily human activities. It consist of organic waste, non-combustibles, bulky waste, hazardous waste, construction waste etc. Solid Waste Management is the process of managing waste which includes collection, transportation, treatment and disposal.

Sustainable Solid Waste Management (SWM) is defined as a system that is economically viable, socially acceptable and environmental friendly. Besides to being technically, financially, environmentally, politically, institutionally, and socially feasible, the waste management system must be designed to fit local conditions. It must be able to continue over time without depleting the resources it requires

#### **Environmental Sustainability**

Sustainability will be attained if the current waste disposal scenario, which imposes a heavy burden on the environment and resources, is changed to a closed-cycle system that prevents the loss of nutrients, energy, and raw materials. The prevention of waste generation, which includes waste minimization and reduction, is more important than recovery. In addition to preventing or avoiding the generation of unnecessary waste, sustainable waste management promotes the development of clean technology.

#### **Institutional Sustainability**

The primary responsibilities fall under the public sector, usually the municipal government in any waste management system. The local government is obliged to have ultimate authority over matters and be held responsible for the functioning of the system. To ensure adequate performance of private enterprises, an appropriate legislative and regulatory framework with suitable compliance and enforcement mechanisms is essential.

#### **Financial and Economic Sustainability**

Determining the actual costs and benefits of all waste-related activities requires full-cost analysis. It is more sustainable to employ ability-to-pay cost-based fee collection systems in addition to full-cost accounting rather than relying only on donor or foreign funding. In the end, there should to be a link between the waste management expenses

and the sources of income (service user charge, income from sale of recovered materials, nominal fees, etc) related to waste management operations.

### Social Sustainability

Waste management services need to be accessible to all societal classes regardless of their income, ethnicity or social status. It is also important to think about how to improve the handling and collection of informal waste.

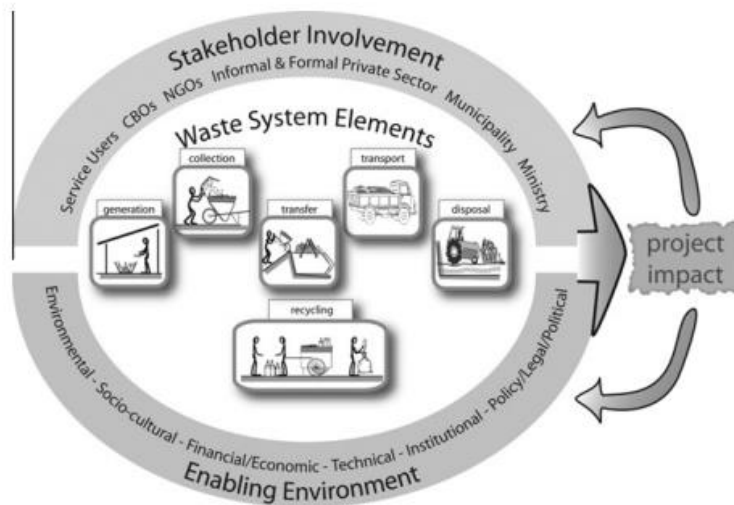


Figure 1 : Graphical representation of Sustainable Solid waste Management Approach

### 3.2 Solid waste project assessment

In the past, evaluations of waste technology or facilities have mostly concentrated on technical aspects such as the plant's performance in terms of the amount of waste it processes, the coverage of services, and any associated environmental effects. But experts now agreed that sustainable and integrated solid waste management encompasses much more than just the environmental and technical aspects. (UNEP & Cal Recovery, 2005). There are numerous factors that influence the performance of a solid waste management infrastructure, including those that are technical, environmental, financial, institutional, legal, and socio-cultural (Guerrero et al., 2013). These factors vary from place to place. Success or failure factors can also be associated to:

- Social acceptance and mobilization issues (social element)



- Legal, institutional, and stakeholder agreements that define roles, duties, and management responsibilities (institutional element)
- Operational and financial needs, as well as methods for recovering costs (economic element).

A simplified method for evaluating solid waste projects has been developed by the ISSOWAMA (Integrated Sustainable Solid Waste Management in Asia) association. The basis for analyzing the project’s “drivers of success” or “reasons of failure” is provided by this method. Expert knowledge and overall case study experience were employed to define the qualitative indicators that impact the project’s success or failure ( Zurbrügg et al., 2012).

*Table 2: Qualitative Indicators to assess Solid Waste Project*

Qualitative Indicators to assess Solid Waste Project	
Technical functionality/ appropriateness	Level of local skills for design and construction.
	Level of local skills for operation and maintenance
	Use of local materials
	Level of performance considering expected goals
	Level of flexibility to changing conditions (adaptability)
Health and environmental impacts	Level of workers related health protection and health care services
	Level of community related health protection
	Adherence to environmental regulations
	Adherence to the agreed-upon emission limits
Costs, finances and economics	Level of cost efficiency
	Level of cost recovery

Social aspects	Level of social commitment
	Level of social acceptance/support
	Level of institutional acceptance/support
	Level of social demand
	Level of social interaction
	Level of social inclusion
Organizational strength and institutional support	Level of in-house staff skills and capacities
	Level of performance and quality monitoring and evaluation
	Level of political support
	Level of institutional support

### 3.3 Circular economy situation of SWM in Kathmandu

The concept of Circular Economy is relatively new and most people in Kathmandu are unaware about it. Its principles and benefits are not well known or understood. There is a linear economy-driven society in developing nations like Nepal, particularly in Kathmandu, where the take-make-dispose system predominates and post-consumption of goods is not given much thought (Shrestha, 2018). Upcycling has gained popularity in the city as a result of the emergence of numerous creative businesses that seek to create a more sustainable and circular vision for Kathmandu. For instance, creative recycling businesses like Khaalिसि and Doko Recyclers have begun offering households free waste collection services so they can sell their recyclable waste.

### 3.4 Defining Public–Private Partnerships

The UNPPPUE defines PPP as a tripartite contractual agreement that combines the public (government and municipalities) and private (formal and informal enterprises) sectors to provide basic services based on sustainability, social responsibility, commercial viability, and public accountability (fairness, competitiveness, and transparency). The agreement also involves the effective participation of civil societies, which includes communities, non-governmental organizations, and research groups as beneficiary target groups.

According to the Asian Development Bank, PPPs are a range of potential partnerships between public and private entities in the provision of infrastructure services. An effective PPP allocates duties, responsibilities, and risks between public and private partners in the best possible way.

Public-private partnerships, or PPPs, are typically viewed as an alternative to full privatization. In PPPs, the government and private businesses share ownership and co-responsibility for providing specific services. Through these collaborations, the public sector's concerns about job generation, social responsibility, environmental awareness, and local knowledge are combined with the advantages of the private sector, such as dynamism, financial accessibility, technological expertise, managerial effectiveness, and a spirit of entrepreneurship ( Ahmed & Ali, 2004). The best of both sectors could be provided by PPPs. However, in order to develop a successful partnership, certain enabling environment or prerequisites must be met to promote mutual trust and a cooperative working relationship. Effective PPPs emphasize the advantages that both the public and the private sectors have when performing particular tasks. The government may contribute to a PPP in the form of capital investment, transfer of assets, or other commitments that support the partnership. Additionally, the government offers social responsibility, environmental awareness, and political support. The role of private sector in the partnership is management, operations, innovation and to make use of its expertise in commerce to run the project efficiently. The partnership's structure should be developed to distribute risks to the party who can minimize costs and maximize performance while managing those risks.

PPPs combine the resources, skills and expertise of both the public and private entity by sharing of risks, rewards and responsibilities. By assigning day-to-day operations to the private sector, this approach allows governments to benefit from their expertise while focusing on planning, policy, and regulation. PPP collaboration needs to be based on each partner's expertise addressing the needs of public through the proper allocation of

- a. Resources,
- b. Risks,
- c. Rewards, and
- d. Responsibilities

One of the factors contributing to the growing interest in PPPs is the belief that PPPs avoid the negative impact of either exclusive public ownership or complete privatization for service delivery. PPP approach is effective in providing public services as it integrates the best potential of both party: the public sector with its regulatory actions and protection of public interests, and the private sector with its resources, management expertise, technology and innovativeness (UNECE, 2008).

### **3.4.1 Origin of Public Private Partnership in Nepal**

The public-private partnership (PPP), which combines the best practices of the public and private sectors, emerged as an innovation for effective development management and service delivery in the 1990s. From the beginning of 1990, Nepal has also used PPP to build infrastructure, produce public goods and utilities, and offer a wide range of other services, including education, health and sanitation, and agriculture. Prospects for a successful PPP are good in many areas, but the outcomes are inconsistent because of issues with low levels of trust, undeveloped private sector, lack of funding, lack of bureaucratic support and unstable political environments. (Adhikari, 2010).

Biratnagar is the first municipality of Nepal to contract the private sector for solid waste management. Every day, about 50 tons of solid waste are disposed of in Biratnagar. In Biratnagar, private sector involvement in solid waste management began in 1997–1998. The solid waste management service that the municipality was providing was ineffective prior to this public-private partnership. However, political instabilities and a lack of defined government policy posed difficulties and challenges for Americorp, the first contractor. A later agreement was made with another company known as Silt, which was functioning until 2007. One significant thing that Silt established was the strong relationship it had with the city, which enabled it to be a pioneer in the implementation of waste management fees for residential and commercial properties. Since 2007, Samajik Sudhar Tatha Batabaraniya Bikas Manch has been in charge of the SWM contract. Solid waste collection, transportation, and disposal fall under the responsibility of this contractor.

In Nepal, there were only a few private investors because of internal conflict within the country, political instability and many other things. With the enactment of the constitution in 2015 and growing political stability, foreign and domestic private

investors started to invest in different sectors in Nepal. This is how the public-private partnership started gaining attention.

### 3.4.2 Motivation for Engaging in PPPs

The three primary reasons that motivate governments to adopt PPPs for infrastructure are:

1. To attract investment from private capital.
2. To become more effective and efficiently utilize the resources that are available.
3. To reform the sectors by assigning roles, duties, rewards, and accountability.

### 3.4.3 Enabling Environment for PPP

PPP is primarily driven by the market, and the private sector's involvement must be sustained by an enabling environment. An enabling environment for PPP is one that will help

- Reduce barriers in the chain of municipal solid waste(MSW)
- Encourage W-t-E development driven by the market and
- Maintain a balance between the risks shared by the public and private sectors.

### 3.4.4 Stakeholders of Public Private Partnership

There are three main stakeholder groups and three types of partnerships linkages. The PPP is specifically known as partnership between the Private sector and Government. The partnership between the Government and the Civil Societies is based on the Government's policy to include and empower the Civil Societies when needed.



**Figure 3: Public Private Partnership Structure**

#### **Public partners**

The Central and Local Government Bodies, as well as Ministries, Departments, Municipalities, DDC, and VDC, were included among the stakeholders under the

Government category. This also applies to donor organizations and other government-owned businesses.

### **Private partners**

The Formal and Informal Private Sector, which includes businesses, industries, companies, nonprofit organizations, service providers, NGO, CBO, and individual stakeholders, makes up the second category of stakeholders. Private parties must be duly registered legal entities that meet all applicable Nepalese requirements and have the legal right to make these kinds of agreements. Private party allowed to involve into PPP collaboration include:

- Domestic or foreign private enterprises
- Non-governmental organizations (NGO/INGOs)
- Community based organizations(CBO's)
- Cooperative organizations

### **Citizens and Civil Society**

The consumers, which include service users who are accountable for waste generation, make up the third category of stakeholders. Civil society play different roles at different PPP stages. Their responsibility is to make sure that their request for a specific service is fulfilled during the project identification phase. During the project structuring and formulation phase, it is necessary to ensure that the specific project components and implementation strategies comply with participatory processes and are acceptable to all stakeholders. This offers the chance to learn more about the real demand for services as well as the willingness to pay for them. Civil society also keeps an eye on and oversees the quality of services provided by the service's private operator in the post-implementation phase.

#### **3.4.5 Structuring a PPP: PPP Models**

Service contracts, management contracts, lease agreements, concessions, and BOT/BOOT are examples of common PPP contract types. Sub-national governments agree to pay the private partner for services rendered over an extended period of time, primarily by allowing the private operator to collect tariffs and service charges. The following models are used to describe partnership agreements:

- i. Operation & Maintenance Contract (O & M)**  
Publicly owned assets are operated and maintained by a private operator for a predetermined period of time under a PPP contract. The municipal or other public body continues to be the asset's owner.
- ii. Design-Build-Finance-Operate (DBFO)**  
The private party designs, constructs, finances, and operates the facility during the term of the lease. When the lease expires, the private partner transfers the facility to the government.
- iii. Build-Own-Operate (BOO)**  
A facility or service that the private sector finances, constructs, owns, and runs is a permanent asset.
- iv. Build-Own-Operate-Transfer (BOOT)**  
A private company is granted a license to finance, plan, construct, and run a facility (collecting fees from users) for a predetermined amount of time, following which ownership returns to the government (municipality).
- v. Buy-Build-Operate (BBO)**  
A public asset or assets are transferred to a private or quasi-public organization, typically with an agreement that the assets will be upgraded and operated for a specified time. At the time of transfer, the contract is used to exercise public control.
- vi. Operation License**  
A license or other authorization to run a public service is granted to a private operator, typically for a specified time. IT projects frequently use this.

Similarly, Public Private Partnership and Investment Act, 2019 of Nepal allows implementation of any infrastructure project through PPP, either of the following methods may be applied:

- i. Build and Transfer (BT)
- ii. Build, Operation and Transfer (BOT)
- iii. Build, Own, Operation and Transfer (BOOT)
- iv. Build, Transfer and Operation (BTO)
- v. Lease, Operation and Transfer (LOT)
- vi. Lease, Build, Operation and Transfer (LBOT)
- vii. Development, Operation and Transfer (DOT)
- viii. Management, Operation and Transfer (MOT)

ix. Rehabilitation, Operation and Transfer (ROT)

Nepalese municipalities have implemented PPP modules under the BOOT, BOT, and O & M contract types so far.

### **3.4.6 Challenges of PPP**

#### **Making PPP work for the poor**

Municipalities should include provisions in PPP to address issues pertaining to the poor and marginalized groups, according to government policy guidelines in Nepal. The municipal poverty baselines and poverty reduction strategy paper -PRSP has stated that PPP need to be designed in favor of urban poor and socially disadvantaged communities.

#### **Making PPP Care for Environment and Work Climate Change Impacts**

The nation's delivery of climate-smart infrastructure has depended heavily on private investment and technology, including infrastructure financing through PPP models. PPP arrangements may be an appropriate model of service delivery when the following situations exist:

- The service cannot be provided with the expertise and financial resources of the government.
- Private partners can deliver better quality service than the governments.
- The involvement of private partners is permitted by regulations and can commence earlier with their help.
- The private sector is sufficiently competitive, and users are accepting of the participation of private partners.
- The service's results are readily quantifiable and priced.
- User fees may be imposed to recover the partial or full cost of the service.
- PPP offers a potential for some innovation.
- There are opportunities to support local economic development by adapting the latest technology and innovation.

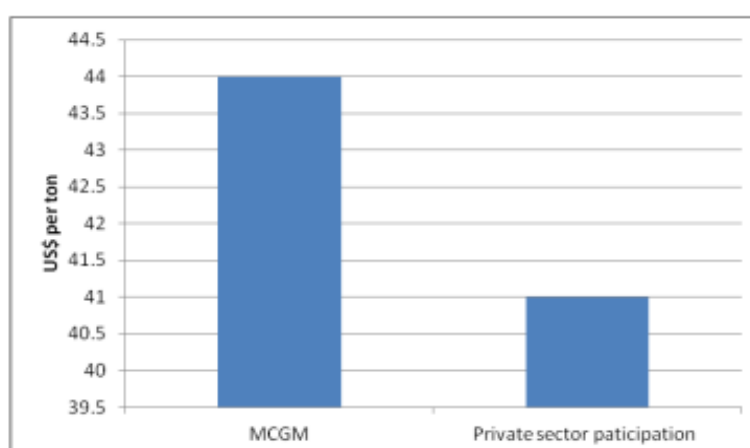


### 3.4.7 Arguments of PPP in SWM in developing countries

PPP contributes to the improvement of SWM services in developing countries in various ways (Muneera, 2012). These are explained under the following subheadings:

#### **Finding 1: Reduce the management cost**

By employing private capital, PPP helps minimize the burden on local governments' budgets. Researchers found that between 30 and 50 percent of local government expenditure is saved when the private sector participates (Awortwi, 2004). PPP is an approach that lowers waste management costs while improving service quality (Massoud et al., 2003). The involvement of private sector helped to lessen the service costs by half in cities of Latin American with higher labor and vehicle productivity (Cointreau-Levine & Coad, 2000). PPP, for instance, lowers the cost of waste management in Mumbai, according to Indian studies on SWM.



*Figure 2: Comparison of net cost of waste management under two approaches in Mumbai, India 2000 – 2001.*

The above figure compares the cost of waste management for the Municipal Corporation of Greater Mumbai (MCGM) with that of the private sector's contribution. The figure illustrates how the private sector has managed solid waste at a low cost.

#### **Finding 2 : Improve the services and getting more benefits**

PPP helps to improve the service and maximize the value of waste. While municipalities are preoccupied with open dumping, the private sector typically tries to turn garbage into compost that can be sold to make money.

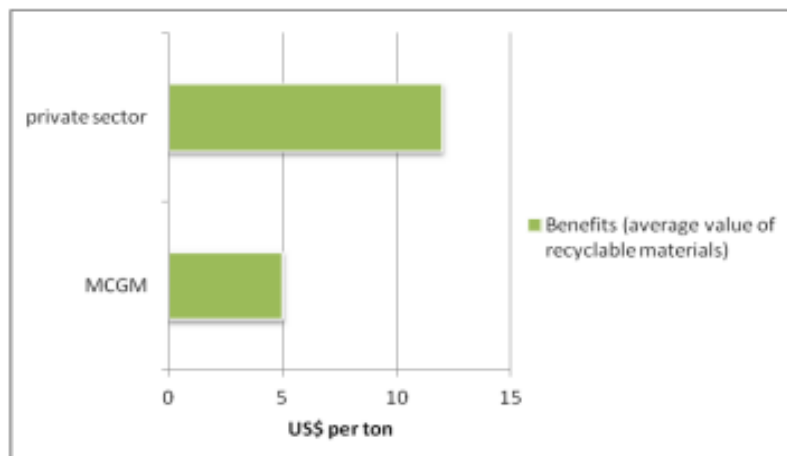


Figure 3: Benefits that the private sector and MCGM receive (average value of recyclable materials)

The benefits received by the Municipal Corporation of Greater Mumbai (MCGM) and the private sector are depicted in the above figure. It demonstrates how the waste benefits the private sector more. Protection of the environment and public health is facilitated when the Municipal Government (MG) or private sector makes more use of waste (by making compost or sanitary landfills).

### **Findings 3 : PPP helps to collect more waste**

Due to increased financial investment and the acquisition of advanced technologies by the private sector, municipalities are able to collect more waste than before. In 2000, the public sector removed 45 percent of the waste in Colombo, Sri Lanka, and the private sector removed 55 percent of the waste due to private sector involvement in urban solid waste management (USWM). Service areas have grown in the course of time.

### **Finding 4 : Waste management methods mechanized**

Due to a lack of machinery or equipment, the majority of municipalities find it difficult to handle solid waste. PPP facilitates the removal of more waste and helps to mechanize the waste management process. In order to reduce waste generation, the private sector starts processes to mechanize solid waste management, which includes collection, transportation, and treatment.

**Finding 5 : Increase public awareness and participation**

The SWM plans would not be successfully implemented if environmental ethics and awareness were lacking. Hence, for plans to be successful, knowledge of the issue or project is essential. An NGO called Seth Sevana conducted some awareness campaigns in the Moratuwa area of Sri Lanka. In the Moratuwa area, 1,280 families were encouraged by Seth Sevana to separate their waste at the source. As a result of this, the NGO was able to establish small-scale composting units, generate biogas, recycle paper, and facilitate information sharing among network members for the benefit of the community. The Community Environmental Initiatives Facility provides funding for this project (Visvanathan & Tränkler, 2003).

**Finding 6: Increase the efficiency**

PPP boosts SWM's effectiveness. The private sector possesses certain technologies and equipment that aid in time and energy savings.

**Finding 7: More investment**

Budgetary restrictions affect the public sector's ability to offer WM services. Even if taxes are collected from the public, there is still insufficient funds to offer quality services. The private sector has the capacity to invest more funds. This aids local governments in providing better services to the public. Additionally, new concepts, skills, and technology introduced in by the private sector enhance SWM services (The World Bank, 2011). These investments are typically made by the private sector in with the aim of earning a return on their investment. As a result, they even import new technologies and ideas from other nations. It is possible for the private sector to invest in new ideas, technologies, etc.

**Finding 8: Make decision fast**

Delays in decision-making and inadequate coordination typically result in poor service delivery. Typically, developing nation municipalities deal with these issues. However, the private sector has a quicker decision-making process, is proficient at handling problems and maintaining costs under control, and is innovative in its approach, planning, and use of technology.

### **Finding 9: Helps to protect the environment**

Environmental protection could improve if nations collect waste properly and use technology to reduce the amount of waste they produce. "By allocating highly skilled personnel to ensure efficient operation and compliance with environmental requirements, the private sector can help to improve environmental protection." (Ramanadham, 2019).

#### **3.4.8 Critical success factors for PPP MSW Projects**

Critical success factors (CSFs) in SWM projects provide the guidance for stakeholders in developing strategies to eliminate shortfalls and ensure successful and sustainable project. From secondary sources, 17 perceived CSFs were found and verified by a number of experts (Ngullie et al., 2021). These critical success factors would increase the possibilities of success in PPP municipal SWM project.

**Project technical feasibility :** Liu et al. (2019) state that it is crucial to take into account every technical issue in advance of a project feasibility study. Consideration should be given to the appropriate technology based on the type and volume of waste. The choice of technology must also take into account the needs of the operation, the accessibility of replacement parts, and maintenance ease.

**Detailed project planning :** The project should be carefully planned, taking into account factors like site selection, technical consultant selection, and the preparation of the Detailed Project Report (DPR). It is essential to carefully plan the adoption of waste management solutions which suit the project area's socioeconomic conditions and geographic profile.

**Transparent method of procurement:** The success of PPP projects depends on choosing the appropriate private party. A transparent procurement process is the only way to accomplish this. Three key elements have been identified by studies as necessary to achieve transparency: effective communication amongst stakeholders; open consultation between private contractors and public authorities while accepting responsibility for their decisions; and lastly, a defined framework for decision-making established by the private sector. (Zhang, 2005).

**Public Awareness :** Based on experiences in multiple Indian cities, areas with ongoing Information, Education, and Communication (IEC) campaigns have seen

improvements in "Public awareness" regarding waste source segregation. It is essential to educate the public about improper solid waste management, segregation rates, service charge payment, and general cleanliness. The public's perception of waste and awareness of it influence all phases of solid waste management, so efforts should be made by the government and non-governmental organizations to raise public participation and awareness through various media.

**Commitment and responsibility of project partners** A PPP project's output quality is influenced by the stakeholders' attitudes as various organizations with different objectives collaborate to accomplish a shared objective. To establish effective communication between the partner, massive efforts and a strong commitment are needed. Success in partnerships requires the public sector to be willing to work in a setting where there is true partnership with the private sector.

**Capacity building of ULB staff :** Capacity need to be enhanced to allocate the funds in appropriate manner and manage the waste in a economical and environmentally friendly way. Skills in maintenance, monitoring, and characterization are necessary for processing methods such as composting, waste to energy, and biomethanation. Building capacity is crucial to spreading knowledge about how to operate systems effectively. To develop, procure, and oversee PPP operations in MSWM, municipal staff must possess the entire skill set.

**Favourable legal and regulatory framework :** A clearly defined legal and regulatory framework is crucial because one of the government's roles in PPP is to monitor the market. Globally, a large number of governments have set up PPP agencies to manage PPP projects and serve as a regulatory body for PPP initiatives across all industries, all without regard to political pressure. Byelaws for the Polluters' Pay Principle (PPP)-based punishment of offenders may be passed by ULBs. By drafting public health bylaws, Ahmedabad Municipal Corporation (AMC) has made an effort to establish guidelines and standards for a number of SWM procedures. The Municipal Council initiated the development of these strict frameworks, which have allowed the city to meet service level benchmarks in garbage collection (SWMD, AMC).

**Strong Monitoring & evaluation system :** Since PPP projects rely on the provision of services, it is critical to have efficient performance evaluation procedures in place to guarantee that the agreed-upon level of service is being delivered. Good practices for

monitoring MSWM services have been implemented in India, where technologies such as radio frequency identification (RFID), walkie talkies, geographic information systems (GIS), global positioning system (GPS), and general packet radio service (GPRS) are integrated for MSWM system monitoring (Garg et al., 2007). Robust monitoring and evaluation systems are crucial because they allow for the extensive collection of data, which helps ULBs have a detailed understanding of issues at different stages of service delivery.

**Strong and competent private sector partner/s :** PPP projects require a dependable and well-organized private partner to succeed. To take on PPP projects, it needs to have strong managerial, technical, and operational capabilities. An entity or person possessing the technical, managerial, and financial capacity to undertake and successfully finish projects is considered a strong private partner.

**Good Governance :** Policymakers, government departments, and their various agencies are essential components of the institutional structure for the successful implementation of PPP projects ( Liu et al., 2019). During the planning and development stages of a project, good governance is essential. For PPP in MSWM, acquiring land for processing and disposal has proven to be a difficult task (Hazra & Goel, 2009). Delays in acquiring land, obtaining environmental consents, and moving utilities have caused many PPP SWM projects to not proceed as planned. In a PPP arrangement, it can also play the role of facilitator, mediating disputes between the contractors and the waste generators.

**Waste Segregation :** Mixed waste collection from the source makes the value extraction uneconomical. Waste needs to be separated at least into three categories: wet, dry, and household hazardous waste. The degree of waste segregation determines the possibility of treating waste in an economical manner and extracting recyclable material. If a household or business doesn't separate its waste, the ULBs have the authority to impose penalties. To further enhance waste segregation at the source, incentives for it can be implemented, such as a refund on property taxes and other ULB-levied taxes. The financial sustainability of MSWM PPP projects depends on waste segregation momentum being sustained over an extended period of time (Devkar et al., 2013).

**Public engagement and support :** A successful waste management system depends on behavior change and public involvement. Enforcing best practices will help authorities safeguard citizens' fundamental rights, and citizens' participation in those practices will help them fulfill their fundamental responsibilities. Through user fees and source segregation, the public contributes significantly to the privatization process. It is essential for sustainable solid waste management that service users be consulted and included in decision-making procedures. Finance and cost recovery are significantly impacted by public participation.

**Political support :** Strong and continuous political support creates the ideal environment for PPP projects to succeed (OECD, 2008). Solid waste project implementation may encounter difficulties if political leadership changes and the new leadership is unwilling to approach the project with the same enthusiasm (Massoud & El-Fadel, 2002).

**Appropriate risk allocation and sharing :** As a general rule, risks should be assigned to the party most capable of handling them at least in terms of cost. In order to ensure equitable risk allocation between public and private sector entities, they should both closely monitor the procurement process during PPP contract negotiations. The private sector needs to clearly understand the risks involved and the best way to manage them in order to price the risks appropriately. For its part, the public sector must clearly identify the various risk categories and determine whether to transfer, share, or retain the risks.

**Appropriate toll/tariff :** Making the project feasible for revenue generation without imposing excess tolls or tariffs during the operation phase is one goal of adopting the PPP approach in MSWM. To achieve sustainable MSWM in a PPP setup, appropriate toll/tariff following a thorough assessment of "willingness to pay," affordability, and proportionality are essential. Project success is indicated by full O&M cost recovery. In addition to other services like electricity and water bills, MSWM service bills may be billed concurrently. To cover their operating and maintenance costs, the majority of ULBs in India depend on property tax revenue. In order to recover costs, some ULBs have implemented a user-fee model that involves determining respondents' willingness to pay (WtP) through surveys. To maintain the balance between public affordability private profitability, the government can also provide periodic service payments to the

private sector as a subsidy to cover project costs and allow for reasonable profit-making (Jacobson & Choi, 2008).

**Integration of informal sector :** Groups, individuals, and microenterprises that provide informal waste services are included in the informal waste sector. There is no official solid waste authority that sponsors, recognizes, finances, or permits them. The authorities and society have not acknowledged the informal waste workers' contributions to solid waste management, and they are often viewed with contempt as a social blight. Organizing informal waste workers into associations and cooperatives, CBOs (Community Based Organizations), MSEs (Micro and Small Enterprises), and formalizing them by adopting them into the formal system are some of the different approaches to formalization that have been identified. Initiatives that have been successful in the past have provided training to unpaid waste collectors by hiring them at the facilities. Through the provision of social benefits, infrastructure enhancements, and improved health and safety amenities, the informal sector can be effectively integrated into the system, thereby augmenting the project's overall success.

**Adequate financing :** One of the main barriers to efficient solid waste management in developing nations is the lack of sufficient funding for the majority of ULBs. PPP projects are financed by the private sector, so the availability of appealing and adaptable financial instruments, such as equity, debt, securities, and supplier and purchaser credit, is essential. (Zhang, 2005). In order to ensure the projects' economic viability, the government may explore alternate revenue and financing sources to fill the financing gap for private investors.

### 3.5 PPP Policy Review

#### 3.5.1 National

Numerous laws pertaining to solid waste management govern every aspect of its operations. Key ones include the following:

##### **a. Solid Waste Management National Policy, 1996**

In 2053 BS (1996AD), the first Solid Waste Management National Policy was implemented to address the solid waste management issues resulted due to urbanization. The management of waste in urban areas was highlighted in the policy. This policy is still in force.



### **b. The Environment Protection Act, 1996**

The Environment Protection Act (1996), sub-article 7.1, forbids the careless disposal of waste that could negatively affect the public's health or the environment. This comprehensive environmental protection act serves as the foundation for all other environmental laws, including waste management regulations.

### **c. The Local-Self Governance Act 1999**

The act was introduced within the context of decentralization. It states that municipalities now have complete control over solid waste management (SWM), including collection, transportation, and ultimate disposal, in addition to other responsibilities and environmental protection authority.

### **d. Solid Waste Management Act, 2011**

The Government of Nepal formulated the Solid Waste Management Act of 2011 which came into effect on 15 June 2011. The development, management, and operation of infrastructure for the collection, processing, and ultimate disposal of MSW has been delegated to local entities, such as municipalities. Reducing, reusing, and recycling (or 3R) is encouraged by the act, and part of that is requiring local bodies to segregate MSW at the source. Additionally, it allows for community and private sector participation in solid waste management.

According to Section 13 of the Act, no one is allowed to perform any solid waste management-related work without first obtaining a license from the local body. If the necessary technology is unavailable domestically, it allows licensing a foreign company.

The Act's Section 14 outlines the service-related areas in which the private sector may be involved, and Section 15 specifies the standards for selecting private operators.

Section 17 of the Act allows for Public Private Partnership (PPP) in SWM sector and

Section 18 allows for levying of SWM service charges to make SWM service self sustaining.

### **e. Solid Waste Management Regulation 2013**

In accordance with the provisions of the Solid Waste Management Act, 2068, the government of Nepal formulated the Solid Waste Management Regulation in 2013. This regulation highlights the need for hazardous waste to be separated at the source and states that producers are ultimately responsible for the proper disposal and management of their separated waste. Additionally, the regulation has prioritized waste minimization and segregation at the source. And this has highlighted the local government's responsibility to raise public awareness and encourage appropriate waste management.

### **f. Solid Waste Management National Policy, 2079**

The Solid Waste Management National Policy 2079 encourages technology transfer and development, public involvement, co-financing, and experience sharing in the waste sector. It has established four goals, which are as follows:

- Providing standards and guidance to the law regarding the management of waste from residential, commercial, and tertiary sectors;
- Reducing waste's harmful effects on the environment and general public health;
- Making clear the functions of federal agencies in the handling of waste;
- By employing innovative waste management technologies, waste can be mobilized as a resource and contribute to the national economy.

To accomplish its goals, the policy has established eight strategies. The strategies consist of:

- Establishing a legal basis for waste management by classifying wastes based on their characteristics.
- Developing and putting into practice distinct standards according to waste classification.
- Encouraging the sustainable use of disposal sites by effectively reducing waste production at its source.
- Increasing citizens' responsibilities for waste management.
- Clarifying the functions of the local, provincial, and federal governments in waste management.

- Considering co-financing, collaboration, partnerships, and participation top priority.
- Establishing a solid database through waste management study and research.
- Improving waste management organizations' and stakeholders' capabilities.

For each waste management strategy, the following operational policies have been established:

- The local levels are responsible for management of household waste whereas the concerned organization or institution will have to be responsible in managing hazardous, chemical, industrial and medical waste produced by them.
- The policy has also promoted waste segregation at the source as well as waste reuse, recycling, and composting.
- The "Polluters Pay" principle is used to determine the service charge based on the type and volume of waste.
- The government will prohibit the disposal of waste in any public areas, including roads, protected areas, lakes, wetlands, river systems, wildlife habitats, and heritage and religious sites.
- In addition to launching an awareness campaign about civic duty, waste management-related topics will be included in school curricula.
- Seek to establish partnerships and collaboration with national and international NGOs for the construction of large-scale infrastructure, as well as to mobilize foreign aid and co-finance all three levels of government.
- The Public-Private Partnership model will mobilize the private sector for solid waste management.

The role of central, provincial and local government have been defined to implement the policy.

- **Central government:** Formulate policy, law and byelaws, conduct study and research, technology development, mobilizing foreign aid.
- **Provincial government:** Co-financing in development of infrastructures related to waste management and maintain coordination among local bodies.
- **Local government:** Overall management of solid waste collection, processing and disposal.

There are some efforts made towards building a PPP legal framework suitable for Nepal based on the experiences of other countries. The federal government has PPP Act, PPP policy, PPP regulations, and some guidelines in place so far.

#### **a. Investment Board Act 2011**

The Investment Board Act's Articles 5 and 7 outline the duties of the Investment Board Nepal. Its responsibilities are as follows:

- Inviting competitive proposals from investors, assess them, negotiate, approve, and sign project agreements.
- To purchase land in accordance with current laws and regulations or to make government land available for the purposes of approved investments.
- Collaborate together with local organizations and government ministries to promote investment.

The Investment Board Act of 2011 delineates the priority investment sectors in Article 9. The Act stipulates that the investment necessary for the implementation of various infrastructure projects, such as "Solid Waste Management and Treatment in Urban Areas," shall be mobilized in compliance with this Act, "irrespective of whatever stipulation made in existing laws."

#### **b. PPP Policy 2015**

Under this policy, the government plans to work with the private sector to develop a range of physical infrastructure, including transmission lines, highways, bridges, and hydropower projects.

- Includes a provision for "Unsolicited Proposals"
- The Nepalese government will acquire land.
- Project preparatory fund provisions
- Provisions for Viability Gap Funding
- Clearly defining the roles and duties of the PPP Steering Committee and PPP Center
- Within a year, guidelines for the operation of the project preparation facilitation fund and the viability gap fund will be prepared. The government will choose which projects to build under PPP.
- International bidding is required for projects valued at more than Rs 1 billion.

- Projects worth at least Rs 500 million will begin the procurement process after receiving approval from the PPP Steering Committee.
- The approval of the project design and other documents by the PPP Center is mandatory for projects valued at more than Rs 100 million, which also require government subsidy or viability gap funding.
- The law permits the government to provide tax incentives to construct PPP projects.
- The government and private developers will share the risk and rewards.

### **c. Public Private Partnership and Investment Act, 2075**

The Public-Private Partnership and Investment Act of 2075 was adopted in order to promote the nation's economic growth by encouraging domestic and foreign private sector investment in the construction of infrastructure and the delivery of services. Its main objective is:

- To regulate the public-private partnership's projects that are to be executed
- To amend and incorporate the investment-related legal provisions;

The following specification included under the Act.

- Provision concerning Approval of Investment, Project Implementation, and Investment Board.
  - Implementation of project shall be carried out by concerned local level, province government, federal government or the board under their jurisdiction.
- Provision related to projects carried out through public-private partnerships.
  - Any project relating to infrastructure structure may be carried out.
- Provision concerning Private Investment.
  - Any project shall be built, operated and managed by private sector having an investment of six billion rupees or more.
- Facilities and Incentives for the project implemented under this act.
  - Provision of Viability Gap Fund for construction, operation and expansion of the projects.
  - Additional incentives may be available if developer completes the project before the specified time or less costs than estimated costs.

### **Functions, duties and power of the board**

- To formulate projects to be conducted through the public private partnership or private investment.
- To recommend to Government of Nepal to make available financial or non-financial incentives and facilities.
- To coordinate and facilitate for purchasing or taking on lease land above ceiling that is required for the project.
- To ensure transparency, fairness and competition.
- To coordinate with government of Nepal to develop Nepal as a destination of foreign investment having prepared an investment-friendly atmosphere.
- To maintain coordination among various ministries, concerned provinces, local levels and private sectors for project development, investment promotion and projects implementation.

### **Functions, duties and power of the Public Private Partnership Unit**

This unit shall carry out feasibility study of the projects, select the developers and facilitate the public agencies in constructing and operating the projects. Its functions are as follows

- To prepare working policies, procedures and directives on the policy issues relating to public private partnership.
- To provide necessary assistance to the investor in preparation and implementation of the project.
- To regularly conduct studies and researches on practices and experiences of public private partnership at international level and to offer appropriate format for Nepal.

### **d. Public Private Partnership and Investment Regulation 2077**

This regulation was introduced for the procedural implementation of the PPPI Act 2075. The following specification included under this Regulation.

- Provision concerning structure of Officials and Board.
- Provision related to Implementation of project under public private partnership.
- Provision concerning Investment Approval and Private Investment.
- Provision for project Agreement and Implementation.

- Provision for Facilities, Incentives and Security.

#### **e. The Fifteenth Plan (Fiscal Year 2019/20-2023/24)**

This plan attempts to accomplish the desired goal by collaboration with the community, cooperative, and private sectors. Waste management facilities with modern technology will be built in major cities and industrial regions. The organic fertilizers will be used in agriculture that will be produced by processing disposable waste. There will be less emissions of greenhouse gases.

### **3.5.2 International**

#### **a. India**

India has experienced some success with WTE, but not significant because PPP for WTE has not been fully explored. Given the financial resource limitations, institutional fragility, and lack of technical expertise and capabilities that municipal authorities face, the framework has identified the necessity and significance of introducing a PPP approach in setting up waste processing facilities for MSW processing and disposal. The Department of Economic Affairs (DEA), Ministry of Finance (MOF), released a National Public-Private Partnership Policy in 2011 to act as a comprehensive framework defining the essential guiding principles for carrying out PPP projects across various sectors. Additionally, it outlines a simplified PPP process with four stages: identification, development, procurement, and management and monitoring of PPP contracts. Furthermore, for PPP agreement options in the context of integrated MSW management, a comprehensive structure encompassing MSW collection, segregation, and disposal was developed. Three options for PPP agreements were established under this framework, taking into account MSW functions and who could best carry them out: (i) functions that could be best carried out by private sector alone, (ii) functions that could be carried out by municipal authorities and/or private sector, and (iii) functions that could be best performed by the municipal authorities alone.

A WTE scheme was developed and introduced by the Ministry of New and Renewable Energy (MNRE) in 2007. The primary goals of the scheme were to: (i) develop five PPP-based pilot WTE projects; and (ii) In order to develop and demonstrate WTE, create a favorable environment and provide financial and fiscal support. The program was implemented between 2007 and 2015, and each year's progress was documented and communicated.

Since the 1980s, efforts have been made to incorporate processing and disposal technologies into India's MSW management chain. However, nearly all of these projects have not operated to their intended capacities, which has resulted in the facilities' closure or termination of operations ( Huang et al., 2018). These were summarized as:

- No reliable supply of committed municipal waste in both quantity and quality;
- Low heat value as a result of waste from construction and demolition, which increased the difficulty and cost of WTE operations;
- WTE equipment was not designed properly to handle the MSW in India; and
- Inadequate financial viability and due diligence from private investors.

#### **b. People's Republic of China**

A favorable environment for the development and market-based operation of WTE facilities has been established by a number of national laws, policies, and regulations. Alongside the WTE's rapid development is a clear acceleration of sector industrialization. The main factors contributing to WTE's success in the PRC are strict environmental and social compliance, effective public relations that garner community support, a range of financing options and government subsidies, advanced technological and dependable equipment, cost-effective operation and maintenance by the private sector, and strong government policies and regulations with enforcement. The following six policies and regulations are particularly important to WTE industrialization and market-based construction and operation because of their capacity to lower WTE costs and attract in private investors.

- i. The Ministry of Finance (MOF), the Ministry of Ecology and Environment (MEP), the Ministry of Housing and Urban-Rural Development (MOHURD), and the National Development and Reform Commission (NDRC) jointly released the **“Notice of Enforcing Municipal Solid Waste Treatment Tariff Mechanism to Promote Solid Waste Treatment Industrialization”** (NDRC Price Document No. 872) in 2002 (NDRC 2002b). In an effort to encourage industry industrialization, the concept of a fee collection system for MSW treatment was introduced in this notice. All governmental organizations, institutions, businesses, social communities, and municipal citizens are responsible for covering the necessary costs of MSW treatment.



- ii. **“Comments on Promoting Industrialization of Municipal Wastewater and Solid Waste Treatment”** in 2002 (NDRC 2002a), MOHURD, NDRC, and MEP jointly released (NDRC Investment Document No. 1591) to supplement above Document No. 872 in the following areas:
- Promoting the involvement of various organizations in the funding and operation of municipal solid waste treatment plants in order to speed up the "marketization" of MSW transportation, treatment, and collection.
  - Employing the ideas of marginal profit and gradual full-cost recovery to establish the MSW treatment tariff (tipping fee).
  - Promoting the development of MSW utilization facilities.
  - Enabling the private sector to participate in concession agreements for a maximum of 30 years in the management and funding of MSW treatment facilities.
  - Offering a preferred electricity tariff for power consumption resulting from MSW treatment.
  - In order to supervise the commercialization of MSW treatment facilities, the local government will set up guidelines and quality control procedures.
  - The sector's orderly industrialization is being promoted by the central government.
- iii. **“Management Method for Concession Operation of Public Utilities”** A comprehensive directive for accelerating WTE's industrialization through PPP is MOHURD Order No. 126 (published by MOHURD in 2004).
- iv. **“Guidance on Creating Financing Mechanism in Major Sectors for Attracting Private Sector Investment”** (Guofa Document No. 60) (State Council 2014) states that social community investment, particularly private sector investment is further encouraged in infrastructure development areas. Large-scale operation is preferred over dispersed operation of individual facilities in order to lower capital and operating costs.
- v. Following the issuance of the above-mentioned guidance, NDRC issued the **“Guidance on Government and Private Sector Partnership”** (NDRC Investment Document No. 2724), issued in December 2014 (NDRC 2014), specified that MSW treatment is included in the scope of PPP projects and that concession operation (build-operate-transfer, build-own-operate-transfer, and build-own-operate) and service contracting models can be used. It also defined the government's

responsibilities in PPP project implementation and the mechanism for sharing investment return and risks. The requirements for local government in implementing PPP projects are also outlined in this document. These include the setting up of a robust operation mechanism, the enforcement of standardized project management, and improved policy assurance to ensure the smooth development of PPP projects. In addition, this document introduces a monthly reporting system to track the status of PPP projects and offers general contract guidelines.

- vi. In January 2015, the State Council Office issued “**Comments on Promoting Third-Party Treatment of Environmental Pollution**” (Guoban Document No.69) (State Council Office 2014), outlines the possibility of hiring a third party to provide pollution control and local environmental rehabilitation services. As such, the use of a PPP model is encouraged and WTE is covered under the category of third-party environmental services.

### **Sector Subsidies and Preferential Taxation**

The "Notice on Improving WTE Feed-In-Tariff Policy" states that feed-in-tariff (FIT) for WTE projects consists of three components: a tariff that applies to the production of coal-fired electricity, provincial and federal subsidies. According to the central government, enterprises that engage in energy conservation and environmental protection, such as WTE, are eligible for preferential taxation policies that encompass the following two aspects:

- Income tax exemptions and reductions.
- Due to tipping fees, incomes are not subject to value-added tax.

## CHAPTER 4 : CASE STUDY

### 4.1 NATIONAL

#### 4.1.1 Venture Waste to Energy (Vw2E) Pvt. Ltd.

It is located in Panmara, Ward-6, Dharan Sub-Metropolitan City and covers an area of 1 bigha and 2 kathhas. Venture Waste to Energy P. Ltd. (Vw2E) is a private company established in order to develop waste to energy project employing Anaerobic Digestion. Waste is no longer seen as something to be thrown away but rather as an important resource. There are 35 employees working for the company. The daily gas generation capacity is 1200 kg, which can power 200–250 auto rickshaws. Although the plant can process 30 metric tons of waste per day, only 13 to 18 metric tons are being processed at present.

It is Nepal's first waste to energy project approved by Investment Board Nepal as one of the priority project for the sustainable management of municipal waste. It is under Public Private Partnership model in partnership with the Alternative Energy Promotion Centre(AEPC) under Nepal's Ministry of Energy and Dharan Sub-Metropolitan City After 20 years of operation, it will be transferred to the Dharan sub-metropolis. For the time being, the sub-metropolis will receive one percent of the company's profit. The government will cover the remaining forty percent of the budget, with the company covering sixty percent.



Figure 4: Venture Waste to Energy Pvt. Ltd. and Segregation centre for MSW

The collected waste is first segregated into two categories: biodegradable and non-biodegradable wastes. The non-biodegradable are further segregated into recyclables and non-recyclables materials constituting 25% of each of the total waste. The recyclables are provided for local recyclers for recycling and upcycling. 50% of total

remaining wastes are biodegradable which are further processed through Anaerobic Digestion. In the process, recovering energy to produce Bio Compressed Natural Gas(Bio-CNG) and Bio-fertilizers. The entire process is environment friendly.

In Nepal, about 60% of waste generated is organic and hence, biomethanation is appropriate technology for the waste-to-energy projects. Venture Waste to Energy is currently operating three-wheeler tempos in Dharan and is commercially producing and supplying renewable fuels for public transportation. It offers better mileage and is less expensive than gasoline. It produces and sells organic fertilizers to the neighborhood market. This project uses a modern waste water treatment system to treat wastewater in addition to producing energy and fertilizer. It is creating an emerging market for biogas and giving waste workers employment opportunities, partially replacing the import of fossil fuels (Progress at Glance: Year in Review, 2021)

### **Problems and issues**

The company is operating in small capacity and facing some issues and challenges to operate in its full capacity which includes:

- Inadequate supply of solid waste by the municipality : Municipality collects waste from old settlements only which is not sufficient for the waste to energy process to work in its full capacity. The company is planning to collect waste from all the wards but not getting permission from the municipality as they are not reaching at agreement point for collection service charge.
- Lack of Policy and guideline : Only 25 trial autos are running still as approval from government is needed to operate more autos. The modification in these vehicles is required to use this gas. There is no government policy and guideline to use CNG in autos/tempo.
- The organic fertilizer is expensive for locals compared to chemical fertilizers.

#### 4.1.2 Gandaki Urja Pvt. Ltd.

Gandaki Urja Pvt. Ltd., is a private company located in Pokhara. The company developed and currently operates a 45 TPD Compressed Bio-gas Bottling plant in PMC ward 32. The Alternative Energy Promotion Centre (AEPC) will contribute NPR 5.4 crore of the project's NPR 25 crore capital cost through its large biogas plants initiative (NFEJ, 2020).



*Figure 5: Bio gas plant ( Gandaki Urja Pvt. Ltd)*

The facility uses a multiple feed Continuous Stirred Tank Reactor (CSTR) digester to convert agricultural and vegetable wastes, pig manure, and animal waste from cows and buffaloes into biogas. The digester can feed 45 TPD because it receives about 20 tons of cow and buffalo dung, pig manure, and agricultural and vegetable wastes each day. The resulting bio-gas is then refined and compressed to create Bio-CNG, which is then packaged and distributed as an alternative to LPG in appropriate cylinders or cascades. As an additional valuable product for the sustainability of the environment, the plant will also produce enriched organic fertilizer.

To build and run the plant, the developer has teamed up with SLPP RE-NEW, a reputable Indian technology provider with fifteen years of industry experience. When turning over the project to the developers, the technology provider must also train the plant's operators and employees to ensure a smooth transition. The major financial indicators show that this project is financially feasible. The project has an internal rate of return of 14.93% and an 8-year payback periods (Office Of the Investment Board, 2019).

## **Problems and issues**

- The government gives a subsidy of 980 rupees on LP gas cylinders that consumers buy for 1800 rupees. But there is no subsidy on biogas. The biogas produced by Gandaki Urja had to be sold three rupees per kg cheaper than LP gas. The produced gas is being used by some restaurants, hotels, hospitals and others in Pokhara. The consumers put pressure to reduce the price of biogas as they have to compete with LP gas.
- Even during shortage of chemical fertilizers, the organic fertilizer produced by the company has not been able to sell as there is not any subsidy from the government. Gandaki Urja can produce 1500 tons of fertilizer annually when operating at full capacity. Now it is producing only 400 tons annually of which 300 tons are sold annually. The farmers who are aware of the benefits of using organic fertilizer and some government agencies buy the fertilizers to distribute as subsidy.

## **4.2 INTERNATIONAL**

### **4.2.1 Municipal solid waste composting for profit through public-private-partnership(A2Z Infrastructure Limited, India)**

The company, A2Z Infrastructure Private Limited (A2Z-PL) was founded in 2011. Being one of the top waste management companies in India, it is a subsidiary business of the A2Z Group. A2Z-PL operated 21 integrated resource recovery facilities (IRRF) across India at the time of the assessment, processing 8,000 tons of municipal solid waste (MSW) per day in total. The company's main goal is to provide sustainable waste management solutions to municipalities across India. The Ludhiana Municipal Corporation (LMC) and A2Z-PL have a partnership agreement that covers the collection, transportation, processing, and disposal of MSW in five jurisdictional zones within Ludhiana. A2Z and the Ludhiana Municipal Corporation signed a 25-year PPP agreement for the collection and processing of waste produced in five different Ludhiana zones. A2Z developed into a reliable and financially viable waste management and reuse company by taking advantage of the shortcomings in the municipality's waste management strategy, as well as the rising cost of energy and chemical fertilizers. Resources recovered from the collected waste offer A2Z opportunities to strengthen its business strategy. The severe lack of power in the city has increased demand for RDF-generated electricity, indicating a steady source of income for A2Z. Furthermore, inexpensive and ecologically friendly agricultural input

options are essential given Ludhiana's advanced agricultural sector. The market's availability of compost made from municipal solid waste (MSW) provides farmers with a less expensive and safer fertilizer option. A2Z-PL thinks that its initiatives will contribute to addressing the environmental and health issues linked to inadequate waste management and India's energy and fertilizer shortages.

In 2012, the Ludhiana business made a net profit of approximately 25-30 million Indian Rupees (Rs.). The municipality covered the entire cost of waste collection, bin provision, transportation, and processing, which came to Rs. 395 per ton. The primary source of the company were the revenue from the sale of recovered resources, such as compost, high density plastics, and metals.

KEY PERFORMANCE INDICATORS (AS OF 2015)						
Land use:	20 ha					
Capital investment:	USD 1,114,620					
Labor:	300 (210 unskilled, 90 skilled)					
O&M cost:	USD 5,249/day					
Output:	150 tons of compost / day					
Potential social and/or environmental impact:	Creation of 300 jobs, reduction of GHG emissions, waste management cost savings, improved environmental health.					
Financial viability indicators:	Payback period:	3-3.5 years	Post-tax IRR:	N.A.	Gross margin:	N.A.

This partnership provides A2Z with exclusive ownership, which allows them to continuously and unrestrictedly access waste in five municipalities and free land for all operations. The success of A2Z Ludhiana is based on five guiding principles, and the company's business model is built around providing multiple value propositions:

- Adopting a public-private partnership (PPP) and synergies in business operations to implement an inclusive and integrated approach; self-sustainability through the use of several revenue streams;
- No compromise for the quality of product;
- Maximum extraction of resources; and
- Strict adherence to rules and guidelines.

### Key partners

The following companies are key partners:

- Krishak Bharti Cooperative Limited
- Ludhiana Municipal Corporation

- Indian Farmers Fertilizer Corporation Limited,
- Indian Potash Limited,

### **Key activities**

The following are main task of the company:

- MSW collection and transportation
- Compost production form MSW
- Organic, metal and plastic materials extraction
- Compost, metal and plastic product sales and production
- Monitoring stock market

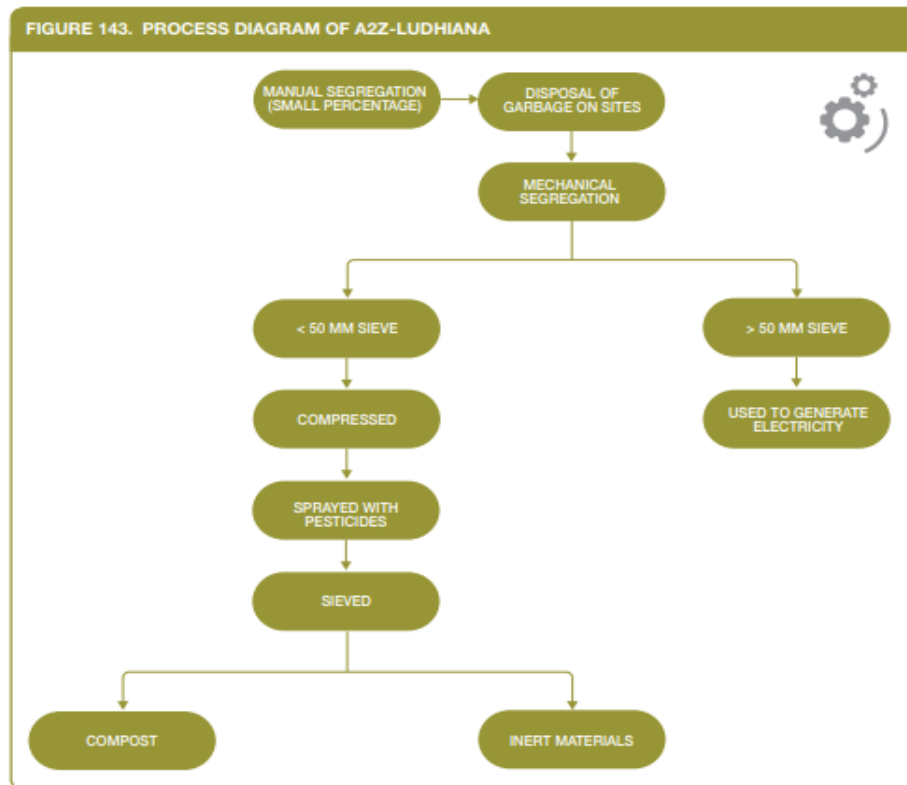
### **Value Propositions**

- Provision of fuel derived from refuse for power generation
- Farmers purchase organic fertilizers that are rich in nutrients at a highly competitive cost.
- A feasible approach to the city's solid waste management that keeps Ludhiana's residents in a healthy environment
- High density plastic (HDP) recovery for use in industry

### **Revenue streams**

- Compost sales
- Sales from metals – RDF
- Sales from high density plastics
- Waste collection fees/charges from LMC
- Shares trading on the stock market





*Figure 6: Process diagram of Atoz-Ludhiana*

### **Considerations for scalability and replicability**

Key factors contributing to this company's success are:

- Increasing fertilizer prices and industrial demand for power supply, indicate a potential increase in the market for the recovered resources, high-density plastic, compost, and RDF.
- The region's strong industrial development and highly developed agricultural status necessitate a solution that benefits both.
- The state government's strong commitment to provide a conducive environment for the implementation of public-private partnerships projects.
- Positive reporting of A2Z's activities and potential benefits by media.
- The general public's acceptance of A2Z's activities has made waste collection easier.
- Policy initiatives that eliminate subsidies for chemical fertilizer and grant capital investment subsidies to new and existing compost business.

## CHAPTER 5 : STUDY AREA

### 5.1 Introduction

Madhyapur Thimi Municipality is one of the evolving municipality and it is the fourth developed municipality in Kathmandu Valley. The Municipality is located only 7 km east of Kathmandu and bounded to the east and south by the Hanumante River and to the west and north by the Manohara River. The total area covered by the Municipality is 11.47 km<sup>2</sup> consisting of 9 wards. According to census 2021, the total population of the municipality is 1,19,756 residing in 39,966 households. Male population is(50.7%) and female population is(49.3%). The municipality has an average number of 3.75 person per household with population density of 10,441. It is located at an altitude of 1326 meters above sea level.

‘Madhyapur Thimi’ is one of the major ancient cities in Kathmandu Valley which is famous for its history, art, culture and craftsmanship. In this context, the tourism development of this area is prioritized in recent years to gain a new dimension if several of these heritages are exposed to serve the outer world. The municipality which has been renowned as the municipality of open-defecation free, completely vaccinated, perfectly educated, has also been renowned with green vegetables, and clay-pottery. The city-area starts at the distance of 800 m east on the Araniko Highway from Koteswor Chowk, of the Capital city, Kathmandu. Major land use change in the municipality is the conversion of agricultural areas into residential areas to cater the increasing population. The municipality's old settlement is limited to the valley's elevated terrace, while new construction is haphazardly scattered along the banks of rivers and rich low-lying agricultural areas. The new development areas includes: ward 1, 2 and 3 while old settlement(core area) are wards 4, 5, 6,7,8 and 9.

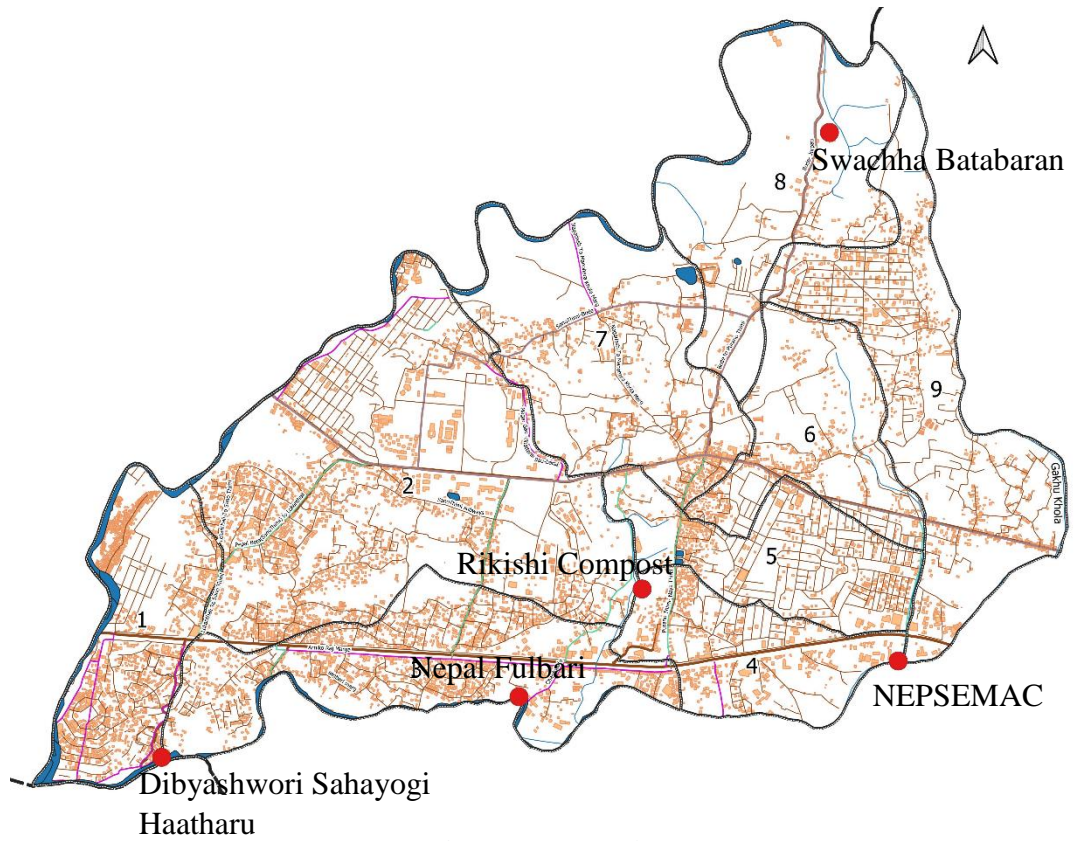
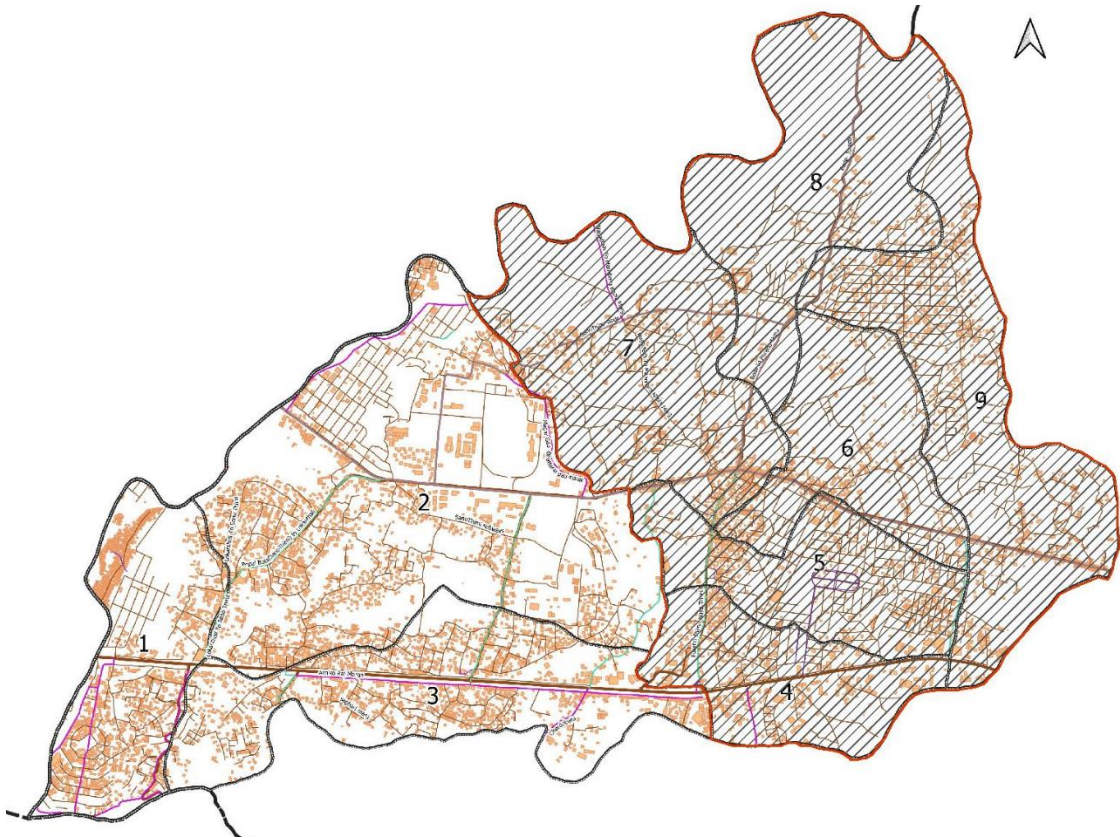


Figure 7: Study Area Map with Waste Management Centres

Table 3: Demographic Information of Madhyapur Thimi Municipality

Ward No.	Household	Male	Female	Total Population	Area/sq.km
1	6000	11632	10827	22459	0.86
2	3435	6634	6229	12863	2.66
3	6385	12122	11807	23929	1.26
4	2540	4799	4720	9519	0.68
5	2172	4045	4093	8138	0.75
6	2165	4058	4052	8110	0.76
7	2706	5139	5002	10141	1.4
8	2885	5410	5401	10811	1.29
9	3678	6907	6879	13786	1.42
Total	31966	60746	59010	119756	11.47
Household size	3.75				



*Figure 8: Map showing core area of Madhyapur Thimi Municipality(Ward 4,5,6,7,8,9)*

## **5.2 Solid waste management in Madhyapur Thimi**

There is Environment, Sanitation and Disaster Management Section in the municipality responsible for the management of solid waste. There is solid waste service in all the wards of the municipality but not in all the communities. The households of some old settlement area does not pay service charge so waste collection is not done in these areas. The municipality collects waste from core areas only which includes temples, paati, open spaces. The municipality has five registered private service providers for solid waste management which includes NEPSEMAC, Nepal Fulbari, Swachha Batawaran, Dibyashowri Sahayogi Haatharu and Rikishi Compost. The collection fee of Rs.100 to 300 is charged from each household depending on their size and use. The annual tax is paid by these private companies as per business tax. The municipality does not have transfer station and landfill site. The waste is transported to Sisdol and Banchare Danda for disposal in coordination with KMC.

Table: Registered Private Company for SMW in MTM

Private Company	Contract period	Mode of payment	Collection fees
NEPSEMAC	5 years	Business tax	Rs. 100 to 300
Nepal Fulbari			
Swachha Batawaran			
Dibyashowri Sahayogi Haatharu			
Rikishi Compost	10 years	Business tax	No fees

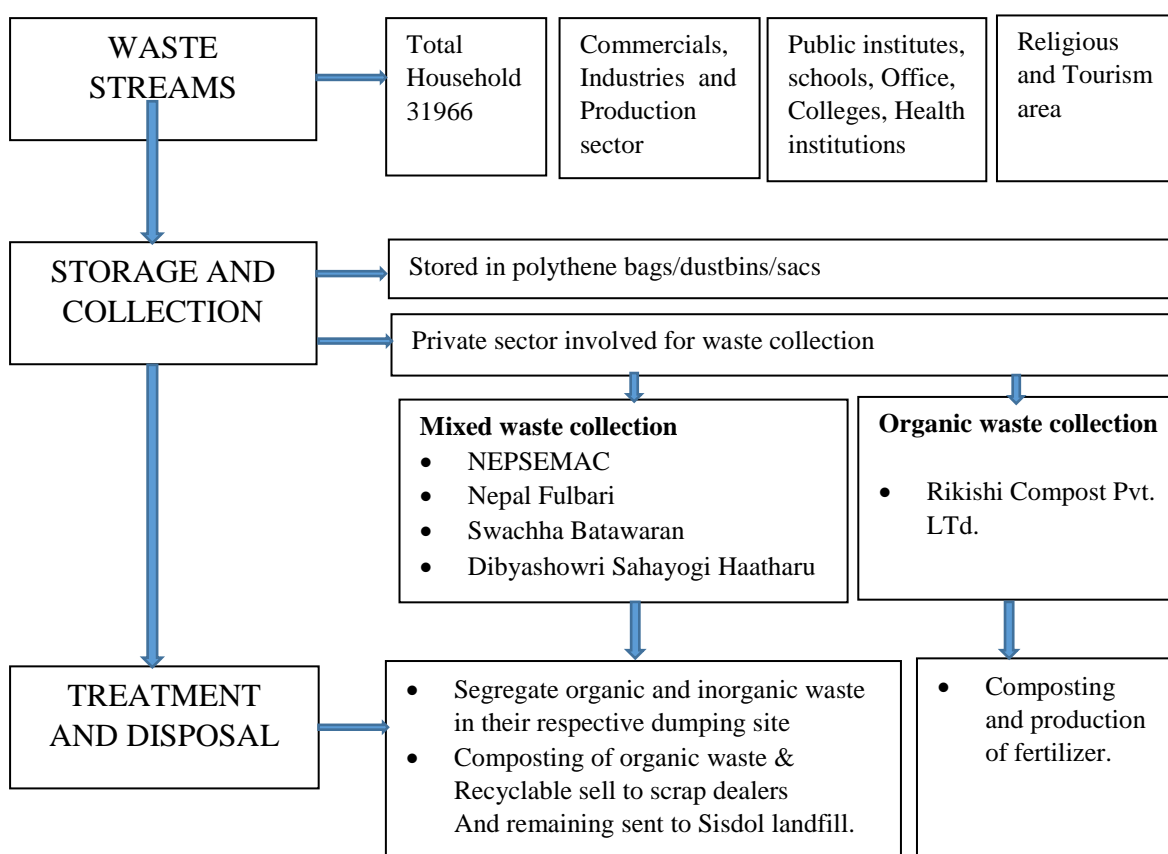


Figure 9: Existing Practices of SWM in Madhyapur Thimi Municipality

### 5.2.1 Waste categories

According to the MTM Environmental Section, the major waste producers in the municipality are households, commercial establishments, institutions, industries, health institutions, etc. The wastes generated by health institutions like Hospitals and Industries contain hazardous and infectious waste materials. They should be treated or

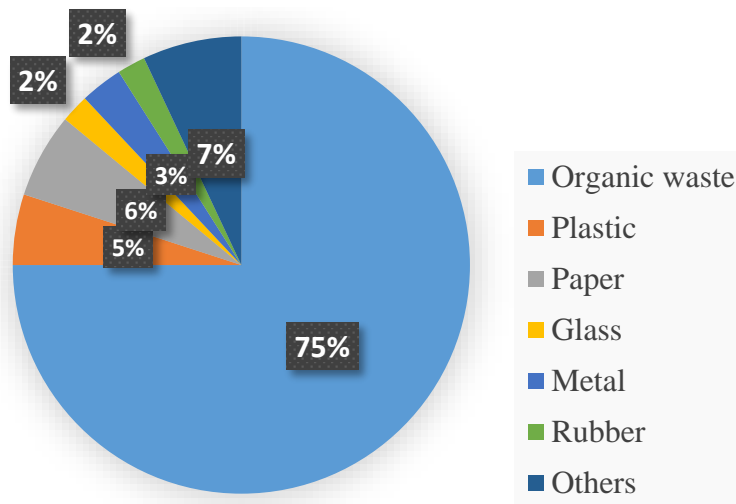
managed separately. Therefore, in general municipalities have categorized the waste into following categories:

Simple Waste			Hazardous Waste	
Organic	Inorganic	Others	Health Institutions	Industries
Kitchen waste, fruits and vegetables	Plastics, paper, glass, metal, textiles,	Construction waste, dead animal bodies/birds	Syringe, date expired medicine, sanitary pad,	Coal, chemicals, gas, vehicles, colors, mercury, lead

### 5.2.2 Waste generation and composition

The waste generation of municipality is 55 tons/day. Around 35 tons/day of solid waste is generated from households and 20 tons/day from institutional, commercial and other areas. The main source of waste of the municipality is the household waste followed by commercial and institutional waste in which 75% are organic waste and 25% are inorganic waste(recyclable and reusable).

The amount of solid waste produced is determined by a variety of factors, including the degree and type of commercial activity, food habits, and standard of living. Planning for the collection and disposal of municipal solid waste requires access to data on the quantity variation and generation of this waste. Determining the source, kind, generation rate, and composition of solid waste is crucial for monitoring and handling current waste management systems as well as for informing institutional, financial, and regulatory decisions (Sharholy et al., 2008).



*Chart 1: Waste Composition in MTM. Source: Municipality*

### 5.2.3 Collection and disposal

The door-to-door collection system is managed by different private organizations involved in waste management. The four private companies collect mixed waste from the households and then transport to their respective stations. The waste is collected at every alternate days in a week. In the stations, segregation of organic and inorganic wastes is carried out and then composting of organic waste takes place whereas recyclables are sold out to scavengers. The residuals are then transported and disposed at Sisdol landfill site. These companies have initiated source segregation in few areas. Similarly, Rikishi Compost collects only organic waste from the households and is then transported to the company site at Bishnukunda where composting is done.

Private companies do the majority of the street sweeping. There are 18 sweepers employed by the municipality to sweep temples, paati, open spaces once a day. Cleanliness campaign is conducted during festivals to clean these religious places. Tree plantation and greenery alongside main road of Lokanthali and Gathaghar is done by NEPSEMAC and Nepal Fulbari.

### 5.2.4 Resource recovery and recycling

Thimi Municipality is actively promoting composting at the community and household level. It has started providing training to 60 number of local people for household level composting of organic waste and distributed 35 compost bins. Rikishi compost collects organic waste and produce sellable fertilizer. Similarly, the two registered private companies NEPSEMAC and Nepal Fulbari collect mixed waste and manually segregate

the waste in their own dumping site. Composting of organic waste is done and sell the recyclable to Kawadi. These companies has provision for discount upto 25% from service charge if households provide segregated waste. However, it is not being so effective. There are no recycling programs in MTM. No data of recycling and composting rate is recorded yet.

### **5.2.5 Special waste management system of MTM**

The municipality has 2 hospitals, health posts and several clinics that generate medical waste. Madhyapur Thimi Hospital and Nepal Korea Friendship Municipality Hospital and health posts manage has to treat the hazardous waste waste themselves and only non hazardous waste is collected by municipality. It is found that waste from clinics are mixed with the general waste. Industrial wastes are also managed by the industries themselves but only some treat the waste before disposing. Construction waste is dumped with regular waste or used to cover low lying areas. Dead animal bodies are found to be thrown in the street. The waste such as industrial waste, dead animal bodies, construction debris, bulk and electronic waste are increasing day by day, so addressing of such type of waste need to be planned by the municipality.

### **5.2.6 Tole Lane Organization**

There are 5 tole TLO's in the municipality. The municipal authorities monitor the waste related issues in the community though these organization. Last year, four programs on Household Waste Management is carried out by municipality through TLO and various composting programs, cleanliness campaigns.

### **5.2.7 Organizational and Financial Aspects**

Environment, Sanitation and Disaster Management Section is responsible for waste management in Madhyapur Thimi municipality. This section has 3 officers, 18 sweepers, 5 collection vehicles and 2 drivers. The finance for waste management is mobilized mainly through internal revenue from other infrastructure services such as electricity. The municipality collects only annual business tax from private sectors responsible for waste collection. The municipality has formulated solid waste management policy which includes:

1. Public Private Partnership for Solid Waste Management and Resource Mobilization Guideline 2067 and
2. Basic Sanitation and Solid Waste Management Act 2079



### 5.2.8 Study Area: Rikishi Compost Pvt. Ltd., Bishnu Kunda, MTM-04

The study area is Ward 4 of Madhyapur Thimi Municipality which has a total population of 9,519 of which 4,799 are male and 4,720 are female. The ward consist of 2540 households and occupies land area of 0.68 sq. km. Solid waste management is one of the priority areas identified as part of developing clean cities and has been taken into the top priorities by the Local Authorities of Madhyapur Thimi. Also, the Local Government aims to develop the municipality as a tourist destination as it is rich in historical and cultural monuments. The ward has initiated best practices of solid waste management and created opportunities for waste to resource through partnership with Rikishi Compost Pvt. Ltd.

#### i. Background of the Project

Rikishi Compost Pvt. Ltd. was established in 2018 with the financial investment of the municipality and technical assistance of Rikishi Private Limited. It is located in Ward 4 of Madhyapur Thimi Municipality and occupies land area of 6 ropani(3070 sq.m.). They had started collecting wastes from Ward No. 4 of the municipality as a pilot project. They produce odourless compost from household waste using the Japanese technology known as CNBM technology. The monthly composting capacity is 20 ton. The company collects 3 to 4 ton waste per week from households and produces upto 10 to 15 ton per month. Initially waste was collected from 2000 households of core areas but now it has decreased to 600 households.



Fig: Core Areas of Ward 4



Fig: Rikishi Compost

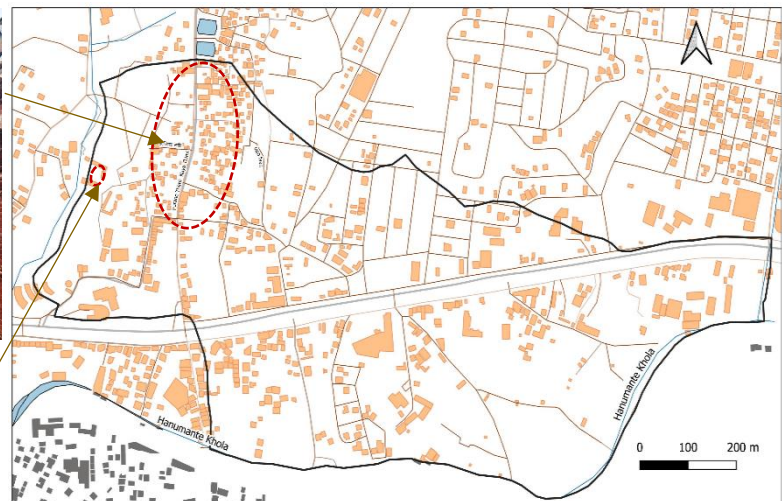


Figure 10: Study Area

## ii. The Waste Management System

### Storage, collection and transportation

The sites of Rikishi have their own protocol of collection of waste. The company distributed customized designed bucket set of 32 litres for households with Rs.550 to store only biodegradable organic waste. Along with bucket the company also distributes the material which is known as Tokozai which is a mixture of Bran, Husk, Red clay and Dry Leaves is a perfect composition for waste collection from source with no odor. The bucket designed had holes covered with net. This is because, mixture with Tokozai and household waste will release heat and this would require the vapor to go out of the bucket since fruits and vegetables normally have 90% or more of water content.

Source segregation is practiced in these households. They store organic waste in the bucket and other waste in the plastic bag. The household has to follow certain procedures to store waste. First, they have to put Tokozai whose volume must be equal to the waste volume in the bucket and then the waste can be put in the bucket above Tokozai. In this way, the waste and Tokozai is put together in a sandwich manner, so that it can be store more than a week without any odor



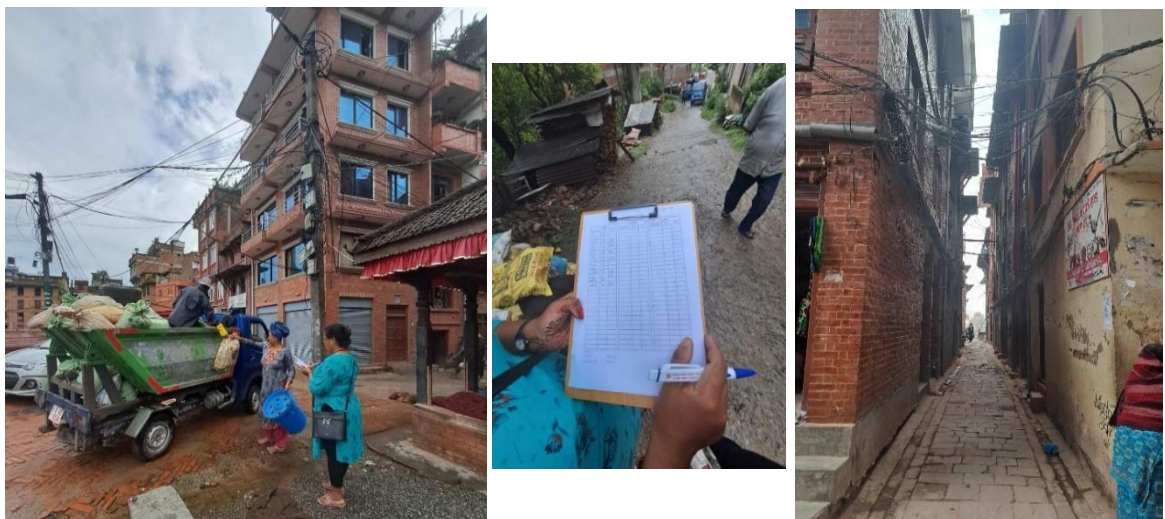
*Figure 11: Waste Storage at Kitchen in the households and decay.*

The waste is collected every Tuesday morning once a week. One mini garbage picker is mobilized for door to door collection of waste. The tipping hopper is designed so that waste can be dumped directly into the disposal area without spilling any. The household dump their waste into the garbage picker and takes a sag of Tokozai to mix with waste if they require. One female worker is mobilized to keep record of the volume of bucket filled by waste and sag of Tokozai taken by respective households. The documentation is

crucial in every stage to record which bucket number owner is compromising on their process, make sure that the waste collected from household are not rotten and as per the standard of CNBM technology and then actions are taken accordingly. The collected waste is then transported to the Rikishi Compost Pvt. Ltd. where composting is done. One of the main obstacles to achieving a higher coverage of waste collection is the limited accessibility of certain areas for waste collection trucks, particularly in core areas with narrow lanes, and the general lack of public awareness regarding the importance of collecting and managing waste safely.



*Figure 12: Customized Designed Bucket Set and Tokozai*



*Figure 13: Households dumping waste and taking Tokozai, record keeping of Household waste and waste collection in core areas*

### **Treatment and disposal**

The company uses composting as a highly effective method of waste management and disposal. Compost manure is made by fermenting and decomposing organic materials

at a high temperature of 60 to 80 degrees, which eliminates all pathogens and weed seeds. The compost manure production requires daily monitoring of temperature level which has to be 60 to 80 degree celcius and periodic turning of compost once a week is carried out. Only 15% sunlight is allowed to pass through transparent sheet roof cover. The residuals from Tokozai and Household waste which includes tree trunk, few chocolates cover etc are used as compost for plantation in the site.



*Figure 14: Composting done at site*

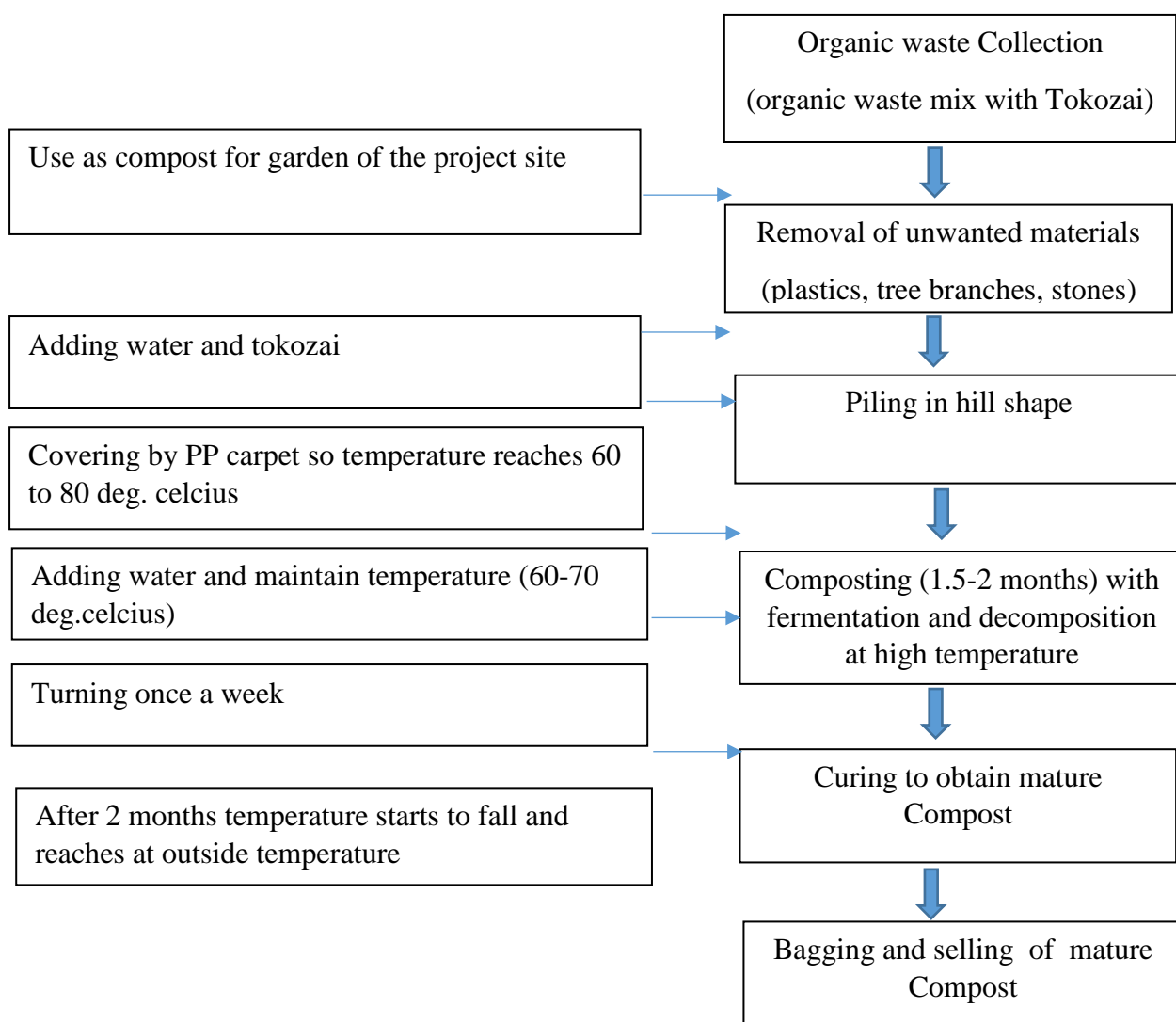


Figure 15: Flow chart of Rikishi Composting

### iii. Solid Waste Project Assessment: Success and sustainability factors

#### Technical appropriateness

The project produces odourless compost using modern, scientific and sustainable technology developed in Japan known as “CNBM Technology” where ‘C’ stands for Carbon, ‘N’ for Nitrogen, ‘B’ for Bacteria and ‘M’ for Minerals. This technology provides a

balanced supply of nutrients to crops by balancing vital components such as C, N, B and M. During the initial phase, the company faced challenges which includes people's lack of understanding technology, sceptical of the new technology and doubts about the materials used for producing compost manure. They had to organize events on a regular basis to inform people about the technology and distributed free samples to the farmers and households to guarantee the effectiveness of the fertilisers.

As per CNBM technology a balance mix of Bran, Husk, Leaves and Red Mud is prepared called 'Tokozai' that prevents the waste from spreading bad smells. For the preparation of Tokozai, a



Figure 16: Tokozai( balance mix of Husk, Bran, Red Mud and Leaves)

trained staff is required who received training from Japanese expert and this knowledge has been transfer to other staff in the company as well. These substances used for Tokozai preparation are easily available from different sources. Rikishi Compost's product is produced as per the standard Government.

Table 4: Measurement result of Fertilizer Content

Parameter	Unit	Compost of Rikishi
PH		7.0
C:N		11.5
Phosphorus	%	2.03
Nitrogen	%	1.42
Potassium	%	1.84
Organic carbon	%	17.6
Moisture	%	15.24
Arsenic	%	2.94

## **Health and environment**

Unlike other compost, Rikishi Compost does not have a foul smell nor is wet. Composting reduces methane which is a greenhouse gas emission coming from landfills. Reduces the need for chemical fertilizers that helps restore forests, wetlands and habitats by improving the quality of soil. On community level there has been no incidence of health risk and nuisance as they produce odourless compost.

A place's cleanliness can be used to describe how well its waste management infrastructure is being effective. When people are free to move about the designated walking area without being forced to deviate from their intended route by the presence of a spatial garbage hurdle or breathing difficulties caused by an atmospheric garbage hurdle, the area can be considered clean. Any obstacle of that kind would cause a distracted passer ( Bhele, 2019). Prior to the project, the households were dumping wastes at open ground and forests nearby creating environmental pollution. This project has improved the waste management and cleanliness of the community and community members are supportive of the project.

## **Economic aspects**

It was started in 2018 with the financial investment of the municipality and technical assistance of Rikishi Private Limited. The project started with an initial capital of Rs 2.5 million. The company has 27 staff at present. Their main service is compost production and sales. They target farmers as well as plant nurseries. Their main clients are the vendors and dealers who collaborate with the government to provide farmers with compost fertilizers. Compost worth of rupees 30 million was sold in fiscal year 2019/20.

## **Social aspects**

The company has conducted street play's, events, trainings and awareness programs for household segregation at source level, training of operational staff etc Awareness is increasing among the people about the benefits of segregation at source. They provide trainings for the candidates to provide technical assistance to various public and private organizations on waste management techniques using CNBM technology. The project has provided 27 new employment opportunities prioritizing particularly to local people and woman.

The template shown in the picture above gives illustrations to the households to understand what can be kept in the bucket and what not. Tokozai is only for degradable household waste, so the waste and Tokozai is put together in a sandwich manner, so that it can be store more than a week without any odor and decay.



*Figure 17: Template showing the process of storing waste in bins at households and trainings provided on waste management techniques.*

### **Organization and institution**

The immediate past Mayor of Madhyapur Thimi Municipality supported construction of this composting facility. The company is led by the most experienced leader in the field of organic fertilizers. Initial investment which includes land and infrastructure development were assisted by the municipality. Communication is carried out on daily basis with the Japanese founder of CNBM technology to evaluate the composting process is being done accurately to maintain the quality. The staffs are well trained and skilled for effective operation and management.



## CHAPTER 6 : FINDINGS AND ANALYSIS

### 6.1 Public- Private Partnership Stakeholders in waste management value chain

The immediate past Mayor of Madhyapur Thimi Municipality supported construction of this composting facility as a pilot project and helped gather community support for it by listening to community member concerns and providing information and examples of the benefits of this new facility. The project adopted some concept of PPP model. It follows Management, Operation and Transfer (MOT) type of contract. The contract period for the project is 10 years. Initial investment and infrastructure development was assisted by the municipality and the Province government which includes: land, shed structure, vehicle and driver, machinery equipments. The company pays only business tax to the Municipality and does not charge any fees for the collection service provided to the households. The multiple stakeholders are involved in sustainable waste management i.e. local government (municipality, ward-04), private company (Rikishi Compost Pvt. Ltd.) and households (service users). The role of these stakeholders are;

- **Municipality:** Development of necessary infrastructures for the establishment of waste recovery project, monitoring and evaluation of private party, supporting and protecting of public interest, formation of policy, planning and regulation.
- **Private sector:** Use of technology, operation and management of the project, sales and marketing of product
- **Households:** Proper source segregation as per company protocol, provide the segregated waste to the company in the specified time

### 6.2 Analysis of Public Private Partnership performance in Household waste collection

A household survey of 25 people was done and their perspective regarding the services of solid waste management by the involvement of private sector was gathered. The data was collected in inclusive manner by including different types of building use, age group, gender, occupation and household ownership.

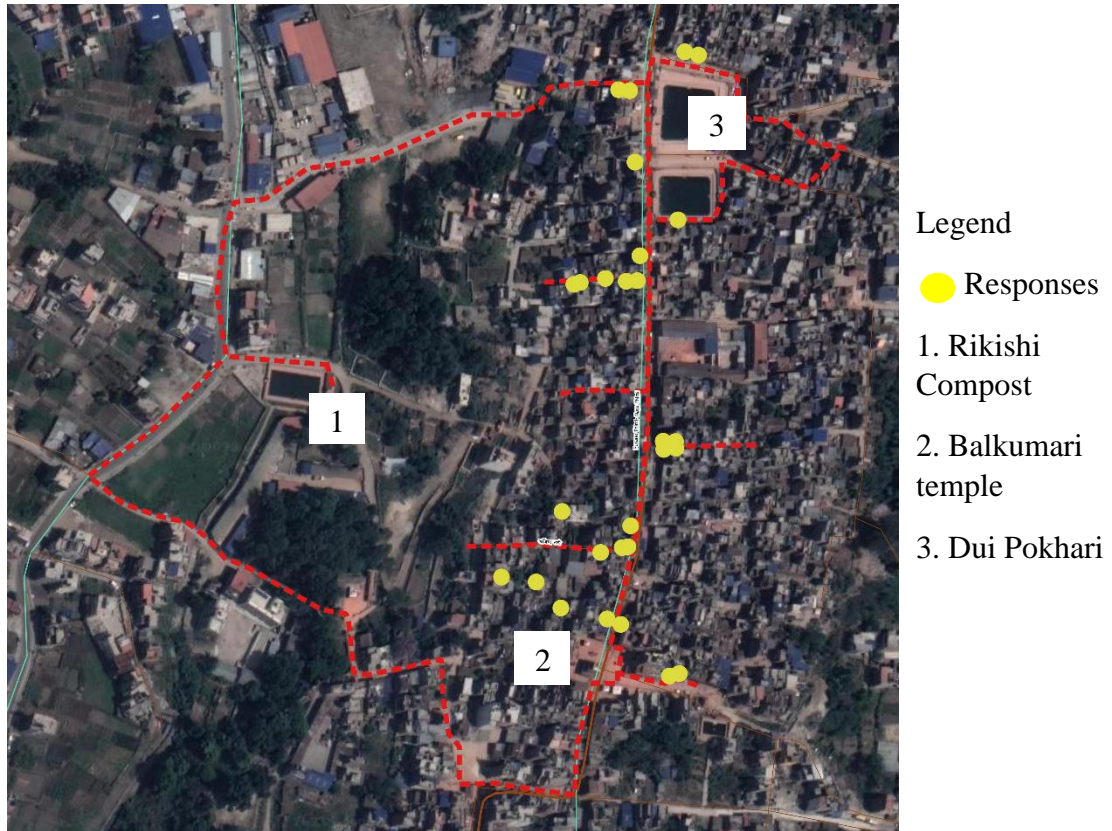


Figure 18: Waste collection routes and Respondents

## A. Characteristics of Households in the Study Area

### a. Gender of Respondents

Majority of the respondents were female with 72% and the rest were male respondents with 28%. The study includes both male and female.

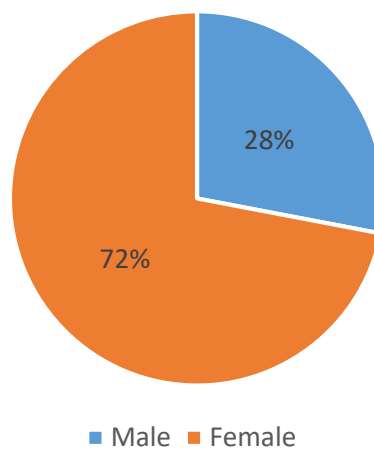
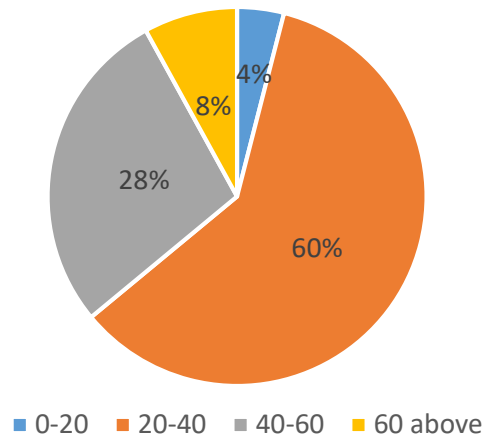


Chart 2: Gender of Respondents

### b. Age

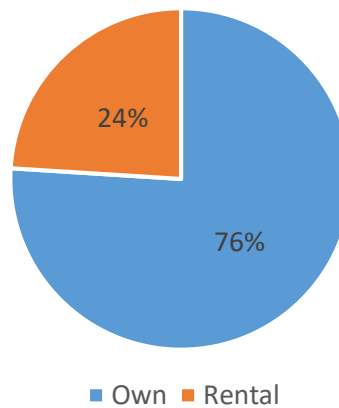
Among the 25 respondents, the age group of 20-40 years were majority with 60% then followed by the age group of 40-60 years with 28%, age above 60 years with 8% and age below 20 years with 4%.



*Chart 3: Age of Respondents*

### c. Household Ownership

Among the 25 respondents, majority of them were house owner with 76% and rest of them are renter with 24%.



*Chart 4: Household Ownership*

### d. Family Size

Among the 25 respondents, 64% households have 4 to 8 members, 28% have less than 4 members and 8% have more than 8 members. The majority of households have 4 and 5 members. The family size is important factor to analyze bucket filling time of a family.

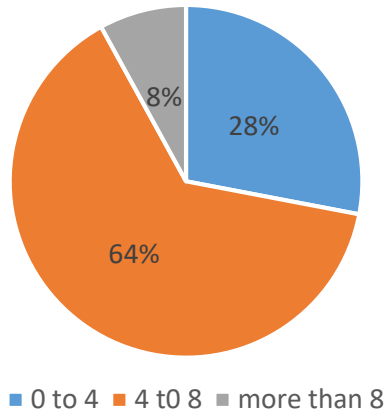


Chart 5: Family size

**e. Occupation**

In the survey, it was found that majority of the respondents(44%) have their own business(shops) ,some of them are housewife(32%), 12% were involved in the services, 4% are students and 8% were from other categories.

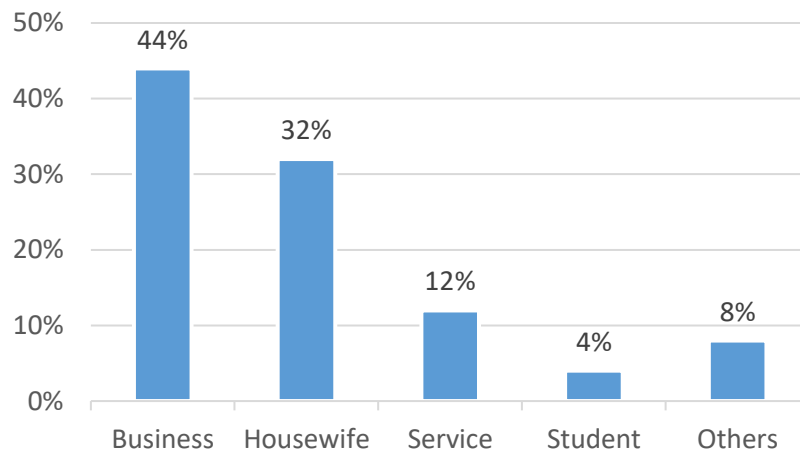
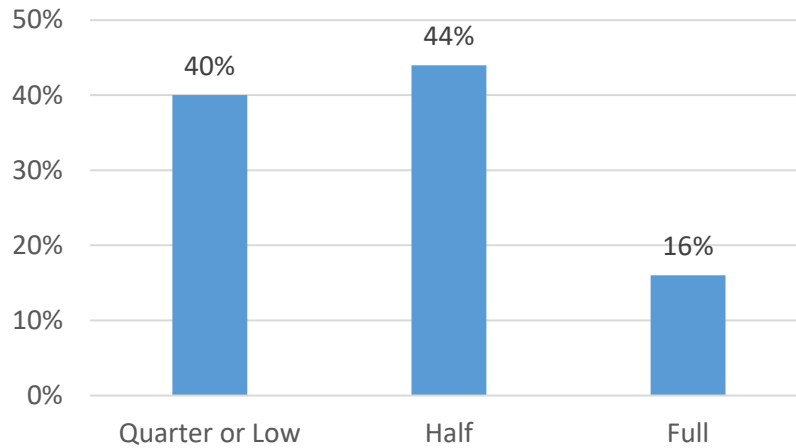


Chart 6: Occupation of respondents

**f. Bucket filled per week of a family**

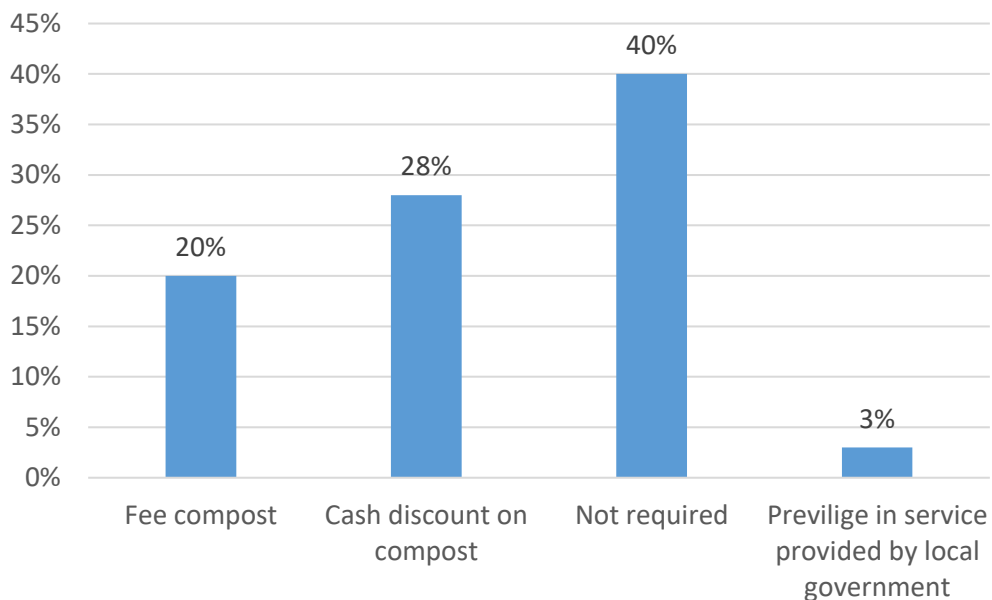
As per the survey, 40% of households bucket is quarter or low filled, 44% half filled and 16% of households bucket is full in a week. The bucket is full for very few households in a week and during feast and festivals. The size of the bucket is appropriate for the use.



*Chart 7: Bucket filled per week of a family*

**g. Preferred advantage for source segregation**

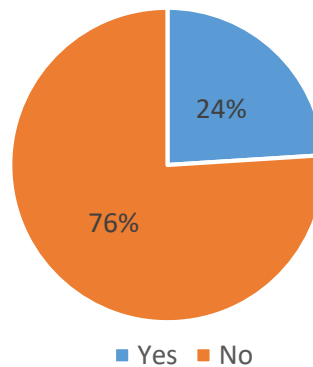
In the study area only limited number of households are segregating waste. Their views regarding preferred advantage to encourage source segregation was gathered. Majority of households does not require any sort of incentive (40%), some households require cash discount on compost(28%) produce by the company while few of them need free compost(20%) followed by privilege in service provided by local government(3%).



*Chart 8: Preferred advantage for source segregation*

### **h. Willingness to pay for improved collection service**

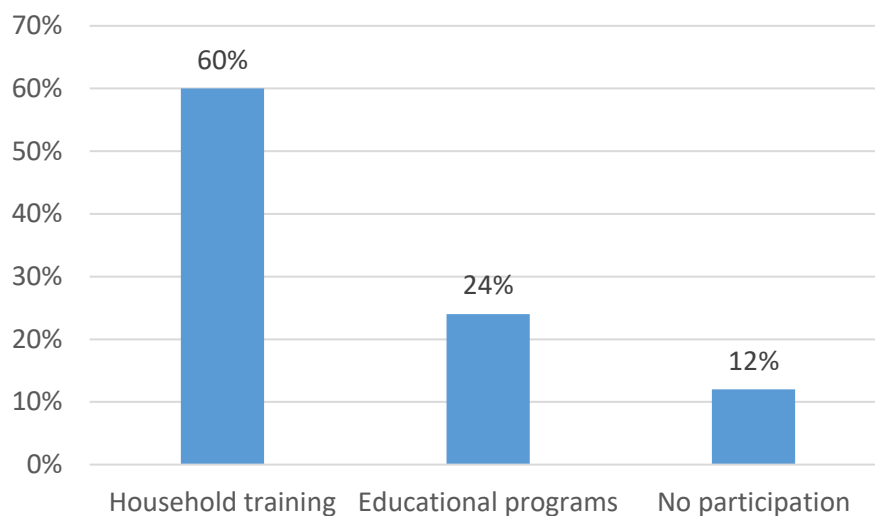
The company does not charge any fees for waste collection in the study area while other private companies charge collection fees. Most of the households(76%) are not willing to pay for the service as they think company is earning from the waste they give to them. Few households(24%) are positive to give waste collection fees if required.



*Chart 9: Willingness to pay for improved collection service*

### **i. Community participation in waste management process**

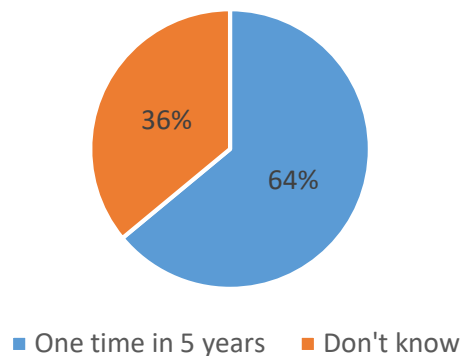
According to the survey, 60% of households received training on protocols of source segregation by the company members at their house, 24% attended educational programs organized by company regarding sustainable waste management practices and remaining 12% households did not participate in household training and educational program.



*Chart 10: Community participation in waste management process*

#### **j. Monitoring of service by Local Government or Private company**

According to the respondents the authorities of private company organized household program to monitor whether the source segregation is being done as per the company's protocol or not. Most of the households(64%) received the service once after one year of company started while other households(36%) were not monitored.



*Chart 11: Monitoring of service by Local Government or Private company*

#### **B. Service reliability component to evaluate PPP performance**

The perception of PPP based on service reliability was measured by different variables which includes cost (affordability), coverage and accessibility, consistency per week, frequency of collection and cleanliness of community. As per the respondent, the company does not charge collection fees so every household are satisfied for the cost effective service. The door to door collection service is provided except for the few households that are not accessible due to narrow alleys and covers small area of the ward. The service is consistent once a week i.e. Tuesday. Prior to the project the households used to dump waste in the open field and nearby forest. So cleanliness of surrounding has improved.

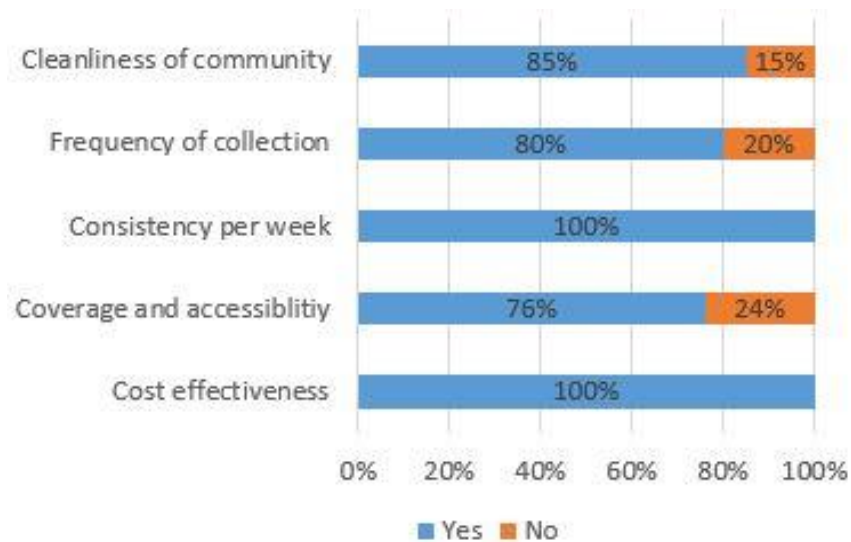


Chart 12: Service Reliability assessment

### 6.2.1 Key informant Analysis on Success and Failure factors of Project

As per Key Informant Interview with local government authorities and private company officials, the waste recovery project is facing some issues and challenges to be dealt with which may lead to failure of project. It includes:

#### **Lack of Detailed Project Planning**

The facility is operating in small capacity and is not able to expand due to small land area. As per Tulsi Bhakta Tako, Community Development Officer, “Rikishi Company was established with the aim to collect the organic waste from all wards of the municipality but it is not operating in full capacity due to land area restrictions. It is difficult to expand the facility further due to unavailability of land in the municipality”. The municipality is planning to develop cultural heritage walk which includes the area around the facility because it lies within the proximity of heritage area . It is creating obstacle so need to be relocated.

#### **Financial constraints for expansion to larger scale**

The municipality has huge initial investment and lacks investment for further expansion of the facility to larger area. So, municipality plans to expand composting facility under umbrella concept with Changunarayan municipality. Changunarayan municipality has available land for the expansion of facility. In order to minimize development loads, investment, and operating and maintenance costs, consideration should be given to the



possibility of inter-municipal coordination and sharing of these facilities and equipment.

### **Lack of communication and coordination**

The local authorities and private company is lacking proper coordination and communication at present as per local authorities.

### **Declining participation in source segregation**

Initially the households were informed the municipality would not collect waste so all of them participated in providing segregated waste to the company. However, the household participation has decreased later. Several factors are responsible for the decrease in participation of the households which includes:

- Other private companies collect mixed waste so the households are attracted towards it.
- The households finds time consuming to follow the protocols of source segregation as directed by the company.
- The households who requires compost for agriculture practice household composting.

### **Lacking proper market for the sale of product**

The main source of income of the company is compost production and sales. As per Production head , Milan Giri, “The company is sustaining through the sale of compost but it is not being able to make significant profit. The company faces challenge to compete with chemical fertilizer which is highly subsidized by the government.”

### **Inappropriate risk sharing and allocation**

As per Tulsi Bhakta Tako, Community Development Officer, “During operation it was found that there is huge investment of the municipality and it is being costly for the municipality to operate in small scale”. Therefore, in order to ensure fair risk allocation between them, parties involved in the public and private sectors must pay special attention to the procurement process during contract negotiations.

### **Lack of political support**

The pilot project was initiated with the support of immediate past mayor who helped to gather community support for the project. But the new leadership is not willing to start the project with same enthusiasm. As per Ward chairperson, Bal Krishna Shrestha, “Rikishi company is kept as alternative option for waste management because it is being unable to expand its facility to larger scale. The ward has prioritized on household composting through distribution of compost bins at cheaper price. He also adds that the households wants the expansion of Rikishi company and they have also concern about it.” Similarly, changing governments every five year is affecting to expand the facility to other municipalities as the new leadership does not support the project initiated by previous one as in case of Chandragiri municipality.

### **Lack of monitoring and evaluation system**

The municipal authorities lacks monitoring of service at household level, site survey is not done. Monitoring and evaluation is carried out through Tole Lane Organization. It need to establish proper monitoring and inspection mechanism.

## **CHAPTER 7 : DISCUSSION**

### **7.1 Public- Private Partnership Stakeholders in waste management value chain**

The private sector collaborating with the public sector is crucial in delivering SWM services, developing the necessary infrastructure for waste treatment and disposal in local government entities, and maintaining the services in an economical and efficient manner (Asian Development Bank, 2013). The PPP stakeholders have various functions, duties and responsibilities throughout the waste management value chain. The government authorities are responsible for monitoring of the project. The study finds that local authorities monitor and evaluate the project but not regularly and lacks proper schedule and standard measures. As per the agreement, the private company operates and manages the project. The project is running efficiently and smoothly in a small capacity. The main source of income to run the project is the sale of compost. The high quality organic fertilizer produced by the company is expensive than chemical fertilizer and faces challenge to compete with chemical fertilizer. The local production of organic fertilizer should be subsidized instead of the current practice of subsidizing imported chemical fertilizers. The households aware of benefits of source segregation, sustainable waste management practices and does not require compost for agriculture are participating in the project. Due to negligence and lack of knowledge some of households are not properly segregating waste as per the protocols of the company which results in discard of such waste for processing. The households are attracted towards mixed waste collection by other private companies. This is result of lack of awareness among people. Hence, extensive and regular trainings, awareness campaigns and workshops should be conducted to increase the public participation in source segregation and made aware of benefits of resource recovery.

### **7.2 Analysis of Public Private Partnership performance in Household waste collection**

In the study area, the perception of households regarding service reliability by the involvement of private company was measured by different variables which includes cost affordability, coverage and accessibility, frequency of collection, consistency per week and cleanliness of community. The core areas lack rental revenue so as an incentive the municipality does not charge service fees to the affected households. Most of the households are not willing to pay for the service if needed because they think company is earning from the waste provided by them and they lack sufficient source of income. The unwillingness of users to pay for solid waste services is a common

phenomenon in cities across the developing world (Cointreau-Levine S. , 1994) . Although privatization can be financed through a variety of methods, including loans, private sector financing, and budgetary allocations, user fees are considered to be a more sustainable way of funding. The service charge should be imposed by assessing the willingness or ability of the people to pay. The lower income group may be given discount on service charge. The service is focused on core areas and covers limited and small areas of the Ward. Unlike other compost, Rikishi Compost does not have a foul smell nor is wet. Prior to the project, the households were dumping wastes at open ground and nearby forests leading to environmental pollution. So cleanliness of surrounding and waste management has improved after the implementation of the project. However, some households still dump waste to nearby forest if they are not able to give waste to private waste collectors due to time constraints. The majority of the households feel positive impacts of the project in the community.

### **7.3 Key Informant Analysis on Success and Failure factors of Project**

There are various enabling and constraint factors for the success and failure of PPP projects which includes technology suitability, health and environmental impacts, institutional, social and economic aspects. The selection of technology is appropriate as per the context. The material resources are easily available and reduces the need for chemical fertilizers. The company conducted training on source segregation and waste management initiatives at household and community level that help to gather community support. The project was started with the aim to collect the organic waste from all wards of the municipality. But the facility is not being able to expand due to the small land area. The appropriate site selection is crucial for waste related projects. As per KII with municipal authority, the municipality has huge initial investment for the project and lacks investment for further expansion of the facility to larger scale. Hence, both public and private sector party ensure fair risk allocation between them. The previous mayor of Madhyapur Thimi Municipality encouraged the building of a new composting facility and worked to gain support from the locals by paying attention to their concerns and providing information and illustrations of the advantages of the new facility. However, the private company and local authorities is lacking communication and coordination since last year. The continued support of the political representatives is most important factor for successful PPP project.

#### 7.4 Policy gap review

There are numerous policies on solid waste management which governs all the activities related to its operation. Solid Waste Management Act 2068 provides for Public Private Partnership (PPP) in SWM sector. The Madhyapur Thimi municipality formulated Basic Sanitation and Solid Waste Management Guideline 2079 that encourages private sector participation through PPP modal. Similarly, Solid Waste Management National Policy 2079 promotes co-financing, public participation, public-private partnerships, technological development and transfer in waste sector. This policy emphasizes on contributing to the national economy through mobilization of waste as resource by utilizing innovative technologies in waste management. However, these policies does not include: material recovery and Waste-to-Energy specific Standard Concession Arrangement for the purpose of regulating and promoting its development. It should include; government financial support, key performance indicators, risk sharing between the two parties, incentives and penalties, monitoring and inspection procedures and remedy measures to address default events. Moreover, these policies does not talk about marketing provision for the recovered products from waste. As per the primary case studies the government does not have a policy of subsidizing biogas and organic fertilizers so it is not getting competitive market. These solid waste related enterprises are operating in small capacity.

## **CHAPTER 8 : CONCLUSION AND RECOMMENDATION**

The municipality has initiated best practices of Sustainable Solid Waste Management in partnership with private company. Collaboration between private sector and public sector has become crucial for providing SWM services efficiently and cost effectively. The study identifies both constraining and enabling factors that affect PPP project success and failure. The involvement of private sector in the community has positive impact as cleanliness of community has improved; service is cost-effective and consistent; initiated source segregation through community participation and monitoring of service is performed. Besides, there is not continued monitoring and awareness program. So, the responsible authorities need to conduct regular public participation, training and awareness program to receive information about changing needs and suggested solutions of the service users.

The success or failure of PPP waste recovery project is influenced by many factors such as technical, environmental, financial, institutional, legal and socio-cultural. The success factors of the project includes: appropriate technology as per context, health and environmental benefits, led by experienced leader and initiated with strong support of immediate past mayor. However, problems such as inappropriate site selection, lack of detailed project planning, inadequate finance for upscaling, lack of continued political support and inappropriate risk sharing, inadequate monitoring and inspection mechanism can be seen in the study area. There is lack of provision of subsidy scheme or incentives for the support of materials and products recovered from waste. There is need to create an improvement in enabling environment. Appropriate framework for feasibility study, risk sharing mechanism, dispute resolution process, monitoring and feedback mechanism should be developed for success of PPP projects. PPP is mainly driven by the market, and obtaining and maintaining the private sector's involvement requires an enabling environment. Being revenue driven, such decentralized models have the potential to become financially viable. However, such models, which are at a early stage of development require strong institutional mechanism, governance, policy and market support to become successful on a large scale.

### **a. Recommendation for Replication and Upscaling pilot project**

- i. Households within the designated area must provide segregated waste compulsorily to the company, if they fail to do so, penalties or fines should be imposed.
- ii. The municipal authorities must guarantee the sufficient amount of waste to be supplied continuously that is crucial to make the waste recovery project work.
- iii. The site selection should also be done appropriately to accommodate future expansion of the facility, cater demand of increasing population and gather community support. The selection of appropriate project site is crucial for the waste recovery projects.
- iv. Ensure a balance between risk and reward for both government and private sector, with an appropriate risk sharing mechanism.
- v. Identify and implement the needed measures to enhance the marketing of products and increase consumers' confidence in recovered and recycled products.
- vi. Increase public awareness, acceptance and participation in environmentally-friendly waste management practices. They should be successfully reached and informed.
- vii. To manage a full cost recovery of O&M cost, the users could be charged for the provided waste management service. The lower income group may be given discount on service charge.

### **b. Policy Recommendation**

- i. Mainstreaming the PPP into local level. There need to be institutional structure of public, private and co- operative sector partnership in the local bodies.
- ii. The central government should initiate subsidy scheme or incentive to encourage and support products recovered from waste and enhance SWM related enterprises on a large, commercial scale.
- iii. A resource recovery and WTE-specific Standard Concession Arrangement need to be developed and implemented by the authorities for the specific purpose of regulating and promoting its development.

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## ANNEXURES

### ANNEX 1: QUESTIONNAIRE

#### Questionnaire for government institution

Name of key informant:

Working profession:

Name of office:

Address:

1. What is the source, composition of waste generated and collection/day carried out?
2. How is waste management being done?
3. What are key drivers for adoption of PPP?
4. What is role of municipality/ward in Public Private Partnership?
5. What are challenges and issues with private sectors involvement in the selection, implementation and monitoring of project?
6. How PPP help to improve SWM services?
  - a) Reduce the management cost (higher labour and vehicle productivity)
  - b) Improve the services and getting more benefits
  - c) PPP helps to collect more waste
  - d) Waste management methods mechanized
  - e) Increase public awareness and participation
7. Does the municipality have the adequate institutional capacities and are capable enough to monitor the quality of service of private contractors?
  - a) How often is monitoring of services carried out? Field visits? Who monitor it?
  - b) Is the consequence of not performing according to the contract clear in the contract?
  - c) Who oversees contract management?
  - d) Mechanism for Conflict management between community and municipality?
  - e) Work being done as per contract or not?
8. What are risk sharing mechanism/profit sharing mechanism?
9. Is there community participation in the process by providing opportunities, trainings and educational programs? Are communities in favour of Public

private partnership and has this model improved the solid waste services in community

10. Is the choice of technology and equipment for waste recovery appropriate for the context?
11. What are the critical factors for successful PPP? Failures of PPP?  
  
Enabling factors for the project  
  
Constraints for the project
12. Are policy and regulations for waste management adequate and in case of PPP? What improvements required?
13. Is budget for solid waste management programs is adequate at municipal level?
14. Does municipality take service charge? What is source of finance for waste management?
15. What steps need to be taken for effective waste management? Initiatives?

## **Questionnaire for private institution (Respective Authorities)**

Name of key informant:

Working profession:

Name of office/organization:

Established date:

Covered area:

1. What is the source, composition of waste collected and collection/day carried out? What are waste recovery mechanisms and its capacity per day?
2. What are waste collection, storage, segregation, treatment and residual disposal method involved? What are problems and challenges ?
3. What are key drivers for adoption of PPP?
4. Technical functionality/appropriateness:
  - a. Choice of technology and equipment for waste to energy appropriate for the context?
  - b. Is there sufficient local availability experience (skills) to operate and maintain the technologies or equipment used in the case?
  - c. Is there sufficient local availability of material resources (supply of material and spare parts) for technologies or equipment used in the case?
  - d. Is there sufficient availability or access to space and facilities to increase capacity?
5. Health and environmental impacts:
  - a. Does the project safeguard workers' well-being and health?
  - b. Does the project safeguard community well-being and health?
    - i. Do hardly any accidents/diseases occur in the communities which are related to the solid waste management case?
    - ii. Are complaints minimal about any form of nuisance (noise, insects, rodents, malodours, etc.) caused by the project and are rectified through appropriate measures?
    - iii. Is serious environmental pollution (which may directly influence health of the community) avoided through appropriate measures?

6. Costs, finances and economics:
  - a. Does the project provide the service cost-efficiently?
  - b. Is cost recovery of the waste handling functioning and sustainable?
    - i. Do revenues outweigh the cost of providing the service?
    - ii. Are beneficiaries of the service willing and able to pay the suggested tariffs to the project for the waste handling?
    - iii. Are sources of public funding (tax money) available to the project and provided in the long term (if required)?
  - c. Does municipality pay enough for the service?
  - d. What incentives/subsidy is provided from government? What must be done?
    - i. Provision of subsidy
    - ii. Tax-free
    - iii. Availability of land
    - iv. Capital investment(vehicles, machines, manpowers)
    - v. Appropriate agreement period
    - vi. What must be the role of local government in PPP?
  - e. Is there proper market for the sale of product?
    - i. Income or benefits from compost?
    - ii. Is waste segregation proper and adequate for economic value extraction?
7. Social aspects:
  - a. Is there Community participation in the process by providing opportunities, trainings and educational programs? Initiatives/programs?
  - b. Have beneficiaries been informed about their duties towards and their benefits from the case?
  - c. Has this model improved the solid waste services in community? How?
  - d. Are beneficiaries favorable and support the project ?
  - e. Do beneficiaries have the possibilities to give feedback or to complain to the management?
  - f. Does the project take specific gender issues into account?
  - g. Does the project provide equitable service (also for the poor)?
8. Organizational strength and institutional support:

- a. Have the employees, managers, operators working with the case/technology been sufficiently trained?
  - b. Is a monitoring system in place to evaluate performance of the case (audits, inspections)?
  - c. Does the project assisted of political support?
  - d. Does the project have a well-functioning collaboration with local authorities (e.g. the municipality)?
9. What are the critical factors for successful PPP? Failures of PPP?
10. Policy and regulations for waste management adequate and in case of PPP? What improvements required?
11. What steps need to be taken for effective waste management? Initiatives?

**Household/Respondent detail:**

- 1) Age:
  - 0-19
  - 20-39
  - 40-59
  - 60 and above
- 2) Gender:
  - Male
  - Female
- 3) Family member:
  - 0-3
  - 4-7
  - 8 and above
- 4) Rent/owner:
  - Renter
  - Owner
- 5) Building Use
  - Residential
  - Commercial
  - Mixed- use
- 6) Education Level
  - High school or below
  - Bachelor's degree
  - Master's degree
  - Doctorate
- 7) Occupation:
  - User's group
  - Businessman
  - Student
  - Housewife
  - Services
  - Others



- 8) What is the source of waste generated?
- Residential
  - Industrial
  - School
  - Shops/restaurant
  - Mixed-use
- 9) Generally, what includes your waste?
- Compostable waste(kitchen waste)
  - Recyclable waste(paper, plastic, glass, metal)
  - Medical waste(expired medicines, bandages)
  - Domestic hazardous waste
  - Electronic waste
- 10) Bucket filled per week of a family?
- Quarter or Low
  - Half
  - Full
- 11) Do you use separate bins for different kind of waste(Waste segregation)?
- Yes
  - No
- 12) Willingness to participate in source segregation?
- Yes
  - No
- 13) What are the barriers for source segregation? What need to be done?
- 14) Preferred advantage for segregating waste at source?
- Compost free
  - Cash discount on compost
  - Privilege in service provided by local government
  - Not required
- 15) Community participation in the waste management process? Do you attend?
- Household Training
  - Educational programs
  - No participation
- 16) Does the municipality or private company survey the service performance?

- Yes
- No

17) Willingness to pay for improved solid waste management service?

- Yes
- No

18) Service reliability component:

a) Cost affordability

- Yes
- No

b) Coverage and accessibility

- Door to door collection
- Collection from nearby accessible point

c) Waste Collection Consistency per week

- Yes
- No

d) Cleanliness of community

- Cleanliness has improved significantly
- Not so considerable

e) Frequency of collection

- Collection once a week is insufficient
- Sufficient

a) Quality of personnel with households

- Responsible and cooperative
- Uncooperative

## ANNEX 2: KEY INFORMANTS INTERVIEW /HOUSEHOLD INTERVIEW



Figure: Ward Chairperson, Ward-04,  
Bal Krishna Shrestha



Figure: Community Development Officer, (  
Tulsi Bhakta Tako  
(Environment, Sanitation and Disaster Management  
Section at Madhyapur Thimi Municipality)



Figure: Service User Survey(Household)



Figure: Production Head, Rikishi Compost

## ANNEX 3: IOE GC



त्रिभुवन विश्वविद्यालय  
Tribhuvan University  
इन्जिनियरिङ अध्ययन संस्थान  
Institute of Engineering

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Date: November 26, 2023

### To Whom It May Concern:

This is to certify that the paper titled "**Public Private Partnership in sustainable solid waste management: A case of Madhyapur Thimi**" (Submission# 582) submitted by **Pampha Moktan** as the first author has been accepted after the peer-review process for presentation in the 14<sup>th</sup> IOE Graduate Conference being held during Nov 29 to Dec 1, 2023. Kindly note that the publication of the conference proceedings is still underway and hence inclusion of the accepted manuscript in the conference proceedings is contingent upon the author's presence for presentation during the conference and timely response to further edits during the publication process.

Bhim Kumar Dahal, PhD  
Convener,  
14<sup>th</sup> IOE Graduate Conference



# Public Private Partnership in sustainable solid waste management: A case of Madhyapur Thimi

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## Abstract

Sustainable solid waste management through Public Private Partnership (PPP) projects have been initiated in the municipalities of Nepal. This research emphasizes on private sector participation for sustainable practices in waste sector to reduce waste to landfills and create opportunities. PPPs combine the skills, knowledge and resources of both the public and private sectors through appropriate sharing of risks, rewards and responsibilities. This study explores roles and responsibilities of the major stakeholders of PPP and how they are working collaboratively to manage solid waste sustainably in the Ward 4 of Madhyapur Thimi Municipality. The municipality has initiated best practices of solid waste management and created opportunities from waste to resource through partnership with Rikishi Compost Pvt. The various enabling and constraints factors for the successful operation of the project were studied through perception of local government, private party and affected households. A mixed method approach was employed for data collection including interviews, observation, questionnaire survey and also collection of required information from documents, journals and past researches related to the study. In addition, the study examined case studies with good practices of SWM through PPP model, reviewed PPP and SWM policies focusing on private sector participation for turning waste to valuable resource. The study finds that peoples' participation, monitoring, training and awareness program for segregation at source is not conducted on regular basis. The local government lacks proper monitoring and feedback mechanism, financial investment and land for the expansion of the project to larger scale. The private company faces difficulty to compete in the market due to lack of subsidy to the recovered product, inadequate supply of segregated waste and lacks continued political support. Based on the analysis, strategies for improving enabling environment for successful implementation of PPP in sustainable SWM have been explored.

## Keywords

Sustainable Solid Waste Management, PPP, Segregation at source, Enabling environment

## 1. Introduction

The solid waste management is a major environmental issue in most of the cities of developing countries, including Nepal. Since decades, the management of the city's waste has been extremely problematic, particularly with regard to the placement of landfills. Inadequate scientific disposal has also led to issues with public health and the environment [1]. The current waste management practices in Kathmandu Valley are based on a "collect and dump" approach that neglects potential for turning waste into valuable resources. Thus, there is an opportunity to shift from a waste management to a resource management approach [2]. Most of the waste ends up at Sisdol landfill due to lack of formal recycling and reutilization facilities. There is need of formal system for resource recovery either waste to energy, composting or recycling within the city. The development of sustainable industries will reduce the effects of waste and create opportunities for jobs, building materials, renewable fuel and compost for crops. In order to achieve sustainable waste management the municipalities need to adopt circular approaches to waste to overcome obstacles and capitalize on opportunities [3]. There is the involvement of private sector, International Non-Government Organization (INGO's) in the research and development of waste sector due to the limited budget allocated for Solid Waste Management (SWM) from the government [4]. In recent years, government has made policies to enhance private sector participation for waste management by adopting new

technologies. Public-private partnership is encouraged to build and run bioenergy, organic fertilizer, and waste treatment. PPPs can be an effective tool to mobilize the skills and resources of both the public and private sectors through sharing of risks, rewards and responsibilities. The private sector can contribute finance, technology, and innovation to enhance the infrastructure development process and can deliver quality, faster and cost effective and efficient public services. To maximize the strengths of each sector, it is beneficial to have both the public and private sectors playing active roles in a mutually beneficial environment.

The average per capita Municipal Solid Waste (MSW) in Nepal is 273.44 gm/capita/day. Total MSW generation is 23.01 tons/day in which household waste is 11.50 tons/day, commercial waste is 10.04 tons/day and institution waste 1.46 tons/day [5]. Urban population growth and economic development are the main factors contributing for the rapidly rising MSW generation. As solid waste management has a direct impact on the environment and public health, it has been identified as one of the key areas for developing clean cities by the Madhyapur Thimi local authorities. According to the Community Development Officer of the municipality, the waste generation of municipality is 50 tons/day. Around 35 tons/day of solid waste is generated from households and 15 tons/day from institutional, commercial and industrial areas. The main source of waste of the municipality is the household waste followed by commercial and institutional waste in which 70% are organic

waste and 30% are inorganic waste(recyclable and reusable).

The municipality and ward-04 has initiated sustainable practices of waste management through partnership with Rikishi Compost Pvt. Ltd. since 2018. The main objective of this study is to assess the role of Public Private Partnership for effective service delivery in sustainable management of municipal solid waste, taking the case of Madhyapur Thimi. The specific objectives are:

- To explore how PPP model is working in solid waste management valu chain.
- To analyze the impact of the involvement of private sector on municipal SWM.
- To analyze the factors for success and failure of PPP and then recommend strategy for effective PPP in SWM.

## 2. Research Methodology

The interpretivist paradigm with mixed methods is adopted for the research to explore the role of multiple stakeholders in PPP for sustainable waste management and identify factors for success and failure to implement PPP. For the study, both qualitative and quantitative techniques of data collection were used which includes questionnaire survey, interviews, and observation. The survey was carried out in Ward 4 of Madhyapur Thimi Municipality with three major stakeholders of PPP project mainly, local government, private company and affected households. The enabling and constraint factors for the project success were studied through Key Informant Interviews with local government (municipality and Ward representatives) and Rikishi Compost Pvt. Ltd. Household interview was carried out with service users to evaluate the performance and service delivery of the project.

Table 1: Framework for data collection

Main Objective	Specific Objectives	Variables	Data Sources
To assess the role of Public Private Partnership for effective service delivery in sustainable management of municipal solid waste.	To explore how PPP model is working in managing solid waste from the point of generation to its final treatment and disposal.	<ul style="list-style-type: none"> <li>• Role of local government, private company and households.</li> <li>• Issues and challenges in waste management chain</li> </ul>	KII, Service user survey, Site observation
	To analyze the impact of the involvement of private sector on municipal SWM.	<ul style="list-style-type: none"> <li>• Health and environmental impacts.</li> <li>• Social impacts.</li> <li>• Cost, finances and economics</li> <li>• Organization and institutional support</li> </ul>	KII, Service user survey, Site observation, Literature review on good practices of SWM
	To analyze the factors for success and failure of PPP and then recommend strategy for effective PPP in SWM.	<ul style="list-style-type: none"> <li>• Enabling and constraint factors of PPP</li> <li>• PPP project in national and international context</li> <li>• National PPP and SWM policy</li> <li>• Strategies for improving PPP enabling environment</li> </ul>	Literature review, Site study, Policy review

## 3. Literature Review

### 3.1 Sustainable Solid Waste Management

Sustainable Solid Waste Management is a system that is economically feasible, socially acceptable and environmental

friendly. Besides to being technically, financially, environmentally, politically, institutionally, and socially feasible, the waste management system must be designed to fit local conditions. It must be able to continue over time without depleting the resources it requires. To attain sustainability the current concept of refuse disposal that imposes heavy burdens on the environment and resources should be transformed into a closed-cycle system [6]. Supporting and promoting clean technologies is vital for sustainable waste management, as is preventing or avoiding the production of unwanted waste.

### 3.2 Solid waste project assessment

A simplified method for evaluating solid waste projects has been developed by the ISSOWAMA (Integrated Sustainable Solid Waste Management in Asia) association. The basis for analyzing the project's "drivers of success" or "reasons of failure" is provided by this method. Expert knowledge and overall case study experience were employed to define the qualitative indicators that impact the project's success or failure[7]. These indicators include:

- Technical appropriateness and functionality
- Health and environmental impacts
- Costs, finances and economics
- Organizational strength and institutional support
- Social aspects

### 3.3 Defining Public–Private Partnerships

Public–private partnerships (PPPs) are typically viewed as an alternative to full privatization in which the government and private businesses share co-ownership and co-responsibility for the provision of specific services [8]. PPPs is an effective means that combines the skills and resources of both the public and private party by sharing risks and responsibilities. This approach enables government agencies to benefit from the expertise of the private sector, and allows them to focus instead on planning, policy and regulation. PPP collaboration must be based on the expertise of each partner in order to meet public needs through proper allocation of:

- Resources,
- Risks,
- Rewards, and
- Responsibilities

The belief that PPPs avoid the negative effects of either complete privatization or exclusive public ownership for service delivery is one of the factors contributing to the growing interest in PPPs. PPP approach is effective in providing public services as it combines the best potential of both party: the public sector with its regulatory actions and protection of public interests, and the private sector with its resources, management expertise, technology and innovativeness [9].

### 3.4 Stakeholders of Public Private Partnership

The Central and Local Government Bodies, as well as Ministries, Departments, Municipalities, DDC, and VDC, were

included among the stakeholders under the Government category. This also applies to donor organizations and other government-owned businesses. The Formal and Informal Private Sector, which includes businesses, industries, companies, nonprofit organizations, service providers, NGO, CBO, and individual stakeholders, makes up the second category of stakeholders. The consumers, which include service users who are accountable for waste generation, make up the third category of stakeholders.

### 3.5 Critical success factors for PPP in MSW Projects

The identification of critical success factors (CSFs) in SWM projects provide the guidance for stakeholders in developing strategies to eliminate shortfalls and ensure successful and sustainable project. From secondary sources, 17 perceived CSFs were found and verified by a number of experts [10]. These critical success factors would increase the possibilities of success in PPP municipal SWM project.

Table 2: CSFs for a solid waste project

S.N.	Critical Success Factors
1.	Project technical feasibility
2.	Detailed project planning
3.	Transparent procurement process
4.	Public Awareness
5.	Commitment and responsibility of project partners
6.	Capacity building of ULB staff
7.	Favourable legal and regulatory framework
8.	Strong Monitoring & evaluation system
9.	Strong and competent private sector partner/s
10.	Good Governance
11.	Waste Segregation
12.	Public engagement and support
13.	Political support :
14.	Appropriate risk allocation and sharing
15.	Appropriate toll/tariff
16.	Integration of informal sector
17.	Adequate financing

### 3.6 Arguments of PPP in SWM in developing countries

Public Private Partnership (PPP) help to improve Solid Waste Management services in several ways in developing nations [11].These includes:

- Reduce the management cost
- Improve the services and increase benefits
- PPP helps to collect more waste
- Waste management methods mechanized
- Increase public awareness and participation
- Increase the efficiency
- More investment

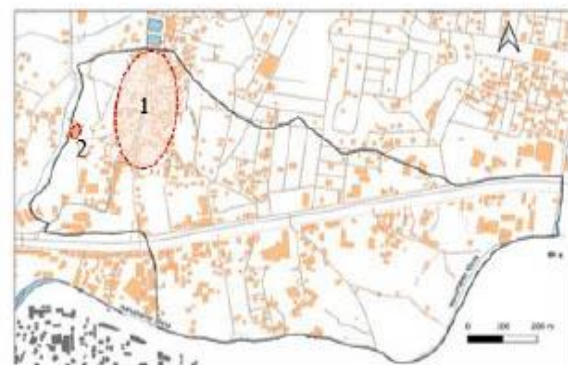
PPP invests private capital to reduce the burden on local governments' budgets. It attempts to maximize the benefits from waste and aids in service improvement. Budgetary restrictions make it difficult for the public sector to offer waste management

services. Additionally, the private sector contributes new concepts, innovations, and expertise which help to improve the SWM services [12].Environmental protection could be enhanced if countries collect waste properly and use technology to reduce waste volume.

## 4. Study Area

The study area is Ward 4 of Madhyapur Thimi Municipality which has a total population of 9,519 of which 4,799 are male and 4,720 are female. The ward consist of 2540 households and occupies land area of 0.68 sq. km. Solid waste management is the top priority of the Local Authorities of Madhyapur Thimi for developing clean cities to develop the municipality as a tourist destination as it is rich in historical and cultural monuments. The municipality has initiated best practices of solid waste management and created opportunities for waste to resource through partnership with Rikishi Compost Pvt. The company was established in 2018 with the financial investment of the municipality and technical assistance of Rikishi Private Limited. They had started collecting organic wastes from Ward No.4 of the municipality as a pilot project. The monthly composting capacity is 20 ton. The company collects 3 to 4 ton waste per week from households and produces upto 10 to 15 ton per month. Initially waste was collected from 2000 households of core areas but now it has decreased to 600 households. Several factors are responsible for the decrease in participation of the households which includes:

- Other private companies collect mixed waste so the households are attracted towards it.
- The households finds time consuming to follow the protocols of source segregation as directed by the company.
- The households who requires compost for agriculture practice household composting.



Index

1. Core area (service area)
2. Rikishi Compost Pvt. Ltd.

Figure 1: Map of Study Area, Ward-04

### 4.1 The Waste Management System

The sites of Rikishi have their own protocol of collection of waste. The company distributed customized designed bucket set of 32 litres for households with Rs.550 to store only biodegradable

organic waste. Along with bucket the company also distributes the material which is known as Tokozai. It is a mixture of Bran, Husk, Red clay and Dry Leaves for waste collection from source with no odor. Source segregation is practiced in these households. The waste is collected every Tuesday morning once a week. One mini garbage picker is mobilized for door to door collection of garbage. The collected waste is transported to the Rikishi Compost Pvt. Ltd. where composting is done. Composting is a highly effective waste disposal and management system used by the company.

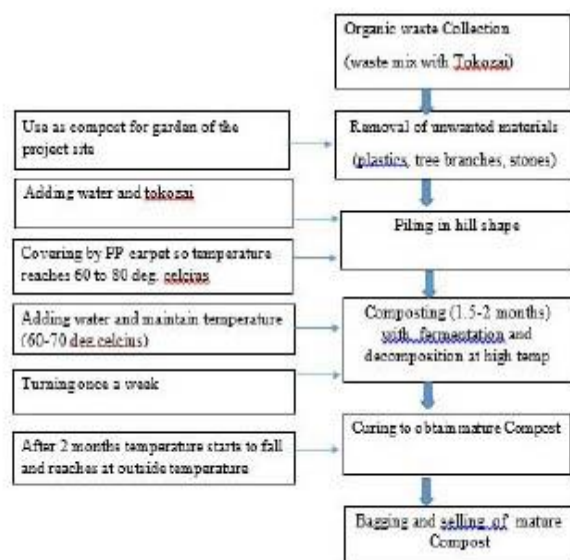


Figure 2: Flowchart of Rikishi Composting

## 5. Findings and Analysis

### 5.1 Public- Private Partnership Stakeholders in waste management value chain

The multiple stakeholders are involved in sustainable waste management of Ward 4 of Madhyapur Thimi. They are local government (municipality, ward-04), private company (Rikishi Compost Pvt. Ltd.) and households. The role of local government is to develop necessary infrastructures for the establishment of waste recovery project and monitor the project. Infrastructure development and initial investment was provided by the municipality and Province government which includes land, shed structure and machinery equipments. The private sector has technical assistance including operation and management of the project. Also, the company is responsible for the sales and marketing of compost. The role of households is proper source segregation and provide the segregated waste to the company in the specified time. The source segregation should be done as per company's protocol.

### 5.2 Public Private Partnership performance in Household waste collection

The research used random sampling technique with a sample size of 25 respondents who are service users of the waste recovery project. The majority of service users were house owner because the service is provided in core areas of Ward-04.

Female respondents rate was higher than that of males in the study area.

Table 3: Demographic Information of Respondents

Category	Value	Number	Percentage
Gender	Male	7	28
	Female	18	72
Age(years)	0-20	1	4
	21-40	15	60
	41-59	7	28
	60 and above	2	8
Occupation	Business	11	44
	Service	3	12
	Housewife	8	32
	Student	1	4
	Others	2	8
Household ownership	Own	19	76
	Rental	6	24
Family size	0 - 4	7	28
	5 - 7	16	64
	8 and above	2	8

As per the service user survey, the company has conducted trainings and awareness programs for household segregation at source level. According to the survey, majority of households received training on protocols of source segregation provided by the company.

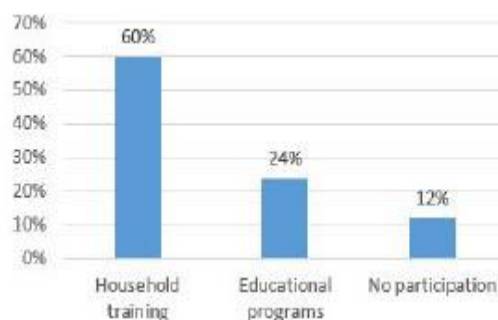


Figure 3: Community participation in waste management process

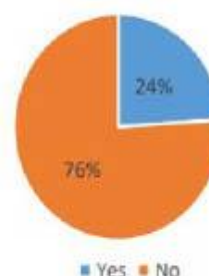


Figure 4: Willingness to pay for improved collection service

In the study area, most of the households 76% are not willing to pay for the service as they think company is earning from the waste they give to them. Few households are positive regarding the payment of service charge if needed.



According to the respondents, the authorities of private company organized household program to monitor whether the source segregation is being done as per the company's protocol or not at the beginning of the project. Most of the households 64% received the service once after one year of company started while other households 36% were not monitored.

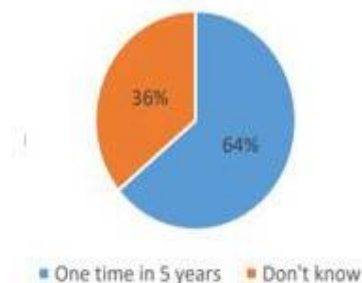


Figure 5: Monitoring of service

In the study area only limited number of households are segregating waste. Their views regarding preferred advantage for source segregation was gathered. Majority of households does not require any sort of incentive (40%), some households require cash discount on compost produced by the company (28%) while few of them need free compost (20%) followed by privilege in service provided by local government (3%).

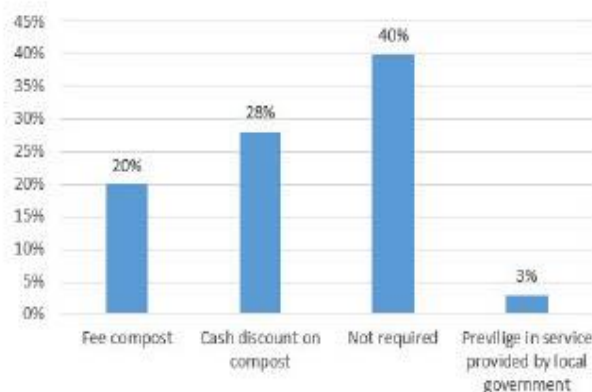


Figure 6: Preferred advantage for source segregation

The perception of PPP project based on service reliability was assessed by different variables which includes cleanliness of community, cost affordability, consistency per week, frequency of collection, coverage and accessibility. The company does not charge collection fees so every household are satisfied for the cost effective service. The service is consistent once a week. Prior to the project the households used to dump waste in the open field and nearby forest leading to environment pollution. So cleanliness of surrounding has improved after the implementation of the project. However, some households still dump waste to nearby forest if they are not able to provide waste to private waste collectors due to time constraints. The majority of the households feel positive impacts of the project in the community.

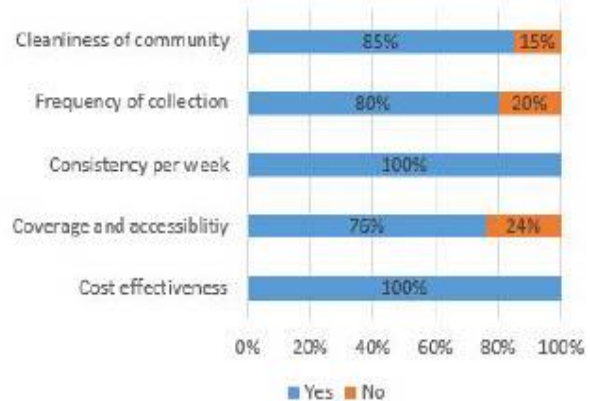


Figure 7: Service reliability component to evaluate PPP performance

### 5.3 Key Informant Analysis on the Issues and Challenges of waste recovery project

As per Tulsi Bhakta Tako, Community Development Officer of the municipality "The Rikishi Company was established with the aim to collect the organic waste from all wards of the municipality but during operation it was found that there is huge investment of the municipality and it is being costly for the municipality to operate in small capacity and difficult to expand the facility further due to inadequate finance and unavailability of land".

According to Ward chairperson-04 "Rikishi company is kept as alternative option for waste management because it is being unable to expand its facility to larger scale. Company and Local authority is lacking communication since one year. The households wants the expansion of Rikishi company and the local authorities have also concern about it".

As per Milan Giri, Production Head of Rikishi Compost Pvt. Ltd "The company is successfully running and operating. The facility is expanding in other municipalities. Despite, we are facing some challenges to run the project. The company has to compete with chemical fertilizers for the market. The other private companies are collecting waste without source segregation which attracts household toward it."

### 5.4 Success and sustainability factors

**Technical appropriateness:** The project produces odourless compost using modern, scientific and sustainable technology developed in Japan known as "CNBM Technology" where 'C' stands for Carbon, 'N' for Nitrogen, 'B' for Bacteria and 'M' for Minerals. This is a technology based on fermentation by microorganisms at a high temperature of 60-80 degree celcius. As per CNBM technology a balance mix of Bran, Husk, Leaves and Red Mud is prepared called 'Tokozai' and distributed to every households to mix with organic waste. Tokozai prevents the waste from spreading bad smells. These substances used for Tokozai preparation are easily available from different sources.

**Health and environment:** Unlike other compost, Rikishi Compost does not have a foul smell nor is wet. Composting reduces methane which is a greenhouse gas emission coming from landfills. Reduces the need for chemical fertilizers that helps restore forests, wetlands and habitats by improving the

quality of soil. Prior to the project, the households were dumping wastes at open ground and nearby forests creating environmental pollution. This project has improved the cleanliness of the community.

**Economic aspects:** It was started in 2018 with the financial investment of the municipality and technical assistance of Rikishi Private Limited. Their main service is compost production and sales. The company is sustaining through the sale of compost but it is not being able to make significant profit. The company faces challenge to compete with chemical fertilizer which is highly subsidized by the government. The project has provided employment opportunities prioritizing to local people. There are 27 workers in the company.

**Social aspects:** The company has conducted operational staff training and street plays, events, trainings and awareness programs for household segregation at source level.

**Organization and institution:** The company is led by the most experienced leader in the field of organic fertilizers. Initial investment which includes land and infrastructure development were assisted by the municipality. The pilot project was initiated with the support of immediate past mayor who helped to gather community support for the project.

## 6. Discussion

The PPP stakeholders have various functions, duties and responsibilities throughout the waste management value chain. The government authorities are responsible for monitoring of the project. The study finds that local authorities monitor and evaluate the project but not regularly and lacks proper schedule and standard measures. As per the agreement, the private company operates and manages the project. The project is running efficiently and smoothly in a small capacity. The main source of income to run the project is the sale of compost. The high quality organic fertilizer produced by the company is expensive than chemical fertilizer. The company faces challenge to compete with chemical fertilizer. The local production of organic fertilizer should be subsidized instead of the current practice of subsidizing imported chemical fertilizers. The households aware of benefits of source segregation, sustainable waste management practices and does not require compost for agriculture are participating in the project. Due to negligence and lack of knowledge some of households are not properly segregating waste as per the protocols of the company which results in discard of such waste for processing. The households are attracted towards mixed waste collection by other private companies. This is result of lack of awareness among people. Hence, extensive and regular trainings, awareness campaigns and workshops should be conducted to increase the public participation in source segregation and made aware of benefits of resource recovery.

In the study area, the perception of households regarding service reliability by the involvement of private company was measured by different variables which includes cost affordability, coverage and accessibility, frequency of collection, consistency per week and cleanliness of community. The core areas lack rental revenue so as an incentive the municipality does not charge service fees to the affected households. Most of the households are not willing to pay for the service if needed because they

think company is earning from the waste they give to them and they lack sufficient source of income. The unwillingness of users to pay for solid waste services is a common phenomenon in cities in the developing world [13]. User charges are seen as a more sustainable means of financing, even though privatization can be funded using different means such as budgetary allocations, private sector financing and loans. The service charge should be imposed by assessing the willingness or ability of the people to pay. The lower income group may be given discount on service charge. The service is focused on core areas and covers limited and small areas of the Ward. Unlike other compost, Rikishi Compost does not have a foul smell nor is wet. Prior to the project, the households were dumping wastes at open ground and nearby forests leading to environmental pollution. So cleanliness of surrounding and waste management has improved after the implementation of the project. However, some households still dump waste to nearby forest if they are not able to give waste to private waste collectors due to time constraints. The majority of the households feel positive impacts of the project in the community and support the project.

There are various enabling and constraint factors for the success and failure of PPP projects which includes technology suitability, health and environmental impacts, institutional, social and economic aspects. The selection of technology is appropriate as per the context. The material resources are easily available and reduces the need for chemical fertilizers. The company conducted training on source segregation and waste management initiatives at household and community level that help to gather community support. The project was started with the aim to collect the organic waste from all wards of the municipality. But the facility is not being able to expand due to the small land area. It is operating in small capacity. There is unavailability of land in the municipality and unable to find land for its expansion to larger scale. The appropriate site selection is crucial for waste related projects. As per KII with municipal authority, the municipality has huge initial investment for the project and lacks investment for further expansion of the facility to larger scale. Hence, both public and private sector party need to pay proper attention during the procurement process to ensure fair risk allocation between them. The immediate past Mayor of Madhyapur Thimi Municipality supported construction of a new composting facility and helped to gather community support for it by listening to community member concerns and providing information and examples of the benefits of this new facility. However, the private company and local authorities is lacking communication and coordination since last year. The continued support of the political representatives is most important factor for successful PPP project.

## 7. Conclusion and Recommendation

The municipality has initiated best practices of Sustainable Solid Waste Management in partnership with private company. In this study, the significant roles and responsibilities of the local government (municipality, ward-04), private company and the service users for the implementation and efficient operation of the waste recovery project were evaluated. The study identifies both constraining and enabling factors that affect PPP project success and failure. Collaboration between private sector and public sector has become crucial for providing SWM services

efficiently and cost effectively. For successful implementation of PPP projects it is necessary to create an improvements in enabling environment. Both the public and private party should conduct meetings on a regular basis to monitor the progress and improve the constraints. The responsible authorities should conduct regular public participation, training and awareness program to receive information about changing needs and suggested solutions of the service users. In the study area, the local authorities monitor the project but not regularly. Need to develop effective monitoring and evaluation mechanisms to verify that the service level is being provided as agreed and to find out people are satisfied with the service or not. Measures should be taken to ensure the households within the designated area must provide segregated waste compulsorily to the company, if they fail to do so, they have to pay penalties or fines. Proper segregation of MSW increases the recovery of materials and energy from the waste stream. Source segregation of waste should be made mandatory. The municipal authorities must guarantee the sufficient amount of waste to be supplied continuously that is crucial to make the recovery projects process work.

The selection of appropriate project site is crucial for the solid waste projects. For upscaling and replication of this project, site selection should be done properly to accommodate future expansion of the facility and gather community support. It is necessary to ensure a balance between risk and reward for both government and private sector, with an appropriate risk sharing mechanism. Local government should develop management procedure and standard for quality assurance to supervise the marketing of MSW treatment facilities and measures should be taken to increase consumers' confidence in recovered and recycled products. There should be provision of subsidy scheme or incentives for the support of materials and products recovered from waste. The government should initiate subsidy scheme to encourage and support SWM related enterprises on a large, commercial scale. There is lack of institutional structure of public, private and co-operative sector partnership in the local bodies and lack of the provisions and clear policy to invest approach in the existing financial acts and regulations. The PPP projects for sustainable waste management which are at early stages of development require strong institutional mechanism, governance, policy and market support to become successful on a large scale.

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