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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 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 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.	• Role of local government, private company and households. • Issues and challenges in waste management chain	KII; Service user survey, Site observation
	To analyze the impact of the involvement of private sector on municipal SWM.	• Health and environmental impacts. • Social impacts • Cost, finances and economics • Organization and institutional support	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.	• Enabling and constraint factors of PPP • PPP project in national and international context • National PPP and SWM policy • Strategies for improving PPP enabling environment	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 starategies 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 possiblities 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 include:

- 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.

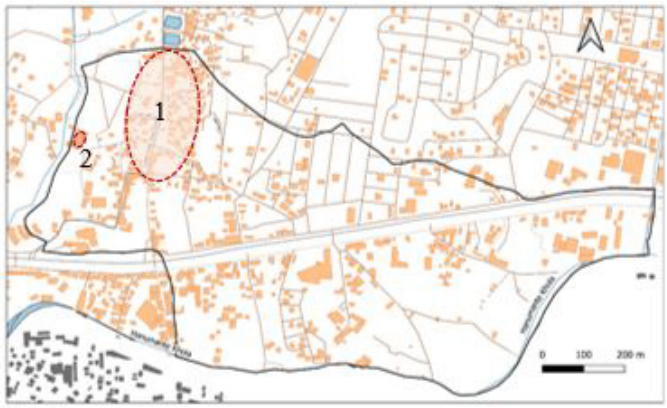
4. Study Area

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.

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.



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

Figure 1: Map of Study Area, Ward-04

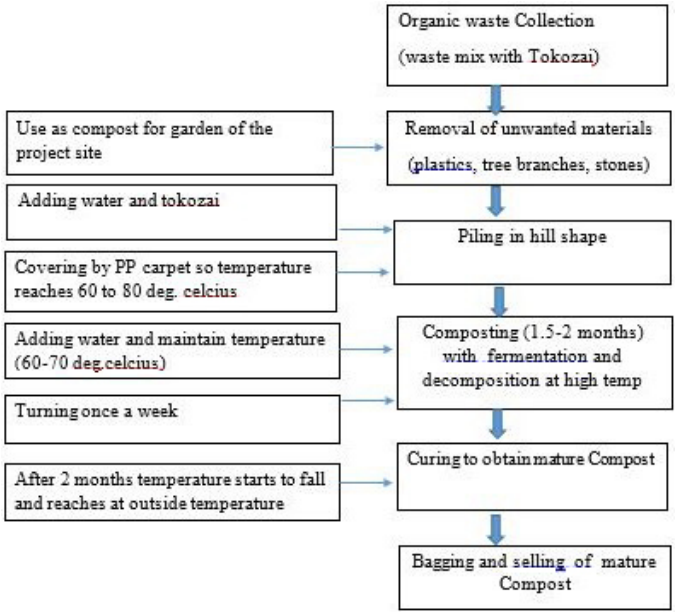


Figure 2: Flowchart of Rikishi Composting

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 infrastrutures 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.

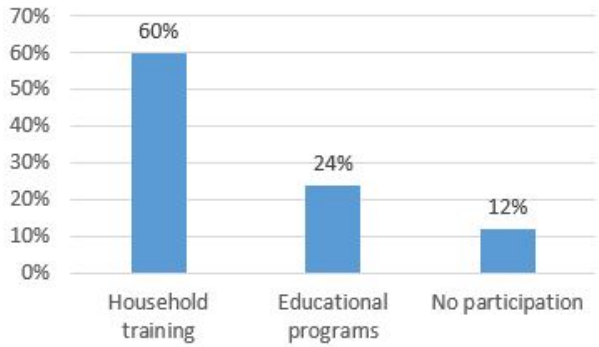


Figure 3: Community participation in waste management process

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.

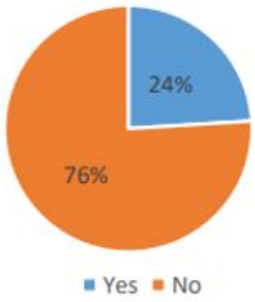


Figure 4: Willingness to pay for improved collection service

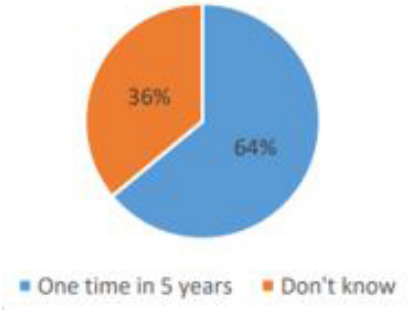


Figure 5: Monitoring of service

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%).

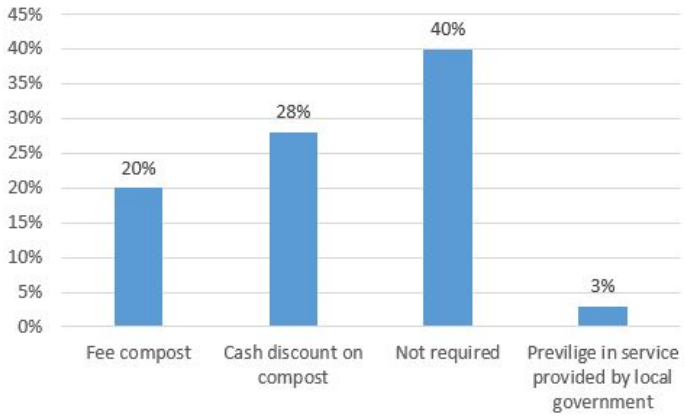


Figure 6: Preferred advantage for source segregation

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.

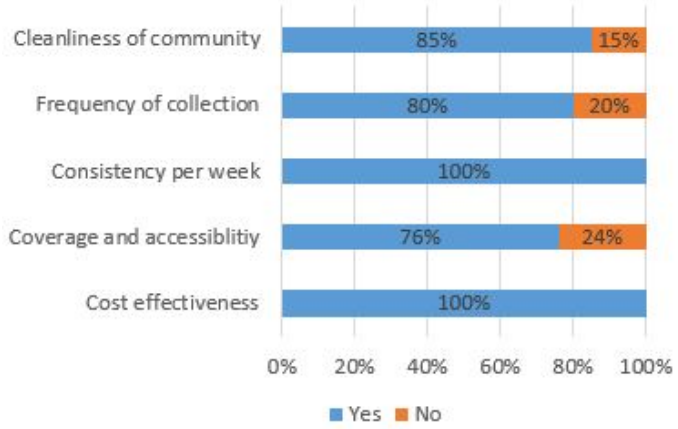


Figure 7: Service reliability component to evaluate PPP performance

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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