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Stakeholders Participation in Managing Solid Waste at the Point of Generation: A case of Kirtipur

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

Keywords
Source reduction, Stakeholder's, Policy, Willingness

1. Introduction

Source reduction, known as waste prevention, means reducing waste at the source, and is the most environmentally preferred strategy. Waste management reduce and eliminate adverse impacts of waste materials on human health and the environment. However, managing solid waste is one of the major challenges in urban cities. In a global scenario, 54% of the world's population currently lives in urban areas which are expected to increase to 66% by 2050. Around the world 1.3 billion tons of solid waste are generated per year, amounting to a footprint of 1.2 kilograms per person per day [1]. Waste generation in municipalities of Nepal is about 3023 tons per day and the average per capita waste generation is 0.223 kg/person/day. The organic waste composition was highest (54%) in 2075/76 compared to the inorganic waste (33.3%) and other wastes (12.7%). Among the metropolitan cities, the quantity of daily waste collection was highest in the household (15900 kg/day), followed by business complex (7700 kg/day) and the educational institutes (4680 kg/day)[2]. So, source reduction is one of the best method for waste management.

Rapid urbanization and industrialization improved the socio-economic conditions and consumption pattern which results high per capita waste generation. Unmanaged disposal of waste in landfill site results in the scarcity of land, health, environment hazard. Thus, to mainstream waste management, waste generation need to be managed from the source. Waste management in urbanization is a global issue that requires immediate attention and research in order to limit its consequences. This study will give a proper working framework in individual basis for the source control of waste and reduces various effects that is created due to landfill site. Waste reduction is to reduce waste to conserve space in our landfills and reduce the need to build more landfills which take up valuable space and are a source of air and water pollution. A CBS survey in 1997 shows that solid

waste (59%) is one of the major environmental problems in Nepal followed by sewerage (25%), air pollution (7%) and water pollution (5%)[3]. Kirtipur is also facing the waste problem. According to CBS/2009, maximum waste generated in Kirtipur is organic waste and is about 74.2% in 2006, and other waste such as paper, plastic, etc.[4].

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

1. To explore the current scenario in managing MSW at the point of generation in Kirtipur.

2. To identify the role of stakeholders in the management of solid waste at the source.

3. To identify the policy gaps in the proper management of MSW at the point of generation.

Also the research is limited to household level waste reduction of ward 2, Kirtipur and the findings obtained will be entirely context based.

2. Research methodology

In this research, the stakeholder's participation in solid waste was reviewed using research paradigm like post positivism which focuses on contextual and multiple reality. The research strategy used was triangulation. Inductive research methodology was used since it begins with observations and theories that are put forth near the conclusion of the research process as a consequence of observations and analysis. To achieve the main objectives of the research, qualitative methods and a combination of primary and secondary sources have been used.

The study includes a site survey of residential buildings of ward 2 of Kirtipur. The study also measures the public perception from individual and organizational level on the concept of source reduction. Direct observations and questionnaires/in-depth interviews served as the basis for the survey. The result obtained was triangulated since the data collected were from literature, survey, KII and case study for the analysis.

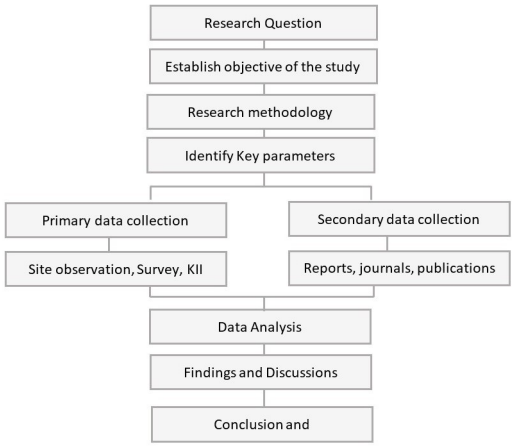

Figure 1: Flow chart showing method of research

3. Literature Review

3.1 Various dimension of Solid waste reduction at point of generation

Source reduction is an approach that precedes waste management to save costs and natural resources, and preserve the local environment. The purpose of source reduction is product reuse, material volume reduction, toxicity reduction, increased product lifetime and decreased consumption [5]. This can be implemented by education and research, financial incentives and disincentives, and strict regulation. Households can minimize residual waste and increase the volume of materials recycled by improving waste separation and changing purchasing behavior [6]. One way to promote waste minimization is by using informational intervention strategies which aims to change people's knowledge, perceptions, motivations or norms and thereby promote sustainable waste behavior.Informational intervention strategies uses norm activation model theory which is related with value, belief and norms. When people are aware of their consequences then they start thinking their behavior can contribute to reducing problems which changes the personal norm and results in waste minimization activities. Another way to promote waste minimization is by using clean technology [7].

3.2 Stakeholders in waste management

A successful implementation of source reduction programme requires the co-operation of all stakeholders such as household communities, non-governmental organizations, private sector, educational institutions, industries and rag-pickers. Thus, to determine the potential impact of the

stakeholder on the decision-making process, Stakeholder Management Models has been employed. Power Versus Interest Grid is a common stakeholder analysis approach and is categorized as a top-down or analytical method of categorization to classify stakeholders into four groups based on their relative power and interest. Different stakeholders have their own roles in waste management such as:

- **Central Government:** The role of central government in the waste management is formation of SWM plans and policies, investigation, research, new technology and innovation, etc.
- **Provincial government:**The role of provincial government is development of infrastructure, help in coordination of local governments.
- **Local government:**The role of local government is collection, treatment and disposal of solid waste.
- **Public:**The role of public is to follow the rules and regulation made by the government.
- **NGO's/INGO's:**The role of NGO's/INGO's is to conduct various awareness programs and trainings.
- **Tole lane organization:**Their role is to know the issues and problems of public and solve it through the collaboration with local government.

As per the institutional and managerial setup in Nepal, Ministry of Federal Affairs and general administration (MoFAGA) guide all the activities and operation at local level, ministry of forest and environment maintain the environmental quality by drafting policies, norms, Investment board of Nepal supports the local level governments in developing projects on PPP and Alternative promotion centre under ministry of energy, water resources and irrigation helps to protect environment, promote renewable or commercially viable alternative energy.

3.3 Policy Review

Various policies were reviewed for the source reduction as;

- **SWM Act,2068** explains the responsibilities of local governments in minimizing waste generation, segregation of waste, and safe disposal of harmful waste. Also the Act mandates local bodies to take the necessary steps to promote 3R (Reduce, Reuse, Recycle), including the segregation of MSW at the source.
- **SWM rule,2070**explains local body shall fix in segregation of at least organic and non-organic solid waste at its source under.
- **NUDS** mentioned that 3R system need to be practiced in all municipalities.[8]
- Strategy of **fifteen five-year plan** is to adopt new technologies with participation from the private sector for waste management.[9]

4. Study Area

Ward two of Kirtipur was selected as the study area.The total population of the area is 6728(3610 males and 3118 females) with coverage of 71.89 hectares which includes 1863 number of dwellings.Following my visit to the municipality and KII with the senior officer of the environment and solid waste management department, out of the 10 wards waste management in ward number 2 is significantly more challenging than in the other wards.

First, the sample population was identified in order to calculate the sample size for the study.The research study used random sampling techniques, with a sample size of approximately 50 respondents.The following classifications were used to determine the sample size:Age, gender, class, type of use for the building, height of the building, Tole, and renters. Since the saturation level was reached after the 50 respondents, I limit my survey to 50.

Figure 2: Map showing ward 2,Kirtipur

Table 1: Demographic information of surveyed people in ward 2

Category	Value	Number	Percentage
Gender	Male	34	68
	Female	16	32
Age(years)	15-24	1	2
	25-64	42	84
	above 64	7	14
Occupation	Service	16	47
	Student	7	21
	Housewife	9	26
	other	2	6
Marital Status	Married	46	92
	Unmarried	4	8

5. Finding and analysis

As per the literature household waste generation at Kirtipur is calculated as 207.97 gram/capita/day and municipal waste generation is 307.4 gram/capita/day [10]. Maximum quantity of waste generated is kitchen waste which can be reduced from household level.

First step for waste reduction at source is segregation of waste and as per survey, it was found around 53% of people are aware of it. Also as per the survey 60per were involved in waste reduction initiatives.In Kirtipur it has been found that the renter population is 11009 (56.63%), owner is 8165(42%) and organizational is 185(0.95%)[11]. It was found that the main responsible behind no segregation are private sector and municipality. Also due to the rented population which results shortage of space.

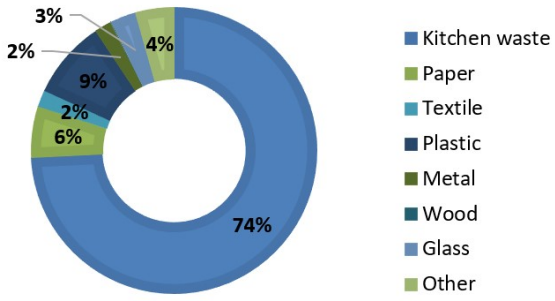

Figure 3: Waste composition in KRM

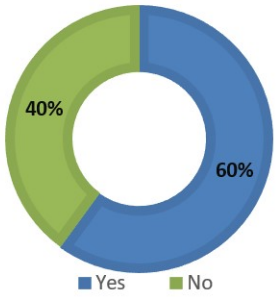

Figure 4: Waste reduction initiatives in ward 2

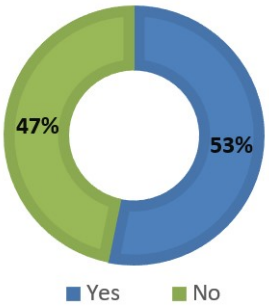

Figure 5: Waste segregation in ward 2

5.1 Waste reduction initiatives

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

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

- "ek bidhalaya, ek sampada, sarsafai abhiyan: every Saturday from different school 25 student clean temples and public places/Ward wise plastic collection" Gyan Bajra Maharjan

After applying recovery rate as per [12] published by National environment agency (Singapore), waste load decreases by 66percent.

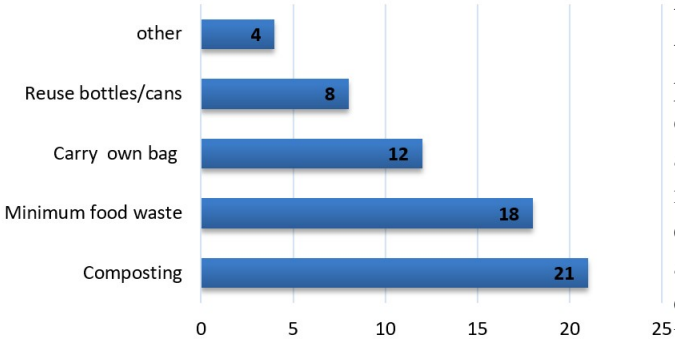

Figure 6: Waste reduction activities in ward 2

6. Discussion

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

Various Dimension of solid waste reduction at point of generation:

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

According to the respondent, obstacles to waste segregation include a lack of dustbins, the absence of separate vehicles, a bad odor, etc. Thus, it is necessary to have distinct vehicles for the collection of different types of waste. Additionally, there is no dustbin provision; as a result, the municipality must provide one. Sixty% of the respondents in the research area are pursuing some waste reduction measures—composting, minimizing food waste, etc.but not properly. Although people in Nepal are aware of the repercussions of rubbish, waste is not controlled since the dominant mentality in the country has not changed.Few efforts have been made, such as composting and segregation, according to the KII and study, but they have not been very effective.

As a result, extensive training, research, financial incentives, and disincentives, as well as strict control, are all necessary [5]. Additionally, the poll found that 80% of respondents had a college degree, but the norm activation model claims that source reduction is not happening because of people's actions and norms[6]Source reduction is aided by promoting recyclable and biodegradable materials as alternatives to non-biodegradable ones. One effective waste management technique is source reduction. Additionally, it is necessary to improve the MSW sorting, recycling, and reuse capabilities of local groups. Additionally, developing and implementing strategies for garbage output reduction, recycling, and reusing.

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

Municipalities and NGO/INGOs must also be moved to the right because they have significant power but little motivation. Sudhar Samiti and Hariyali Upabhokta Samiti must also be hauled up because they have enormous interests but little influence. Therefore, every stakeholder may work effectively in

this manner, and problems can be reduced.To determine the potential impact that a specific stakeholder group may have on the decision-making process, stakeholder management models are required.Poor decision-making and a lack of citizen involvement in the strategy have made it difficult to provide an effective waste management service.

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

Municipalities merely give preference for collecting and disposing of rubbish. The municipalities do not place a high priority on the 3R (reduce, reuse, and recycle) approach for efficient sustainable trash management.Although SWM operation was mostly the responsibility of municipalities, there is no provision of Solid Waste Management Technical Support Center (SWMTSC) to provide technical support for technical, capacity building, policy, and planning related to SWM in municipalities.At present, there is no dedicated unit at the federal and provincial levels to provide technical support to local governments in all aspects of SWM which need to be developed especially for policy formulation, developing SWM standards and guidelines and capacity building for local government.

7. Conclusion and Recommendation

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

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

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

SWM infrastructures for treatment, recycling, and recovery, so that very little waste needs to be disposed of in landfills.

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References

[1] CRC Mohanty. Reduce, reuse and recycle (the 3rs) and resource efficiency as the basis for sustainable waste management. *Proceedings of the Synergizing Resource Efficiency with Informal Sector towards Sustainable Waste Management, New York, NY, USA*, 9, 2011.

[2] Amrit Maharjan, Singh Bahadur Khatri, Luna Thapa, Ramesh Raj Pant, Pankaj Pathak, Youb Raj Bhatta, Kedar Rijal, and Kiran Bishwakarma. Solid waste management: Challenges and practices in the nepalese context. *Himalayan Biodiversity*, pages 6–18, 2019.

[3] Pervez Alam and Kafeel Ahmade. Impact of solid waste on health and the environment. *International Journal of Sustainable Development and Green Economics (IJSDGE)*, 2(1):165–168, 2013.

[4] Harshit Khandelwal, Arun Kumar Thalla, Sunil Kumar, and Rakesh Kumar. Life cycle assessment of municipal solid waste management options for india. *Bioresource technology*, 288:121515, 2019.

[5] Measurement Process. Lecture 6 : Variability Lecture 6 : Variability. pages 1–5.

[6] Ellen Van der Werff, Leonie Vrieling, Bas Van Zuijlen, and Ernst Worrell. Waste minimization by households–a unique informational strategy in the netherlands. *Resources, Conservation and Recycling*, 144:256–266, 2019.

[7] Valli Manickam Iyyanki V. Muralikrishna. nologies , Recycling , and Reuse Industrial Wastewater Treatment Tech-. *Clean technologies*, 2017.

[8] Ministry Of Urban Development. National Urban Development Strategy. *National Urban Development Strategy*, 84:487–492, 2017.

[9] National Planning Commision. The Fifteenth Plan (2076/77-2080-81). pages 1–418, 2019.

[10] World Bank. Solid Waste Management Strategic Planning. 2011.

[11] Central Bureau of Statistics. Kathmandu District Profile. 2018.

[12] Waste statics and overall Recycling.