

# Investigating Household Knowledge, Attitudes, and Practices in Solid Waste Segregation, Recycling and Management: A Study of Kathmandu Metropolitan City

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## Abstract

*Globally, 2.6 billion people in the world do not use proper methods of waste disposal. Some 1.1 billion people still dispose of waste in open places, thus facing many health-related problems. In Nepal too, currently, around 450 metric tons of solid waste are generated in Kathmandu every day. In such a context, the objective of this study is to assess household knowledge, attitudes, and practices related to solid waste segregation, recycling, and management in Kathmandu Metropolitan City. With a substantial sample size of 1400 households, the study provided a comprehensive analysis of current waste management behaviors. The results suggest that households with knowledge about waste segregation have good solid waste management practices, including reuse and recycling, while controlling for other socio-economic covariates. This paper concludes that providing information on waste segregation and other waste management-related aspects could potentially encourage households to adopt good solid waste management practices. The waste collectors are found to be the best channel to disseminate such information.*

**Keywords:** Attitudes; Kathmandu valley; Knowledge; Solid waste; Waste management practices

## 1. Introduction

Solid Waste Management (SWM) involves the handling process of solid materials from production to disposal. Different societies adopt various methods of handling solid wastes, including burning, burying, dumping in open fields, or riverside disposal. Improper SWM has adverse effects on both human life and the environment, leading to land pollution, reduced productivity, water and air pollution, disappearance of certain animals, and the spread of transmitted diseases. The increase in waste is closely linked to urbanization, industrialization, commercialization, and modernization. Changes in consumption patterns also contribute to the growing quantities of waste materials. Historically, households and societies reused, recycled, and absorbed most of what they produced. However, with the rapid growth of population, industries, commercial enterprises, and unplanned urban development, waste production has surged. Solid Waste Management has become a topic of public debate, with the production of municipal solid waste showing a significant increase over the past decade, both in absolute terms and per capita.

The environmentally acceptable management of municipal solid waste has become a global challenge due to limited resources, ever-increasing population, rapid urbanization, and industrialization worldwide (Pokhrel & Viraraghavan, 2005). In the context of Nepal, particularly in Kathmandu, the challenges associated with solid waste management have been persistent for over a decade (Dangi et al., 2017). Municipal solid waste management poses a significant challenge for cities in developing countries, including Nepal (Rai et al., 2019). The issue of solid waste is a global concern, with 54% of the world's population residing in urban areas expected to increase to 66% by 2050 (UN, 2015). This urbanization, coupled with changes in consumption patterns, has led to an increase in waste generation (Goncalves et al., 2018).

In Nepal, effective solid waste management is particularly challenging in cities with high population density, such as Kathmandu, Lalitpur, Biratnagar, and Pokhara (Asian Development Bank, 2013). Despite efforts, the waste generated in major urban centers, particularly the Kathmandu Valley, poses a significant problem, with approximately 620 tons/day (Shrestha et al., 2014).

## 2. Objectives of the Study

The main objective of the study is to examine people's knowledge and attitudes regarding solid waste materials and practices of solid waste management in the Kathmandu Metropolitan City.

### 3. Review of Literature

Solid waste management is a pressing issue in many developing countries, and Nepal is no exception. The literature discussed here explores various aspects of solid waste management, ranging from household waste segregation to the challenges faced by municipalities. Each study provides valuable insights into the determinants, practices, and potential solutions related to solid waste management in Nepal.

Khanal et al. (2023) investigated the at-source household waste segregation practices among youths in Nepal. The study reveals a satisfactory level of source segregation, with gender significantly influencing the practice. However, dissatisfaction with waste management services is noted, indicating the need for improved collection practices. The findings stress the importance of proper monitoring mechanisms to ensure effective waste segregation.

Khadka et al. (2021) focus on understanding the factors affecting household waste generation in Kathmandu Metropolitan City. Their study reveals that household size and income significantly impact waste generation, with organic waste comprising the majority. The findings emphasize the importance of considering socioeconomic factors in waste management planning to formulate effective strategies.

Giri (2021) explores the solid waste management practices of a hotel in Kathmandu, emphasizing the benefits of an integrated solid waste management system. While the hotel has established systems for waste generation records and recyclables recovery, challenges persist, such as unsatisfactory waste segregation and time-consuming waste transportation. The study underscores the importance of addressing these challenges for a more comprehensive implementation of integrated waste management.

Rai et al. (2019) explored the challenges and preferences of residents regarding municipal solid waste collection services in Bharatpur Metropolitan City. The study identifies critical elements such as collection frequency, timing, and cleanliness of streets influencing residents' willingness to pay. The findings suggest improvements in waste collection frequency and infrastructure, emphasizing the role of community involvement for effective municipal waste management.

Maharjan and Lohani (2019) address the broader challenges of municipal solid waste management in Nepal. Their findings highlight the inadequacy of current practices, emphasizing the need for

sustainable solutions. The paper recommends waste-to-bioenergy and fertilizer production as suitable methods, emphasizing the importance of community awareness and strong regulations for effective waste management.

Maskey (2018) highlights the importance of waste segregation at the household level for effective municipal solid waste management. Despite legal mandates in Nepal, successful implementation remains a challenge. The study identifies key factors influencing waste segregation practices, including environmental awareness, waste collection services, willingness to pay, composting, and weekly segregation. The findings emphasize the need for tailored educational efforts and consideration of household traits before enforcing regulations.

Neupane (2013) focuses on the solid waste management scenario in Hetauda Municipality. The findings reveal a dominance of organic waste in household and commercial sectors. While residents show awareness of waste management issues, challenges in waste reduction and effective management persist due to infrastructural and manpower limitations.

Studies specific to Kathmandu Metropolitan City shed light on challenges and opportunities. Dangi et al. (2017) assessed environmental policy implementation in solid waste management, emphasizing the challenges faced in Kathmandu. Similarly, the study by Shakya and Tuladhar (2013) highlighted the state of municipal solid waste management in Nepal and emphasized the lack of efficient systems.

#### **4. Research Methodology**

This study uses the data collected by Kathmandu Metropolitan City in the year 2017/18. A comprehensive household survey was conducted by the metropolitan city, with the help of the Shodhashala-Center for Research and Policy Studies administered through a household questionnaire. The household questionnaire consisted households socio-economic and demographic status including some behavioral information on the household waste disposal practices. A total 1400 households were interviewed. This sample comprises all the wards of the Kathmandu Metropolitan City (33 wards) and sample was distributed across the wards based on the proportional allocation method. This study employs both descriptive as well as analytical method for the analysis. The descriptive part includes summary statistics of the key waste and knowledge related variables, whereas the analytical part includes a logistic regression that aims to identify the factors influencing the good waste segregation practices in Kathmandu Valley.

Researchers use a logistic regression model to identify the determinants of the good waste segregation practices in Kathmandu Valley. The Logistic Regression Equation can be specified as

$$\Pr(Y_i=1) = X_i \beta_i + e_i$$

Where  $Y_i$  is the binary outcome variable.  $Y_i$  takes the value 1 if  $i^{\text{th}}$  household is observed to practice good waster segregation practices (defined as below) and 0 otherwise. With this dummy dependent variable as specified in (1), the researchers have taken several socio-economic variables as the independent variable to examine if they have any association with good solid waste management practices. These includes, the household level attributes, household head specific attributes and a set of dummy variables that captures the Household's knowledge and exposure to solid waste management practices. The  $e_i$  is the usual residual term that is assumed to be independently and identically distributed.

The model estimated is

$$\ln(\pi_i/1-\pi_i) = a + b1 \text{ hh\_age} + b2 \text{ hh\_edu} + b3 \text{ hh\_sex} + b4 \text{ hhsz} + b5 \text{ floor} + b6 \text{ room} + b7 \text{ expenditure} + b8 \text{ has tv\_radio} + b9 \text{ listen news in tv\_radio} + b8 \text{ edu\_high} + b9 \text{ aware\_climate} + b10 \text{ aware\_env} + b11 \text{ community\_mem} + b12 \text{ elect\_mem} + u_i$$

$$\pi_i = \text{prob}(y_i == 1)$$

The description of the variables is provided in the following Table 1.

Table 1: Description of the Variables and Expected Sign

Variable	Nature	Description	Expected Sign
$Y_i$	Dummy	Takes value 1 if household is observed to have good SW management practices	
hh_age	Continuous	Age of the Household Head	+
hh_edu	Contunous	Education of the Household head measured as the highest grade completed	+
edu_high	Contiinuous	Highest level of education completed by a household member	+
hh_sex	Dummy	Sex of the Household Head, 1 if male	+/-
hhsz	Continuous	Number of family members in House	+/-
floor	Continuous	Number of floors in House	+/-

room	Continuous	Number of rooms in the House	+/-
expenditure	Continuous	Monthly Expenses of the Housheold	+
has_tv_radio	Dummy	If household has a TV or radio, 1 if yes	+
listen_news_in_tv_radio	Dummy	If household head listen new onTV or Radio regularly, 1 if yes	+
aware_climate	Dummy	If household head has heard about climate change, 1 if yes	
aware_env	Dummy	If household head is aware of Air Pollution in Kathmandu Valley, 1 if yes	+
community_mem	Dummy	If family member is a member of community organisations	+
elect_mem	dummy	If family member is an elected member, 1 if yes	+

A discussion on the construction of the dependent variable as well as discussion on the variables of primary interest eg awareness related variables merits some discussion. The dependent variable takes value 1 only if a household is observed to have a good practice in all three categories namely waste segregation between organic and non-organic matter, separation of recyclable of wastes and waste disposal during designated time /venue. This consideration of the outcome variable is due to the fact that good waste disposal practices should comprise all the dimension as the good practice in one dimension yet bad dimension in another dimension would result into the ineffective waste management.

Among the independent variables, a few variables are of the primary interest in the paper. In particular, the researchers measure the level of knowledge and attitude of the household by a set of dummy variables namely whether the household has TV or Radio at home, whether the household head watches/listen the news regularly, whether the household is aware of the climate change issues or not, whether the household head is aware about environmental pollution in the Kathmandu valley, whether any household member is also member of community organisations such as ‘tole sudhar samiti’ or ‘aama sammuha’, and whether any household member is ever elected member of the local municipality. The researchers assume that these variables capture the level of awareness and attitude towards the good solid waste management practices in Kathmandu Valley.

## 5. Results and Discussion

Table 2 provides the summary statistics of the variables under in the study. Table 3 presents the household behaviour related to good solid waste management practices in Nepal. And Table 4 provides the logistic regression results from the equation.

Table 2: Summary Statistics of Variables (n=1400)

Variable	Mean	Sd	Min.	Max.
Good Solid Waste Management Practices	0.36	0.41	0	1
hh_age	42.00	30	22	90
hh_edu	5.00	6.78	0	16
edu_high	11.00	8.33	8	16
hh_sex	0.20	0.18	0	1
hhsz	4.22	3.46	2	11
floor	2.50	1.13	1	6
room	7.23	6.45	1	24
expenditure	41233.00	30000.00	5000	150000
has_tv_radio	0.85	0.34	0	1
listen_news_in_tv_radio	0.37	0.45	0	1
aware_climate	0.66	0.37	0	1
aware_env	0.73	0.56	0	1
community_mem	0.08	0.12		
elect_mem	0.002	0.004	0	1

(Source: Kathmandu Metropolitan Household Survey 2017/18)

Table 2 presents summary statistics for a set of variables based on a sample size of 1400 observations. Good Solid Waste Management Practices: On average, the respondents exhibit good solid waste management practices, with a mean score of 0.36. The standard deviation indicates the variability in the responses. Household Age: The average age of the households in the sample is 42 years, with a

considerable standard deviation, indicating a wide age range. Household Education: On average, the education level of the households is 5.00, with a wide range of educational attainment.

The average highest education level in households is 11 years, with significant variation. The average sex composition of households is 0.20, potentially indicating the proportion of male members. The average household size is 4.22 members, showing moderate variability. Households have an average of 2.5 floors and 7.23 rooms, with the number of rooms varying widely. Average household expenditure stands at 41,233, with considerable variability. About 85% of households own a TV or radio, and 37% of households regularly listen to news on these platforms. Climate awareness is present in 66% of households, while 73% are aware of environmental issues. Community membership is observed among 8% of respondents, while only 0.2% are part of an electoral committee.

Table 3: Good Soil Waste practices in Kathmandu Valley

Measurement	Question	Mean	Sd
Separation of Waste	Do you usually separate the waste between organic and in organic matter?	0.45	0.37
Recycle and Reuse of the Waste	Have you ever reused the things like plastic, glass during last one week?	0.16	0.15
	Do you usually recycle the organic matter at home?	0.18	0.23
Disposal of waste in Designated Time and Venue	When you throw the garbage last time, was it on the designated venue and time by municipality?	0.67	
Overall good SWM		0.36	0.41

Overall, researchers find that about 36 percent of the households were observed to have good solid waste management practices in the sample. That means that, one in every fourth household is have the good solid waste management practices in all three dimensions, i.e practice of the separating the waste between organic and non-organic matter, practice of recycling/reusing both organic and non-organic matter and throw of the garbage in designated time and venue. Indeed, when looked into the disaggregated figures, the practice of separating the waste between organic and non-organic was as high as 45 %, however a lower proportion of the household were found to recycling/reuse the organic matter and throw in designated time and place.



Table 4: Logistic Regression Results

	Model 1	Model 2
VARIABLES	Log of Odds	Marginal Effects
hh_age	-0.00211	-0.000374
	0.0188	0.00332
hh_edu	0.0284	0.00503
	0.0389	0.00688
edu_high	0.152	0.0264
	0.229	0.0388
hh_sex	-0.210*	-0.0378*
	0.121	0.0220
Hhsize	-0.2740286	-0.0079801
	0.1631406	0.00999
Floor	1.99	0.058
	1.09	0.071
Room	-0.0071	-0.0002
	0.0026	0.0002
Expenditure	0.9427	0.027
	1.03	0.038
has_tv_radio	0.0876***	0.0155***
	0.0154	0.00272
listen_news_in_tv_radio	0.404***	0.0747***
	-0.122	-0.0234
aware_climate	0.0592***	0.0105***
	-0.0202	-0.00357
aware_env	0.127***	0.0225***
	-0.0165	-0.00291
community_mem	0.00706	0.00125
	-0.00611	-0.00108
elect_mem	0.0350***	0.00619***
	-0.0100	-0.00177
Constant	-2.937***	
	-0.927	
Observations	1400	1400

## 6. Conclusion

This study sheds light on the current state of Solid Waste Management (SWM) in the Kathmandu Metropolitan City, Nepal. The findings reveal that the city faces significant challenges in effectively managing solid waste, with only 36% of households exhibiting good SWM practices in terms of waste separation, recycling, and proper disposal. The study aimed to address key research questions related to household waste disposal methods and determinants influencing solid waste separation practices. The results highlight that the issue of solid waste management is multifaceted, involving complex challenges such as inadequate waste collection, lack of awareness, insufficient resources, and a historical legacy of inefficient practices. The study found that despite various efforts, the city struggles to manage the 620 tons of waste generated daily, leading to environmental pollution and health hazards. The literature review aligns with the study's findings, emphasizing the global challenge of SWM, particularly in rapidly urbanizing and developing countries like Nepal. The literature highlights the need for efficient systems and the adverse impacts of improper waste management on the environment and public health. The historical context provided in the literature review underlines how waste management practices evolved over time, reflecting the challenges posed by urbanization and industrialization. Several studies mentioned in the literature review stress the importance of considering socioeconomic factors, education levels, and community engagement in formulating effective waste management strategies. The regression analysis in this study reveals that certain household-level factors, such as awareness of environmental issues, membership in community organizations, and education levels, significantly influence good solid waste management practices. These findings underscore the importance of targeted awareness campaigns and community involvement in improving SWM.

In conclusion, the study provides valuable insights into the current state of SWM in Kathmandu and emphasizes the need for comprehensive and sustainable solutions. The findings can inform policymakers, municipal authorities, and community organizations in designing effective strategies to address the challenges associated with solid waste management in the Kathmandu Metropolitan City. The results underscore the importance of a holistic approach, involving public awareness, community participation, and improved waste management infrastructure, to achieve sustainable and environmentally friendly solid waste management practices.

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