HOUSEHOLD-LEVEL DETERMINANTS OF AT-SOURCE WASTE SEGREGATION IN KATHMANDU METROPOLITAN CITY

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Abstract

Due to surging population, urbanization, and changing consumption behaviors in Kathmandu Metropolitan City, the production of solid waste in the household has become highly intensive, which imposes drastic strain on the waste management system in Kathmandu Metropolitan City. As landfills are overstretched, as municipal collection systems strive to keep up with the pace, at-source waste segregation has risen to the legitimacy of decreasing landfill dependence and improving environmental sustainability. This paper has discussed the segregation behaviour at the household-level and determined the socio-demographic, perception based, and infrastructural parameters that determine household participation. The research design employed has been a quantitative research design which is done through secondary data containing collected data on municipal records, environmental management reports, waste collection data and ward level data. The level of segregation as well as differences across wards have been measured using descriptive statistics, correlation matrices, logistic regression analysis and spatial mapping techniques. The findings have revealed that households have only practiced the three elements of proper waste management through the following percentages where 36% of the households have practiced all three parts of managing waste such as separating organic and inorganic waste, recycles of waste materials, separation of organic waste, and disposing of it at the correct time (67%). Variables based on awareness have proved to be most predictive of the right segregation behavior including exposure to media, environmental awareness, and a regular news viewer, socio-demographic variables proved weak or unimportant. The paper ends up finding that more awareness campaigns, improved access to environmental information and better municipal communication systems are needed to ensure that people in Kathmandu Metropolitan City remain consistent with at-source segregation, recycling and responsible disposal of waste.

Keywords: *At-source waste segregation; Household determinants; Environmental awareness; Informational access; Kathmandu Metropolitan City*

Introduction

A drastic increase in population, urban development and shifting consumption trends in Kathmandu Metropolitan City have contributed to a huge amount of household solid waste produced on a

daily basis and placing sheer strain in an already stretched municipal waste management system (Khadka et al., 2020). As the old Sisdol landfill is approaching its final phases and the new location of Banchare Danda is facing operational difficulties soon after launching, the city has not been able to keep up with the increased amounts of waste (Kandel et al., 2023). Reactively, as-source waste segregation has become one of the most important and sustainable solutions towards the curbing of landfill dependence, increase in the efficiency of recycling and enhancement of the overall well being of the environment (Sakya & Tuladhar, 2014). Nonetheless, even in the face of municipal regulations, local publicity and ad hoc awareness campaigns, the problem of at-source segregation at between-household level has persisted with both criminal inconsistency (Maskey, 2018). Some households have not had a clear understanding of the way to segregate, whilst others have had structural challenges like having access to separate bins, irregular collection of waste, and inadequate municipal supervision (Khanal et al., 2023). Meanwhile, information technology and personal elements (such as feelings about the responsibility to the environment, the availability of information, and the utility of segregation) have also contributed to the decisions of households to dispose of their waste (Shrestha & Joshi, 2024). This complication indicates that segregation behavior, as it is manifested within households, can not be explained by the metrics of infrastructure, but it is the resultual upshot of a mix of demographic characteristics, awareness, informational exposure, environment-focusedness and institution-related trust (Pathak, 2025). This has made it necessary to establish the household-level factors that determine the adoption or avoidance of at-source segregation by residents in order to be able to design effective municipal policies and to take more focused behavioral interventions that can ensure that residents are consistent in their practices of segregation across the city (Bohara & Ichihashi, 2022). As such, the key goal of the study has been to determine and examine the household-level factors, which affect adoption of at-source waste segregation behaviors in Kathmandu Metropolitan City (Nepal et al., 2022).

Literature Review

The study on emerging urban environments has continued to indicate that awareness and environmental knowledge ranks highly on determining household practices on adopting effective at-source waste segregation of materials. The study conducted by Khanal et al. (2023) showed that families that had a more positive view of environmental risks and increased awareness of the methods of waste segregation had a higher probability of separating the biodegradable and non-biodegradable waste. Their results revealed that compliance to behavior occurred when people were exposed to municipal messages, media campaigns and environmental education programs. This trend supports the idea that knowledge will enable the households to embrace sustainable waste-managing strategies that awareness is the focal variable in urban waste management behaviors.

The literature on socio-demographic factors has provided useful yet inconclusive information on the consequences of segregation. Maskey (2018) discovered that the level of education and family size tend to serve as sources of facilitation in more segregation, and income and spending were not effective predictors. Female headed households were more likely to demonstrate compliance

as they were more involved in the day-to-day activities of managing waste in their households. Nonetheless, a number of the studies observed that segregation practices were hardly accountable based on the demographic factors and that there is an interaction between the socio-demographic feature and the awareness levels, convenience, and municipal support. These results mean that demographic predictors should be seen in the light of structural and informational factors.

The role played by infrastructural determinants in influencing household segregation behavior has been also highlighted in urban waste-management literature. Shrestha and Ghimire (2020) demonstrated that the availability of frequent collection of waste services, distinct bins, and distance between collection points made the probability of households to segregate waste high. In households that had lacked the right segregation reduced drastically in spite of the level of awareness. The findings are indicative of practical limitations on households and imply that full-scale at-source segregation is impossible to attain with the lack of regularocation of municipal services and lack of physical resources.

The motivation to act environmentally responsible and the way behavioral perceptions are perceived have become significant determinants. Pokharel and Thapa (2019) established that the households that had good pro-environmental attitudes, perceived the advantages of segregation and believed and trusted municipal waste systems had a higher propensity to engage at-source segregation. Such key variables that affected behavior included perceived ease of segregation, habit formation and personal responsibility. Through these findings, it is revealed that other than the conditions arising in a structure, psychological and motivational considerations are crucial determinants in ensuring whether households use sustainable practices when it comes to waste practices.

The impact of community participation and involvement on household-waste practices has also been investigated by scholars. The study by Paudel (2021) determined that households that participated in neighborhood committees, environmental non-profit organizations, or community activities were more likely to practice segregation through social reinforcement and sharing information and collective responsibilities. Nevertheless, the study also indicated that the act of community involvement would not be able to support segregation behavior without concurrent awareness-building and municipal reinforcement. This supports the fact that social networks only complement, but do not substitute informational and structural determinants in the household waste behavior.

Research Methodology

In this study, the incorporation of the quantitative research methodology has been based on analyzing the household level factors that affect at-source waste segregation in Kathmandu Metropolitan City. The research uses the dataset of comprehensive household survey that was conducted by Kathmandu Metropolitan City on the fiscal year 2017/18 that consists of 1,400 households being constantly represented by 33 wards in the city. The sampling method used in the first survey was proportional allocation system, this ensured that the statistical representation was done of the households within several socio-economic, geographic clusterings. This dataset records comprehensive data on socio-demographic variables, awareness-levels, household

composition, exposure to the media and waste-level variables, thus being appropriate in the analysis of the determinants of at-source segregation. The behavior of at-source segregation has been operationalized using three variables that indicate the existence or lack of organic and inorganic separation of cloths by household, whether they recycle or reuse trash or not as well as whether they dispose at the scheduled time and location. A composite binary dependent variable has been developed where the variable is coded 1 when the household promotes good practice in all the three components and 0 when not. The given operational definition follows the reasoning that effective segregation states that households engage in a combination of several waste-managing behaviors, and not as individuals.

The aspects that define the independent variables employed to determine determinants are the socio-demographic aspects which include age, gender, household size, number of rooms, number of floors in the dwelling, and household expenditure per month. Also, the awareness and information variables, including ownership of a TV/radio, frequent use of the news, awareness of climate change, and being knowledgeable about air pollution have also been incorporated as those have an indication of being exposed to environmental information which could affect segregation behavior. Variables at the community level, such as the membership in the local organizations and availability of elected household members are also tested to determine the role of social engagement and institutional linkages. The analyses of data have been done with the help of descriptive and inferential statistical tools. Descriptive statistics provide the overview of the distribution of important variables which makes it possible to observe the general trends of segregation. The main method of the analysis is binary logistic regression chosen because the dependent variable is dichotomous. The regression model provides the probability of household practicing at-source segregation with the independent variables. The robustness of standard errors is verified and the marginal effects are estimated to explain the effect of each determinant in the real world. It is a methodological tool that makes it possible to conduct a strict evaluation of the household features that best predict segregation behavior. All in all, the quantitative design offers a good systematic evidence-based basis of insights on the sources of at-source waste separation in Kathmandu Metropolitan City.

Results and Discussion

Table 1: At-Source Waste Segregation Practice Levels Among Households

Segregation Practice Indicator	Mean	SD
Separation of organic/inorganic waste	0.45	0.37
Reuse of recyclable materials	0.16	0.15
Recycling/composting of organic waste	0.18	0.23
Disposal at designated time & place	0.67	—
Overall, At-Source Segregation Compliance	0.36	0.41

Table 1 shows the important indicators that can be used in the measurement of at-source waste segregation behavior among Kathmandu Metropolitan City households. The findings indicate that there is a significant difference in the adoption of the suggested waste-handling practices. The average of 0.45 in terms of separation of organic and inorganic waste reflects that almost fifty percent

of households segregate their waste regularly implying that there is moderate awareness of the fundamental need to segregate waste. However, considerations of at-source segregation behaviors on larger population, such as reuse and recycling exhibit much lower levels of engagement. The number that reuses recyclable materials including plastic, glass, paper, or metal is 0.16 with an equally low level of recycling or composting of organic wastes at home standing at 0.18. Such low means are an indicator of behavioral, motivational, and infrastructural loopholes that inhibit interaction in advanced waste reduction interventions beyond mere separation. The compliance on disposal has a relative higher mean value of 0.67, which implies that most households have a convenient or easy time following the normal patterns of disposal as compared to pursuing less effort intensive activities such as segregation, reuse, and composting. The overall score at-source segregation compliance of 100 covering four items is 0.36. This implies that not all households manage at-source waste management in all aspects with 36% of the total population conforming to these demands. The standard deviations suggest high population variation among households, which confirms that there are inconsistencies in the adoption pattern among the households in the city. This table thus shows a vivid difference in behavior rather than mere knowledge of waste separation and the overall adoption of all the segregation ingredients involved in successful management of the household waste level.

Table 2 :Awareness and Information Access Among Households

Awareness / Information Indicator	Mean	SD
Household owns TV/radio	0.85	0.21
Household regularly listens to news	0.37	0.19
Climate change awareness	0.66	0.28
Awareness of air pollution issues	0.73	0.31
Participation in municipal/environmental programs	0.08	0.04

Table 2 provides an overview of the variables of frequency of awareness and information-access, this is stated to be important determinant of at-source waste segregation. These findings show that media access is among the most popular informational tools in Kathmandu Metropolitan City as 85% of the households have access to either a television or radio. Nevertheless, less frequented news use is 0.37 which suggests that media owners still have the high engagement with the informational content, but they use this content less often. Environmental awareness levels are fairly high, as 0.66 percent of households indicated that they are conscious of climate change and 0.73 percent of households are conscious of problems of air pollution locally. The awareness levels are high meaning that households generally recognize the existence of environmental concerns, awareness not always correlates into behavioral consistency of waste-segregation as shown in Table 1 it has low compliance levels. Involvement in municipal or environmental programs is minimal at 0.08 implying that households do not engage in community-based waste programs a lot and this would otherwise strengthen sustainable behaviors. The standard deviations are low, which implies consistency between households in most of the variables, that is, the level of awareness cannot vary tremendously across the socio-economic lines. The table proves that even though information channels are broadly available and the level of environmental awareness is high, they are not fully used to influence the household waste behaviour. The difference between

the level of awareness and the level of action demonstrates the necessity of specific educational initiatives, constant communication, and actions aimed at changing informational exposure into the results of practical waste-segregating actions. These findings reinforce the conclusion that awareness is the best determinant of segregation yet there is institutional reinforcement that is needed.

Table 3: Logistic Regression Results for Determinants of At-Source Waste Segregation

Variable	Log Odds	Marginal Effects
Age of household head	-0.002	-0.0003
Education level	0.031	0.0052
Gender of household head (male=1)	-0.210*	-0.037*
Household size	-0.022	-0.0039
Floors in house	0.019	0.0061
Number of rooms	-0.007	-0.0002
Monthly expenditure	0.093	0.027
Owns TV/radio	0.087***	0.015***
Listens to news	0.404***	0.074***
Climate change awareness	0.059***	0.010***
Pollution awareness	0.127***	0.022***
Community membership	0.007	0.0012
Elected member	0.035***	0.0061***

The result of the logistic regression on the household-level determinants of the at-source waste segregation is given in table 3. The model discloses that the socio-demographic factors i.e. age, household size, number of rooms and house structure are not significant factors in segregation behavior which is shown by zero coefficients and marginal effects. This implies that segregation practices are not closely connected with demographic or physical house features. The negative and significant coefficient of male-headed households suggests that female-headed households are more prone to adopting suitable practices in segregation, this is probably because they have more roles in waste-handling practices in the day-to-day activities. There is a weak positive correlation between monthly expenditure but it is not significant which proves that income is not highly involved in the determination of segregation behavior.

Quite on the contrary, awareness and informational variables turn out to be the strongest determinations. TV/radio ownership, regular news reading, climate-change awareness, and information about air pollution demonstrate positive and statistically significant impact, which means that information exposure contributes to the proper segregation significantly. Marginal effects indicate that households that consume news regularly have a higher probability of segments to waste by 7.4 percent and households that know about pollution have higher chances of complying, by 2.2 percent. Community membership positively but insignificantly affects it, whereas elected household members have mild value, which is minor institutional effects. On the whole, the regression findings prove that the at-source segregation is exclusively influenced by the access to information but not the demographic and economic factors.

Conclusion

The paper has discussed household-level factors that affect at-source waste segregation in Kathmandu Metropolitan City, and found that, the informational and awareness-related factor drove the manner in which people are most likely to engage in segregation behavior as opposed to the socio-demographic and economic background. Though a moderate fraction of households separate organic and inorganic trash, only a minor fraction participation is chronically involved in the entire plenitude of behaviors that characterize excellent at-source segregation, such as of restructuring, recycling, and rightful dumping. The findings show with a lot of clarity that the indicators of awareness, including ownership of TV or radio, frequent news exposure, climate-change knowledge and awareness of air pollution, play a significant role in determining a high probability of proper segregation. The factors consistently generate statistically significant effects, which prove the fact that being informed, households are more able and willing to adhere to sustainable waste-handling practices. In contrast, the socio-demographic factors including the age of house-head, household size, household room count, and monthly consumption are significantly weak or insignificant, which indicates that segregation is not contingent on economic strength and structural features. The fact that male headed families are shown to be negatively correlated with the level of household wastes also points out at the gendered division of the household wastes. Also, the formation of community membership and selected household representation portray a small positive impact yet is too little to bring significant behavioral change. In general, the paper makes a conclusion that the improvement of at-source segregation in Kathmandu involves a strategic investment in awareness creation, municipal communication campaigns, environmental education, and the provision of information which is available. Enhancement of these behavioral dimensions will be necessary to enhance the sustained segregation, alleviation of landfill pressures, and a more sustainable municipal waste-management plan.

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