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Issues and Challenges

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Chapter 13

Household Waste Management and the Role of Gender in Nepal

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Introduction

Cities in South Asia are growing rapidly and, in most cases, without planning. Although urban growth brings economic opportunities to the city residents when managed properly, it creates all sorts of challenges when it is unplanned. It also reduces the permeable areas of the city as poor people tend to migrate to the cities and live in the slums, which are mostly built on low-lying floodplains or over swamps (McGranahan, Balk, & Anderson, 2007), making high-intensity rainfall problematic as the run-offs may overwhelm city infrastructure (Douglas et al., 2008). The problem gets aggravated when solid waste is dumped in open spaces, and the drainage system results in flooding and waterlogging (Pervin et al., 2019). When the run-offs run over unplanned and unmanaged waste dumpsites, leachate ends up in the soil, polluting the groundwater. Since most cities in developing countries use groundwater for household use, groundwater pollution creates a public health problem. Improperly disposed plastic waste not only blocks the city drainage systems but also ends up in water bodies such as rivers and lakes and ultimately affecting the marine ecosystem (Ferronato & Torretta, 2019). Therefore, managing the unplanned urban growth and municipal solid waste will be some of the key challenges local authorities will face in the coming years (Cohen 2006; Hoornweg and Bhada-Tata 2012).

In Nepal, urbanization is increasing at an alarming rate, putting enormous pressure on municipal services, particularly for managing the growing amount of waste generated (World Bank 2018). Before 2015, Nepal had less than 20% urban population. In 2015, Nepal adopted a new constitution, which has changed the political and administrative structure of the country. As a result of this change, the urban population suddenly jumped to 67% overnight. This change is due to the new administrative structure. Several villages have been clubbed together as new municipalities despite the fact that these new municipalities do not have the basic infrastructures (roads, hospitals, and safe drinking water). In the coming years, the headquarters of these municipalities are expected to have improved physical infrastructure

and basic facilities, encouraging the rural population to migrate to these newly improved cities. Due to the lack of proper infrastructure, most of the wastes produced in municipalities across Nepal are not being managed properly, creating environmental and health threats, especially in the slum and squatter areas, where the residents are less likely to afford better services and are often neglected by city officials.

In the coming years, these urban clusters are expected to have a better provision of basic services that incentivize rural to urban migration. This fact is found in most cities in Nepal, especially those around the main highways, reaching an annual urbanization rate of 3–4% (Bakrania, 2015) for the fastest-growing ones. This puts a lot of pressure on public services as it increases the amount of waste the cities have to deal with. Thus, waste management is one of the major challenges of unplanned urbanization. At the moment, municipal solid waste is not managed properly as a small fraction of the waste generated in the urban areas has been collected by waste collectors. The rest of the waste is burnt, dumped in open space, or used as fertilizer after composting. Scattered waste generally ends up in the drainage system that blocks the flow during excessive rainfall, resulting in water logging and urban flooding (Pervin et al., 2019).

For managing solid waste (MSW) properly, the segregation of different types of waste at the source is the first and the foremost important element. Without segregation at the source, the three key principles of MSW management – reduce, reuse, and recycle (3Rs) – could not be implemented properly. A study using data from Nepal's municipalities suggests that recycling plastic waste at a reasonable rate (67% recovery rate) could finance plastic-related waste management costs in Nepal (Bharadwaj, Rai, & Nepal, 2020). In addition to the 3Rs, properly disposing of the remaining waste is equally important, without which cities may face water logging issues when improperly disposed waste blocks the drainage canals (Pervin et al., 2019). Providing information on how to manage household waste better and installing waste bins in the streets help in increasing the cleanliness of the neighbourhood (Nepal et al. 2021). Housing price appreciates significantly in clean neighbourhoods in comparison to unclean neighbourhoods of the city (Nepal, Rai, Khadayat, & Somanathan, 2020). Therefore, 3Rs should now be 4Rs (reduce, reuse, recycle, and proper disposal), where the final R is taken for granted in general, but this is one of the equally important elements of MSW management. In Bharatpur, the majority of the city residents feel that the waste pick-up service has not been managed properly, and they are willing to pay 10–28% extra fee on top of the regular fee that they have been paying if the service gets improved (Rai, Nepal, Khadayat, & Bhardwaj, 2019).

Segregating household waste at the source means the involvement of household members in waste management, which sounds like a trivial issue but requires awareness of why segregation at the source is needed

and how to do it properly. Studies suggest that sharing knowledge and experiences improves environmental values among citizens (Oskamp et al., 1991), while peer influence increases the probability of segregation at source and composting (Park, Lamons, & Roberts, 2002) and increases the reuse of discarded materials (Ekere, Mugisha, & Drake, 2009). Incorporating awareness programmes in school education would help entrench this kind of behaviour (Licy et al. 2013). Once environmentally friendly behaviour is established, such as recycling, it continues and being part of an environmental organization strengthens commitment to supporting the improvement of environmental quality (Torgler, García-Valiñas, & Macintyre, 2008).

This chapter focuses on the role of gender in the at-source segregation of household waste and recycling behaviour. There is a lack of understanding of the gender dynamics involved in at-source segregation, composting of biodegradable waste and recycling of useful materials. Therefore, using relatively large size of gender-disaggregated household survey data from one of the metropolitan cities in Nepal (Bharatpur), we try to better understand how gender roles and relations influence waste management at household level by examining the role of gender on at-source segregation, composting of biodegradable waste, and recycling of useful materials. We find that households where women take charge of managing household waste segregate waste at-source more often and tend to compost more in comparison to households where men are in charge of managing the household waste. However, there is no difference in recycling (selling to the collectors) of paper and plastic materials based on who manages the household waste. Still, more often than men, women tend to either give the paper/plastic waste to the collectors (for free) or throw it outside, suggesting that it is important to understand who is to be targeted to make a change in properly managing solid waste.

13.1 Inter-Linkages between Gender and Household Waste Management

Waste generation and management depend on social and cultural factors. Each society deals with these issues in different ways because demographic characteristics and socio-cultural norms and practices vary among places, societies, and communities (Vineeshiya and Mahees 2019). Gender relations are not equal and vary throughout the world in daily life as well as at work. These asymmetrical relations are based on traditional and stereotypical dimensions of the sexual division of labour upon which notions of gender are constructed. Therefore, one has to start to underline the importance and need to analyze environmental issues on the basis of gender. Conventional gender roles assign women the reproductive roles, i.e., work and activities related to domestic and care work such as childbearing and caring, care activities within the household that support family well-being

such as cooking, cleaning, fetching water, washing, and attending to sick and elderly; while men are assigned the productive role, i.e., work related to activities that produce goods and services for consumption or trade (Moser 1989: Muhammad and Manu 2013).

Such gender division of roles has prompted suggestions that women tend to be more concerned about the environment (Davidson et al. 1996) and that they have a stronger sense of civic responsibility and willingness to improve the living conditions of the households, making them more active in social changes and thus an important channel of communication (Bulle, 1999), and that women are more altruist than men (Dietz, Kalof, & Stern, 2002).

Other studies have found that women are more likely to express their concern about the environment while men are more likely to influence other's behaviours (Dunlap, 1983); women are significantly more concerned than men about the local issue but not regarding global issues (Blocker & Eckberg, 1989) but less likely to take action (Blocker & Eckberg, 1997). On the contrary, Teal & Loomis (2000) found no significant impact of gender on willingness to pay for environmental programmes.

Various studies have shown the linkages between gender and waste management. Gender issues are present in waste management, from day-to-day handling activities at household levels to decision-making processes at the highest levels (Muchangos and Vaughter, 2019). Four main thematic areas have been identified in waste and gender by scholars and practitioners working in these areas. These are the gendered definition of waste, the gendered division of responsibilities for waste; community-based initiatives; and policy and practice (Tiwari 2001, Muller and Schienberg 1998, Scheinberg et al. 1999). Each of these is explained briefly below.

Gendered definition of waste

Women's and men's individual decisions and choices are shaped by a combination of the roles and expectations assigned to them by the socio-cultural and gender structure and norms. This extends to the field of waste, and hence, 'waste is not a (gender) neutral concept' (Muchangos and Vaughter, 2019:4). Although waste is defined as something that does not have any value or is of use, individuals may differ in identifying and defining what is of value or useful for whatever reason. Thus, men and women will define something as waste depending on their role. For example, at the household level, something that is of no use or value for men may be of use for women as compost or animal feed, and similarly, something that is scrap to women could be of use to men as some machinery part.

Gendered division of responsibilities for waste: The division of responsibilities in waste management roles is also influenced by gender. The gender division of roles places all the work and activities related to cleaning and

waste handling in the household and at times in the community on women, as this is part of their reproductive role and that too without pay. Waste management at the household level falls under women's role as part of their domestic work and thus places them in the position of waste collection, reuse, and sell at the household level (GWA and WASTE 2010, Scheinberg et al. 1999, Wilson et al. 2015). Gender plays a significant role in waste management outside the household level too. For instance, due to women, particularly women from poorer households, lower income-generating opportunities in developing countries for various reasons, including lack of skill, education, training, capital, women form the predominant group to survive by recovering materials from waste (Dias and Fernandez 2013, Muchangos and Vaughter 2019, Furedy 1990, Nguyen et al. 2003, Ocean Conservancy 2019, Scheinberg et al. 1999). However, at the higher levels of waste management – processing, planning, and decision-making – outside of the household, it is the men who are the main actors (GWA and WASTE 2010, Samson2003, Tiwari 2001, Woroniuk and Schalkwyk 1998).

Diving deeper into looking at different meanings and streams of waste, the link with gender in terms of power relations become evident as gender inequalities in access and control over resources come into play. For example, given the gender structures prevalent in most communities, women have less access and control over resources; therefore, when waste materials become valuable and income resources, then women often have limited access to these (GWA and WASTE 2010, Scheinberg et al. 1999, Woroniuk and Schalkwyk 1998). This is true not just at the community (or higher) level of waste management but also household level because although often household is looked like an indivisible unit, in reality, women and men within the household have differential access and control of resources (Kabeer, 1994). These clearly demonstrate that gender structure and dynamics are intricately linked to waste management.

Community-based initiatives: Women's role and responsibility for cleanliness extends to the community level, and thus, they are actively involved in taking and depositing the household waste at the community collection and dump sites, often also keeping the community area clean, but all these are voluntary unpaid work (Samson 2003, Fredericks 2008). As soon as these waste collections and dumping work become monetized, there is usually a shift, with men taking over this work and women being pushed away (Muller and Schienberg 1998, Scheinberg et al. 1999, Wilson and Velis 2015). It is also often found that women who work in waste activities as paid workers are assigned to the lowest rung, underpaid, and work in dangerous social and human conditions; hence they are considered low-class citizens (GWA and WASTE 2010, Muller and Schienberg 1998, Samson 2003).

Gender also influences the micro waste enterprises in terms of access to finance and waste material(s). Given the inequality in access to resources, women have less access to financial resources to set up such enterprises.

Furthermore, there is also the association of certain materials for setting up such micro-enterprises to either men or women; for instance, plastic and textiles wastes are associated with women, while metal and construction wastes that are regarded as 'resource-intensive and physically demanding' are associated with micro-enterprises of men (Muchangos and Vaughter, 2019:5).

Policy and practice: The gender structure and division of labour and roles places the women's role in the domestic and private sphere while the men's role is in the public sphere. As an extension of this and women's subordinate position in society is the curtailment of women's decision-making rights. Consequently, women are often restricted from accessing public positions, their political participation is curtailed, and their views and needs are often not considered. Despite women's high involvement in waste management activities at the household, and sometimes at the community level, they are absent in the higher decision-making and policy levels resulting in limited, if not none, integration of gender issues and women's roles in the programmes, plans, and policies. All these processes and levels are male-dominated (GWA and WASTE 2010, Muller and Schienberg 1998, Woroniuk and Schalkwyk 1998) and are reflected in the absence of consideration of gender perspectives and gender needs of women in waste management policy, information and education practice (Muchangos and Vaughter 2019, Schultz and Stiess 2009, Tiwari 2001, Wilson et al. 2015).

This chapter tries to explore behavioural differences between men and women in waste management habits and practices. It also attempts to examine if and to what extent gender affects waste management practices. Previous studies have tackled these questions in different places of the world with similar answers. A study (Bennagen, Nepomuceno, & Covar 2002) found that women tend to have a higher probability of segregating waste in comparison to men in Manila, and so did Beall (1997) in Bangladesh and Pakistan. A major reason for this is that in developing countries, following the gender norms and practices, the husband goes to work while the wife stays at home and is responsible for the unpaid care work (Addaati L et al. 2018), of which waste segregation is a part. Taking the premise that environmental behaviours are shaped by socio-cultural and political factors, this study, focusing on Nepal, explores this further.

13.2 Material and Method

13.2.1 Study Area and Waste Management System

This study is based on a household survey from Bharatpur Metropolitan City (BMC), one of the six metropolitan cities in Nepal, with a population size of around 300,000. This city is located in south-central Nepal, which is the fourth biggest city in the country. Out of 29 wards (smaller administrative

units of the Metro), this study covers 14 wards as these wards are relatively more urban, comprising the core city area and its surroundings.

A few years back, the Asian Development Bank conducted a survey across the municipalities of Nepal in order to understand the volume of waste generated in Nepal's urban centres (ADB 2013). During that time, Bharatpur generated 32.5 tons of household waste and around 7 tons of commercial waste daily. Of this, 80% was organic, but only 25% of the waste was collected for disposal. After restructuring the city in 2017, Bharatpur Metro is spending approximately 2% of its total budget (NPR 80 million or US$0.7 million out of NPR 4.15 billion total city budget) on municipal waste management and related issues. This municipal budget is complemented by user fees collected from the households and businesses for disposing of solid waste generated by the households and the businesses.

Two private companies are providing door-to-door waste collection services in the city under a public-private partnership, where households who subscribe to the service pay NPR 30–100 (30 cents to US$1) and businesses pay NPR 200–4,000 (US$2–40), depending on the frequency of the waste collection service per month and volume of waste generated by the business entity. Currently, the subscription to the service is voluntary, and around 70% of city residents are subscribing to the waste collection service (Rai et al., 2019). Since the service fee is nominal and does not cover the full cost of waste management, the city provides a lump-sum subsidy to the private companies to cover their waste management cost.

Those households who do not subscribe to the service either compost biodegradable waste, feed the animals, burn, or dump in open space or drains, clog the drainage system (Pervin et al., 2019) and pollute both surface and groundwater with public health consequences. The collected waste is dumped on the riverbank in the absence of a sanitary landfill. The city encourages its inhabitants to compost organic waste by providing a 50% subsidy on a composter and door-to-door collection of plastic waste from some areas. However, due to heavy subsidies on the composter, the supply of composters is limited each year.

A major problem reported is that the pick-up service is irregular, and the frequency of the collection varies across neighbourhoods, making the pickup time uncertain (Rai et al., 2019). As a result, households put their waste outside their houses to be picked up by the waste collector, but rag pickers often search through the waste piles hoping to get reusable and recyclable material, thus leading to scattering the plastic wastes in the streets, open spaces, and drainage canals, increasing the risk of waterlogging (Pervin et al., 2019). The study suggests that housing price in such unclean neighbourhoods is 25% less in Bharatpur as compared to cleaner neighbourhoods (Nepal et al., 2020), suggesting ample benefits for keeping the neighbourhoods clean.

Plastic waste is one of the key components of municipal solid waste, and some municipalities are implementing a ban on the use of single-use plastic bags. The success of such a ban on the use of single-use plastic bags has mixed results in Nepal, which mainly depends on the enforcement of the ban with sufficient fines for the violators (Bharadwaj, Baland, & Nepal, 2020). Therefore, putting extra tariffs on importing the raw materials to make single-use plastic materials (bags and bottles) may help encourage recycling plastic waste since the additional tariff makes the virgin plastic raw material expensive (Bharadwaj, Rai, et al., 2020).

13.2.2 Methodology

One of the key outcome variables (y) is whether the households segregate household waste as the source, which is a binary variable, where $y = 1$ means that the household segregates household solid waste, and $y = 0$ means that they do not segregate it. Using different sets of control variables, we try to understand what influences the source waste segregation decision and the role gender plays in this decision. The logistic regression model provides internal consistency as it constrains the probability between 0 and 1, whereas linear probability models (LPM) do not assure this. However, in practice, the coefficients estimated from the LPM approximate the marginal effects from logistic regressions. Therefore, we use both LPM and logistic regression for our analysis.

In the study area, some households segregate paper and plastic waste from degradable waste while others do not. Therefore, we have collected information on the segregation of waste as a whole, the segregation of plastic and paper waste for selling, and the segregation of degradable waste for composting. For paper/plastic waste disposal methods, two options are identified: (1) sell to the vendors, or (2) give to waste collector, including burning or throwing it elsewhere. As households could use different options to manage paper/plastic waste (part of their waste could be sold and the other part given to the waste collector or thrown out/burnt) and these decisions are not independent of each other, the error terms are likely to be correlated. To address this issue, we use seemingly unrelated regressions (SUR). To analyze the degradable waste management decision, a simple logit or linear probability regression is enough as the households' responses are divided into two categories: managed at home (in composter or pit) or not.

Differentiating home management from other methods is an issue of interest as managing municipal solid waste at home is beneficial for two reasons: (a) it would reduce the waste collection burden and lower the waste management costs for the municipality and (b) household could compost the organic waste that could be used as fertilizer and sell reusable and recyclable items once they segregate the waste at source for extra income. In addition, these activities are beneficial to the local environment.

13.3 Data and Variables

13.3.1 Data Collection

For the research, primary data were collected from the Bharatpur Metro. The research team organized several consultation meetings, including focus group discussions with the relevant stakeholders (city officials, private companies that manage, collect, and dispose of municipal solid waste, and service seekers). These stakeholder consultations helped identify the main issues that the city faces while managing municipal solid waste. With this information, the research team was able to develop a context-specific questionnaire for the household survey.

Out of 29 wards (smaller administrative units), we collected data from 14 wards, which mainly form the core city area and the surroundings. Five women enumerators, who were trained for the survey, interviewed households during the September–October period of 2017. To ensure consistency, a field supervisor was also present whenever support was needed. Each enumerator interviewed about 210 households, with a total of 1,050 households in the sample. These 1,050 households were selected using a stratified random sampling technique, where the study area was first stratified into 14 segments (by ward). Within each ward, there were several smaller communities called Tole Lane Organizations (TLOs), with approximately 100 households on average in each TLO. In the study area, there were around 350 TLOs. We first randomly selected 150 TLOs using the proportional to population sampling method from 14 wards, and within each TLO, we randomly selected 7 households for the survey. The response rate was 100% since none of the households sampled for the survey declined to participate in the survey. If the household head was not available in the first visit, the enumerator visited the household a second time. Electronic devices were used for collecting the data, which helped the field supervisor with real-time monitoring of the survey for quality control.

13.3.2 Descriptive Statistics

Table 13.1 provides the basic statistics of the data used for the analysis. The total sample is divided into two groups based on who manages the household waste: men and women. The first part of the table shows the descriptive statistics of the outcome variables, while the second part shows the control variables used for the analysis. Out of the total sample, 62% of the respondents and 82% of the household waste managers were women. The decision to segregate household waste depends on perceived costs and benefits. However, rather than monetary costs, we use households' characteristics to understand the waste segregation decision.

Table 13.1 Variables and Descriptive Statistics

	Variable description	Women	Men	Difference (t-stat)
Outcome variables				
Waste segregation	= 1 if the hh segregates waste	0.87	0.65	−5.903 ***
Waste Disposal Method				
Home	= 1 if waste managed at home	0.73	0.43	7.81 ***
Waste collector	= 1 if waste is given to waste collector	0.86	0.88	−0.68
Other2	=1 if waste is managed by another method	0.90	0.93	−1.26
Paper and plastic management				
Sold	= 1 if this waste is sold	0.24	0.09	5.97***
Other3	= 1 if waste is given to waste collector or other	0.86	0.63	6.17***
Degradable waste management				
Home4	= 1 if waste managed at home	0.72	0.37	8.966***
Other5	= 1 if it is not managed at home	0.28	0.63	−8.966***
Control Variables				
Age of the disposer	Age of the disposer (in years)	40.72	44.82	3.621***
Age of the hh head	Age of the hh head (in years)	42.63	44.59	1.694*
Education				
Education in years	highest education attained by respondent (in years)	8.3	10.66	6.934***
Low education	5 years or less	0.29	0.14	5.308***
Med-Low Edu	between 5 and 9 years	0.19	0.11	3.14***
Med-High Edu	between 10 and 11 years	0.25	0.26	−0.337
High Edu	12 years or more	0.27	0.48	−5.482***
Log monthly Expenditure	hh's monthly expenditure (in thsd NPR)	3.15	3.3	6.934***
Rented	= 1 if hh have rented room/flat	0.24	0.13	−3.697***
Family size	family size of the respondent	5.01	4.97	−0.217
Degradable waste	percentage of degradable waste per week	0.77	0.72	−3.092***
Ethnicity (% of total)				
Brahman/Kshetry	= 1 if ethnicity is brahman/kshetry	0.63	0.73	2.597***
Hill Dalit	if ethnicity is hill dalit	0.04	0.04	−0.122
Hill Indigenous	= 1 if ethnicity is hill indigenous	0.3	0.21	−2.635***
Tarai Indigenous	= 1 if ethnicity is tarai indigenous	0.02	0.01	−1.127
Other	= 1 if ethnicity another one	0.01	0.01	−0.073

Source and note: Household Survey 2017; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In the analysis, we control for both the waste disposer's age and the respondent's age (who is also the household head) since they are likely to be two different individuals and may have an impact on the decision to segregate the waste at home. One can think that an older household head has more experience and maybe more likely to reuse items than a younger one, and this will affect waste segregation decisions at the household level. Moreover, the age of the disposer is also likely to influence segregation decisions for similar reasons. We measured education in two different ways – years of schooling and education categories (illiterate, low, low-medium, medium, high school, and above). This was done because the effect of the schooling may not be linear. Increasing education by one year at a low level of education is likely to be different from the increase of one year at a higher level. Plus, with those categories, one can see the differential impact of education by gender: women have lower levels of education in the sample (48% of male and 27% of female in the sample has higher educational level). Other control variables are demographic characteristics and ethnicity of the households (Table 13.1).

13.4 Results

We discuss the key results in this section. We divide the results and discussion into three parts: (i) waste segregation at source: whether the household segregates waste at source, (ii) paper and plastic waste management: how paper and plastic waste is dealt with and (iii) degradable waste management: if degradable waste is composted at home or managed differently. In Table 13.2, results are displayed in three different segments where standard errors are clustered at the TLO level, and ward level fixed effects are used to account for heterogeneity across the wards that are not accounted for in the data or other unobservable. Such heterogeneity includes party affiliation of elected ward Chairs, their style of management, and other institutional differences across the wards. Such a fixed-effects model could minimize the omitted variable bias for a causal interpretation of the results.

13.4.1 Waste Segregation at Source

The first segment of Table 13.2 shows marginal effects from logit regression from three different models where the outcome variable is whether the household segregates the waste generated at home and if there is any difference based on the gender of the waste manager at home. The first model is the basic model, where we control for household demographics and the education of the respondents. In the second model, we control for additional variables, including ethnicity, household consumption, and total waste generated. In the third model, we measured education in terms of

Table 13.2 Gender and Household Waste management

	Waste segregation decision			Paper and plastic		Degradable waste
	(1)	(2)	(3)	Sold	Other	At home
Women disposure	0.075** (0.037)	0.090*** (0.035)	0.088*** (0.035)	0.037 (0.028)	0.123** (0.035)*	0.119*** (0.038)
Women respondent	0.073** (0.029)	0.069** (0.029)	0.062** (0.03)	−0.016 (0.023)	0.069** (0.028)	0.050* (0.029)
Disposer's age	0.000(0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.000 (0.001)	0.000 (0.002)
Respondent's age	0.003** (0.002)	0.003* (0.002)	0.002(0.002)	−0.001(0.001)	0.003**(0.001)	0.002(0.002)
Resp's edu (yrs)	0.081*** (0.025)	0.071*** (0.027)		0.000 (0.002)	0.005* (0.003)	0.005 (0.004)
Log monthly exp		0.004 (0.017)	0.006 (0.018)	0.030* (0.016)	−0.008 (0.020)	0.014 (0.027)
Hill dalit		−0.089 (0.057)	−0.092 (0.056)	−0.116 *** (0.045)	−0.104* (0.055)	−0.081* (0.045)
Hill indigenous		−0.035* (0.020)	−0.035* (0.029)	0.01 (0.020)	−0.043* (0.024)	−0.027 (0.027)
Tarai indigenous		−0.107*** (0.041)	−0.111** (0.043)	0.021 (0.063)	−0.081 (0.077)	−0.129* (0.077)
Other ethnicity		−0.052 (0.066)	−0.048 (0.068)	0.072 (0.088)	−0.176 (0.107)	−0.102 (0.075)
Family Size		−0.001 (0.005)	−0.002 (0.005)	0.005 (0.004)	0.001 (0.005)	0.004 (0.005)
Rented home		−0.031 (0.022)	−0.029 (0.022)	−0.035 (0.021)	0.001 (0.005)	−0.025 (0.021)
HH total waste		0.009*** (0.003)	0.009*** (0.003)		0.000 (0.026)	
Constant		−2.780*** (0.707)	−3.002*** (0.820)	−1.933** (0.773)	−0.099 (0.085)	0.281*** (0.104)
Observations	1,050	1,050	1,050	1,050	1,050	1,050
Log pseudo-likelihood	−347.52	−336.33	−337.78			−387.74
Pseudo R-squared	0.27	0.29	0.3		0.28	0.42
R-Squared				0.57		
Breusch-Pagan Stat				22.22***		

Notes: Instead of years of schooling, levels of education (low, medium, medium-high, and high) are controlled for in Model 3, but coefficients are insignificant and not reported in the table to save space. In each regression, we control for ward-level fixed effects; clustered standard errors at the TLO level are reported in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

categories (low, low-medium, medium, high with illiteracy as the base) as the effect of education may be non-linear.

Results suggest that when women are managing the household waste, it increases the probability of segregating the waste by around nine percentage points compared to the situation where men are managing the household waste (with an average segregation rate of 65% when men manage the household waste). This means that women tend to segregate household waste more than men by approximately nine percentage points. This result is robust to alternative specifications and significant at the 5% level.

The coefficients for the respondent age are positive and significant in all three models, suggesting that experience matters for segregating household waste. The respondent education seems to matter as well when used as years of schooling, but the level of education does not make much difference in segregating household waste.

Renting and family size seems to have no significant effect on the likelihood of segregating waste. This is interesting because one could expect those renting the house would segregate less as they probably care less about the place they rent and also because they are less likely to have animals to feed organic waste. Finally, the amount of total waste has a positive and significant effect on the probability of segregation at the source, meaning that as the total amount of waste increases, the likelihood of segregating waste at the source increases. Possibly, a larger volume of waste may indicate a better chance of earning some additional income from recycling and also the economies of scale for composting the degradable waste after segregation.

13.4.2 Paper and Plastic Waste Disposal

The survey collects two methods of managing paper and plastic waste: (a) selling to the vendors (after segregation) or (b) other (keeping all waste together and sending it with the waste collectors or managing differently that includes burning and throwing out). Since these two decisions are interdependent, we use seemingly unrelated regression (SUR). The Breusch-Pagan test[1] is significant in suggesting the interdependent error process of these two models, requiring joint estimation. Our interest here is to see if the waste is segregated at home and recycled to the extent possible and if gender has a role in this, which not only helps to recycle paper and plastic waste but also lowers the waste management costs of the municipality as a household may also compost the degradable waste once segregated.

Our results (Table 13.2, second block) indicate that gender of the waste manager does not have much influence on selling (recycling) paper/plastic waste, meaning that men and women do not tend to have different behaviour regarding selling recovered paper and plastic from the waste stream. They may both sell when there is such an opportunity.

For 'other' methods (it includes – given to waste collector for free, burning, throwing elsewhere), the coefficient of women waste manager seems to be significant, suggesting that women waste managers tend to give paper/plastic waste to waste collector more often for free or manage it with alternative methods (throwing, burning, etc.). When women dispose of waste, the probability of using 'other method' increases by 12.3 percentage points in comparison to men managing the paper/plastic waste, keeping the other variables into account, suggesting that some targeted interventions on the awareness-related activities may help the household waste manager for properly disposing of household waste.

13.4.3 Degradable Waste

How the households manage the degradable waste is the final outcome variable, which is measured as binary (= 1 if degradable waste is managed at home (put in a pit/composter or fed to animals, 0 otherwise)). Since it is a binary outcome variable, we use logit regression. The last column of Table 13.2 reports the marginal effects. When women are the managers of household waste, the probability of composting or feeding to animals increases by 12 percentage points as compared to the men counterparts. When the respondent is a woman (household head), the probability of managing degradable waste at home increases by five percentage points, keeping other controls into account.

13.5 Discussion and Conclusion

In this chapter, we examine whether gender matters in household waste management decisions. Given the gender division of roles and responsibilities in Nepali culture, over 80% of the household waste managers are women, and they tend to segregate household waste more often than their male counterparts (7.5 to 9 percentage points more than men) and also tend to compost the degradable waste more often (12.3 percentage points higher) at home, but women more often tend to either give the paper/plastic waste to the collector for free or throw away instead of selling; and importantly education does not seem to have any influence on this. The socialization process as per gender structure is clearly the dominant factor in shaping the behavioural patterns of waste management at the household level.

Based on the gender division of labour, women are primarily responsible for all domestic work related to cleaning, food preparation, family health, maintenance of the home, and homestead, while men have the responsibility of the provider and income earning. With these basic primary responsibilities, women and men may view, manage, and prioritize domestic waste and its disposal differently (Muller and Schienberg, 1997). The gender construct shapes the way men and women value and revalue waste materials for

different purposes, such as domestic use, other uses, saving on expenditure or for income, and so have different definitions of what is waste or garbage. Thus, as mentioned above, there is a gendered definition of waste, garbage, and resources (Muller and Schienberg 1997, Muller 2015, Poswa 2004), which reflects in the way they manage and dispose of waste.

The gender inequalities in access to and control over resources are also a critical dimension. Often women do not have equal access, right, or allocation of family finances, particularly where the woman does not earn an income herself. Consequently, this affects the choices women have on waste disposal methods. Time, another precious resource, also comes into play as women have multiple roles. Women are primarily involved in reproductive work, but at the same time, they are also involved in productive work and community work. Thus, given women's heavy workloads, they often have less available time, leading to men and women assigning different values to time spent on waste disposal.

We witness all these clearly in the findings described above, given in the following:

1. The gendered notion of women being the ones to take care of the health and hygiene of the household ingrains in women their responsibility of segregating and managing the household waste.
2. As a means of saving expenditure, women tend to manage degradable waste at home.
3. Women's gender roles also extend to caring for animals and managing home gardens; therefore, more women compost and use the waste to feed animals.
4. Women's way of valuing or revaluing waste as well as the value given to time spent on waste disposal differs from men leading to the finding that women waste managers are more likely to either throw or give the paper/plastic waste to the waste collectors (or throw/burn).

Overall, our study revealed that the gender of the household waste manager has differential impacts on waste disposal and degradable waste management approach, where women waste managers more often tend to segregate household waste and compost the degradable waste as compared to the situation where men are the managers of the household waste. Thus, gender roles, norms, and practices significantly shape the different behaviours of men and women when it comes to managing household waste. The finding that education, renting a house, or the size of the family does not play a significant factor in practice shows how deeply the socialization of gender roles and norms is entrenched in society. These factors are subsumed under gender roles and relations.

Given the gender structure and practices, women and men have different roles and priorities in the households and communities, which can be in contradiction to or in competition with each other, and this extends to

waste management too. Therefore, it is crucial to recognize gender roles and relationships to efficiently plan and implement waste management.

These findings are important since segregating waste at home, recycling recyclable papers/plastics wastes, and composting degradable waste at home not only help in reducing the volume of the waste that goes to the landfill and extend the life of the landfill sites but also generates compost fertilizers to the households and also some cash income if they sell paper/plastic waste. South Asians also prefer to see waste to energy programmes from segregated organic waste (Haque et al. 2019). Such behavioural change for at-source segregation of waste and managing it properly not only helps generate resources for sustainable financing of the municipal solid waste management (Bharadwaj, Rai, et al., 2020) but also leads to appreciating housing property value in cleaner neighbourhoods (Nepal et al., 2020).

Since men and women tend to manage household waste differently, it is necessary to reach out to the right group of people to raise awareness for better management of household waste. For example, focusing on women may be a good option for policies to be effective since the majority of the household waste managers are women (over 80% in our sample) who are more likely to segregate and compost degradable waste.

Since women play a major role in the consumption and generation of waste at the household level, it is important to value their role and recognize them as a key to bringing about changes in their waste disposal and management habits by 'creating campaigns and information that are geared towards them' for effective behaviour changes. As primary caregivers, they can also be relied upon to share such awareness with the members of their family and children in particular (Ocean Conservancy, 2019:54). At the same time, the critical point is that such information and campaign should not be based on gender stereotypes, and directed only at women, and ignores the importance of changing men's behavioural patterns and attitudes towards waste management activities (GWA and WASTE 2010, Schultz and Stiess 2009). There need to be targeted messages for both men and women as well as for the different age groups.

Our results suggest that if the municipality intends to reduce the volume of the municipal solid waste at source, it would be better to provide training to women waste managers since they make up around 80% of the total waste managers in the sample and will have more effect in comparison to providing such training to men. Two kinds of policies are needed; (i) awareness-raising policies and (ii) economic incentives, where one cannot go without the other. Indeed, people need to be aware of the benefits of segregation but also need economic incentives to make sure they segregate the waste at the source. For example, pricing municipal waste collecting services differently based on whether households segregate waste and charging a lower monthly fee to those who segregate would be a good starting point for encouraging households for at-source segregation. Lack of awareness and incentives will lead to improper management of municipal solid waste, such as littering, even

though waste bins are available. Not practising the 4Rs[2] leads to several problems such as not segregating household waste at home, not participating in cleanup activities, and not being cooperative in finding a solution for waste management. These problems can amplify, and the city can face more important challenges such as the clogging of drains, especially during the rainy season leading to waterlogging (Pervin et al., 2019). Waterlogging pollutes the surrounding environment and can become a major public health problem during rainy seasons when city residents use groundwater (using hand pumps) for drinking. Thus, changing city residents' behaviour is the key to solving the city's waste management problem since nothing can be done if the city residents are not aware of the drawbacks that their actions are causing. Understanding gender role in household waste management helps cities design appropriate intervention programmes.

Acknowledgement

Notes

1 The Breusch–Pagan (BP) test is one of the most common tests for heteroskedasticity. It begins by allowing the heteroskedasticity process to be a function of one or more of the independent variables, and it is usually applied by assuming that heteroskedasticity may be a linear function of all the independent variables in the model.
2 **R**educe, **R**euse, **R**ecycle, and p**R**oper disposal (4Rs).

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