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Article

Designing solid waste collection strategy in small municipalities of developing countries using choice experiment

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Designing solid waste collection strategy in small municipalities of developing countries using choice experiment



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ABSTRACT

Household waste management is one of the major challenges of municipalities in developing countries. In many large cities, private service providers deliver the service of household waste collection for a fee, but in smaller cities this service is not always available as it may not be profitable for private providers as a result majority of the waste remains uncollected. Determining a waste collecting fee for the first time is challenging for any municipal authority. In this context, this study conducted a choice experiment (CE) survey to determine household preferences for a household waste collection system in Ilam municipality in eastern Nepal. CE is considered reliable and has increasingly been used to elicit preferences for goods and services. The results indicate that implicit price of the attributes of municipal waste management including waste collection frequency is USD 0.44 for an additional time per month, distance to waste collection center is USD 0.19/minute walk up to seven minutes and subsidy to bin is USD 0.038 for every 10% subsidy increase. Based on the implicit price and different combinations of attributes, households are willingness-to-pay between USD 0.20 to USD 0.75 per month for different household waste collection management schemes. The aggregated maximum willingness-to-pay of municipal households for waste collection services is USD 40,900, which is equivalent to the annual municipal expenditure on sanitation and street light activities.

1. Introduction

The urban population is increasing rapidly in developing countries with high levels of rural-to-urban migration and increased economic activity (Buhaug & Urdal, 2013; Henry, Yongsheng, & Jun, 2006). Along with urbanization, booming economic activity and increased living standards, urban households have increased their consumption. This has accelerated the generation of waste and consequently waste management has become one of the biggest challenges facing many cities in developing countries (Minghua et al., 2009). Due to poor infrastructure and inefficient or non-existent organizational structures to manage waste, vulnerability to water contamination and water logging is very high in many cities of developing countries (Guerrero et al., 2013; Henry et al., 2006). This poses serious environmental, health and economic threats to neighborhoods (Henry et al., 2006). Protecting cities and their neighborhoods from waste-related hazards and improving environmental outcomes require the development of strategies to reduce the levels of waste, improve waste-management and improve waste collection services.

Most commonly, municipalities are responsible for waste-management in cities, however, many municipal authorities in

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developing countries face severe resource constraints and hence services are not provided (Sujauddin, Huda, & Hoque, 2008). Henry et al. (2006) suggest that waste-management cost could be as high as fifty percent of the total budget for some municipalities in developing countries. The municipalities do not have options left other than charging fee to collect household waste. Hence, they may rely on private contractors to provide waste-management services and collect waste from households for a fee (Ahmed & Ali, 2004). In the developing countries like Nepal, private service providers do not exist in small towns to collect household waste. This may be because of limited viability due to the number of households available, who subscribe to their service.

In the absence of private service providers or adequate human resources, the waste-collection service of some city authorities reaches very limited households (Isa, Asaari, Ramli, Ahmad, & Siew, 2005). This can raise dissatisfaction and poor environmental outcomes among communities where waste collection service is not available. Aside from inadequate geographic coverage, household waste-collection systems are often not effective due to lack of information about collection schedules, improper bin collection systems and poor route planning (Hazra and Goel, 2009). A reliable set of revenue sources is an absolutely necessary condition for the sustainability of these solutions – or of any solution (Lohri et al., 2014). This is especially true if the poor are to be included. However, there are evidences that low-income households have expressed their willingness-to-pay (WTP) for waste collection services (Korfmacher, 1997).

One of the strategies to address such income-WTP issue in the context of waste management is to impose a volume based waste fee (Hong, 1999). This may encourage households for recycling and/or reuse of the products and also enhance satisfaction of the households who generate less. Usually income poor may have less consumption hence less waste production and a lower fee (Hoornweg & Bhada-Tata, 2012). Therefore, waste management system needs to consider the variation on these parameters; otherwise, it will be neither economically efficient nor politically feasible.

This suggests that a municipal waste collection can be viable when household fee recovers the cost of management. Usually, people contribute when their preferences are included in the public policy or program (Renn, Webler, Rakel, Dienel, & Johnson, 1993). This study used a choice experiment to determine WTP of municipal residents for reliable waste collection services, as it is widely acknowledged for its credible estimations (List, Sinha, & Taylor, 2006). CE estimates the part-worth utility of each attribute included in the experiment and its results are well suited for benefit transfer (Hanley, Wright, & Adamowicz, 1998; Rolfe, Bennett, & Louviere, 2000).

There are several existing studies using CE in municipal solid waste management. These studies mainly focus on large cities and aim to improve existing waste management system in Korea, London and Thailand (Challcharoenwattana & Pharino, 2016; Karousakis & Birol, 2008; Ku, Yoo, & Kwak, 2009); assessing waste disposal facility in Malaysia (Pek & Jamal, 2011); and reducing solid waste production in Macao (Jin, Wang, & Ran, 2006). Participants of existing studies are well known about waste management. This study elicited WTP to assess the feasibility of waste collection services in small municipalities of developing countries.

In relatively small municipalities, private collectors are not available mainly due to the restricted economic viability due to population size. Given the negative externalities associated with the absence of waste-management, it is possible that there is a potential social gain from the continuance and expansion of municipality provided services. For these services to be sustainable, awareness of household preferences is essential for the design of services.

2. Materials and methods

2.1. Study area

The study was conducted in the Ilam Municipality of Eastern Nepal (Fig. 1), which was established in 1958. The municipality has 4732 households with 18,633 residents (CBS, 2012). In the early stages of establishment, the rate of urbanization of the municipality was quite slow but in the recent decades it has accelerated due to improved communication, transportation, healthcare, and educational facilities. In addition, Ilam municipality is one of the leading municipalities in Nepal which has imposed a ban on plastic bags, as it is famous for eco-tourism.

The selection of this municipality for the study is mainly motivated by the initiation of Ilam municipality to introduce wastecollection services to households in the urban area without imposing a collection fee. The municipality collects only about one third of the total household waste generated and spends about 23 percent of its total budget on waste-management (MoLD, 2004). Existing solid waste collection system of Ilam municipality collects only 51 percent (3.9 t/per day) of the total generated waste, which is 7.6 t per day (Phuyal, 2012). The amount of waste generated has increased with increasing population, which has increased the collection costs. A previous study of waste-management in the municipality also suggested that awareness of the service is one of the major problems for collecting household waste in the municipality (MoLD, 2004).

2.2. Methodology

2.2.1. Discrete choice experiment

A discrete choice experiment (DCE) was used to elicit preferences of the households of Ilam Municipality for household wastecollection services. Choice experiments are based on the neo-classical economic theory that consumers maximize their utility by selecting the best among available alternatives which produce utility for them. Respondents are presented with a given set of alternatives each comprising of a bundle of attributes with varying levels. The attributes are related to the problem under investigation and the levels indicate the change in the quality or quantity of alternatives. In this case, the attributes are related to municipal household waste-management strategies.



Fig. 1. Map of Ilam Municipality.

Choice experiments are founded on the Lancaster's theory (Lancaster, 1966) that consumers receive benefits from the characteristics of goods rather than goods themselves. Therefore, with respect to waste-management, this study elicits households' preferences for the attributes or characteristics of waste-collection. For example, households are interested in attributes such as how waste would be collected, how much they would have to pay and how often waste-collection would occurs. Understanding of such preferences is vital for informing policy development and acceptance.

Choices made are analyzed by using random utility theory considering that the utility of a choice comprises an observed component and an error (unobservable) component (Hensher, Rose, & Greene, 2005; Manski, 1977). The utility level (U) of individual (*i*), associated with alternative (j), can be described by an indirect utility function, which can be expressed as;

$$U_{ij} = V_{ij} + e_{ij} \tag{1}$$

where, V_{ij} is the deterministic component and ε is the random or unobservable portion.

As a choice experiment assumes that respondents are rational and select alternatives with higher utility, the probability that individual i will select alternative j over another alternative n is given by:

$$\operatorname{Prob} (j|C) = \operatorname{Prob} \{ (V_j + e_j) > (V_n + e_n), \text{ all } n \in C \}$$

$$\tag{2}$$

where C is the complete choice set. To estimate Eq. (2), the latter component (ε) is assumed to be independently and identically distributed (IID), with a Gumbel distribution and scale parameter μ having a value equal to 1 implying constant error variance.

The individuals' indirect utility function (V_j) can be estimated using a multinomial logit (MNL) model. The utility function is:

$$V_{ij} = ASC + \beta x_{ij} + \gamma s_i^* (ASC \text{ or } x)$$
(3)

where, ASC is the alternative specific constant, which allows the analyst to control for unobserved attributes, x is a vector of attributes, β is coefficients of attributes x. The source of heterogeneity can be explored by introducing socioeconomic characteristics (Hensher et al., 2005). The socioeconomic characteristics (*s*) with coefficient vectors (γ) are interacted with attributes and/or the ASC. In this study, ASC is 1 for alternatives and 0 for status-quo or current situation.

In order to relax from IID assumption of MNL model, we estimated random parameter logit (RPL) model, which breaks down βx_{ij} of Eq. (3) into two components. This can be expressed as;

$$V_{ij} = ASC + \beta' x_{ij} + \eta x_i + \gamma s_i * (ASC \text{ or } x)$$
(4)

where, $\beta' x_{ij}$ is a vector of coefficients of mean of the population and η is a vector of individual deviations from the population mean.

2.2.2. Selection of attributes and their levels

The first step of DCE is to identify attributes and their levels. This was carried out by five focus group discussions (FGDs) with the residents and business communities of Ilam municipality. One focus group was carried out with local entrepreneurs including owners of hotel, restaurant, tea shop and grocery store, and four focus groups with municipal residents. The idea of conducting FGDs is to understand local people's perception of managing household waste, to identify attributes related to household waste collection system, which are important to them, and to understand current and expected levels of the selected attributes. Focus group participants were selected purposively to include households from the market area, highway area, and other rural wards of the municipality. In addition, gender, ethnicity and age groups were also considered while selecting the participants of focus group discussions.

During focus group discussions, participants were asked to prepare a list of characteristics of a household waste collection system. Then they were asked to select the most important characteristics based on the majority voting system (Rai & Scarborough, 2013). They selected distance between collection point and house; subsidy for dustbin; and frequency of collection as major attributes of waste collection. These major characteristics of household waste collection corroborate with existing literature, which affect waste collection services (Dahlén & Lagerkvist, 2010). After selecting major attributes from the majority voting of focus group participants, a range of the levels of the selected attributes including monthly household waste collection fee were discussed.

Based on the generated waste, households and entrepreneurs expressed their waste collection frequency from once in a week to 10 times in a month. Similarly, they expressed that two-way distance between houses to waste collection point should not be more than seven minutes, which is almost 250 m, if waste collection agent cannot provide door to door service. They strongly stated that they would not be able to carry their waste bags beyond this distance. After selecting attributes and their levels, we discussed with municipal officials about the selected attributes and their levels. The levels of subsidy were redefined, then finalized for the experiment. The selected attributes are presented in Table 1.

2.2.3. Choice experiment design

The next step is to design the experiment, which creates choice scenarios, based on the selected attributes and their levels. Usually orthogonal designs are used to create hypothetical choice scenarios; however they are more relevant for linear models and are unlikely to be efficient in logistic specification (Bliemer & Rose, 2008; Rose & Scarpa, 2007). Further, cost effectiveness can be achieved by reducing the sample size required by the use of an efficient design. Hence, an efficient design was constructed using Ngene 1.0.2 software. The D-efficient design strategies produce significantly improved results in terms of relative efficiency compared to the orthogonal design (Rose, Bliemer, Hensher, & Collins, 2008).

The p-efficient design requires prior information on parameters, which could be obtained from existing studies, piloting and assumptions (Bliemer & Rose, 2010; Ferrini & Scarpa, 2007). In this study, first we designed the experiment guessing sign of the parameters. Then we conducted a pilot survey and ran regression based on the pilot survey. The coefficients of attributes from pilot survey were used to design the experiment for the final survey. Using Ngene software, 20 choice sets were created using D-efficient design, which were divided into five versions of the survey questionnaire. This means each version has four choice sets and each household received four sets of choice scenarios. Each choice set included two policy alternatives (Alternative 1 and Alternative 2)

Table 1

Selected attributes and their levels.

Attributes	Description	Levels
Frequency of collection	The frequency of collecting waste. This was described in number of days as interval.	 i. 0* ii. 10 times per month (every 3 day) iii. 6 times per month (every 5 day) iv. 4 times per month (weekly)
Distance	Two-way walking distance between home and waste collection point in minute. That the municipal vehicle stop at the given point and all neighboring households are required to bring their waste in the given point. This will be decided by municipality later.	i. 0*
		ii. 1 min
		iii. 5 min
		iv. 7 min
Subsidy	One time subsidy provided by the municipality to buy dustbin. The dustbin will be distributed through the Municipality.	i. 0*
		ii. 25%
		iii. 50%
		iv. 75%
Monthly fee	Waste collection fee paid to municipality per month in NRs**	i. 0*
		11. 25
		111. 50 iv. 100
		IV. 100

Note: * denotes the levels used in current situation. ** NRs is Nepalese currency (1 USD~NRs 102).

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Fig. 2. An example of choice set.

plus the status-quo. In each version, all questions remained the same except choice scenarios.

2.2.4. Household survey

We interviewed 420 households, which is almost nine percent of the total municipal households. A systematic random sampling strategy was applied to select the households. It means first household was selected randomly and then every 10th households were interviewed. The selection of the household intervals is due to the sampling intensity. The first selected household received first version of the choice scenarios and second selected household received the second version and so on. It means every 11th approached household received the same version of the choice scenario.

The member of household of either gender above 20 years old was interviewed. If household heads are out of the city, then the member of household managing the household activities in the meantime were asked to participate in the interview. All approached households participated in the interview. Household surveys in developing countries, a 100 per cent response rate can be expected if local enumerators are employed to conduct interviews (Hung, Loomis, & Thinh, 2007; Rai & Scarborough, 2013). During the survey, each respondent was presented four cards and asked to choose one option from each card. The cards were visual depictions of choices

Table 2Sample characteristics.

Variables	Description	Mean (SD)	Number (%)
Age	Average age of the respondents in years	35.24 (14.85)	-
Education	Average education of the respondents in years	2.72 (1.37)	-
Family size	Number of household members	3.64 (1.60)	-
Household head	The respondent whether household head or not. If yes coded as 1, otherwise 0	-	251 (60%)
Gender	Gender of respondents, this is coded as 1 when respondent is Male and 0 for female	-	156 (37%)
Land availability	Open space available in their building area, Yes $=1$, No $=0$	-	139 (33%)

and used pictures and bars and included different levels of the same four attributes (Fig. 2). In addition to the differing choice scenarios, respondents were provided with socio-economic and household waste management information.

3. Results and discussion

3.1. Sample characteristics

Table 2 reports demographic characteristics of sample households. 63 percent were female; 60 percent of respondents were household heads and 40 percent were the members who were managing household activities. This may be due to the fact that migration for abroad employment prevails in Nepal (Samir, 2014). The average age of the respondents was 35 years old. This indicates that households are headed by young population in the town. The sample shows that only one third of the households have extra land within the dwelling and rest of them has only building area.

3.2. Waste generation and management

Ilam municipal households produce mainly six types of waste (Fig. 3). Out of total household waste generated by municipal households, 76% is organic waste. This is followed by plastic (13%), paper (5%) and so on. Other waste consists mainly medical, textile and leather wastes. Similar household waste composition was found in the capital city of Nepal (Dangi, Pretz, Urynowicz, Gerow, & Reddy, 2011).

The response of households reported in Fig. 4 indicates that they have several strategies to manage their household waste. Majority of organic wastes are utilized; more than half households feed such waste to their animals and additional 24% sell it or give to their neighbors. This is expected as the municipality is largely inhabited by indigenous community, who rear pigs for either commercial or subsistence purpose (CBS, 2012). The result indicates that only 22% households do not utilize organic waste; they either throw, bury or send to municipal waste collection. Throwing organic waste can be minimized by expanding municipal waste collection service since only 12 percent have access to the current service. In addition, a small number of households practicing composting is expected since only one-third have open space in their building area.

More than two-third municipal household burn plastic and paper waste and another 29 percent of household send plastic and paper to municipal waste collection. Burning of household waste particularly plastics and paper are common in developing countries (Al-Khatib et al., 2007). This may be the reason behind the very low number of household throwing paper and plastic elsewhere. This



Fig. 3. Waste generations at Ilam Municipality.



Fig. 4. Waste management practices at Ilam Municipality.

may help to make city clean but burning contributes to air pollution and may release toxic chemicals. Linking these households, who either burn or throw elsewhere, with scrap dealers may contribute to clean environment and earn (Phuyal, 2012).

3.3. Choice response analysis

Table 3

Choice responses data were analyzed using NLOGIT/LIMDEP software. Of the total, 3.33 percent of respondents (14 respondents) selected *current situation* in all given choice scenarios. In our estimation, these respondents are defined as protest respondents and assume that they will not participate in fee based household waste collection system.

A RPL model was estimated with 500 iterations and *monthly fee* as random parameter with triangular distribution (T). The model presented in Table 3 is a result of several estimations. At first all attributes are estimated as random parameters and then the model was re-estimated considering insignificant attributes as non-random parameters (Hensher et al., 2005). In RPL, triangular distribution of the cost attributes determines the finite moments of WTP distribution (Daly, Hess, & Train, 2012) (Table 4).

The result of RPL model indicates that respondents prefer increased frequency of waste collection, increased distance between collection spot and their home, and subsidy for dustbin. But, increased frequency of collection; and distance between collection point and their home has limitation as prescribed in the levels of these attributes as reported in Table 1. Beyond this limit, as per focus groups municipal residents' preferences could be negative. As expected they have negative preferences for increased waste management fee. In general, segregation of waste, composting of organic waste and reusing/recycling other materials reduces the volume of waste. Since, the majority of the residents of Ilam Municipality are not segregating household waste, their preferences for frequent waste collection service is expected. In addition, respondents prefer that the distance between the waste collection spot should not be beyond seven minute walk time (two-way). They also don't want the collection spot next to their households because of smell during collection as door-to-door collection service is not possible due to the size of road in the municipality.

The selection of socio-economic variables is based on previous studies. The generation of household waste is influenced by family size, income, age and sex of respondents (Ekere, Mugisha, & Drake, 2009; Sujauddin et al., 2008). In Nepal, usually landholding size or building area in the urban area is a proxy for income of the households. These socio-economic variables were interacted with ASC.

Age of respondents had a positive and significant coefficient indicating that elder respondents selected waste management alternatives over the status quo compared to young counterparts. In Nepal, elderly people are found to favor local environment management activities compared to young generation (Rai & Scarborough, 2015). This could be because younger people have high mobility as they go outside of their town for study and job.

Variables	Coefficients (SE)
Attributes	
Frequency of collection (times per month)	5.82e-2 (1.95e-2)***
Distance between collection point and home	2.48e-2(1.22e-2)**
Subsidy for dustbin	4.97e-3(1.82e-3)***
Waste collection monthly Fee	-1.33e-2(1.17e-3)***
Socio-economic variables	
Age	2.68e-2(8.95e-3)***
Family size	0.443 (8.71e-2)***
Building area	-0.298 (0.264)
Male	0.231 (0.237)
ASC	-0.163 (5.39e-2)***
Standard deviation of random parameter	
Waste collection monthly fee (T)	6.67e-3 (5.87e-4)**

Note: *, ** and *** denote significant at 1%, 5% and 10% levels.

Table 4

(7)

Tuble 1			
Estimation of implicit price	and their minimum	and maximum in p	arentheses.
Variables		Im	plicit Price (NR

Variables	Implicit Price (NRs)
Frequency of collection (times per month)	4.57 (2.93–8.61)
Distance (minute walk)	1.94 (1.24–3.66)
Subsidy to bin (%)	0.39 (0.25–0.73)

In addition, the coefficient of family size indicates that household with large family select alternative frequently compared to their small family neighbors. This is expected that large families produce more waste compared to small families or quantity of waste produced is positively associated with the number of family member. Therefore, large families may prefer alternatives over status quo frequently compared to their small family neighbors (Batllevell & Hanf, 2008).

The other two variables, building area and sex of respondents are insignificant. However, their signs are as expected. Households having more building area may have space to manage solid waste and practice solid waste management themselves (Philippe & Culot, 2009). Therefore, their preferences to stay at current situation are strong, which is indicated by the negative coefficient of the building area. On the other hand, male has positive preferences for waste management compared to their female counterparts as indicated by the sign of male variable. This could be due to the fact that the payments are included in policy alternatives and male dominates such decision related to cash payment in Nepalese society (Rai & Scarborough, 2015).

3.4. Estimation of WTP

The coefficients of attributes used in the choice experiments are included in the estimation of implicit prices¹ for each attributes. The implicit prices of any attribute are the negative ratio between the coefficient of the given attribute and the coefficient of the price attribute. Since, cost attributes have triangular distribution; the estimation can be expressed as;

$$IP_k = -\frac{\beta_k}{(\beta_c + \sigma_c \varphi_c)}$$
(5)

Here, IP_k is implicit price for the attribute k β_k and β_c are coefficients of attribute k and cost respectively, σ_c is the estimated standard error of cost attribute, φ_c is a draw from the triangular distribution (Hensher et al., 2005).

The estimated implicit price indicates that respondents would like to pay an additional USD 0.05 for an increase in each frequency of waste collection per month (Table 4). For example, if municipality collects household waste four times in a month or once in a week then household would like to pay USD 0.18 per month. Similarly, household are ready to pay additional USD 0.02 if the two-way distance between waste collection spot and house increases by a minute. For example, if the collection spot is at three minutes walking distance (two-way) from their household then they would pay USD 0.06 per month. But, this increment in distance should not exceed 7 min (two-way). Similarly, if a dustbin subsidy is increased by one percent then a household is ready to pay additional USD 0.004. Using this estimated implicit price, we can estimate the total monthly WTP of a household for different policy scenarios.

The household WTP (WTP_{hh}) can be estimated using the following equation;

$$WTP_{hh} = -\frac{\eta ASC + \Sigma \beta_k * \Delta_k}{(\beta_c + \sigma_c^* \varphi_c)}$$
(6)

where, η is the coefficient of ASC, and β_k is the coefficient of attribute k (frequency of collection, distance and subsidy), Δ is the change in the level of attribute k, β_c is the coefficient of waste collection monthly fee (f), σ_c is the estimated standard error of cost attribute, φ_c is a draw from the triangular distribution (Hensher et al., 2005).

The minimum monthly WTP of household is USD 0.20 for the waste collection mechanism, where the distance between collection spot and household is three minutes, the subsidy for the bin is 25 percent and the municipality would collect household waste once in a week. The maximum household WTP would be USD 0.75 per month, if municipality would collect waste 10 times per month, provides 75 percent subsidy for bin purchase and two-way distance between house and collection spot is seven minutes. In this estimation, we considered these two policy scenarios as minimum and maximum WTP, however, can be estimated based on the different combinations of attributes. This WTP is lower than other municipalities in Nepal such as Bhatarapur Metropolitan residents pay USD 0.29 to USD 0.98 based on waste collection frequency from once in a week to thrice in a week.

The total WTP (WTP_t) for this scenario can be expressed as;

$$WTPt = WTP_{hh} \times P \times Total Household$$

Where,

Total household is the number of household in Ilam Municipality and *P* is the proportion of respondents who are ready to pay for improved services. Here, we assume that households selecting current scenario in all choice scenarios (3.33%) do not have WTP for the management of household waste. This means, 96.67 percent of households are ready to pay for improved waste collection system.

¹ Implicit price or MWTP for individual attribute is the value of the particular attribute that an individual would like to pay for an increment in each unit of the attribute. In general term, this is a price for one unit of attribute that an individual would like to pay to get.

The total monthly WTP in Ilam Municipality under the given minimum and maximum scenarios are USD 945 and USD 3410 respectively.

In this case, Ilam municipality can collect waste collection fees from USD 11,555 to USD 40,900 annually. The expenditure of Ilam municipality for municipality sanitation and street light was USD 51,470 in the fiscal year 2014/15. This means municipal resident's fee can cover only 80 percent of the cost of waste collection and municipality has to put in extra dearth amount as the funds generated from household are not sufficient. However, in the main market area business houses may have an interest to increase the frequency of waste collection, which ultimately could increase waste collection tariffs. In addition, recycling and reusing solid waste may generate additional revenue to cover the cost of waste collection.

4. Conclusions and policy recommendations

The results indicate that residents of Ilam Municipality are willing to pay a waste management fee based upon the services that are provided by the municipality. The waste management service should consider frequency of collection, location of collection point and subsidy to waste collection bin while designing the waste collection service that can encourage households to pay a fee. In Nepal, municipalities carry out activities with the Tole Lane Committee, which consists of 70–100 households, the frequency and location of collection of collection can be identified at Tole Lane level in coordination with concerned committees.

The estimation of this study indicates that the maximum amount they would like to pay is USD 0.75 per month per household for the given policy scenario (waste collection frequency 10 times a month, 75 percent subsidized on the cost of dustbin and waste collection point seven minute far from the home). However, the municipality may introduce progressive fee based on the volume of waste collection, which can be managed based on the collection frequency. Such volume-based waste fee system is found effective in other parts of the world (Ku et al., 2009). Ilam Municipality can generate USD 40,900 annually by endorsing the aforementioned policy, which may cover up to 80% of the annual expenditure of the municipality on sanitation and street light. In addition, recycling and reusing of inorganic waste, and composting of organic waste may generate additional revenue from waste collection. This may also contribute to addressing the problem regarding the dumping site, which is one of the crucial components of the entire waste management process (Dangi et al., 2011).

Introducing waste collection fee may have to face public protest since people may think that they are paying several taxes to the municipality and managing waste is the responsibility of the municipal authority. The choice response analysis indicates that there are particular sub-sections of the society that have shown their strong preferences toward waste management option. For instance, elder people and large families have selected the policy alternatives frequently, these sub-groups of people should be the first target to get public support for implementing waste management policy.

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