

**Who pollutes? – Household solid waste management problem in Kathmandu, Nepal**

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**Abstract**

This paper estimates the impact of household characteristics on waste disposal choices. Waste disposal choices are: (1) Burning/Dumping (2) Collection and (3) Composting. The analysis shows that urban household prefer less composting and more collection which involve no waste processing and it attributes to the environmental degradation. However, education does not seem to influence waste disposal choices. Easy access to public transportation like bus stop increases environmental quality, which can be a recommended as a policy to decrease environment degradation.

Why and how solid waste creates waste management problem.

Waste management is a big challenge for developing as well as developed countries. Ineffective waste management threatens sustainability of environmental resources and puts the public health and animal health at risk.

Rapid population growth, urbanization, industrialization and changing consumption patterns are some of the factors governing uncontrollable waste generation, which creates waste management problem (Visvanathan and Glawe, 2006). Minimizing the waste generation could be an effective tool to avoid solid waste management problem. Previous studies in different countries have indicated that sustainable solid waste management can be achieved by diverting waste stock from landfill, by recycling, composting and incineration. In Nepal, incineration has not been found feasible since it is very capital intensive tool (D. P and Viraraghavan, 2005). As similar to other developing country case studies, composting and recycling are assumed to be two promising solid waste management tools in Nepal (Rathi, 2007 (RATHI 2007)). Recycling and composting with waste segregated at source increase the efficiency of the solid waste management process.

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Since the household generates 70 percent of the total waste, waste stock should be reduced at household level (Dangi et al, 2009). To mitigate the problem of municipal solid waste management through root level, it is necessary to understand waste generation pattern of household, the household behavior and household characteristics influencing waste generation. This paper mainly analyzes the contribution of household on waste generation and identifies the factors influencing waste generation.

### **Research Method**

#### *Research Question:*

How the demographic and socioeconomics characteristics of the households cause the households to choose the specific waste disposal choices?

#### *Hypothesis:*

Primarily, there are two hypotheses in this study.

1. Urban households are more likely to choose 'Burning/Dumping' and/or 'Collection' as the waste disposal choices that involve no waste processing and therefore urbanization contributes to the environmental degradation.
2. Urban household are more inclined to use 'Burning/Dumping' and/or 'Collection' as the waste disposal choices which produces pollution to the environment and do not use any waste processing. Public health awareness encourages people to 'Composting'.

People with higher public awareness practice 'Composting'. This study uses health related occupation as the proxy that represents the public health awareness in the household.

### **Waste Disposal Model**

To understand the household waste disposal behavior, the paper uses household production model, based on Becker's "A theory of the allocation of time" (1965), where household production trades off between time and market input. In household's production process of trading off between time and market input generates the waste and determines the composition of waste generation. However, in this paper, the household production model is utilized on household's waste disposal behavior and their tradeoff between using time or market input (like money) in waste disposal process. Household acts in two roles, first as commodity producer and second as utility maximizer. Household produces commodity using time and market input using production function and uses the best combination of these commodities to maximize their utilities. The main

objective of the model is to maximize utility given the production function subject to time constraint.

$$\text{Max } U=U(Z_1, Z_2, \dots, Z_m) \text{ where } Z= f(X_i, T_i) \quad [1]$$

Subject to goods constraint

$$\sum_i^m P_i X_i = I = V + T_w \bar{w} \quad [2]$$

Where  $Z$  is the production function of waste disposal choices which depend on the market input and/or time; ' $X$ ' is market input i.e. the yearly or monthly fees spent on the waste disposal process and ' $T$ ' is the time spent on waste disposal process and/or land used for waste disposal process like composting and burying.

$Z= f(X_i, T_i)$  can be written as  $Z= f(x, t, w, V, \text{prices, preferences, region, demographic characteristics, access to facility})$

In this paper, utility is maximized with the waste disposal choices, ' $Z$ ', which depend on market inputs( $x$ ), time spent ( $t$ ), waste removal process ( $w$ ), consumption expenditure or income( $V$ ), prices, household preference, region lived, and demographic characteristics like education, dwelling type, household size, plot size and access to facility.

The paper uses data from Nepal living standard survey-II 2003/2004. The survey includes random cross section sample of 4008 representative household from six explicit strata of the country. Six strata are categorized geographically.

The main objective of this study is to find the effect of household characteristics on household solid waste disposal behavior. Since the household waste disposal behavior is a categorical variable with more than two alternatives, this paper uses multinomial logit model.

The data has six categories of waste disposal choices, which are further categorized into three choices according to the similar nature of was disposal choices. For example, Garbage truck collection and private collection is categorized as collection; Dumped and burned is categorized as burning/ dumping category and fertilizer is categorized as composting. Another waste disposal behavior, other, is dropped. Below is the category of the waste disposal choices in the order of its effect to the environment, ordered from poor to better from 1 to 3.

$$TR_i = \begin{cases} 1 = \text{Burning/Dumping} \\ 2 = \text{Collection} \\ 3 = \text{Composting} \end{cases}$$

Waste disposal choice is the categorical dependent variable. The independent variables are region lived, log of nominal per capita consumption expenditure, dwelling types ( if house is rented or not) as

dummy variable, dummy variable kitchen garden, dummy variable access to bus stop as a proxy to access to facility.

### **Result**

The result of marginal effect of multinomial logit regression has been presented for three models. According to the result, urban household has significant positive relation to 'collection' and significant negative relation to 'composting'. This implies that the urban households contribute to the environmental degradation by contributing very less to the waste processing like composting. Education is significant in model 1, where high educational qualification is negatively significant to composting. This result signifies the high opportunity cost of time for more educated person to sort out the waste for composting. Household with the kitchen garden has the significant positive impact on composting.

In urban region, probability of collection increases by 9.6 percent and composting decreases by 30.1 percent. Increase in log of nominal per capita consumption expenditure decreases the probability of composting by 13 percent. In Tarai, flat region in south part of Nepal, the probability of composting decrease by 17 percent; Terai has no significant effect on collection. Surprisingly education level has no significant effect on household waste disposal choices except negative effect on composting. Similarly, bigger household size increase the collection; and not have significant impact on composting. Household with kitchen garden increases the probability of composting by 19 percent and decreases collection by 3 percent. Increase in plot size of household reduces collection by 3 percent. If household owns house, the probability of composting increases by 31 percent and probability of collection decreases by 3 percent. House rented to tenant increases the probability of collection by 4 percent and decreases probability of composting by 46 percent.

Overall, composting is adopted by rural household and household with kitchen garden. Education doesnot have significant impact on household waste disposal behavior. Access to facility like bus stop encourage composting and discourage burning/dumping.

### **Conclusion**

This paper uses effect of household behavior and characteristics on their waste disposal choices. Waste disposal behavior is estimated for two categories of waste disposal, collection and composting, keeping burning/dumping as the base category of waste disposal choice. Education level does not have significant impact on household waste disposal behavior. Similarly, household size increases the demand for collection. House rented has significant positive relation with collection and negative

relation with composting. That means bigger household size generates more waste and increase the demand for collection. Easier access to facility significantly increases composting, decreases collection and burning/dumping, and hence improves environmental quality. Urbanization significantly increases collection and decreases composting. This result is consistent with previous studies that urbanization is source of waste management problem. Similarly, Increase in income is another source of waste management problem since it increases probability of burning/dumping and decreases composting. This result is consistent with Barbier's statement about environmental kuznet curve that income increases environment degradation until the per capita GDP reaches to certain turning point, and many developing country do not produce inverted U shape of Environmental Kuznets curve (EKC) curve since they have less GDP than that of turning point.

After the analysis of household behavior, some of the policy recommendation for government to reduce environment degradation could be to provide easy access to facility information about solid waste management process and its impact on public health.

Table 1: Distribution for waste disposal choices.

Waste disposal selection	Frequency	Percent
Collection	537	14.09
Burning/Dumping	1,154	30.29
Composting	2,119	55.62
	3,810	100

Table 2: Marginal effect of multinomial Logit model for waste disposal choices, keeping Burning/Dumping as the base category.

VARIABLES	(1) Collection	(2) Composting
urban	0.0960*** (0.0134)	-0.301*** (0.0308)
poor	-0.0103 (0.0153)	-0.103*** (0.0392)
lnpcexp	0.0371*** (0.00748)	-0.135*** (0.0248)
tarai2	0.00438 (0.0122)	-0.179*** (0.0526)
kathmandu	0.0280*** (0.00713)	0.0302 (0.0268)
highst_level_compltd	0.000447 (0.000786)	-0.00590 (0.00410)
bus_stop	-0.00338 (0.00880)	0.0123 (0.0471)
house_rented	0.0427*** (0.0164)	-0.468*** (0.138)
hhsz	0.00304** (0.00124)	0.00480 (0.00518)
own_house	-0.0357*** (0.0131)	0.310*** (0.0729)
kitchenGarden	-0.0391*** (0.00839)	0.192*** (0.0274)
plot_size	-0.0350*** (0.0133)	0.0668 (0.0532)
new_house	0.000550 (0.00551)	0.0211 (0.0259)
Constant	-0.405*** (0.0773)	1.158*** (0.259)
Observations	2,633	2,633

Standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

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