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Determinant of Solid-Waste Management in Debre Birhan Town

Adimias Wendimagegn

Department of Statistics, College of Natural and Computational Science, Debre Berhan University, Debre Berhan, Ethiopia

Email address:
adimaswend@gmail.com

Abstract: Most of the developed countries recognized that solid waste management is very crucial for survival (economically) in addition to secure the safety of environment and human health. However, the developing countries like Ethiopia, let alone use its economic benefits, because of various reasons they are dumping of wastes in unauthorized sites, which easily expose to harsh hazards, like environmental pollution and health problem. Hence, the overall objective of the study is to describe and analyze the household solid waste management current situation and examine the influence of demographics, socio-cultural and institutional factors on the factor influencing of solid waste management at household level in the town. The data used in this study for the analysis were obtained from statistical survey by self-administered questioner and direct personal interview method with reference to a total of 1166 households which were selected through simple random sampling. Logistic regression model was used to identify factors that influencing solid waste management at household level in the study area. Though all households have temporary storage in their home, they did not store wastes separately based on its nature. The empirical analyses, using the logistic regression model, shows that, household head educational level, household's willingness to pay for waste collector, household's awareness on solid waste management service are the major determinants of household solid waste management in the study area. Moreover, the qualitative analyses, using the interview, show that manpower, budget, and facilities such as container, adequate vehicles, waste gown, and gloves are the other major factors of solid waste management at household level in debre Birhan town.

Keywords: Household Solid Waste Management, Logistic Regression, Debre Birhan

1. Introduction

Background of the Study

The rapid urbanization that has been taking place during the 20th century virtually transformed the world into communities of cities and towns facing similar challenges on environmental issues in which most of them have to be addressed at international level. Solid waste management became a worldwide agenda at United Nation conference on environment and development in Rio de janeiro in 1992 with a great emphasis on reducing waste and maximizing environmentally sound waste reuse and recycling at first step in waste management [1, 2].

In recent years, urbanization is increasing in most developing countries including Ethiopia. Due to this, the low and middle income countries are really suffering from imbalance between the amount of waste generation and the capacity which need to properly manage their wastes. Imbalance is severely affecting the health condition of the society and the general environmental soundness [4, 5].

Moreover, the primary objective of solid waste management activity is to make the environment sound and safe in human health via disposed of wastes in a well-organized manner. However, through process the stakeholders of the management system, especially in the developed nations, did not stop on disposed of waste in open dump or landfill only rather they tried to convert the trash/solid wastes/ to cash and make strong their economy in addition to environmental aspect. It is very much worthy to directly quote the finding of Smith: "For most industrialized nations today, solid waste management is a multibillion dollar business which is also crucial to survival. Garbage collection agencies remove tons of garbage yearly and sort it for recycling or ultimate disposal" [6].

In addition to the above benefit of well managed solid wastes, it surely is important to produce methane gas for the purpose of electric power generation [3].

However, let alone getting the above stated benefits, Solid waste management (SWM) is one of the critical challenges of developing countries including Ethiopia because of the social, economic and environmental implications once not properly managed. Only 30-50% of the waste generated in developing countries is collected and managed properly. The rest is either burned or left to decompose in open space or dumped in unregulated landfills, which is damaging the environment. Developed countries are able to manage the various types of waste to an acceptable level, contrary to developing nations like Ethiopia which are still struggling to deal with the problem of proper management of solid wastes. With the current rate of urbanization municipal solid waste collection, transportation and disposal have been a major problem of municipalities in most of the Ethiopian cities. Collection of municipal solid waste in most of the cities is difficult and complex because the generation of residential, commercial and industrial waste is a diffuse process that takes place in every house, every building and every commercial and industrial facility as well as in the streets, parks and even in the vacant areas available within the community. In addition to this hilly terrain of many cities, lack of manpower, equipment and financial constraints are factors which aggravate the problem [7-10].

In Ethiopia, alike developing countries, the increase of solid waste generation is resulted from rapid urbanization and population booming. The amount of solid waste in Debre Berhan town and other fast growing areas in the country has been increasing over time, largely attributed to rapid population growth rate. From the total solid waste released by the population in the city, about 50-60% was collected and the rest was unattended. Recently the municipality has increased its coverage to about 85% [7, 11].

Moreover, household solid wastes in Debre Birhan town are observed on the road, burning inside the village and disposed in sewerage. This clearly indicated that, Debre Birhan town population rate and the waste generation rate per household is increasing. But the solid waste management, particularly at household level, is not managed in a well-organized manner. Proper budget is not allocated for municipal waste management. Municipal solid waste management (MSWM) is an integral part of good local governance and one of the most visible urban services influencing local perception of governance. Debre Birhan has also problems that prevent the municipality/ responsible body from doing its task for environmental sound with economic efficiency. This study aims to evaluate the solid waste management system in Debre Birhan town, by identifying factor influencing solid waste management [11, 12].

Improper handling and on site disposal of solid wastes poses a serious problem, which contribute to high morbidity and mortality rate in the town. In MSWM an important starting point is the knowledge of basic data such as the generation rate, characteristics, formal and informal operations in place including producers' behavior. Such information is vital for planning, setting targets and evaluating such targets [12].

Investigation of the existing management practices and factors that constrain these practices is believed to be important in order to gain understanding of the challenges and issues involved in municipal solid waste management. Thus, this research work would try to investigate the key demographic and socio-economic factors such as the relationship between education levels of the household, household size, income, institutional involvement, distance of community waste bin; infrastructure and solid waste management are the focal point of this study.

The general objective of this study is to assess the factors influencing solid-waste management in Debre Birhan Town.

This study would help to generate data and gather information on the municipal solid waste management in Debre Birhan town. Thus the study was hoped to provide some information to policy makers, donors, and environmental protection practitioners who are interest to assist financial, training and legal provision which in turn minimize the constraints of MSWM.

2. Literature Review

There has been considerable the number of researches conducted; focused on factors that affect waste management. Waste is often found as a liquid or solid form. Solid waste is any type of wastes which is hard or not a water-like or liquid form; for example, used plastic bags, broken bags, leftover food or foods remains and the like. It is a by-product of human activities that tends to increase with the rate of urbanization, changing patterns of consumption and the improvement of living standards [13, 14].

The human activities which take place in this world create waste. The wastes could be both solid and liquid types; and the way they are going to be handled, stored, and disposed can expose the environment and public health to risks. If solid waste is properly used, it can be a valuable resource, but if it is not effectively managed, it can result in serious adverse impacts on environment and public health. Solid waste management is therefore a critical component within urban sanitation and it is also one of the most important and resource intensive services provided by municipalities [15, 16].

Solid waste management is becoming a major public health and environmental concern in urban areas of Ethiopia. In Ethiopia, like developing countries, increase of solid waste generation is resulted from rapid urbanization and population booming and the average solid waste generation rate is about 0.221kg per person per day and it is also estimated that only 2% of the population received solid waste collection services. One of the poorest environmental performances in Ethiopia pertains to the management of all types of waste and the country lack any disposal or destruction facility, sanitary landfills and incineration. For instance, in Debre Birhan hazardous solid wastes totally untreated, may be put into the

city's municipal dump when properly disposed of, or remain dealt with in the general environment and the situation in Debre Birhan is now being Repeated in the fast developing urban centers throughout the country [16, 17].

3. Methodology

Logistic Regression Model

Logistic regression model is preferable when the dependent variable is qualitative (categorical) in nature. It describes the relationship between a categorical response variable and any set of explanatory variables.

Binary logistic regression

Binary logistic regressions were used to perform logistic regression on a binary response variable. A binary variable has only two possible values, such as presence or absence of a particular event. Models with one or more predictors; we fitted using an iterative-reweighed least squares algorithm to obtain maximum likelihood estimates of the parameters. Binary logistic regression has also been used to classify observations into one of two categories, and it may give fewer classification errors than discriminates analysis for some cases. The binary logistic regression function is defined as:

$$\Pi(X) = \frac{e^{\beta 0 + \beta 1 x 1 + \beta 2 x 2 + \beta 3 x 3 + \cdots + \beta p \times p}}{1 + e^{\beta 0 + \beta 1 x 1 + \beta x 2 + \beta 3 x 3 \ldots \beta p \times p}} \tag{1}$$

Where, β_o = the constant of the equation β_i = the coefficient of the, i[th] predictor.

4. Result of Statistical Analysis and Discussion

Binary logistic regression is applied to assess the relationship between overall perception of persons which is dichotomized response variable (Yes/No) and independent variables. SPSS version 16 is used to perform binary logistic

regression by making positive perception as reference category.

Table 1. *Omnibus test of model coefficient of influencing solid waste management.*

		Chi-square	Df	Sig.
Step 1	Step	74.264	8	.000
	Block	74.264	8	.000
	Model	74.264	8	.000

The null hypothesis of Omnibus test of model coefficient states that information about the independent variables does not allow us to make better prediction of dependent variable. Therefore we went to be state, the chi-squared value is significant because the value of p=0.000 is less than values of α=0.05. We have sufficient evidence to reject H_0, and conclude that there is association between independent variable and influencing solid waste management.

Table 2. *Hosmer and Lemeshow Test for the influencing solid waste management.*

Step	chi-square	Df	s.g
1	6.966	8	0.540

The Hosmer and Lemeshow Test is a measure of fit which evaluates the goodness of fit between predicted and observed probabilities in classifying the response variable. The hypothesis is;

H_0: the model is good fit v_s

H_1: the model is not good fit

Since the Hosmer-Lemeshow goodness of fit test P-value is 0.540 which is greater than 0.05, we do not reject the null hypothesis that is the predicted and observed values are closed. Therefore, at the final stage result of the Hosmer-Lemeshow statistics lead to the non-rejection of the null hypothesis saying the model fits the data which agrees with the previous likelihood ratio test.

Table 3. *Variables in the Equation.*

		B	S.E.	Wald	Df	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	education(primary and above)	.862	.643	1.800	1	.180	2.368	.672	8.343
	Stay	-.041	.027	2.354	1	.125	.960	.910	1.012
	family(above 5)	-1.423	.597	5.684	1	.017	.241	.075	.776
	pay(no)	-.939	.538	3.041	1	.081	.391	.136	1.123
	Awareness (no)	-1.669	.568	8.625	1	.003	.188	.062	.574
	Service			7.339	2	.025			
	service(not enough access)	2.199	.842	6.821	1	.009	9.016	1.731	46.956
	service(enough access)	1.212	.814	2.215	1	.137	3.360	.681	16.578
	policy(yes)	-1.810	.535	11.463	1	.001	.164	.057	.467
	Constant	1.413	.884	2.558	1	.110	4.109		

Interpretation of odds ratio

The odds ratios of currently being solid waste manage for primary education level are greater than one about 2 (OR =2.368) time the odds uneducated level of currently being solid waste manage by taking the other variable are constant. The coefficient of year of stay is negative indicating that

when the year of stay is decrease by one year then to dispose solid waste manage is decrease by 4%(OR=0.96) given that the effects of other variable are constant. And the odds of currently being solid waste manage of family size (above 5) are less than one implying that about 75.9%(OR=0.241) as compared the reference by taking the other variable are

constant.

The odd of currently being solid waste manage for the not willing to pay for waste collectors is less than about 60.9%(OR=0.391) as compared with the reference by taking the other variable are constant. The odds of currently no awareness about solid waste manage technique is less than one implying about 81.2%(OR=0.188) as compared with communities who have awareness about solid waste manage technique by taking the other variable are constant. Similarly the odds of currently being solid waste manage to not enough access for waste storage are greater than one about 9 (OR=9.016) times the odds of currently being solid waste manage for no evidence about the waste storage around their village by taking the other variable are constant. Enough access is greater than one about 3 (OR=3.360) as compared to the reference of none at all by taking the other variable are constant. Finally, the odds ratios of currently being solid waste manage for implementation of government policy is less than one about 83.6% (OR=0.164) as compared with doesn't implementation government policy by taking the other variable are constant.

5. Conclusion

Solid waste management is being a serious agenda in the world since it is a major cause for environmental pollution and human health risks this study also indicated that Debre Birhan town dispose solid waste management practice is very weak in terms of status, spatial coverage and solid waste management facility. This study intended to identify the most important socio-demographic characteristics of solid waste management. It implies that, the type and rate of household solid waste production are varied depending on the living condition of each household. The town municipality did not assign solid waste container in any parts of the town; rather, they orient the household to store their wastes and handover to the private waste collectors or municipal vehicle when it tours in their village.

Significance testing for the logistic coefficients using Wald test and likelihood ratio show that family size, awareness, access of private collector's serves, and government policy implementation are significant factors.

To assess the fitness of the model the maximum likelihood ratio test and Hosmer and Lemeshow test are used. As we can see the fitted binary logistic regression model is expectedly determined the socio-cultural, demography factor on dispose solid waste management in Debre Birhan town.

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