Ecological Solid Waste Management Act and Factors Influencing Solid Waste Management in Barangay Pansol of Quezon City, the Philippines

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Abstract

With rapid increase in population and economic growth, the Republic of the Philippines is facing a major challenge for effective management of its growing municipal waste. The government has enacted the Republic Act 9003, which is also called the Ecological Solid Waste Management Act of 2000, to overcome the challenges of waste management. This study was conducted in barangay Pansol of Quezon City in the Metro Manila to assess the impact of this act on households' waste generation and management practices at barangay level. A sample of 117 households surveyed in the barangay is used for the analysis. Factors that significantly impact waste generation are age of household head, employment status, household size, annual income, recycle and awareness about waste segregation policy. Thus, households with these characteristics should be focused to minimize households' waste generation and improve current waste management practices. Awareness on various aspects of waste and accessibility of Material Recovery Facility can also help lessen waste generation and improve waste management processes. It was discovered that not all households have government provided services of waste collection and street sweeping. Therefore, there should be wider geographical coverage of door-to-door collection and street sweeping services.

Introduction

An archipelago of 7,107 islands, the Philippines is located in South-East Asia with an area of 300,000 square kilometers; making it 73rd largest country in the world (CIA, 2013). The population of the Philippines is 92.34 million with an annual growth rate of 1.9% (NSO, 2012a) and 45.3% people are residing in urban areas (NSO, 2013a). Philippines' economy is also growing rapidly. National Statistical Coordination Board (NSCB, 2013) reported Philippines to have 7.8% gross domestic product (GDP) growth for the first quarter of 2013, which surpassed countries like China (7.7 percent), Indonesia (6 percent), Thailand (5.3 percent) and Vietnam (4.9 percent), thus becoming the fastest growing economy among Asian countries (Santos, 2013). Therefore, it is one of the fastest developing countries with equally increasing rate of population and urbanization, impacting significantly on its waste generation. This condition has created both environmental and health problems (Atienza, 2011; Guzman & Reyes, 2003).

The Philippines government has tried to address problem of waste management by enacting various policies. Policies were

implemented as early as 1938, which prohibited dumping of refuse or substances of any kind into the rivers. In later policies, proper collection and disposal of waste and the provision of penalties for non-compliance were emphasized. In this regard, the local government units (LGUs) were highlighted to make effective implementation of solid waste management (SWM) programs. But the problem of solid waste continued to be like before. Among others, "command and control" nature of the law that failed to create cooperation between communities and various stakeholders; the archipelagic nature of the country; lack of infrastructure for efficient transportation especially in provinces, inner cities and barangays (lowest administrative units) and bureaucratic political system are known to have contributed in inefficient implementation and ineffective monitoring of waste management programs (Atienza, 2011).

The most notable policy came with the implementation of the Philippines Republic Act (RA) 9003, also known as the Ecological Solid Waste Management Act of 2000 which is considered to be a broad- based and comprehensive approach to SWM by promoting 3 Rs: reduce, reuse, and recycle (DENR, 2001). Compared to previous laws, which were considered to be disorganized and fragmented, this act was enacted as a holistic approach to adopt a systematic, comprehensive and ecological program that will ensure the protection of public health and environment. Although implementing polices into practice have not been an easy path and almost all the local government units are not capable of fully implementing the act because of various financial, technical and manpower constraints (Mercado, 2006). Even when these general constraints exist, any action taken will be more effective when it is context-specific because of differences in socio-economic and geographic characteristics and their unique capacity. Thus, the objective of this study is to find out the socio-economic and various other factors influencing solid waste generation and management practices by taking a specific barangay into consideration. In particular, households (HHs) are focused for analyzing their waste generation and management behavior as they are the major source, which contributes from 60% to 90% of total municipal waste (EU, 2014). The total waste generation by the HHs is impacted by the differences in waste management policies and practices (Parfitt et al., 1994). Thus, this study is conducted to see how the implementation of policies is impacting the practices. It analyzes the factors impacting waste generation and management strategies at the HH level in order to identify the most effective approach that can be undertaken by the concerned authorities.

Methodology

Study Area

The average waste generation in the Philippines is 0.3 kg per person per day in rural areas and 0.7 kg per person per day in urban areas (Atienza, 2011). Thus, responding to urban waste will help accomplish the management of higher share of overall waste. This study targets Metro Manila, which is the metropolitan region with 16 cities and 1 municipality. The region is the political, economic, social, cultural, and educational center of the Philippines. It is the most populous of the twelve defined metropolitan areas in the Philippines and 11th most populous in the world. As of 2007 census, it comprises of 13% of the national population but accounts for only 0.21% of the country's total land area and has a density above 700 people per square kilometer (more than double the national average). It also accounts for 33% of the nation's GDP (PAFP, 2013). Being the most populous and economically active area of the country, the generation of waste is also high in this region. According to Department of Environment and Natural Resources (DENR), residents of Metro Manila are responsible for one-fourth of the country's daily output of solid waste. In 2010, an estimated 7,000 metric tons of waste was produced in Metro Manila with an average of 0.66 kg per capita per day and the government has estimated an increase of 131% of total waste generation (16,166 daily metric tons and per capita generation of 0.874 kg) by 2020 (Storey, 2012).

In Metro Manila, different levels of compliance to the implementation of RA 9003 among local government units (LGUs) can be noticed. While some LGUs are already becoming a model site in the implementation of the Ecological Solid Waste Management Act, others are gathering lessons to improve their compliance with segregation at source, segregated collection, establishment of material recovery facilities (MRFs), and management of residual waste (Atienza, 2011). Quezon City is one of such cities within Metro Manila, which has successfully implemented SWM policies and plan. The average waste generation in Quezon City has increased from 0.66 kg per person per day in 2003 to 0.74 kg per person per day in 2013 (EPWMD, 2003; EPWMD, 2013). With regard to RA 9003, the Quezon City government has also enacted various city ordinances pursuant to RA 9003 and those relevant for this study are presented in Table 1.

Quezon City enacted "the City Ordinance No. SP-1707, S2006", which required the HHs to segregate their waste at source into wet or biodegradable and dry or non-biodegradable. The "*Hiwa-hiwalay na Basura sa Barangay Program*" took effect only on July 1, 2011 for compulsory waste segregation at source by the HHs (QC, 2014). According to the annual report of Quezon City (2012), the waste collection efficiency in the city is 100% after the implementation of this program. However, piles of uncollected waste can still be seen on the roads of Quezon City (NSWMC, 2014). Thus, there is a huge contrast between published reports and

Table 1. Salient features of RA 9003 and relevant city ordinances pursuant to the act

S.N.	RA 9003		City Ordinance	
	Section	Provision	Number	Provision
1.	10	LGUs are primarily responsible to implement and enforce the provisions of act	SP-982, S-2000	To create Environmental Protection and Waste Management Department (EPWMD) mainly to: ● Implement an efficient garbage collection and disposal system; ● Monitor and enforce of all environmental laws and city ordinances
			SP-1323, S-2003	To adopt guidelines and procedures for a unified approach on SWM
2.	10	Collection of segregated solid waste shall be conducted at barangay (lowest administrative unit) level specifically for biodegradable, compostable and reusable waste	SP-1323, S-2003 Article II (Rule 6)	The Quezon City government through EPWMD shall be primarily responsible in collecting solid waste from door-to-door, on the specified collection day without fail. For areas where the garbage collection truck has no access, pushcarts/garbage buggies shall be used for the door-to-door collection of solid waste
	17 (c)	Barangay should ensure 100% waste collection efficiency		
3.	21	Mandatory segregation of solid waste at source	SP-1707, S-2006	Segregation of solid waste at source
4.	20	Waste diversion through composting, re-using and recycling activities	SP-2122, S-2011 Section 4 (B)(d)	Barangay SWM committee shall organize training for barangay residents on segregation, composting, recycling and livelihood opportunities from used recyclable waste
5.	32	Creation of Material Recovery Facilities (MRFs) in every or cluster of barangays	SP-2122, S-2011 Section 4 (B)(c)	MRF includes solid waste transfer station or sorting station, drop-off center, composting facility and recycling facility. Barangay SWM committee shall establish MRF within the barangay or use MRF of a nearby barangay
6.	55	Mandated continued efforts to develop public awareness about SWM by National Solid Waste Management Commission in coordination with other concerned actors	SP-1323, S-2003 Section 8	Conduct information, education and communication (IEC) campaigns for public
7.	48 (3)	Prohibition on open burning of solid waste	SP-2122, S-2011	Prohibition on open burning of garbage, trash or any other refuse material

Source: (NSWMC, 2000; EPWMD, n.d.)

ground reality that makes it more necessary to find out the actual situation at the ground level.

Barangay in the Philippines has a population of at least two thousand inhabitants except in highly urbanized metropolitan areas with population of at least five thousand inhabitants (DILG, 2013). This study was conducted in barangay Pansol of Quezon City. Based on key informant interview, barangay Pansol was selected for its low compliance to RA 9003 to find out the reasons that led to this low compliance and various problems faced by the HHs to follow the policies. Barangay Pansol has a land area of approximately 148 hectares and population of 28,537 (NSO, 2012b). There are five different communities in barangay Pansol; namely, La Vista and Loyola Grand Villas, which are gated communities and Pansol Proper, Kaingin I and Kaingin II, which are non-gated communities. A total of 117 HH respondents were selected randomly and interviewed using semi-structured questionnaire from February to March 2014, from three non-gated communities. HHs' biodegradable and non-biodegradable waste is only considered in this study. To collect HHs' total waste generation data, interviewees were asked to estimate their HHs' quantity of daily or weekly total waste generation. Interviews were also conducted with concerned officials in Metro Manila Development Authority, Quezon City and barangay Pansol including various other stakeholders like non-governmental organizations (NGOs), junkshop owners and street sweepers. STATA 13 software was used to analyze mean, frequencies and to run multiple regression model.

Variables Selection and Empirical Model

A multiple regression analysis was performed to determine the factors impacting HHs' solid waste generation. This study uses ordinary least square (OLS) model which is often used for fitting the regression line. Total waste generation per day by the HH is taken as dependent variable. For the selection of independent variables, only those variables, which are significant after running the regression model, are selected for the analysis. The selected significant independent variables are age of household head (HHH),

employment status of HHH, HH size, annual income of HH, HHs that recycle waste and HHs' awareness about waste segregation policy. The summary of the selected variables is given in Table 2. Age of HHH is a continuous variable and is expected to have a negative correlation with the waste generation. Study by OECD (2014) found that middle-aged and older people are more involved in waste separating and recycling activities. Since older people tend to comply more with social norms, it is expected that with such sense of responsibility they also end up producing lesser waste. Employment status of the HHH is a dummy variable, which takes the value of 1 if the HHH is employed and 0 otherwise. It is expected to positively affect the waste generation, because when employed, HHHs will have more purchasing power and hence will lead to more waste generation. A study conducted by Sankoh et al. (2012) has also found a positive correlation between employment status and waste generation. HH size is a continuous variable that is expected to positively influence the total waste generation, as it is natural to generate more waste with increased HH members. Various studies have also found a positive correlation between HH size and waste generation (Sankoh et al., 2012; Afroz et al., 2011; Sujauddina et al., 2008). Annual income of HH is a continuous variable and is expected to have a positive correlation with waste generation. Increased income will increase purchasing power of the HH and hence is expected to consume more. Various studies have found positive correlation between annual income and waste generation (Bandara et al., 2007; Sankoh et al., 2012; Afroz et al., 2011; Sujauddina et al., 2008). HH that recycle waste is a dummy variable, which takes the value of 1 if the HHs recycles and 0 otherwise. It is expected to have a negative affect on waste generation assuming HHs who recycle waste will have more knowledge and experience on waste generation and proper management which can have impact on waste generation in a responsible manner (Afroz et al., 2011). HHs' awareness about waste segregation policy is a dummy variable, which takes the value of 1 if the HHs are aware about waste segregation policy and 0 otherwise. It is also expected to have a negative affect on waste generation. Waste segregation policy, along with segregating waste, also educates about importance of 3 Rs. Thus, this might indirectly impact HHs' waste generation behavior as well. Study by Afroz et al. (2011) found that those concerned about the environment generates less waste and gets involved in improving waste management strategies. Awareness about the waste segregation policy is also expected to educate people regarding negative impact of waste on the environment. Thus, this variable is anticipated to have negative impact on total waste generation. The expected correlation of the selected dependent variable and explanatory variables, based on the literature review are presented in Table 2.

The empirical specification for OLS model is given by:

$$\text{HH waste generation per day} = \beta_0 + \beta_1 (\text{age}) + \beta_2 (\text{employment status}) + \beta_3 (\text{HH size}) + \beta_4 (\ln \text{annual income}) + \beta_5 (\text{recycle}) + \beta_6 (\text{policy awareness}) + e \quad ...(1)$$

Where,

β_0 = constant term, β_n = coefficient of explanatory variables, ln = natural log and e = error term.

The diagnostic tests were carried out to see if there were any problems of multicollinearity and heteroskedasticity in the data. According to Pindyck and Rubinfeld (1981), to check for multicollinearity, variation inflation factor (VIF) is better than correlation coefficient method that fails to yield conclusive results. VIF test gave a mean value of 1.10 that is below 10 meaning multicollinearity does not exist among the variables. Breusch-Pagan/Cook-Weisberg and White's test on the other hand showed significant p-value which means that heteroskedasticity does exist for which model was estimated using robust standard errors which according to Nhemachena and Hassan (2007) is the correct way of overcoming the problem of heteroskedasticity of any kind. Using robust standard relatively gives accurate p-values without changing either the significance or the coefficients of the model (Wooldridge, 2006).

Table 2. Summary of variables and hypothesized relation of explanatory variables against dependent variable

Dependent Variable	Definition and Measurement	Expected Sign
Waste generation	Waste generated by each HH on a daily basis; in kg/HH	-
Independent Variables		
Age	Age of HHH; in years	-ve
Employment status	Employment status of HHH; 1=employed, 0=otherwise	+ve
HH size	Number of family members in HH; in headcount	+ve
Annual income	Annual income of HH; in Philippine Peso	+ve
Recycle	Whether HH recycle waste; 1=yes, 0=otherwise	-ve
Policy awareness	Awareness about waste segregation policy; 1=yes, 0=otherwise	-ve

Source: Field Survey (2014)

Results and Discussions

Socio-Economic Characteristics of HHs

Table 3(a). Socio-economic characteristics of the households

Characteristics	Total
Sample size	117 (100)
Male headed HH	64 (54.70)
Number of employed HHH	70 (59.83)
Households living in owned house	98 (83.76)

Note: Figures in parenthesis indicate percentage
Source: Field Survey (2014)

Table 3(b). Socio-economic characteristics of the households

Characteristics	Mean	Standard Deviation	Min	Max
Age of household head (HHH) (in years)	45.78	11.81	21	76
Formal education attainment of HHH (in years)	10.76	2.27	6	16
HH size	5.41	2.09	1	10
Annual income of HH (in Philippine Peso)	186560.7	107389.4	40000	480000
Waste generated by HH per day (in kg)	2.48	1.47	0.32	6.57

Source: Field Survey (2014)

This study found that 54.7% of the HHs are male headed and 45.3% are female headed. 59.83% of the HHH are employed as government officials, private company employees or are involved in small business activities. 83.76% of the houses are self-owned and the rest lived in rented apartment or house. On average, HHH is about 46 years old, which means most of them are in their middle age. HHHs have attained an average of more than 10 years of formal education. All the HHHs are literate, more than the literacy rate of Quezon City of 98.32% (QC, 2013). Average HH size in barangay Pansol (5.41) is larger than Quezon City's average of 4.3 (NSO, 2013a). On average, each HH generate 2.48 kg of waste per day. Average waste generation per capita per day is 0.46 kg, less than Quezon City's average of 0.74 kg per capita per day (EPWMD, 2013). Average annual HH income of 186560.7 Philippine Peso is less than national average of 235,000 Philippine Peso (NSO, 2013c). These data show that despite barangay Pansol being situated in a city, its socio-economic characteristics are more similar to the rural settings of the Philippines.

Factors Affecting Total Waste Generation

Table 4. Result from OLS model

Variables	Coefficient	Standard Error	t	P-value
Age	0.016	0.008	2.00	0.040**
Employment status	0.348	0.188	1.85	0.051*
HH size	0.200	0.047	4.21	0.000***
Log annual family income	1.476	0.163	9.08	0.000***
Recycle	0.479	0.192	2.49	0.005***
Policy awareness	-1.082	0.507	-2.13	0.067*
Constant	-16.475	1.978	-8.33	0.000***

Note: *** at 1%, ** at 5% and * at 10% level of significance
Number of observations = 117
F (6, 110) = 28.06 Probability > F = 0.0000***
Root MSE = 0.96523 R-squared = 0.5885

The result from OLS model is shown in Table 4. About 59% of the variance in dependent variable is explained by the selected explanatory variables for this study. This study finds that HH size, annual family income and HHs that recycle waste have a highly significant positive correlation with waste generation. The positive coefficient of HH size (1% level of significance) indicates that,

holding all other variables constant, increase of additional family member in the HH will increase the HH's waste generation by 0.2 kg per day. This positive relationship is supported by the previous literatures (Sankoh et al., 2012; Afroz et al., 2011; Sujauddina et al., 2008). It is also apparent that more the family members in the HH, more the waste will be generated because of increased consumption of goods. The positive coefficient of annual family income variable (1% level of significance) indicates that, holding all other variables constant, a percent increase in annual family income will increase HH's waste generation by 0.015 (1.48/100) kg per day. This positive relationship is also supported by previous literatures (Bandara et al., 2007; Sankoh et al., 2012; Afroz et al., 2011; Sujauddina et al., 2008). The income of the HH is directly related with waste generation, because higher the income, HHs can afford to buy more goods and may increase HH consumption, hence generate more waste. The positive coefficient of recycle variable (1% level of significance) indicates that, holding all other variables constant, HHs who recycle waste generates more waste than who don't recycle by 0.48 kg per day. This result is not in line with the previous study conducted by Afroz et al. (2011). This may be because HHs should have more quantity of waste in order to recycle. Age of HHH has positive correlation (significant at 5%) with waste generation. This indicates that, holding all other variables constant, a year increase in age of HHH will lead to increase in HH's waste generation by 0.02 kg per day, which was not expected and does not support the finding by OECD (2014). This also shows that older people tend to generate more waste than younger ones. The employment status of HHH as expected has positive correlation (significant at 10%) with waste generation. This indicates that, holding all other variables constant, HHs with employed HHH generates more waste than unemployed HHH by 0.35 kg per day. This may be because the employed HHH can afford to consume more or purchase more goods and also have less time to take care about waste management in their HH. This result is also supported by the previous study by Sankoh et al. (2012). Lastly, policy awareness has negative correlation (significant at 10%) with waste generation, which was expected and supported by previous study by Afroz et al. (2011). This indicates that HHs who are aware about waste segregation policy generates less waste by 1.08 kg per day than HHs who are not aware. This may be because HHs who are aware about the policy are more responsible in handling the waste properly.

Current SWM Services Provided in Barangay Pansol

There are three types of waste management services provided by the local government in the study area. The city government provides waste collection facility for 3 days a week (twice for biodegradable and once for non-biodegradable waste), which HHs uses as per their convenience. Around 3% of the HHs uses the service only once in two weeks, 19% uses once a week, 39% uses twice a week and another 39% uses three times a week. Street sweeping service is provided 6 days a week, except Sunday, but is available only on main roads that cover only 75% of the surveyed HHs. During the field survey, it was observed that houses that are situated far from the barangay office did not have street sweeping facility. MRF includes a solid waste transfer station or sorting station, drop-off center, a composting facility, and a recycling facility (NSWMC, 2000). MRF of barangay Pansol has composting, recyclables sorting and storing facilities. But, it is only limited to the usage by barangay staffs who bring recyclables from their home and in return receive points that can be traded for daily necessary items like sanitary goods from the MRF office. Unfortunately, very few (4.27%) of the interviewed HHs are aware about MRF in their barangay but did not use the facility.

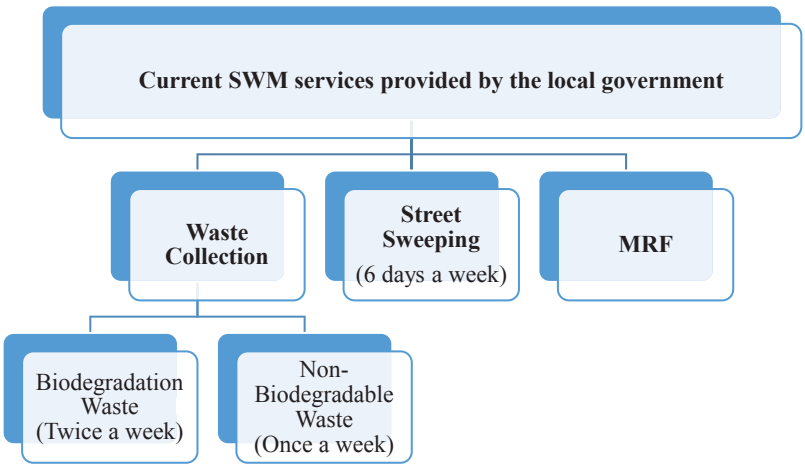

Figure 1. Current SWM services provided in barangay Pansol
Source: Field Survey, 2014

SWM and Waste Disposal Practices in Barangay Pansol

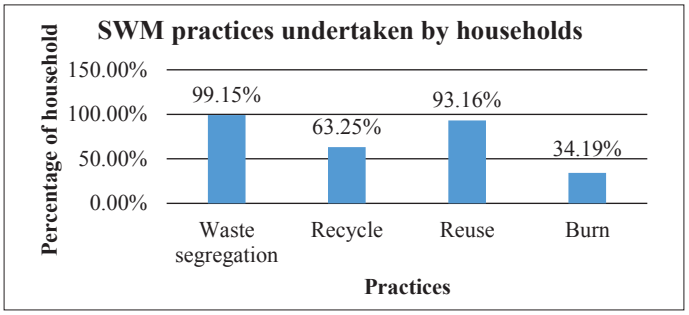

Figure 2. SWM practices by the HHs in barangay Pansol
Source: Field Survey, 2014

In this study, almost all HHs segregate (99.15%) and reuse (93.16%) waste in some ways. When asked for the reason for waste segregation, most of the HHs said that it is compulsory according to law and if they do not segregate, their waste would not be collected. Some of the HHs who segregate waste said that they are concerned about the environment and cleanliness about their home and neighborhood. HHs reuse mostly plastic bags, rice sacks, bottles and cartons. This study shows that 63.25% of the HHs recycle their waste. Most of the respondents who recycle waste have done so only after they have started segregating the waste. HHs who do not recycle waste (36.75%) said that it takes time and space to sort and store recyclables. They are further discouraged by the less quantity of recyclable waste, which gives a very little monetary benefit after selling. Out of 63.25% of the HHs who recycle waste, around 47% of them sell the recyclables to formal sector, i.e. junk shops, 46% sell it to informal sectors who come to buy recyclables in their homes and 7% gives the recyclables either to street sweepers or to neighborhood children for free to help them make some money. Section 48 (3) of RA 9003 and Quezon City ordinance number SP-2122, S-2011 strictly prohibits open burning of garbage, trash or any other refuses material. But in the study area, around 34% of the HHs are found to be burning their waste. The HHs burn mainly plastic, paper and yard waste to get rid of them easily.

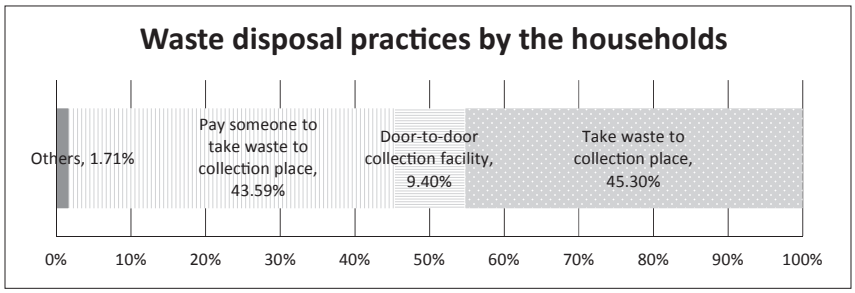

Figure 3. Waste disposal practices by the HHs in barangay Pansol
Source: Field Survey, 2014

According to Quezon City ordinance SP-1323, S-2003 Article II (Rule 6), door-to-door collection of waste should be done from each HHs within the city. Even for areas where the garbage collection truck has no access, pushcarts/garbage buggies should be used for the door-to-door collection of solid waste. But during field survey, it was found that only 9.40% of the HHs whose house was located in main roads had door-to-door waste collection service. Most of the houses of the respondents are located inside the main roads with narrow pathways and they should bring their waste to a specified collection place on the main road at specified time during the collection day. Therefore, HHs either carries the waste to the collection place or pays someone to take his or her waste to the collection place. The result shows that almost 43.59% of the respondents paid someone to take their waste to the collection place. The main reasons for the HHs to pay someone is because of far location of the collection place and the collection time is during the early morning hours, which is inconvenient for most of the HHs. Some of the HHs said that they want to help by paying the poor residents in their neighborhood, who collect the waste for living. About 45.30% of the HHs take their waste to the collection place by themselves. This is because the collection place was near by and some HHs couldn't afford to pay someone to take his or her waste to the collection place. 1.71% of the respondents said that they manage their waste by themselves. They give their biodegradable waste, especially food waste to pig farmers and manage non-biodegradable waste by burning.

Conclusion and Recommendation

The findings of this study showed that despite Quezon City's effort to implement RA 9003, it has not been able to fully implement the law in barangay Pansol. Annual income of HH, HH size and HHs that recycle waste have highly significant correlation with waste generation. Employment status of HHH, age of HHH and policy awareness also has significant correlation with waste generation. Thus, these HHs should be focused by the policy makers and concerned stakeholders to reduce HHs' waste generation in barangay Pansol. The local government should prioritize policy awareness campaigns as it has significant negative correlation with waste generation. Recycling can take up time and space but can provide monetary benefit to the HHs by selling the recyclables, which is why effective measures should be undertaken to encourage them to increase the rate of recycling. One of the ways could be awareness on various aspects of wastes; including but not limited to its impact and management. This way HHs might ultimately be interested in managing wastes not just for monetary benefit but also as a responsible citizen. Awareness and accessibility of MRF should be made to the public, where HHs can trade in their recyclables. Most of the households are already segregating and reusing the waste. There should be a wider geographical coverage of street sweeping and each HHs should have a door-to-door waste collection service as per the law.

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