RESEARCH REPORT

NO. 2002-RR3

Solid Waste Segregation and Recycling in Metro Manila: Household Attitudes and Behavior

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This report investigates the ways in which households in Manila deal with their solid wastes, particularly the factors that affect their willingness to separate and recycle. Household surveys reveal that households are generally willing to recycle but are limited by lack of backyards to make use of compost and discouraged by a municipal garbage collection system that is not set up to accept segregated wastes.

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EXECUTIVE SUMMARY

This study examines household waste management systems and the attitudes and behavior of selected middle-income communities in two *barangays*[1] in Metro Manila. The factors that influence household waste segregation and composting are examined using descriptive statistics and regression analysis of primary survey data.

The study identifies some household attitudes and behavior with regard to waste management that are important in designing community-based waste management programs, especially in the light of the country's new law on ecological solid waste management. The study also demonstrates the potential economic benefits from the adoption of resource recovery practices at the household level.

1.0 INTRODUCTION

Solid waste generation is an inevitable consequence of production and consumption activities in any economy. Generally, it is positively related to the level of income and urbanization, with higher income and more urbanized economies generating higher levels of solid wastes per capita (Table 1). Metropolitan cities in developing countries are usually beset with solid waste management-related problems such as flooding, uncollected garbage and inadequate or inappropriate disposal sites.

The Philippines generates more than 10,000 tons of solid wastes per day, with Metropolitan Manila accounting for more than 50% of the total wastes or 5,800 tons/day. Per capita estimates range from 0.30 to 0.70 kg/day, depending on whether the estimate refers to selected residential areas or all sources of wastes (Table 2).

Open dumping is the most common disposal method for solid wastes in the Metropolis. The recent closure of two "landfills" (in San Mateo and Carmona)[2] and the partial closure of the Payatas dump site have resulted in the current garbage crisis in the Metropolis, with

[1] A *barangay* is the basic political unit with a population of at least 2,000 inhabitants that serves as the primary planning and implementing unit of government policies, plans, programs, projects and activities in the community. A city or a municipality may have many *barangays*, depending on its population size.

[2] The San Mateo and Carmona landfills fall short of the engineering definition of a sanitary landfill and are considered more as controlled dumpsites.

serious threats to public health and no clear solution in sight. The San Mateo landfill was closed in December 2000 while the Carmona landfill was closed in 1998. These disposal sites handled 32% and 35% of Metro Manila wastes, respectively. The Payatas open dumpsite, which handled 30%, was temporarily closed on August 2000 right after the Payatas tragedy, where a number of residents perished from a landslide caused by heavy rains. The dump has reopened since then to accommodate limited sources of wastes, mainly from Quezon City, where it is located (MMDA/JICA 1998).

Table 1. Urban Municipal Solid Waste (MSW) Generation in Selected Asian Countries, 1995

Types of Income	*Country*	*GNP Per Capita (USD)*	*Current Urban MSW Generation (kg / capita / day)*
Low Income		490	0.64
	Nepal	200	0.50
	Bangladesh	240	0.49
	Myanmar	240	0.45
	Vietnam	240	0.55
	India	340	0.46
	Lao PDR	350	0.69
	China	620	0.79
	Sri Lanka	700	0.89
Middle Income		1,410	0.73
	Indonesia	980	0.76
	Philippines	1,050	0.52
	Thailand	2,740	1.10
	Malaysia	3,890	0.81
High Income		30,990	1.64
	Korea, Republic of	9,700	1.59
	Hong Kong *	22,990	5.07
	Singapore	26,730	1.10
	Japan	39,640	1.47

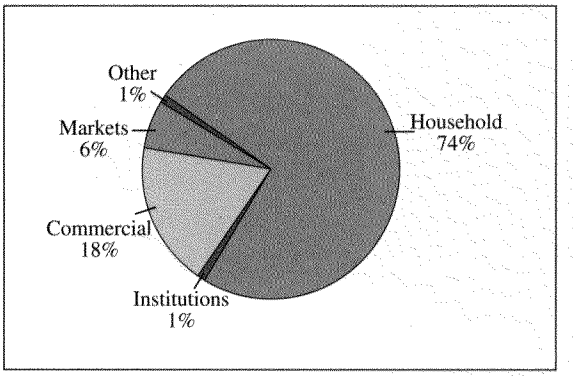
Source: World Bank (1999) *includes construction/demolition debris

The household sector is the primary source of solid wastes in Metro Manila, accounting for almost 75% (Figure 1a). The other important sources of solid wastes are industries, commercial establishments, markets, and institutions including schools and government offices. About 45% of Metro Manila household wastes consist of food/kitchen wastes, 16% paper, 15% plastic, and 9% glass and wood (Figure 1b).

Table 2. Per Capita Estimates of Waste Generation in Selected Cities/ Municipalities, Philippines

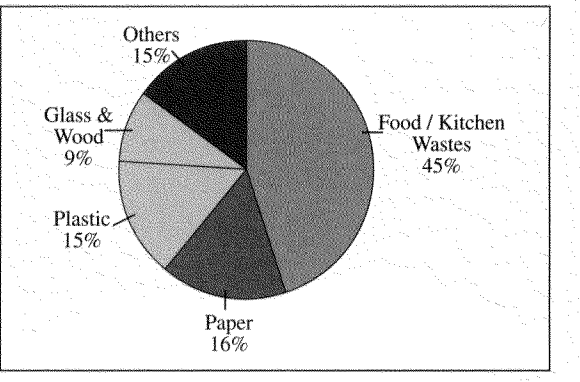
Area	*Coverage*	*Estimate (kg/cap/day)*	*Study*
Mandaluyong City	Residential	0.37	Soncuya & Viloria (1992)
Mandaluyong City	All sources	0.76	
San Juan Municipality	Residential	0.32	
San Juan Municipality	All sources	0.57	
Olongapo City, Luzon	Residential	0.30	GHK/MRM (1995)
Olongapo City, Luzon	All sources	0.39	
Bacolod City, Visayas	All sources	0.39	EMS/JSD * (1995)
Metro Manila	All sources	0.66	DENR/WB (WB 1998)
Metro Manila	Residential	0.42	MMDA/JICA (1998)

* Cited in GHK/MRM 1995



Source: MMDA/JICA 1998

Figure 1a. Sources of Solid Wastes, Metro Manila, 1992



Source: MMDA/JICA 1998

Figure 1b. Composition of Household Wastes, Metro Manila, 1992

Waste segregation[3] at the household level is not widely practiced and waste recycling is minimal. Past efforts to promote waste segregation at source have failed despite the issuance of city and municipal ordinances providing for sanctions and penalties for non-compliance. Some reasons that have been cited for the non-compliance include: indifference of local residents to participate in community waste management-related activities, local government collection services' non-allowance for segregated waste collection, residents' attitude that government has the sole responsibility over garbage management and lack of information and education campaigns. At the same time, the government is convinced that the way to address the garbage crisis in Metro Manila and improve overall solid waste management is by mandating households and other waste generators to segregate at source in order to reduce the wastes collected and disposed into the disposal sites.

This study aims to contribute to a better understanding of household waste management behavior by examining waste management practices and attitudes. More specifically, it analyzes the factors that promote household waste segregation and resource recovery and provides some quantitative measures of household wastes that are recovered, burned, and disposed of. The study also demonstrates the potential economic benefits from the adoption of resource recovery practices at the household level. The results of the study will provide inputs into the formulation of local waste management plans and programs, particularly on community waste segregation and recycling activities.

2.0 SOLID WASTE MANAGEMENT

The Ecological Solid Waste Management Act of 2000 (Republic Act 9003) passed in January 2000 was enacted largely in response to the growing scarcity of disposal sites, particularly in Metro Manila, which resulted in the garbage crisis in the region. The law emphasizes solid waste avoidance and volume reduction through source reduction and waste minimization measures, with the protection of public health and the environment as the primary goal. The four provisions of the law that are of interest to the present study are listed below.

a) Section 20 establishes a mandatory, solid waste diversion rate of 25% within the next five years at the local level. This will require each local government unit (LGU) in the next five years to divert annually, on the average, 5% of its solid wastes away from waste disposal facilities into resource recovery activities such as reusing, recycling and composting.

[3] Waste segregation refers to a solid waste management practice of separating and storing different materials found in solid waste in order to promote recycling and re-use of resources and to reduce the volume of waste for collection and disposal. Waste recycling at the household level refers to resource recovery activities such as recovering or diverting wastes from the waste stream to re-use, sell, give away or compost in the case of food wastes.

b) Section 21 requires the mandatory segregation of solid wastes at source to include household, institutional, industrial, commercial and agricultural sources. The wastes will be segregated and properly marked as can-be-composted, non-recyclable, recyclable or special wastes. Segregation and collection of biodegradable, can-be-composted and reusable wastes shall be conducted at the barangay level, while collection of non-recyclable materials and special wastes shall be the responsibility of the municipality or city (Section 10).

c) Article 4 (Sections 26-33) and Article 5 (Sections 34-35) establish recycling and composting programs, including an inventory of existing markets for recyclable and can-be-composted materials, the establishment of materials recovery facilities at the local level and setting up of drop-off locations for recyclable materials. Standards for non-environmentally acceptable products and packaging will be developed and imposed on manufacturing and commercial establishments.

d) Section 47 provides LGUs the authority to collect solid waste management fees. The LGUs can impose fees sufficient to pay the costs of preparing, adopting and implementing a solid waste management plan. The following factors shall be used as the basis for setting the fees: types of solid waste; amount/volume of waste; and distance to waste management facilities.

The new law creates solid waste management bodies at the national, provincial, city and municipal levels that will ensure its proper implementation. The National Solid Waste Management Commission (NSWMC) is mandated to prepare the national framework and subsequently, solid waste management plans based on the national framework will be prepared at the local level. Another important task of the NSWMC is to approve and monitor the implementation of local solid waste management plans. Solid waste management plans will be prepared at the provincial level on the basis of plans prepared at the city and municipal levels.

The new law establishes a National Ecology Center that will provide consultation, information, training and networking services for the improvement of solid waste management. One of its specific functions is to promote the development of a recycling market through the establishment of a national recycling network to increase recycling opportunities to the public. The Center will be headed by the Director of the Environment Management Bureau (EMB), a line agency under the Department of Environment and Natural Resources (DENR). Multi-purpose environment cooperatives or associations will be established at the barangay level in every LGU for purposes of promoting and supporting the local solid waste management projects and programs.

RA 9003 provides for a solid waste management funding mechanism. It creates the Solid Waste Management Fund with a special account in the National Treasury. This will be sourced from collected fines and penalties, proceeds of permits and licenses, and other sources (including those collected from the implementation of solid waste management plans). Moreover, the fines collected will be allocated to the LGU where the prohibited acts are committed, under some sharing scheme between the fund and the LGU concerned.

Solid waste management activities will continue to be fully financed by the LGU in accordance with the national policy of zero non-government/local government unit (NG-LGU) cost-sharing on the financing of LGU activities in the brown sector, including solid waste management.[4] Under the new law, however, the LGUs are authorized to collect solid waste management fees for its services. In determining the fees, costs directly related to the adoption and implementation of the plan and the setting and collection of the local fees will be considered. The fees shall be based on the following minimum factors: (a) types of solid wastes; (b) amount/volume of wastes; and (c) distance of the transfer station to the waste management facility.

3.0 METHODS

3.1 Conceptual Framework

Household demand for solid waste services is a function of the unit price of solid waste services and other determining factors such as wage, non-wage income, prices of consumption goods, prices received for recyclables, waste components of market goods and quantity of wastes generated by non-market goods (Jenkins 1993). Other socio-economic characteristics are included in models such as household size, age and education. The variables, income and household size, are surrogates for the unobserved household production activities which generate waste as a by-product (Hong et al. 1993).

Some researchers have used this demand for solid waste services framework to model the determinants of household waste recycling (Hong et al. 1993; Jenkins et al. 2000; Reschovsky and Stone 1994). However, due to data problems on recycling quantities, the studies adopted the binary choice modeling approach because the data observed is dichotomous in nature, i.e., whether or not a household recycles. The dependent variable in a binary choice model is a dichotomous variable where Y=1 if a household recycles or Y=0 if it does not recycle.

Jenkins et al. (2000) examined the intensity of recycling different waste materials using an ordered probit model where the dependent variable, i.e., intensity of recycling each material (categorized in 3 levels), is a function of unit price of waste disposal, some characteristics of the local waste management system, and socio-economic factors like household income, age and home ownership. Using the same model, Hong et al. (1993) modeled household recycling participation or the number of times it recycles over a period of time (categorized in 5 levels) as a function of disposal price and socio-economic variables.

Lastly, using a simple probit model, Reschovsky and Stone examined the probability of recycling a specific material and included socio-economic variables and characteristics of

[4] Per 1996 National Economic and Development Authority/Investment Coordination Committee- (NEDA/ ICC) approved guidelines on financing activities with social and/or environmental objectives that have been transferred to the local government units.

recycling programs as independent variables. The first two models examined mainly the influence of waste disposal price on household recycling behavior, while the third model examined the differential effects of recycling systems when combined with unit pricing.

This study examines household waste segregation behavior using binary choice modeling following the studies discussed above. Waste segregation is an activity undertaken to facilitate recycling and disposal and thus entails household resources such as time, space and effort in the same manner as waste recycling.[5] This household activity consists basically of the separation or sorting of wastes into recyclables and non-recyclables, and storing these wastes in separate containers to facilitate recycling and disposal. It is therefore reasonable to assume that the household's decision to engage in waste segregation will be determined by the same factors that influence its decision to engage in recycling activities. However, since the amount or level of effort of waste segregation done by the household is also not observable, the study adopted a dichotomous or binary choice model.

3.2 Sampling and Data Collection

3.2.1 Household Survey and Secondary Data Sources

The sampling and data collection adopted the following procedure. Cities and municipalities in Metro Manila with active waste management programs were identified and two cities with active programs were selected, namely, Paranaque City and Mandaluyong City. Within each city, the barangays with active programs were identified and one barangay in each city was selected after considering the extent of program coverage. In Barangay Sun Valley, Paranaque City, a total of 70 households residing in two communities were sampled and in Barangay Barangka, Mandaluyong City, 73 households residing in two communities, were sampled. Thus, four communities in the two cities were selected after information on the waste segregation behavior of the households was collected from the respective barangays. Information on the extent of household waste segregation practices in the barangay was sourced from homeowners' associations and village organizations. This choice-based sampling design was adopted to ensure a sufficient representation of segregating households in the sample.[6]

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[5] The term recycling is often used loosely to mean many things at various levels. In this study, recycling at the household level refers only to resource recovery activities such as recovering or diverting wastes from the waste stream to reuse, sell, give away or compost in the case of food wastes. Household recycling requires cleaning or washing the recyclables, sorting them into different materials, storing them in the household's premises, setting them out for collection or bringing them to drop-off zones. Recycling in its technical meaning refers to the treatment of used or waste materials through a process of making them suitable for beneficial use and includes any process by which solid waste materials are transformed into new products in such a manner that the original products may lose their identity, and may be used as raw materials for the production of other goods or services (RA9003, Section 3[bb]). With this definition, it is reasonable to say that recycling occurs at the recycling establishments.

[6] This sampling bias was corrected by applying choice-based sampling correction during the estimation process using the LIMDEP weighing procedure.

In each of the two barangays selected, one segregating and one non-segregating communities were chosen. The 143 households in the four selected communities were sampled using a systematic random sampling design, i.e., the n^{th} household from a landmark, usually the subdivision or village gate, and every n^{th} household thereafter until the sample size of 135 was reached. A number of questionnaires were excluded from the analysis due to incomplete information and the final sample totaled 135, with 62 households sampled from Barangay Sun Valley and 73 from Barangay Barangka. Out of the 135 households, a total of 76 were practicing waste segregation while 59 were not.

A pre-test was conducted and the survey questionnaire was subsequently refined. Six university student enumerators, supervised by two project staff, were hired. The 10-page questionnaire took an average of 30 minutes to implement. The enumerators were instructed to interview the mother or wife in the household, if available, otherwise, the father or husband or any adult who was available.[7] The questionnaire collected information on the following: (a) community waste management activities; (b) household level of environmental awareness and response to garbage crisis; (c) household solid waste generation and disposal; (d) household solid waste segregation and resource recovery; (e) household waste management attitudes; and (f) household socio-economic characteristics.

The study also used secondary data and the major sources are the following: (1) Masterplan on Solid Waste Management in Metro Manila in MMDA/JICA (2) Linis Ganda report on recovered materials in Metro Manila; (3) Report on solid waste characteristics in Mandaluyong City and San Juan Municipality; and (4) Report on the Muntinlupa Eco-waste Management Program.

3.2.2 Quantity of Household Wastes

Existing estimates of the quantity of wastes generated were based on actual collection and weighing of wastes. Randomly sampled households were given two plastic bags to store their solid wastes, one for a weekday and the other for a weekend. These wastes were collected twice a week and weighed individually to estimate the generation rates. As the samples were collected directly from households, there was no room for scavenging. For waste characteristics, the collected wastes were dumped together and mixed thoroughly and a representative sample was taken to comprise the composite sample (Soncuya and Viloria 1992).

In the present study, the respondents were asked to estimate the wastes they generated in a day in kilograms, according to the following three waste types: food/kitchen wastes, yard wastes and mixed or all other wastes. The sample households were also asked to estimate the proportion of the wastes that they recovered, burned and disposed of out of the total wastes they generated. Recovered wastes were broken down into categories: re-used/ composted; sold; and given away. Using this information, the wastes that the households

[7] About 60% of those interviewed were the mother or wife in the household.

reported as "generated" were considered as "disposed", since these did not include the recyclable wastes they generated, and the amount of wastes recovered was estimated as a residual. Thus, the total waste generated by households is the sum of recovered, burned and disposed wastes.

3.2.3 Waste Segregation and Resource Recovery — Econometric Analysis

Econometric analysis was implemented to investigate the factors that influence waste segregation and composting behavior of households. The regression approach used by the study follows that of models for binary choice, specifically the probit model, where the dependent variable is a dichotomous variable, i.e., Y=1 if the household is engaged in waste segregation or waste composting and Y=0 if it does not, regressed on some socio-economic household characteristics as well as on some waste generation and recovery attributes of the household and the community.

The logit model may also be used to explain the behavior of a dichotomous dependent variable. The logit model uses the logistic cumulative distribution function (CDF), while the probit uses the normal CDF. While the question of which model to use in a binary choice analysis is unresolved, it has been observed that in most applications, it does not make much difference since the models give similar results (Greene 1997; Gujarati 1995).[8]

The empirical model is of the following form:

$$w_{ij} = \beta_1 x_{ij} + \beta_2 y_{ij} + \beta_2 z_{ji} + u_{ij} \quad (1)$$
$$(i = 1, 2, \ldots., n; j = 1, 2, \ldots, m)$$

where

- w_{ij} is dichotomous taking a value of 1 if household $_i$ in barangay $_j$ segregates or composts its wastes and 0 if otherwise
- x is a vector of household socio-economic characteristics
- y is a vector of household waste management-related behavioral and attitudinal variables
- z is a vector of community waste management-related attributes
- u is the error term.

The following are the variables that were included in the regression analysis: household socio-economic variables – income, age, household size and presence of yard (dummy); household waste management-related variables – total wastes disposed, time spent at home by mother (dummy), revenue received from sale of recyclables, and garbage fee (dummy); and a community waste management feature – garbage fee (dummy) and ordinance (dummy).

[8] The choice of a probit model in this study is based on the observation of the researcher that most of the similar studies reviewed used this model.

The predicted value of the dependent dichotomous variable, w_{ij} in the specified binary choice model above, is interpreted as the probability that the household will segregate/ compost or has the propensity to segregate/compost its wastes, given a particular household characteristic in x_{ij}, say household income, all other things remaining constant. Estimation was done using maximum likelihood method and the software LIMDEP was used in the descriptive and regression analysis. The slope coefficients or the betas in a probit regression are interpreted differently from the slope coefficients in a linear regression model since the model deals with the probability of some event occurring (Gujarati 1995).

The marginal effect of a binary independent variable in a probit regression is given by the marginal probability coefficient and is calculated as the mean values of the regressors included in the model. It is interpreted, in the case of the model given above, as the effect of a unit change in a regressor on the probability that a household will segregate/compost. (The software LIMDEP offers this as an option). Statistical tests were conducted to test the hypothesis that socio-economic factors were significant in determining the probability that a household will engage in waste segregation and composting. Other standard statistical tests such as difference between two means and independence of two variables, were conducted.

3.2.4 Economic Benefits of Resource Recovery

The present study examined three categories of benefits or avoided costs from resource recovery activities, namely: (a) reduced private collection and disposal costs; (b) reduced environmental costs during collection and at the disposal site such as health and amenities; and (c) reduced environmental impacts from the extraction of natural resources. Benefits (a) and (b) are quantified using Philippines data and in estimating benefits from avoided environmental costs (b), the study adopted/modified an assumption regarding the magnitude of private versus environmental disposal costs based on a United States study. Benefit (c) is discussed qualitatively based on a review of the literature.

In estimating avoided private collection and disposal costs, the cost per ton of waste disposed, based on Metro Manila Development Authority (MMDA) costs, together with the report on purchases of recyclables through the Linis Ganda[9] program were used. No data on costs and benefits of resource recovery could be obtained. The study made the assumption of positive net benefits from household resource recovery activities. The reduced environmental costs were estimated by assuming that the environmental costs were higher than the private disposal costs by a factor of 2 (refer to Section 5.0 on Benefits from Resource Recovery).

[9] Linis Ganda is a privately-initiated resource recovery and recycling program. Although national in scope, it is most active in Metro Manila. It has the following components: waste segregating at source, minimizing garbage dumping into rivers and streets, decreasing the volume of garbage brought to dumpsites and landfills, and helping to improve the social acceptability and living conditions of junkshop owners and waste pickers. Its network of program participants includes 17 environment cooperatives in the 17 cities/municipalities of Metro Manila, 572 junkshops and 1,000 eco-aides or door-to-door recyclable collectors. In 1999, it reported a total of about 95,000 tons of municipal solid wastes collected from households and delivered to recycling establishments. In 1996, it was declared by the Untied Nations Habitat II summit in Istanbul, Turkey as the best practice of handling garbage in the world.

3.3 Limitations

The present study has two limitations. First, it was necessary to limit the sampling to the middle-income communities as the practice of waste segregation is still generally limited to households in middle and above middle-income communities. The analytical model used by the study is a dichotomous regression model (i.e., probit) that requires a sufficient number of 'yes' and 'no' observations. Thus, it was necessary to do a purposive sampling of communities where there were sufficient households practicing 'yes' and not practicing 'no' waste segregation.

Although this sampling procedure may not allow the generalization of the results to Metro Manila, the results can provide insights into the waste management practices of other similar communities.[10]

The second limitation of the study has to do with the self-reported data on the quantity of household wastes disposed. While the study did not intend to collect data on waste generation in quantity terms, it nonetheless asked households to make an estimate of the weight of their daily wastes (in kilogram). Several empirical studies on waste generation pointed out the potential bias in self-reported data, although it can be argued that the measurement of waste generated through actual weighing is also beset with problems such as measurement errors as pointed out by Kinnaman and Fullerton (2000). Nonetheless, the per capita estimates of wastes generated in this study based on self-reported data, compare reasonably well with existing estimates based on measured data.

4.0 RESULTS AND DISCUSSION

4.1 Socio-economic and Waste Management Profiles of Study Sites

4.1.1 Barangay Sun Valley, Paranaque City

Physical and Demographic Characteristics

In the year 2000, Paranaque City had a total population of 449,811 persons over a total area of 47 km^2 or an average density of 9,570 persons/ km^2. Population-wise, the city accounted for 4.5% of Metro Manila's population and 0.59% of the country's population. It had a total number of 94,109 households with an average household size of 4.75.

Barangay Sun Valley is one of the 16 barangays in the city of Paranaque, with a population density of 173.5 persons/ha. There are 6,617 households residing in 20 subdivisions, villages, compounds and communities. The barangay is middle class

[10] There are no estimates of the percentage of households practicing waste segregation in Metro Manila. However, this study ventures to make an "estimated guess" of 20-30 %.

with 50% of the population belonging to well-off households, although there are depressed communities, including squatter colonies in some areas.

Waste Management Program

The city generated a total of 254.0 tons of solid wastes in 1999 or a per capita waste generation of 0.55 kg/day. As early as 1990, the city (then still a municipality) issued an ordinance (Ordinance No. 90, series of 1990) regulating garbage disposal within the municipality and providing a penalty for non-compliance. The ordinance was limited to regulating illegal dumping of wastes in public places, including the seashore or shoreline and requiring the use of appropriate garbage containers and putting them out for collection at the scheduled time. In terms of waste segregation, the city is governed by existing ordinances of the Metro Manila Development Authority (MMDA).

Barangay Sun Valley's Total Segregation Approach to Ecological Waste Management program is popularly cited as one of the most successful programs in community-based waste management in Metro Manila. The basic philosophy of this program, conceptualized in 1996 and implemented in 1998, is contained in three principles - Segregation at Source, Segregated Collection and Segregated Destination.

Briefly, the program involves the practice of waste segregation by households and a "no segregation - no collection" rule. Segregated wastes end up in different destinations: (a) biodegradable wastes are composted at composting centers to produce organic fertilizers and sold to farmers, parks and golf operators, and the Department of Agriculture, (b) non-biodegradable wastes and recyclables are collected separately, deposited at the redemption centers, and sold to junkshops and recycling factories; and (c) residual wastes are collected by the city garbage trucks.

No garbage fee is collected by the LGU; however, some communities pay garbage fees through their homeowners' association or directly to door-to-door collectors. The participation rate is low, at 30%, with only 2,000 subdivision households actively participating in the program. The low participation rate according to the barangays' officials, is the indifference of the residents. This could be due to the lack of an effective information and education campaign. The non-participating households rely on irregular collection by city trucks and garbage collection by pushcart boys or they engage in illegal dumping.

In Annex 41, the model subdivision of the program and one of the study sites, wastes are collected by "biomen" using three-wheeled pushcarts. Collection of biodegradable wastes is done twice a day while recyclable wastes are collected daily based on a weekly schedule by types of material (i.e., paper on Mondays, glass on Tuesdays, and so on). Waste composting is done at their Eco-Center located within the subdivision and the composts are then sold to the Barangay. The recyclables can be stored at the center and

sold directly to the junkshops. Households pay a flat monthly garbage collection fee of Pesos 25 (USD 0.63) which is included in the homeowners' association fee. The program in effect is a self-sustaining activity as it allows an effective cost recovery scheme. The program is administered by the homeowners' association and all the 314 subdivision households participated in it.

In Miramar Village and Moonville Subdivision, the other two study sites in Barangay Sun Valley, households do not actively participate in the barangay program and very few households practice waste segregation. There are 190 households in these two communities and the homeowners' associations are not active in waste management. In Miramar Village, an informal market for garbage collection services exist, with young boys from the depressed areas collecting garbage door-to-door for a fee of Pesos 10 to 20 (USD 0.25 to USD 0.5) per collection, depending on the volume of wastes generated, but more often on the generosity of the household. The collected wastes are unloaded into a temporary transfer station just outside the subdivision gate, or directly into the city dump trucks. In Moonville, the homeowners' association hires a garbage truck to collect garbage only once a month and households therefore resort to other means of waste disposal like burning and illegal dumping. Barangay street sweepers also collect garbage from households, salvage the recyclables and dump the residuals at the main routes of the city dump trucks.

Household Socio-economic and Waste Management Profile

The average monthly household income in the study sites in Barangay Sun Valley is Pesos 44,024 (USD 1,100.6) which is substantially higher than the average income in Metro Manila of Pesos 25,000 (USD 625) per month (Table 3). The large deviation from the regional average may be considered reasonable since the town is a middle-income village. The average waste disposed by households is 1.8 kg/day, which is slightly higher than the mean of the study sites. The average floor area of the living quarters is 209 m^2 with the kitchen quarters accounting for 13%. There are 26 households with backyards averaging 88 m^2. On an average, households that sell recyclables earned Pesos 45 (USD 1.13) per month, an insignificant amount. Usually, the payment received for the recyclables are kept by the household helpers.

Table 3. Household Socio-economic and Waste Management Profile in Study Sites

*Variables**	*Unit*	*All Entries (n=135)*		*Brgy. Sun Valley (n=62)*		*Brgy. Barangka (n=73)*	
		Mean	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*
Income	P/month	37,823.0	30,793.0	44,024.0	33,427.0	32,557.0	27,510.0
Household size	# person	5.7	2.6	5.9	2.7	5.5	2.6
Household help	# helper	0.5	1.1	0.7	1.4	0.4	0.8
Age of household head	# year	49.0	13.0	47.0	13.0	51.0	13.0
Household head's education	# year	13.0	2.0	13.0	2.0	13.0	2.0
Household members working	# person	2.2	1.4	3.4	1.5	2.1	1.3
Total waste disposed	Kg/ hh/day	1.8	1.3	2.0	1.6	1.6	1.0
Recycling revenue (n=68)	P/month	27.0	45.0	49.0	54.0	30.0	45.0
Time spent in SWM	Min/week	52.0	50.0	73.0	55.0	34.0	37.0
House size	M^2	150	152	209	191	99	81
Kitchen size	M^2	21	19	27	25	15	11
Yard size (n=45)	M^2	66	122	88	155	36	34

* Unless otherwise stated, n=135; hh = household; Brgy = Barangay

4.1.2 Barangay Barangka, Mandaluyong City

Physical and Demographic Characteristics

In the year 2000, the city had a population of 275,106 covering an area of 26 km^2 or an average density of 9,423 persons/ km^2. The total number of households reported during the census year 2000 was 59,682 or an average household size of 4.6. Mandaluyong City has 27 barangays, four of which are Barangka barangays and two of these Barangka towns were selected as study sites, namely, Barangka Itaas and Barangka Ilaya.[11] These two sites had a combined population of 15,209 persons or 3,456 households.

Waste Management Program

In the year 2000, the solid waste management program in Mandaluyong City was launched as an eco-waste pilot program, under the leadership of the Presidential Committee on Flagship Programs and Projects. Barangka Itaas, however, is one of the few towns in the city that has an active waste management program. The program which was launched in April 2000 included waste segregation, composting, resource

[11] For study purposes, these two study sites are treated as two communities within the Barangka barangay.

recovery and vegetation. It was guided by the MMDA ordinances on waste segregation and prohibition on littering in public places and they had formulated some additional guidelines.

Garbage containers and drums were placed at drop-off points in street corners where residents could deposit their can-be-composted wastes, recyclables and residual wastes. Can-be-composted wastes were collected twice a day from the drop-off points and brought to the composting sites. Recyclables were collected once a day and were brought to the Redemption Center, while a truck hired by the barangay collected the disposable wastes in the evening. Households that were found violating the rules were reprimanded and were required to do community service.

The Barangay did not charge any garbage fee for collection services but drew from its regular budget. Recently it encountered difficulties with funds to pay the waste management personnel. It is considering collecting a garbage fee from the residents in the near future. Revenue from the sale of recyclables and composts were just sufficient to cover production costs.

The program has an active information and education campaign component that helps in promoting participation. Before launching the program, a month-long series of seminars and actual demonstrations were conducted daily in addition to the distribution of flyers and letters of instructions. There were also barangay patrols equipped with loud speakers going around the community with repeated instructions on proper waste disposal.

Barangka Ilaya households do not practice waste segregation. They rely on the city government for garbage collection services. Garbage collection is done two to three times a week. The town is currently preparing guidelines to implement the provisions of RA 9003, particularly that of waste segregation.

Household Socio-economic and Waste Management Profile

Table 3 shows that households in Barangay Barangka in Mandaluyong City, earn a monthly income of Pesos 32,557 (USD 813.93). Although substantially lower than that of the average household income in Barangay Sun Valley, this town is also considered middle class. Total household waste disposed is also lower at 1.6 kg/ day. Household heads in this town are older than those in Barangay Sun Valley and the size of living quarters is half the size.

4.2 Waste Generation and Resource Recovery

4.2.1 Wastes Generated, Recovered, Burned and Disposed

Barangay Sun Valley

On average, households in the sampled communities in Barangay Sun Valley generated 4.34 kg/hh/day or 0.77 kg/cap/day (Table 4a). Of this, food wastes comprised 28%, yard wastes 12% and mixed wastes 60%. About 45% of waste generated was disposed (legally or otherwise), 12% was burned, while the rest was recovered.

Only 36% of food/kitchen wastes were recovered and the rest was disposed of, while for mixed wastes, more than 50% of the wastes were recovered and 34% was disposed. Burning of both mixed and yard wastes were considerable - a good amount of the yard wastes in the sampled communities was burned (43%), while 12% of mixed wastes was burned.[12] Unfortunately, the study was not able to track the flow

Table 4a. Amount of Wastes Generated in Barangay Sun Valley, Paranaque

Waste Types	*Waste Components*	*Disposed*[a]		*Burned*[b]		*Recovered*[c]		*Total Generated*[d]	
		kg	*%*	*kg*	*%*	*kg*	*%*	*kg*	*%*
Food	Vegetable and fruit discards, egg shells, spoiled food, meat and fish bones, etc.	0.78 (40%)	64	0 (0%)	0	0.43 (23%)	36	1.21 (28%)	100
Yard	Grass clippings, flowers, plants, leaves, etc.	0.29 (15%)	55	0.23 (42%)	43	0.01 (4%)	2	0.52 (12%)	100
Mixed	All other wastes	0.89 (45%)	34	0.31 (58%)	12	1.41 (76%)	54	2.61 (60%)	100
Total		1.95	45	0.54	12	1.85	43	4.34	100
Waste per capita (kg/day)		0.36		0.09		0.31		0.77	

Notes: The figures refer to wastes generated per household/day. The percentages in parenthesis refer to column percentages, i.e., 40% of the disposed wastes consist of food, 15% of yard and so on. Percentages may not add to 100 because of rounding.

[a] Estimated by survey respondents in quantity (kg/day or kg/week).

[b] Estimated using data on proportion of wastes burned provided by survey respondents.

[c] Estimated using data on proportion of wastes recovered provided by survey respondents.

[d] Estimated as follows: $TWG_i = twd_i / \% d_i$, where TWG = total wastes generated of waste type *i*; twd_i = total wastes disposed of waste type *i*; and, $\%d_i$ = proportion of waste type *i* disposed.

[12] Open burning of solid waste is prohibited under R.A. 9003, while R.A. 8749 or the Clean Air Act passed in 1999 allows some type of open burning such as the traditional small scale method of community / neighborhood sanitation "siga", traditional agricultural, cultural, health and food preparation and crematoria (Implementing Rules and Regulations of RA 8749). While RA 9003 provides for penalty or fine for non-compliance, it is doubtful that the open burning prohibition can be implemented.

of the recovered wastes to estimate the proportion or amount that ended up in the recycling establishments for re-processing.

Barangay Barangka

Households in the study sites located in this barangay generated, on an average, 2.99 kg/hh/day or 0.56 kg/cap/day (Table 4b). Fifty-five percent of this waste was discarded, 3% was burned and 43% was recovered.

Among the waste types, less than 20% of the food/kitchen wastes was recovered through composting or given as food to animals and most of it was disposed of. While yard or garden wastes like grass clippings, plants, leaves, and flowers, accounted for only 7% of household wastes, 57% of most of this waste was disposed, 32% was burned, and only 11% was recovered.

All other wastes or mixed wastes accounted for 69% of the total wastes generated, more than half or 54% was recovered by households and the rest was disposed. The door-to-door collectors of recyclables who were interviewed, indicated that they re-sold the recyclables they collected to the nearby junkshops, who in turn sold them to recycling establishments.

Table 4b. Amount of Wastes Generated in Barangay Barangka, Mandaluyong

Waste Types	*Waste Components*	*Disposed*		*Burned*		*Recovered*		*Total Generated*	
		kg	*%*	*kg*	*%*	*kg*	*%*	*kg*	*%*
Food	Vegetable and fruit discards, egg shells, spoiled food, meat and fish bones, etc.	0.58 (35%)	82	0 (0%)	0	0.15 (11%)	18	0.71 (24%)	100
Yard	Grass clippings, flowers, plants, leaves, etc.	0.12 (7%)	57	0.07 (86%)	32	0.02 (2%)	11	0.21 (7%)	100
Mixed	All other wastes	0.94 (57%)	45	0.01 (14%)	0.54	1.12 (87%)	54	2.07 (69%)	100
Total		1.64	55	0.08	3	1.29	43	2.99	100
Waste per capita (kg/day)		0.31		0.01		0.23		0.56	

Notes:

[a] Estimated by survey respondents in quantity (kg/day or kg/wk).

[b] Estimated using data on proportion of wastes burned provided by survey respondents.

[c] Estimated using data on proportion of wastes recovered provided by survey respondents.

[d] Estimated as follows: $TWG_i = twd_i / \% d_i$, where TWG = total wastes generated of waste type *i*; twd_i = total wastes disposed of waste type *i*; and, $\%d_i$ = proportion of waste type *i* disposed.

4.2.2 Wastes Recovered by Material

Tables 5a and 5b provide more details on the proportion of wastes recovered by waste types based on the survey results. Households in the sampled communities of both cities recovered most of their old newspapers and glasses that were either sold or given away to door-to-door collectors and junkshops intended for recycling. A larger proportion of the food wastes in the Paranaque communities were recovered for composting, while households in the Mandaluyong communities discarded more than 50% of these wastes. It is interesting to note that middle-income households gave away more than 50% of their recyclables to door-to-door collectors (young boys in pushcarts), who in turn re-used some and sold the rest to junkshops. Plastic wastes, which have a high potential for recycling, had the highest reuse value for households, although almost half of these wastes were disposed instead of collected for recycling.

Only one-third of aluminum cans used by households were recovered by sampled communities in Mandaluyong. Most of these were given away, and the rest were disposed, while the Paranaque communities recovered 70% of aluminum cans, most of which were also given away. Most of the inert materials and hazardous wastes generated by households were discarded and this contributed to environmental degradation. While these materials comprised a small percentage of a household's waste stream, there are recycling possibilities for these wastes that otherwise would end up in the landfills/dumpsites. In order to realize these possibilities, it is necessary to know who the agents that have interests in these materials are, and how they can or why they cannot collect these materials.

4.2.3 Implications of LGU Waste Management Programs

RA 9003 requires LGUs to prepare a 10-year local government solid waste management plan which include, among others, waste reduction strategies that encompasses re-using, recycling, and composting activities. The survey results of this study indicate that for LGUs operating in middle-income communities in Metro Manila, composting of food/ kitchen wastes may be considered as one of the waste management options as less than 50% of kitchen wastes are re-used as composting material.

Household composting is normally undertaken to enhance garden soil or simply to complement gardening as a hobby, while composting at the barangay level is done to raise revenues. These wastes comprise not less than one third of total household wastes disposed into the environment, out of which about 70% is discarded as residual wastes. The management of these wastes through composting, (especially when the process includes garden wastes), can contribute substantially to the waste diversion mandate of the LGUs. Since most of the yard wastes in the sampled communities are either burned or disposed, recovery of yard wastes for composting, together with food wastes, may be included by LGUs as a more effective composting strategy.[13]

[13] Composting food wastes and yard wastes avoid messy and smelly compost which keeps pests away.

The quantity of garden waste composted was found to be the most important variable to explain household composting behavior (Sterner and Bartelings 1999). LGUs should examine other composting technologies that are available in the market (particularly vermin-culture, biogas/retort type organic waste degraders) and consider the costs, (including environmental costs) from application of the different technologies.

While more than 50% of the mixed wastes are recovered by the sampled communities, it cannot be presumed that all of this is recycled. Some of the recyclables that are given away by the households to the door-to-door garbage collectors are in fact re-used by them in their own homes. However, no data was collected to estimate this amount. For the purposes of determining the overall recycling rate, it would be necessary to track and monitor the waste flow from the source all the way to the recycling establishments (Refer to Appendix 2 on waste flow for Paranaque city).

The results on burning of household wastes, particularly yard wastes and some mixed wastes, suggests to LGUs that their solid waste management programs should discourage solid waste burning by highlighting its environmental implications. Refuse burning generates local pollutants such as particulate matter, carbon monoxide and volatile organic compounds that contribute to the already polluted air in Metro Manila brought about largely by emissions from transport vehicles and factories. These pollutants, particularly particulate matter, have been associated with health problems such as chronic respiratory illnesses that result in morbidity and mortality incidences (ENRAP 2000). In addition, the program should include information noted earlier that the composting of food wastes mixed with yard wastes has beneficial effects on the composting process as well as the composted product.

In terms of specific materials, a potential area for the promotion of recycling is the recovery of aluminum cans and plastic wastes, of which less than 50% is recovered by middle-income communities. Recycling aluminum, in particular, results in an avoided environmental cost of USD 220 in terms of air pollution emissions from producing a ton of primary aluminum (Lave et al. 1999). Paper-based wastes (except old newspapers most of which are already being recovered by households) is another area for increased waste recovery.

In the preparation of the Solid Waste Management (SWM) plans and programs, it is important for each LGU to examine the benefits and costs of each strategy, given their respective situations. This activity will help to ensure that local resources and funds are allocated to their best uses. This will require an efficient cost accounting system of its waste management program as well as keeping an eye on the market for the recyclables that are included in their programs.

Table 5a. Waste Recovery by Material in Parañaque, Metro Manila

No	*Types of wastes*	*% composition of waste **	*% of household*	*% of waste generated*					
				(1)	*(2)*	*(3)*	*(4)=(1)+(2)+(3)*	*(5)*	*(6)*
		N=62	*Generate (n=62)*	*Reuse/ Compost*	*Sell*	*Give*	*Recover*	*Burn*	*Dispose*
1	Food wastes	36	100.0	22.4	0.0	13.5	35.9	0.0	64.1
2	Old newspapers	} 12	91.9	13.8	37.9	43.1	94.7	2.6	2.6
3	Paper & cardboard		90.3	8.7	6.3	33.2	48.1	29.5	22.4
4	Plastic	11	100.0	35.3	2.2	17.6	55.1	6.5	38.5
5	Textiles	3	80.6	29.1	0.0	52.4	81.5	6.0	12.5
6	Rubber & leather	3	80.6	6.0	2.0	72.7	80.7	0.2	19.1
7	Petroleum products	–	35.5	5.5	0.0	4.5	10.0	0.0	90.0
8	Yard wastes	} 12	41.9	1.5	0.0	0.0	1.5	43.5	55.0
9	Wood		64.5	28.6	0.0	31.3	59.9	5.0	35.1
10	Aluminum cans	} 8	87.1	3.8	7.4	38.5	49.7	0.0	50.3
11	Metals		50.0	5.0	21.9	39.0	66.0	0.0	34.0
12	Glass	6	96.8	1.8	27.3	33.7	62.8	0.0	37.2
13	Inert material	} 2	37.1	13.0	0.0	13.0	26.1	0.0	73.9
14	Hazardous wastes		54.8	0.1	0.0	12.5	12.6	0.0	87.4

*Source of waste composition for Paranaque; MMDA/JICA, 1992

Table 5b. Waste Recovery by Material in Mandaluyong, Metro Manila

No	*Types of wastes*	*% composition of waste **	*% of household*	*% of waste generated*					
				(1)	*(2)*	*(3)*	*(4)=(1)+(2)+(3)*	*(5)*	*(6)*
		N=73	*Generate (n=73)*	*Reuse/ Compost*	*Sell*	*Give*	*Recover*	*Burn*	*Dispose*
1	Food wastes	45	100.0	7.5	0.0	10.2	17.7	0.0	82.3
2	Old newspapers	} 17	91.8	16.3	30.6	43.3	90.3	0.0	9.7
3	Paper & cardboard		90.4	15.3	2.9	19.9	38.1	3.7	58.2
4	Plastic	16	100.0	38.4	2.4	9.8	50.6	0.0	49.3
5	Textiles	4	94.5	23.8	0.0	37.2	61.0	0.0	39.0
6	Rubber & leather	1	78.1	0.4	1.8	48.9	51.1	0.0	48.9
7	Petroleum products	–	20.5	6.7	0.0	0.0	6.7	0.0	93.3
8	Yard wastes	} 7	26.0	10.5	0.0	0.0	10.5	32.4	57.1
9	Wood		60.3	15.2	0.0	19.8	35.0	0.6	64.4
10	Aluminum cans	} 5	79.5	1.7	5.2	23.1	30.0	0.0	70.0
11	Metals		28.8	5.7	4.8	23.8	34.3	0.0	65.7
12	Glass	3	100.0	2.0	37.0	41.0	79.9	0.0	20.1
13	Inert material	} 2	27.4	10.0	0.0	0.0	10.0	0.0	90.0
14	Hazardous wastes		23.3	5.9	0.0	0.0	5.9	0.0	94.1

*Source of waste composition for Mandaluyong: Soncuya and Viloria, 1992

4.2.4 Implications of Municipal Solid Waste (MSW) Profiling

RA 9003 requires LGUs to estimate and project by source the solid wastes generated by their municipality/city as a component of their solid waste management plan. In addition, they are directed to include in their SWM plan a waste characterization sub-component that will identify the constituent materials comprising the solid waste generated within their jurisdiction. The constituent materials will be identified by volume, percentage in weight or its volumetric equivalent, material type and source of generation (i.e., residential, commercial, industrial, government, etc.).

The basic approach to MSW profiling consists of the conduct of studies that involve sampling, waste sorting and weighing of the individual components of the waste stream. This approach is useful in establishing the baseline information on the waste stream of the municipality assuming a sufficient number of samples, for reliability purposes, can be obtained. It may also be advisable to conduct the study during the wet and dry seasons, as findings show that waste generation practices differ during these two seasons (MMDA/JICA 1998). A constraint for many LGUs to implement this approach would be its cost.[14] For the purposes of establishing baseline information, it would be advisable for those LGUs that can afford to undertake this approach to do so, particularly since the waste diversion target of 25% within five years will be based on the baseline data generated.

The approach used in this research in establishing waste generation and recovery data, is based on self-reported information, where households were asked to estimate the weight of their daily or weekly wastes disposed, and the proportions of the different waste components that they recover and/or burn. It was noted earlier, that the results using this approach are comparable to those based on sampling and actual weighing, and the estimates fall within the range of existing estimated waste generation rates. This study therefore suggests that LGUs that cannot afford to implement the sampling approach can adopt the self-reporting approach by providing the households and other waste generators a self-administered waste generation monitoring sheet to be accomplished over a specified period of time, with minimal LGU supervision. The activity however, should be preceded by an effective information, education and communication (IEC) campaign to encourage cooperation among the community members.

At the national level, the US Environmental Protection Agency (EPA) model for the characterization of municipal solid wastes in the United States is an approach that the Department of Environment and Natural Resources (DENR) can consider as part of the national solid waste management framework. The model, which utilizes a material flows approach to estimate the waste stream on a nationwide basis, is based on production data (by weight) for the materials and products in the waste stream (USEPA 1999). Several adjustments are made, such as for imports and exports, and for diversions from MSW. The production data is also supplemented by waste sampling studies to account for food wastes and yard trimmings. The EPA conducts the study periodically and in between periods, produces a waste characterization update report every year.

[14] It is estimated that the cost of implementing the sampling approach for a sample of 12 households in one barangay, including the characterization of public market and commercial wastes, would approximate Pesos 50,000 (USD 1,250).

4.3 Waste Segregation and Resource Recovery

4.3.1 Socio-economic and Waste Management-related Characteristics

Table 6 compares some socio-economic and waste management-related attributes of the sampled segregating and non-segregating households. The sampled segregating households reported higher monthly incomes compared to households not practicing waste segregation - Pesos 40,450 vs. Pesos 34,440 (USD 1,011.25 vs. USD 861) (NCR average income is Pesos 25,000 (USD 625)). On the average, non-segregating households have larger households and older household heads. The sampled households engaged in waste segregation spend on the average more than one hour a week on waste management-related activities, while those not segregating spend only half the time doing similar activities.

The average waste disposed by households that segregate is higher, 1.84 kg/day, compared to 1.71 kg/day for non-segregating households. The difference may be explained by the larger household size and the larger size of the living quarters of non- segregating households.[15] While the practice of waste segregation is intended to reduce the volume of wastes disposed by the household, this observation indicates that waste reduction is not the principle consideration for engaging in household waste segregation.

Table 6. Socio-economic and Waste Management Profile of Study Sites

Variables	*Unit*	*Segregating (n=76)*		*Non-segregating (n=59)*	
		Mean	*S.D.*	*Mean*	*S.D.*
Income	P/month	44,449.00	31,399.0	34,441.00	29,918.0
Household (hh) size	# person	5.60	2.2	5.90	3.2
Household help	# helper	0.60	1.2	0.50	1.0
Age of household head	# year	48.00	13.0	51.00	13.0
hh head's education	# year	13.00	2.0	13.00	2.0
hh members working	# person	2.20	1.2	2.20	1.6
Total wastes disposed	kg/hh/day	1.84	1.5	1.71	1.2
Recycling revenue (n=68)	P/month	47.00	62.0	14.00	23.0
Time spent in SWM	min/week	73.00	52.0	26.00	32.0
House size	m^2	144.00	158.0	157.00	145.0
Kitchen size	m^2	18.00	15.0	24.00	24.0
Yard size (n=45)	m^2	45	53	96	180

[15] An OLS regression of the quantity of total wastes disposed on house size and household size yielded positive and significant slope coefficients.

4.3.2 Attitudes and Behavior to Waste Management

Since one of the main objectives of the present study is to examine the behavior of households with respect to waste segregation and resource recovery, the following, using frequency analysis, discusses the differences and similarities in such behavior among segregating and non-segregating households in the sampled communities.

Reasons for practicing waste segregation

Most households considered cleanliness and the environment as primary concerns for engaging in waste management activities. Sixty-eight percent engaged in waste segregation because they believed the practice kept their house clean and free of house pests, while 58% thought it was good for the overall environment. Forty-five percent of those practicing waste segregation indicated they did so because it was mandated by local ordinance.

Reasons for not practicing waste segregation

Among households that did not practice waste segregation, 53% cited lack of time or a troublesome chore while 36% indicated that it was of no use since garbage collectors dumped all the wastes into the same truck. Some 19% reported storage space as a problem while 20% regarded waste segregation as not important. Only a few households cited cost as a reason for not segregating which is expected since the respondents were middle-income households.

Reasons for engaging in composting

Both segregating and non-segregating households engaged in resource recovery, primarily to get rid of the recyclables at home and to help others earn additional income; only a few households do so to earn money for themselves. Many did it as a civic duty to help in solving the garbage crisis. Households engaged in composting do so for the following reasons: 75% did it to enhance their garden soil, 35% had leisure time and they were fond of gardening, 30% did it to keep their surroundings clean and 20% did it because garbage collection services were not dependable. Household composting was not done for financial reasons.

Reasons for not engaging in composting

The main obstacle for household members not to engage in composting was the absence of a garden or yard. Another problem was the lack of time. Forty-four percent of non-segregating households were unsure of composting methods.

Most difficult part of waste management

The households were asked to identify the most difficult part of waste management. Among the non-segregating households, 42% indicated inconvenience and lack of time and 17% cited storage place as a problem. Among the households practicing waste segregation, 33% cited storage place while 32% cited inconvenience and time availability.

Most important factor for successful community waste management

The sampled households were asked to identify the most important factor to ensure a successful waste management program. The results showed that a disciplined and active community was necessary for successful waste management, whether they were practicing waste segregation or not, while 22% cited the need for an intensive information and education campaign to motivate residents' participation. Two other factors - the presence of a strong advocate of proper waste management practices and government leadership - were considered not important.

Role of household members in waste segregation

Almost half of the households practicing waste segregation indicated that the mother was in charge of waste segregation. Only 17% of the households that had household helpers, indicated that the helper was in charge of waste segregation. It was common for household members to take turns in the responsibility. It would be interesting to make a study on the limited responsibility of the household helper's role in waste segregation, considering the time involved in the activity.

Resource recovery practices

Almost all of the segregating households gave away their recyclable wastes, while 87% of those not segregating gave away their recyclable wastes. Only 50% of segregating and 55% of non-segregating households, sold their recyclables, mostly to door-to-door collectors or to junkshops. The majority of these middle-income households returned their used bottles with deposit. Only 3% of segregating households reported that they transformed their recyclables into useful products like handicrafts.

Responsibility over garbage collection

The majority of the segregating households and almost half of the non-segregating households believed that garbage collection was a joint responsibility of the government and the residents. However, more non-segregating households considered that garbage collection was solely a local government responsibility.

Willingness to pay garbage fee

Households that were not paying any garbage fees were asked if they would be willing to pay a garbage collection fee if regular collection services were provided. Sixty-four percent of waste segregating households were willing to pay a fee while a higher number (83%) of non-segregating households responded positively to the question.

Preference for basis of payment of garbage fee

The households were not asked the amount they would be willing to pay as garbage fee since this would have entailed a more rigorous formulation of the question, but instead were asked what they thought should be the basis of the fee. Out of the 110 households that responded, the majority of both segregating and non-segregating households preferred a flat fee while about 24% indicated a volume-based fee.

Table 7. Household Attitudes and Behavior to Waste Management in Barangay Sun Valley and Barangay Barangka

	% of household	
	Segregating	*Not segregating*
Reasons for practicing waste segregation	(n=76)	
House kept clean and free of cockroaches and other pests	68	NA
Good for the environment	58	NA
Mandated by city/ municipality ordinance	45	NA
Recyclables sold or given away	34	NA
Composting of food/kitchen waste	16	NA
Reasons for not practicing waste segregation		(n=59)
No time/ inconvenient	NA	53
No segregated collection	NA	36
Not interested/not important	NA	20
No space at home	NA	19
Expensive	NA	9
No knowledge of segregation	NA	5
Reasons for engaging in composting	(n=20)	
Enhance garden soil	75	NA
Fond of gardening	35	NA
Keep surroundings clean	30	NA
Garbage collection not reliable	20	NA
Save on disposal costs	15	NA
Earn money from sale of fertilizers	0	NA
Reasons for not engaging in composting	(n=56)	(n=59)
No garden	61	49
No time/inconvenient	29	27
Kitchen wastes given away/kitchen wastes being collected	21	7
No knowledge of composting	13	44
Bothersome/inconvenient	13	15
Most difficult part of waste management *	(n=76)	(n=59)
Finding a storage place	33	17
Time consuming/inconvenient	32	42
Not a problem/not difficult	22	17
Obtaining information about waste management	7	5
Non-collection of garbage	5	14
Costs money	0	3
Selling of recyclables	0	2
Most important factor for successful community waste management *	(n=76)	(n=59)
Active participation of the community	57	51
Intensive education and information campaign	24	22

Rely on government to lead and be the model	10	12
A strong community advocate	9	15
Role of the household members in waste segregation	(n=76)	
Mother	47	NA
Maid	17	NA
All members of the household	17	NA
Daughter or son	26	NA
Father	11	NA
Resource recovery practices	(n=76)	(n=55)
Give away	99	87
Return bottles with deposit	61	64
Sell recyclables to outsiders	50	55
Transform into useful products	3	0
Reasons for engaging in resource recovery activities	(n=76)	(n=55)
Get rid of wastes	66	76
Good for the environment	66	51
Help in current garbage crisis	54	40
Help others in raising money	43	51
Earn additional money	16	29
No truck collecting garbage	15	11
Area prone to flooding	11	6
Responsibility over garbage collection *	(n=74)	(n=59)
Joint responsibility of household and government	66	46
Responsibility of local government	19	37
Responsibility of household	15	17
Willingness to pay garbage fee (among those not currently paying) *	(n=33)	(n=35)
Yes	64	83
No	36	17
Preference for basis of payment of garbage fee*	(n=59)	(n=51)
Flat fee/household	71	65
Pay by volume	24	29
Pay by weight	2	6
Pay by size of household	2	0
Pay by size of lot area	2	0

* categories are mutually exclusive.

Note: The responses in percentage are arranged from highest to lowest for purposes of presentation. Percentages may exceed 100% because of rounding.

4.3.3 Determinants of Waste Segregation and Composting

Definition and expected signs of independent variables

The probability of household waste segregation and composting behavior is modeled as a function of three sets of variables, i.e., socio-economic household characteristics (INCOME, AGE, HHSIZE, DYARD); household waste management-related attributes (TOTWASTE, FOODWASTE, REVENUE, DMOTHER, DATTITUDE, DFEE), and a community waste management-related feature (DORD). These variables are briefly defined with their expected signs in Table 8. Most of these variables have been found to be significant in empirical studies examining the demand for waste collection services and the probability of household recycling and composting (Jenkins et al. 2000; Sterner and Bartelings 1999; Hong et al. 1993).

Some of these variables warrant some discussion, particularly in terms of what data was collected before the results of the regressions were presented. The variable INCOME reflects the total income of all working household members and from all sources, including remittances from abroad.[16] The survey also collected information on 13 categories of household expenditures as a cross-check for income. Since income data obtained from surveys is usually under-reported for obvious reasons, and some households refused to report their income, the income data used in the regressions is the higher in the two data sets. The empirical evidence on the relationship of income and demand for solid waste services and the probability of recycling is mixed, hence, the expected sign may be positive or negative (Hong et al.1993, Sterner and Bartelings 1999; Reschovsky and Stone 1994; Jenkins et al. 2000).

Households were asked about the size of their yard or garden but the estimates did not seem reasonable. It was therefore decided to create an indicator variable for yard (DYARD with 1=presence of a yard) to explain waste segregation and composting behavior. It is expected that the presence of a yard is more likely to influence a household to engage in waste segregation and composting because of the storage space it provides.

The variable TOTWASTE is the sum of the quantity of food/kitchen wastes, yard wastes and mixed wastes disposed as reported by the households during the survey. It is expected that the more wastes a household generates, the more it disposes, and the higher the probability of it engaging in waste management activities, all other factors being constant, because of the need to manage its wastes and therefore creating a positive relationship between these two variables. The variable REVENUE is the total earnings received by the household from selling its recyclables. It is expected to have a positive sign since a household may be induced to engage in waste segregation if it can earn additional income from selling recyclables.

[16] While the sampled households included in the study represented middle-income households, income was included as an explanatory variable in view of the large variation in income observed among the sampled households (see Table 3).

DMOTHER and DATTITUDE are indicator variables that attempt to capture the influence of time on household waste management behavior. The role of the mother in household waste management in developing countries has been found to be substantial and therefore her employment status can influence the probability that a household will adopt waste segregation and composting practices (MMDA/JICA 1998; CIDS 1995). DATTITUDE is a variable for the household's perception regarding waste management where 1=waste management is time consuming and inconvenient. Both variables are proxy variables for the value of time or the opportunity cost of time spent in the house. Similarly, a household that regards waste management activities as inconvenient will not be inclined to adopt waste segregation and resource recovery activities. Both variables therefore are expected to have negative signs.

Some sampled households are paying garbage fees (i.e. flat), either through their homeowners' association or directly to garbage boys. An indicator variable DFEE is included in the model to examine whether household waste segregation behavior is influenced positively or negatively by this garbage fee. Since the fee is flat, it is predicted that households paying a fee would exert less effort to manage their wastes and engage in waste segregation since they are already paying a fee and thus expect others to do the waste segregation for them. The expected sign of DFEE is therefore negative.[17] The indicator variable DORD represents the presence of a local ordinance in the village mandating waste segregation and the expected sign is positive.

Table 8. Definition and Expected Sign of Explanatory Variables

Independent variable	*Definition*	*Expected sign*
INCOME	Household monthly income (pesos)	+ / -
AGE	Age of household head (# of years)	+ / -
HHSIZE	Number of household members (# of persons)	+ / -
DYARD	Indicator for presence of yard	+
TOTWASTE	Total waste disposed (kg/hh/day)	+
FOODWASTE *	Total food waste generated (kg/hh/day)	+
REVENUE **	Total revenue from selling recyclables (pesos/month)	+
DMOTHER	Indicator for employed mother	-
DATTITUDE	Indicator for convenience of waste segregation	-
DFEE	Indicator for hh paying garbage collection fee	-
DORD	Indicator for existence of local ordinance	+

* included as explanatory variable in waste composting model only
** included as explanatory variable in waste segregation model only
Note: hh = household

[17] If the fee is a unit price, the expected sign would be positive, i.e., a higher fee would induce a household to segregate in order to reduce the quantity of waste it disposes for collection.

Regression Results

The regression results are shown in Tables 9 and 10. In order to provide a more intuitive interpretation of the regression coefficients shown in Table 9, Table 10 gives the estimated marginal effects of the variables that are statistically significant. The coefficients shown in Table 10 can be interpreted as the change in the probability of household waste segregation or composting behavior with respect to a unit change in the independent variable, calculated at mean values. In the case of indicator or dummy variables (i.e., DYARD), this implies that the probability of household waste segregation or composting increases when the household has a backyard. Two probit equations were estimated to explain household waste segregation and waste composting behavior separately.

The regression results show that for the waste segregation equation (W_SEGRTE), the variables DMOTHER, DORD, AGE, TOTWASTE and DFEE are statistically significant and therefore explain household waste segregation behavior at varying levels of confidence. For the equation explaining household composting behavior (ENGAGE_C), the variables DYARD, FOODWASTE AND DORD are significant in explaining composting behavior. The variable REVENUE in the waste segregation equation has the correct sign but it is not statistically significant, implying that earning additional income from selling recyclables is not important in the household's decision to engage in waste segregation.[18]

Among the socio-economic variables, only the variable AGE of the household head has a significant effect on the probability of adoption of household waste segregation practices. The negative coefficient implies that the older the household head, the lower is the probability the household will engage in waste segregation. This result is consistent with some empirical studies that show a negative relationship between the age of household head and the probability of recycling and composting. The negative coefficient may be explained in the following fashion - older people are more resistant to changing their ways of doing things around the house, and since waste segregation and composting may be considered relatively new waste management practices, the households with older household heads are less likely to engage in waste segregation.

As expected, the indicator variable DYARD (Y=1 if household has a backyard) is positive and highly significant in explaining household waste composting behavior. This result supports the observation made earlier that households considered not having a yard as an important reason for not composting. Table 10 reveals that having a backyard increases significantly the likelihood of household adoption of composting practices by 29%. The quantity of food wastes (FOODWASTE) generated by the household has a significant influence on the decision to engage in household composting.

[18] The average revenue from selling recyclables earned by those engaged in this activity is only 27 pesos (USD 0.68) per month which represents an insignificant portion of total household income (see Table 3).

Table 9. Coefficient Estimates of Probit Regression for Waste Segregation and Composting

Independent Variables	*W_SEGRTE*	*ENGAGE_C*
CONSTANT	-0.724 (-0.922)	-2.150 (-3.275) *
INCOME	0.272E-05 (0.555)	0.651E-05 (1.600)
AGE	-0.203E-01 (-1.878) ***	0.436E-03 (0.437)
HHSIZE	-0.932E-01 (-1.625)	-0.511E-01 (-0850)
DYARD	-0.963E-01 (-0.272)	1.052 (3.677) *
TOTWASTE	0.216 (1.670) ***	-0.268 (-1.495)
FOODWASTE	Variable not included	0.869 (-1.927) ***
REVENUE	0.685E-03 (0.164)	Variable not included
DMOTHER	-0.674 (-2.001) **	-0.270 (-0.988)
DATTITUD	-0.355 (-1.068)	0.428 (1.488)
DFEE	-0.614 (-1.724) ***	-0.161 (-0.518)
DORD	2.461 (3.752) *	0.736 (1.780) ***

* significant at 99% confidence level
** significant at 95% confidence level
*** significant at 99% confidence level
t-values are in parenthesis
Variables preceded by "D" are dummy variables

Table 10. Marginal Effects of Significant Variables of Probit Regression for Waste Segregation and Composting

Independent Variables	*W_SEGRTE*	*ENGAGE_C*
IAGE	-0.374E-02 (-1.753) ***	
DYARD		0.292 (3.366) *
TOTWASTE	0.398E-01 (1.746) ***	
FOODWASTE		0.218 (1.876) ***
DMOTHER	-0.138 (-1.871) ***	
DORD	0.399 (5.405) *	0.149 (2.278) **

* significant at 99% confidence level
** significant at 95% confidence level
*** significant at 90% confidence level
t-values are in parenthesis
Variables preceded by "D" are dummy variables

The variable TOTWASTE is positive and significant, implying that the more wastes a household generates, the higher is the probability that it will engage in waste segregation as it may be motivated to manage its wastes. The coefficient of the employment status of the mother of the household (DMOTHER, Y=1 if the mother is employed) is negative and significant and thus implies that the probability a household will adopt waste segregation practices decreases when the mother of the household is employed. The result supports both the observations made earlier that the mother of the household has a significant role in household waste management, and that the time spent by the mother in the household is an important factor in explaining adoption of waste segregation. The probability that a household will adopt waste segregation practices decreases by 14% if the mother of the household is employed.

The variable DFEE is negative and significant. This result is interesting in terms of its policy implication since it suggests that a flat garbage fee as part of a community's solid waste management program will not encourage households to segregate its wastes. A household that pays a fee (flat) would be expected to exert less effort to manage its wastes.

The variable DORD is highly significant and positive in explaining waste segregation and composting behavior of households. The marginal effect of having a local ordinance in influencing the behavior of households with respect to the adoption of waste segregation and composting practices is also highly significant and quite substantial. The issuance of a local ordinance in a community increases the probability of adoption of waste segregation and composting practices by 40% and 15%, respectively.

4.3.4 Implications of LGU Waste Management Programs

The following insights and directions for LGU waste management programs are drawn from the results of the frequency and regression analyses of household waste segregation and composting behavior. It should be noted that these observations may only apply to households in middle-income, highly urbanized communities.

a) There is some evidence from the regression results that the garbage fee that households in the sampled communities pay in exchange for regular waste collection, is providing a disincentive to engage in household waste segregation. This behavior is expected as what is charged for the service is a flat fee rather than a variable fee. Households paying the fee are no longer inclined to manage their wastes since they are already incurring a cost. LGUs that are planning to charge garbage fees for the collection services they provide, should consider this observation and explore the possibility of charging variable fees if the objective is to promote waste segregation and recycling. Under a variable or unit price system, the waste generators pay according to the amount they dispose. This provides an incentive to reduce the wastes they set out for collection by engaging in resource recovery activities.

b) The results confirm the observation made in earlier studies, that time is an important dimension of household waste management. Therefore, the availability of time of household members, especially the mother, can pose a constraint in the adoption of household waste segregation activities. Community waste management programs should stress the trade-offs between time and the benefits from the adoption of such practices, in addition to educating the other members of the household on waste segregation practices in order to encourage them to cooperate. At the same time, LGUs should be oriented towards making their programs convenient to the participants, i.e., a curbside recycling program is seen as more convenient than a drop-off program.

c) LGUs that promote composting of food/kitchen wastes in their waste management programs should consider the fact that the presence of backyards influences the waste composting decision of the household. More importantly, however, even households with backyards can be motivated to donate their can-be-composted wastes for community composting. Community composting programs therefore should ensure that the food and kitchen wastes of the residents are collected regularly, preferably twice a day or at least once a day.

d) The issuance of a local ordinance positively influences a household's behavior with respect to its waste management practices. In addition to the Metro Manila-wide ordinances issued by the MMDA, local ordinances at the barangay level would encourage compliance to the city/municipality-wide ordinances.

e) The following attitudes and behavior of middle-income households towards waste management are important to be considered by the LGUs in the design of their SWM programs. Firstly, households consider the active participation of the community residents as the most important factor for a successful SWM program. Secondly, households believe

that waste management is a joint responsibility of the government and the community. Thirdly, households that are not presently paying for garbage collection services are willing to pay for such services if they are assured of regular collection. Fourthly, many households give away, rather than sell, their recyclables to get rid of them.

4.4 Waste Collection

There are some striking differences in the waste collection systems in the study sites such that it may be useful to examine more closely this aspect of waste management in these communities, particularly in view of the results of this study presented earlier.

4.4.1 The Role of Active Community Participation in Annex 41 Subdivision, Barangay Sun Valley, Paranaque City

Annex 41 has 314 homeowners all of whom are active participants of the barangay's waste management program. It is one of the few communities of Barangay Sun Valley that has adopted waste segregation as a daily habit and as mentioned earlier, is the model community of the barangay's program on total segregation approach to ecological waste management.

The waste collection system in this community is coordinated by the homeowners' (HO) association with the support of the Barangay government and thus, follows strictly the Barangay's waste management program. Biodegradable wastes are collected twice a day and recyclables on a daily basis by "biomen" using pedicabs who are employed by the barangay, while the residual wastes are collected once a week on Saturdays by the city garbage trucks. The biodegradable wastes are brought to the eco-center and sold to the barangay for composting and the recyclables are stored and sold by the HO association that has links with a network of junkshops and waste recycling plants. The schedule for the collection of recyclables and residual wastes is shown in Table 11.

Although households do not get paid for their can-be-composted and recyclable wastes, there is no separate service fee charged for the collection services provided by the association. There is, however, a flat garbage fee of Pesos 25 (USD 0.63) that homeowners pay on a monthly basis included in their Pesos 125 (USD 3.13) monthly association dues. The revenues from the sale of the composts and recyclables are used to maintain the salaries

Table 11. Schedule for Collection of Types of Wastes

Day	*Types of wastes*
Monday	Old newspapers, other paper-based wastes
Tuesday	Glass
Wednesday	Plastics
Thursday	Aluminum cans, metals
Friday	Textiles, rubber, leather
Saturday	Residuals, disposable wastes

of the biomen, who in addition get a 50% commission from the sales. During the first three months of the year 2001, the revenues averaged Pesos 1,612 (USD 40.3) per month. Thus, the collection system is a financially self-sustaining activity.

To ensure that the basic program concepts of segregation at source, segregated collection and segregated destination are complied with, non-segregated wastes are not collected. Recyclables like cans and plastics have to be cleaned and dried, and segregated wastes that do not follow the collection schedule are not collected. Compliance is high and homeowners are satisfied with the workings of the system.

4.4.2 The Role of the Informal Market in Marimar Village, Barangay Sun Valley, Paranaque City

Marimar Village has 165 households divided into two sub-villages with the same waste collection system. The barangay's total segregation program is not active in this community, although there were attempts by the barangay to implement the program in the community earlier on. A probable reason, according to some respondents, is the apparent lack of cooperation on the part of the leadership of the homeowners' association.

Notwithstanding the inactive participation of the village in the barangay's program, a system of waste collection exists in the village that consists of an informal arrangement between the homeowners' association and some young boys residing in the depressed areas outside the town. This arrangement is made because the community cannot rely on the city garbage trucks for regular garbage collection. Most of the households do not practice waste segregation since they claim that no segregated collection is done by the city trucks. Instead, the waste segregation is done at a transfer station just outside the subdivision by the young waste collectors who dump and sort the mixed wastes to collect recyclables. Some of the garbage is brought directly to the city dump trucks parked at the nearby transfer station.

The young waste collectors are allowed to enter the village to collect the household garbage door-to-door using pushcarts. Collection is done 3-4 times a week for two hours daily. On the average, households pay Pesos 10 to 20 (USD 0.25 to 0.5) per collection, depending on the number and size of the bag discarded. According to the survey results and the collectors who were separately interviewed, although there is an unwritten agreement on the price agreed by the households and the waste collectors, the final payment depends on the generosity of the households, some of whom pay as much as Pesos 400 (USD 10) per month.

In this informal market for garbage collection services, the waste collectors earn on the average Pesos 100 (USD 2.5) per collection day for a two-hour work four times a week. The average garbage fee paid by the household is Pesos 93 (USD 2.3) per month.[19] The

[19] In terms of affordability, the Metropolitan Manila Development Authority (MMDA) estimated that the affordable maximum level of user charges from the point of view of Metro Manila's low income group is Pesos 40 (USD 1) per month which represented about 1% of the minimum monthly wage income in 1997 at the time the study was implemented (cited in WB 1998).

average price paid for garbage collection services was estimated using the data on quantity of garbage collected and garbage fee paid. The estimated average implicit price of Pesos 2.25 (USD 0.06) per kilogram of wastes can be taken to reflect an approximation of the household's willingness to pay for garbage collection services.

4.4.3 The Role of Local Government Leadership in Barangay Barangka Itaas

Barangay Itaas in Mandaluyong City has 2,482 households, of which 70% are practicing waste segregation. The town is one community by itself without any subdivisions or villages. The barangay government spearheads the program that was launched in April 2000.

The barangay program is guided by the ordinances of the MMDA with some modifications. The residents are required to bring their segregated garbage to specified drop-off points that are situated in most of the street corners. Each drop zone has a covered drum for can-be-composted wastes, trash hangers with four plastic sacks for recyclable papers, cartons, bottles and steel, and a garbage cage made of plastic net, steel and round bars to store disposable wastes to prevent animals from scattering the trash. Residents are allowed to throw their wastes only from 6pm to 11pm after which the barangay truck collects the disposable wastes. The can-be-composted wastes are collected from 6am to 8am daily, while the recyclables are brought to the redemption center for storage until there is sufficient for sale. Non-compliance of any of the regulations will subject the violator to one day of community service, accompanied by a reprimand from the barangay leaders.

The barangay has a composting center where the 700 kilograms of wastes collected daily are brought for composting. It has an electric composting machine, where leftover food and kitchen wastes are mixed with coconut husks and other catalysts. The mixture is then preserved for seven days. The fertilizer produced is used in growing vegetables and ornamental plants in the green house while any excess fertilizer is sold. According to the barangay officer interviewed, before the program was implemented, two to three trucks were needed to collect the daily garbage of the community. At present, only one truck a day is sufficient. The program has resulted in an avoided collection and hauling cost of Pesos 10,440 (USD 261) monthly.

The local government of Barangka does not collect any garbage fee for the services provided to the community. However, it is seriously thinking of imposing a garbage fee as it has recently been having difficulty sourcing funds to pay the personnel of the program. A fee of Peso 1 to Pesos 5 (USD 0.03 to USD 0.13) per month is being considered. While it realizes that this is a very small amount, the barangay believes that the payment of a garbage fee will improve the participation of the residents in the program.

4.4.4 Implications of the Collection of Household Garbage Fees

The three systems of garbage collection described below provide some insights into the possible approaches the LGUs can undertake to comply with RA 9003 that mandates them to collect garbage fees for collection services rendered to waste generators.

a) Organized communities have the capability to implement their own garbage collection systems, including fee implementation. This approach should be encouraged as long as the privately-collected garbage is appropriately disposed. There are many such community-based collection systems being implemented in Metro Manila where the common ingredient for success is the combined leadership of the homeowners' association and the active participation of the residents in the program. Given the limited resources of the local governments, this will allow LGUs to put more attention and resources into the provision of waste collection services to low income and depressed communities.

b) There is a potential for LGU-implemented garbage collection fee systems in middle-income communities where households are already paying garbage fees. LGUs deciding to implement their own garbage collection fee system can therefore expect little resistance from these households to pay the fee. It is important, however, that the services promised are delivered regularly to ensure sustainability of the system.

c) The Barangka Itaas garbage collection system is a demonstration of LGU leadership in waste management, complemented by a disciplined and cooperative community. The program appears to be effective in terms of diverting wastes from the dumpsites. Furthermore, the composting center is active and self-sustaining.

5.0 BENEFITS FROM RESOURCE RECOVERY

The resource recovery activities of households such as re-using, composting, and selling recyclables are expected to result in a reduction in the volume of wastes that is collected and discarded into final disposal sites. The potential and immediate economic benefits of the waste diversion that result from household resource recovery activities would thus comprise of the avoided cost of waste collection and disposal, less the net cost of implementing the resource recovery activities.

Waste collection and disposal costs have both market and non-market components. The market component includes direct payments for hauling and disposal services. The non-market component consists of the environmental costs of waste collection and disposal such as threats to public health from exposure to pollution, aesthetic problems and road congestion from large hauling trucks. The environmental impacts avoided from diverting recyclables such as glass, plastics, paper, etc. away from the disposal sites are not readily obvious. However, some examples may show the potential impacts these recyclables may have when discarded in disposal sites.[20] (Personal communication, A. M. Freeman, Dec. 2000). Another category of environmental costs is the associated pollution from the extraction of virgin materials.

[20] For example, paper decomposes in the presence of water and oxygen and may contain traces of dioxin, while plastics can also decompose and/or leach out chemicals, including chlorinated hydrocarbons, which might escape from the disposal sites and pose risks to public health and vegetation.

The net costs of implementing the resource recovery activities would consist of private and environmental costs that arise from reusing, composting and selling recyclables less the revenue from the sale of recyclables and the net costs from the activities of the junkshops and recycling establishments.

Linis Ganda, the national resource recovery program active in Metro Manila (see footnote 9 on Linis Ganda), could not provide information on the program's operational costs and revenues. It was also difficult to get costs and revenue data from the junkshops and recycling establishments. It may be reasonable to assume, however, that the private and environmental costs of the resource recovery activities done at the household level such as reusing, composting and selling recyclables are minimal. With respect to the costs arising from the activities of junkshops and recycling plants, this is an area for empirical research.

Very few studies are available that have estimated the environmental costs of solid waste disposal. Two United States-based researches provide estimates of USD 67 to USD 75 per ton of wastes disposed in sanitary landfills (Repetto et al.1992). The authors observed that these estimates were of the same approximate magnitude as the market costs of wastes disposed in the United States. In quantifying the benefits of a pay-per-bag pricing system, they assumed that the environmental costs are equal to market disposal costs.

In developing countries, the physical magnitudes of the environmental impacts from disposal sites can be expected to be larger than in the United States because most of these sites are open dumps, and thus, the environmental costs avoided from waste recovery are expectedly higher. However, the monetary valuation per unit of environmental impact (using willingness-to-pay valuation or WTP) is likely to be less because the WTP to avoid the impacts is lower in developing countries due to lower incomes (Personal communication, A. M. Freeman, Dec. 2000). Given the very poor disposal practices in the Philippines, it may thus be reasonable to assume that the environmental costs per unit are greater than the private costs. The estimate of the environmental cost of waste disposal given in Table 12 assumes that the non-market or environmental cost per ton of waste disposed is twice the private cost per ton, which the study considers a conservative assumption.

The estimates in Table 12 of the private collection and disposal costs saved as a result of waste diversion suggest that in 1999, about Pesos 157.0 million (USD 3.93 million) was saved by the different local governments in Metro Manila through the resource recovery activities of Linis Ganda. At the local level, the implementation of the Muntinlupa Eco-waste program is projected to result in a savings of Pesos 3.5 million (USD 0.09 million) per year over the next five years. The inclusion of the non-market disposal costs avoided results in a substantial increase in the estimated economic savings from waste diversion. The social cost (private + external) avoided in 1999 as a result of resource recovery activities is estimated at Pesos 471 million (USD 11.78 million) and Pesos 14 million (USD 0.35 million) for the national and local programs, respectively.

Table 12. Estimates of Economic Savings from Waste Diversion Using Benefit Transfer, Metro Manila, 1999

Types of disposal costs saved	*Linis Ganda (national)*	*Muntinlupa Eco-waste Management Program (city-based)*
Market (private) disposal costs saved		
- million pesos	157.0	3.50
- million USD	3.9	0.09
Non-market (external) disposal costs saved		
- million pesos	314.0	10.50
- million USD	7.8	0.26
Net benefits from household resource recovery activities		
- million pesos	Positive	Positive
- million USD		
Total		
- million pesos	471.0	14.0
- USD	11.7	0.35

Notes on data sources and assumptions:

1. The average disposal cost/ton used is Pesos 1,600 (USD 40) in Metro Manila and Pesos 534 (USD 13.35) in Muntinlupa, using MMDA data.
2. It is assumed that the non-market disposal cost is two times the market cost.
3. Net benefits from household resource recovery activities are assumed to be positive. This assumption excludes those from junkshops and recycling establishments.
4. Exchange rate: 40 pesos = 1 USD.

The resource recovery activities of the household can also result in avoided environmental costs of primary production of materials in terms of saved energy and resource inputs as well as avoided pollution and degradation. For example, the production of a ton of primary aluminum in the United States is estimated to exact an environmental cost due to air emissions of USD 220, while those for metal is somewhat lower (Lave et al. 1999). In the Philippines, the external cost of logging a cubic meter of virgin log is estimated at Pesos 37,000 (USD 925) in 1997 (ENRAP 2000). This cost is only in terms of foregone value of rice production caused by soil erosion and sedimentation from logging. It is important, however, that in quantifying the net benefits from re-processing aluminum and logs, the accounting of the environmental costs of recycling these materials is not left out. Unfortunately, no additional data is available to allow an exhaustive estimation of these benefits.

6.0 CONCLUSION AND RECOMMENDATIONS

The adoption of a national policy of solid waste avoidance and volume reduction enunciated in RA 9003 is in response largely to the growing scarcity of landfill disposal sites arising from rapid urbanization and the "not-in-my-backyard" or NIMBY attitude of the public. This public opposition against the landfills sited in their area was demonstrated strongly in the recent garbage crisis in Metro Manila where communities prevented garbage trucks from disposing Metro Manila wastes in the temporary landfill in Antique Province. This opposition was also demonstrated in the San Mateo landfill and Payatas dumpsite that resulted in the illegal dumping of wastes everywhere in the city.

The provision of the new law that requires local government units (LGUs) to divert at least 25% of solid wastes generated within the next five years, draws largely from this experience as well as similar situations in the past couple of years in the Greater Metro Manila area. The directive will require the LGUs to undertake very aggressive resource recovery and recycling programs in their respective cities and municipalities. The law does, however, provide for mechanisms to help local governments meet this waste diversion target, one of which is the mandatory waste segregation at source. This provision is intended to directly support and promote waste management practices that reduce the volume of wastes brought to final disposal sites. Some of these practices include waste minimization, reusing, recycling and composting.

The provision on mandatory waste segregation at source, however, is a difficult task for the local governments (who are mandated to enforce it) as well as to the households (who are mandated to implement it). Various ordinances at the local level have been issued in the past by the local government units in Metro Manila cities like Makati, Manila, Pasay, Quezon, Mandaluyong and Muntinlupa, requiring households and businesses to implement waste segregation. So far these ordinances have not been implemented for one reason or another.[21] As mentioned above, the MMDA itself has formulated ordinances, with corresponding fines and penalties, for the proper disposal of garbage that require households and businesses to segregate their wastes.

The survey results of the present study indicate that mandating households to segregate their wastes through local ordinances are important to promote compliance. In addition, it is necessary that the community residents are made aware of the benefits of waste segregation for them to engage in a waste management program. It is important too, that the problems in implementing waste segregation and resource recovery are considered when designing community programs. A major obstacle to the proper implementation of waste segregation is the unreliable and inappropriate garbage collection services provided by the LGUs. Segregated wastes are collected and dumped in the same garbage truck with all other wastes.

[21] Only recently, the MMDA issued an ordinance that directed garbage trucks not to collect non-segregated wastes, effective July 16, 2001 with strict penalties if violated, as provided by RA 9003.

The new law puts the greater burden of improved solid waste management on to the local level. Thus, local government units, particularly at the municipality and barangay levels, need to provide the leadership in their solid waste management projects. Many civic-minded middle-income communities believe that garbage management is the joint responsibility of the government and waste generators. Many households are willing to shoulder this responsibility by paying for collection services. Local governments need to consider this valuable attitude of the communities in their designs of solid waste plans and programs.

One area where local government units should focus on, is financial management in view of the provision of RA 9003, that directs the LGUs to collect fees from waste generators for solid waste management services provided, as well as the perennial problems of lack of funds to implement local programs. Solid waste collection and disposal has traditionally been a (local) government responsibility and as such, SWM is considered good for the public. In principle, however, the service cannot be considered strictly good for the public since waste generators can be excluded from the benefits of collection services if they fail to pay for it. The LGUs should therefore see RA 9003 as an opportunity to finance their SWM projects on a cost recovery basis to enable them to use the funds to improve the SWM services they provide to the public.

The LGUs should also note that the mandate to collect garbage fees allows them to implement a user charge system wherein waste generators are charged according to the amount or volume of wastes collected for disposal (Bennagen 2001). This user charge[22] or unit pricing system is preferred over a fixed or flat pricing system as it provides incentives to waste generators to use waste management services efficiently. Under a unit pricing system, waste generators are faced with a positive marginal cost of waste disposal, that is, there is an incremental cost for them to dispose additional wastes, unlike a fixed pricing system where waste generators pay the same fee, regardless of the quantity of wastes disposed. In order to implement its service fee collection mandate effectively, the LGUs need to upgrade its cost accounting and financial planning capabilities to ensure the design of an efficient rate structure.

The following conclusions are drawn from the analysis of household waste management behavior and practices in middle-income communities in Metro Manila, implemented by this study. These conclusions are consistent with, and support, the policy goals of the new law on integrated solid waste management, in particular, the policy objectives of waste diversion, waste segregation and recovery, and cost recovery.

a) There is room for promoting increased resource recovery at the household level, particularly in the area of composting of biodegradable wastes and recovery of recyclable materials, such as aluminum cans, paper-based wastes (other than old newspapers) and plastic wastes. The benefits and costs of engaging in these activities, however,

[22] In principle, the user charge should be set to equal the marginal damage from waste disposal. However, data availability is a major constraint in the estimation of the marginal damages; moreover, RA 9003 only allows cost recovery with reference to operational and administrative costs.

have to be examined before LGUs undertake them on a full scale, particularly in terms of available technologies and potential markets for the products, as well as their potential environmental costs.

b) Middle-income households are willing to pay garbage fees when assured of regular collection services. In setting garbage fees, LGUs must note that most households would opt to pay flat rates over variable fees. However, a flat garbage fee may not induce households to engage in waste segregation as indicated by the results of this study. LGUs therefore must explore unit pricing of garbage schemes that charge waste generators according to the amount of wastes they dispose. In order to design an effective fee collection system, the LGUs must upgrade their cost accounting and financial planning capabilities to ensure a rate structure that will meet its objectives.

c) A good baseline information on waste management-related concerns is required for effective waste management and decision-making at the local level. The following information - quantity of wastes generated, collected and disposed; quantity of wastes diverted by households, waste collectors and other agents; amount of wastes illegally dumped; amount and types of materials re-processed in recycling plants - are important to assist LGUs in managing their waste diversion targets. Financial information on costs and revenues of SWM programs are necessary in setting up garbage collection fee structures.

In designing their solid waste management programs, LGUs must be aware that waste management is an activity that requires time and effort on the part of the household. The SWM program therefore, must emphasize the benefits to the community as well as to the household, of the adoption of improved solid waste management practices. It would be useful for LGUs that embark on waste segregation and resource recovery programs, to estimate the potential economic savings they can derive from their activities, and use this information to solicit the cooperation of the communities. They must stress to the residents that any financial resources saved would mean available resources for non-SWM basic services such as health and education. At the household level, the SWM program should demonstrate the benefits of waste segregation and composting in terms of cleaner household premises that promote better health conditions of household members.

Lastly, local ordinances (i.e., barangay-level) are important in promoting compliance to city-wide solid waste management rules and regulations. An aggressive information and education campaign should follow the issuance of the ordinance.

In summary, there are no hard-and-fast rules for LGUs to follow in designing and implementing their SWM programs. LGUs should be creative and adapt their programs to the resources at hand. A high-quality database is a good start. A disciplined and cooperative community should be considered a resource by itself that should be tapped to ensure an effective SWM effort. With RA 9003, there should be no hesitation or apprehension on the part of the LGUs to impose garbage collection fees, as the directive to do so is unambiguous. They should look at this mandate as a window of opportunity to finance their SWM activities and to help them achieve their waste diversion targets.

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APPENDIX 1

NOTES ON MATERIALS BALANCE MODELS FOR DOMESTIC WASTE MANAGEMENT

By David James

An appropriate data base for domestic waste management can be established using the concepts of materials balance. This approach was pioneered by Kneese et al. (1970) in their path-breaking work on materials flows and pollution for an entire economy. It was subsequently applied to industrial plants (Russell 1973; Russell and Vaughan 1976) and more recently has provided the basis for models of eco-industrial complexes (Ayres and Ayres 1996).

The framework of accounts for materials flows is the input-output system established by Nobel-prize winner Wassily Leontief (1986). The Leontief model tracks flows of goods and services in economic activities measured in monetary units. Materials balance models use an identical framework but the flows are measured in units of mass. The Leontief model has also been applied to energy flows in an economy (Gorgescu-Roegen 1971, James 1980) and to energy flows in ecosystems (James et al. 1978).

The basic concept of materials balance models is that materials, stocks and flows must obey certain fundamental identities regarding their input to, residence within and discharge from any system of human activities - whether a household, industrial plant or entire economy. These identities are specified in the original work of Kneese et al. (1970) and have been repeated in other works (James 1985). Within a household, the mass of outputs (ie., "waste" and other items disposed) must equal the mass of inputs, less the mass of any materials or items recovered, stored and/or re-used. "Waste" from domestic sources can include solid, liquid and/or gaseous substances, and the household itself may transform items from one form to another. For example, inputs in solid form may be discharged by households in gaseous form if they are disposed of by means of incineration.

The flow of materials associated with domestic waste can be traced further to "downstream" activities such as the collection of bottles, paper and cans, the conversion of green waste to compost, and materials and/or items recovered by "pickers" at landfill areas. The mass of materials disposed of at landfill areas ultimately must equal the mass of inputs entering the chain of activities at household level, less the mass of materials recovered, stored and/or re-used before reaching their final destination.

The input-output accounts of materials flows can be converted to a mathematical model for analytical applications, by deriving input-output coefficients for each of the activities. The most appropriate kind of model is a "donor-controlled" or supply-driven model rather than the "receiver-controlled" or "demand-driven" model originally developed by Leontief (James et al. 1978). Such models can be used to simulate or "predict" the flows of materials passing through the various activities in the waste management chain, including calculations

of the mass of materials ultimately disposed of in landfill areas. The models can also be used to simulate changes in management practices and new technologies for waste recovery, recycling and reuse.

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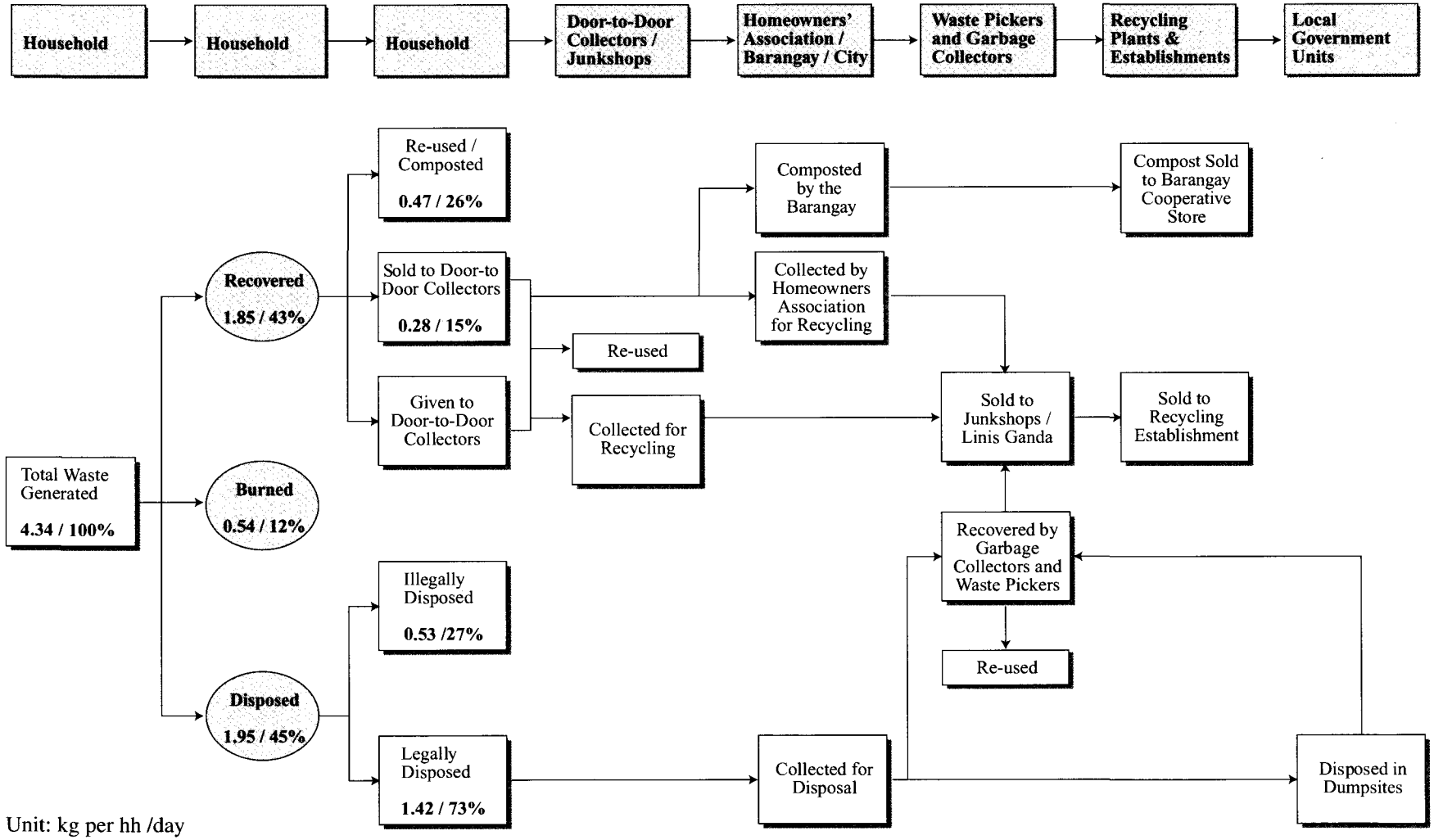
APPENDIX 2 - WASTE FLOW IN PARANAQUE CITY, METRO MANILA.

WASTE FLOW IN BARANGAY SUN VALLEY, PARANAQUE CITY.



Unit: kg per hh /day

APPENDIX 3

CHARACTERISTICS OF TYPES OF WASTES

Types of Wastes	*Waste components*
Old newspapers	Newspapers, comics, magazines
Paper & cardboard	Wrapping paper, paper bags, paper towels, writing paper, cigarette packages, books, corrugated paper & boxes, etc.
Food wastes	Vegetable & fruit discards and peelings, eggshells, spoiled food and bread, meat and fish bones, etc.
Plastic	Plastic bags, plastic containers, toys, styrofoam, etc.
Textiles	Clothing, rags, carpets, hats, other fabric
Rubber & leather	Rubber tires, leather shoes, handbags, etc.
Petroleum products	Oil, grease, etc.
Yard wastes	Grass clippings, flowers, plants, leaves, etc.
Wood	Lumber, plywood, boxes, furniture, toys, tree branches, etc.
Aluminum cans	Cans and other aluminum containers
Metals	Wire, auto parts, iron, steel, etc.
Glass	Bottles, jars, broken glass, etc.
Inert Material	Rocks, stones, tiles, ceramics, bricks, sand, dirt, ashes, cinder, etc.
Hazardous wastes	Batteries, chemicals, pesticides, etc

Source: Soncuya & Viloria (1992)

APPENDIX 4
ACRONYMS AND GLOSSARY

ACRONYMS

CIDS	Center for Integrative and Development Studies
DENR/WB	Department of Environment and Natural Resources/World Bank
EMB	Environmental Management Bureau
ENRAP	Environmental and Natural Resources Accounting Project
MMDA/JICA	Metropolitan Manila Development Authority/Japan International Cooperation Agency
NEDA/ICC	National Economic and Development Authority/Investment Coordination Committee
NCR	National Capital Region
USEPA	United States Environmental Protection Agency

GLOSSARY

Annex 41	A subdivision in Barangay Sun Valley, Paranaque City
Barangay	The basic political unit in the Philippines with a population of at least 5,000 inhabitants in very major cities and municipalities and 2,000 inhabitants in less urbanized areas
Binary choice model	A regression model where the dependent variable is dichotomous or binary in nature, taking a 1 or 0 value.
Choice-based sampling	A sampling design used for binary choice models where the data is deliberately sampled so that one or the other outcome is over-represented in the sample to ensure sufficient number of observations.
HO association	Homeowners' association
IEC	Information, education and communication
LGU	Local government unit

LIMDEP (for LIMited DEPendent)	A computer program for estimating cross section data. Its range of capabilities includes basic linear regression and descriptive statistics as well as advanced regression techniques.
LIMDEP weighing procedure	A correction technique in LIMDEP that is applied to correct for the bias in choice-based sampling. It basically involves generating and using a weighing variable during estimation to re-weight the observations that were sampled deliberately.
MSW	Municipal solid wastes; refers to the solid wastes generated by the households, commercial and institutional establishments in a municipality.
OLS	Ordinary least squares
RA 9003	Is the republic act or law entitled "The Ecological Solid Waste Management Act of 2000" enacted in January 2001.
Resource recovery	Refers to the collection, extraction or recovery of recyclable materials from the waste stream for the purpose of recycling, generating energy or producing a product suitable for beneficial use.
SWM	Solid waste management
Waste recycling	Refers to resource recovery activities intended for reuse, sell, give away or composted in the case of food wastes.
Waste segregation	Refers to a solid waste management practice of separating and storing different materials found in the solid waste stream in order to promote resource recovery.

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