

Solid waste segregation and recycling in metro manila:

[Environment](#), [Pollution](#)



**ASSIGN
BUSTER**

SOLID WASTE SEGREGATION AND RECYCLING IN METRO MANILA:

HOUSEHOLD ATTITUDES AND BEHAVIOR Ma. Eugenia C. Bennagen, Georgina

Nepomuceno and Ramil Covar June, 2002

ACKNOWLEDGEMENTS This study was made possible through a research grant from the IDRC/EEPSEA to the Resources, Environment and Economics Center for Studies, Inc. (REECS). The authors acknowledge with great appreciation the guidance and support throughout the project of Dr. David James, EEPSEA resource person, and the valuable inputs and comments to the various drafts of the report of the following persons: Mr. Jose Logarta Jr., Dr. Aleta Domdom, Dr. G. Bautista, Dr. David Glover, Dr. Hermi Francisco, and Dr. L Vilorio. Many thanks also go to Mr. Salvador Passe and Ms. Helen Agacer for providing access to valuable information and reports. The valuable research assistance of Mr. Vincent Altez and the assistance of the enumerators in the conduct of the household survey are highly appreciated. Comments should be sent to: Ma. Eugenia C. Bennagen, Resources, Environment & Economics Center for Studies (REECS), Suite 405, The Tower at Emerald Square, J. P. Rizal cor. P. Ruazon Sts., Project 4, Quezon City 1109, Philippines Email: bennagen@skyinet. net; reecs@skyinet. net EEPSEA was established in May 1993 to support research and training in environmental and resource economics. Its objective is to enhance local capacity to undertake the economic analysis of environmental problems and policies. It uses a networking approach, involving courses, meetings, technical support, access to literature and opportunities for comparative research. Member countries are Thailand, Malaysia, Indonesia, the Philippines, Vietnam, Cambodia, Lao PDR, China, Papua New Guinea and Sri Lanka. EEPSEA is supported by the International Development Research

Centre (IDRC); the Danish Ministry of Foreign Affairs (DANIDA); the Swedish International Development Cooperation Agency (Sida); the Ministry of Foreign Affairs, the Netherlands; the Canadian International Development Agency (CIDA); the MacArthur Foundation; and the Norwegian Agency for Development Cooperation (NORAD). EEPSEA is supported by a consortium of donors and administered by IDRC. Tanglin PO Box 101, Singapore 912404

Å½ Visiting address: 7th Storey RELC Building, 30 Orange Grove Road Å½
 Tel: 65 6831-6854 Å½ Fax: 65 6235 1849 Å½ E-mail: eepsea@IDRC. org. sg
 Å½ Website: //www. eepsea. org EEPSEA publications are produced by Corpcom Services Sdn. Bhd. in association with the Montfort Boys Town, Malaysia. This program provides vocational training to boys from low-income families and home-based work to mothers. EEPSEA publications are also available online at <http://www. eepsea. org>.

TABLE OF CONTENTS

Executive Summary 1

1. 0 Introduction 1

2. 0 Solid Waste Management 5

3. 0 Methods 6

3. 1 Conceptual Framework 6

3. 2 Sampling and Data Collection 8

3. 2. 1 Household Survey and Secondary Data Sources..... 8

3. 2. 2 Quantity of Household Wastes..... 9

3. 2. 3 Waste Segregation and Resource Recovery — Econometric Analysis..... 9

3. 2. 4 Economic Benefits of Resource Recovery..... 10

3. 3 Limitations..... 11

4. 0 Results And Discussion 12

4. 1 Socio-economic and Waste Management Profile of Study Sites 12

4. 1. 1 Barangay Sun Valley, Paranaque City 12

4. 1. 2 Barangay Barangka, Mandaluyong City 14

4. 2 Waste Generation and Resource Recovery 16

4. 2. 1 Wastes Generated, Recovered, Burned and Disposed 16

4. 2. 2 Wastes Recovered by

Material.....	18
4. 2. 3 Implications of LGU Waste Management Programs	19
4. 2. 4 Implications of Municipal Solid Waste (MSW) Profiling	23
4. 3 Waste Segregation and Resource Recovery	24
4. 3. 1 Socio-economic and Waste Management-related Characteristics	24
4. 3. 2 Attitudes and Behavior to Waste Management	24
4. 3. 3 Determinants of Waste Segregation and Composting	29
4. 3. 4 Implications of LGU Waste Management Programs	35
4. 4 Waste Collection	36
4. 4. 1 The Role of Active Community Participation in Annex 41 Subdivision, Barangay Sun Valley, Paranaque City	36
4. 4. 2 The Role of the Informal Market in Marimar Village, Barangay Sun ,,,, Valley, Paranaque City	38
4. 4. 3 The Role of Local Government Leadership in Barangay Barangka Itaas	39
4. 4. 4 Implications of the Collection of Household Garbage Fees	39
5. 0 Benefits from Resource Recovery	40
6. 0 Conclusion and Recommendations	43
References	47
Appendix 1 — Notes on Materials Balance Models for Domestic Wasted Management	49
Appendix 2 —Waste Flow in Paranaque City, Metro Manila.....	51
Appendix 3 — Characteristics of Types of Wastes.....	52
Appendix 4 — Acronyms and Glossary	53
LIST OF TABLES	
Table 1. Urban Municipal Solid Waste (MSW) Generation in Selected Asian Countries, 1995	2
Table 2. Per Capita Estimates of Waste Generation in Selected Cities/ Municipalities, Philippines	3
Table 3. Household Socio-economic and Waste Management Profile in Study Sites.....	14
Table 4a. Amount of Wastes Generated in Barangay Sun Valley, Paranaque	

.....	16	Table 4b. Amount of Wastes Generated in Barangay Barangka, Mandaluyong
.....	17	Table 5a. Waste Recovery by Material in Paranaque, Metro Manila.....
21	Table 5b. Waste Recovery by Material in Mandaluyong, Metro Manila.....	22
22	Table 6. Socio-economic and Waste Management Profile of Study Sites...	24
24	Table 7. Household Attitudes and Behavior to Waste Management in Barangay Sun Valley and Barangay Barangka.....	27
27	Table 8. Definition and Expected Sign of Explanatory Variables.....	31
31	Table 9. Coefficient Estimates of Probit Regression for Waste Segregation and Composting.....	33
33	Table 10. Marginal Effects of Significant Variables of Probit Regression for Waste Segregation and Composting.....	34
34	Table 11. Schedule for Collection of Types of Wastes.....	37
37	Table 12. Estimates of Economic Savings from Waste Diversion Using Benefit Transfer, Metro Manila, 1999.....	42
42	LIST OF FIGURES	
	Figure 1a. Sources of Solid Wastes, Metro Manila, 1992.....	4
	Figure 1b. Composition of Household Wastes, Metro Manila, 1992.....	4

SOLID WASTE SEGREGATION AND RECYCLING IN METRO MANILA: HOUSEHOLD ATTITUDES AND BEHAVIOR

Ma. Eugenia C. Bennagen, Georgina Nepomuceno and Ramil Covar

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.

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 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

Country	GNP Per Capita (USD)	Current Urban MSW Generation (kg / capita / day)
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
Indonesia	980	0.76
Philippines	1,050	0.52
Thailand	2,740	1.10
Malaysia	3,890	0.81
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)	
Mandaluyong City	Residential	0.37	
Soncuva & Vilorio	Mandaluyong City	All sources	0.76 (1992)
San Juan Municipality	Residential	0.32	
San Juan Municipality	All sources	0.57	
Olongapo City, Luzon	Residential	0.30	

GHK/MRM | | Olongapo City, Luzon | All sources | 0. 39 |(1995) | | | | | | | | | |
 | 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 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. **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. 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 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 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

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] 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.

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 Vilorio 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 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: $w_{ij} = (1 x_{ij} + (2 y_{ij} + (2 z_{ji} + u_{ij} (i = 1, 2, \dots, n; j = 1, 2, \dots, m)$ 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; and 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). 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).

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 Profile of Study Sites

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 km² or an average density of 9, 570 persons/ km². 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 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 m² with the kitchen quarters accounting for 13%. There are 26 households with backyards averaging 88 m². 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	Brgy. Sun Valley (n= 62)	Brgy. Barangka (n= 73)	(n= 135)
Mean	S. D.	Mean	S. D.	Mean	S. D.
Income					
P/month		37, 823	30, 793	44, 024	33, 427
				32, 557	27, 510
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 | 13 | 47 | 13 | 51 | 13 | | Household head's education | # year | 13 | 2 | 13 | 2 | 13 | 2 | | 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 | 45 | 49 | 54 | 30 | 45 | | Time spent in SWM | min/week | 52 | 50 | 73 | 55 | 34 | 37 | | House size | m2 | 150 | 152 | 209 | 191 | 99 | 81 | | Kitchen size | m2 | 21 | 19 | 27 | 25 | 15 | 11 | | Yard size (n= 45) | m2 | 66 | 122 | 88 | 155 | 36 | 34 | | * Unless otherwise stated, n= 135 | | hh = household | | Brgy = Barangay | 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 km² or an average density of 9, 423 persons/ km².

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 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

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

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 4a. Amount of Wastes Generated in Barangay Sun Valley, Paranaque | Waste Types | Waste | Disposed^a | Burned^b | Recovered^c | Total Generated^d | | Components | | | | | . . Table 4b. Amount of Wastes Generated in Barangay Barangka, Mandaluyong | Waste Types | Waste | Disposed | Burned | Recovered | Total Generated | | Components | | | | |

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.

2 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] 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												
Types of wastes % composition of % of household % of waste generated												
waste * (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) 91. 9												
13. 8 37. 9 43. 1 94. 7 2. 6 2. 6) 12 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												

