



Korean household waste management and recycling behavior

Seunghae Lee^{a,*}, Hae Sun Paik^b

^a College of Liberal Arts, Purdue University, West Lafayette, IN 47907, United States

^b Korea Land & Housing Corporation, Land & Housing Institute, Daejeon Metropolitan City, Republic of Korea

ARTICLE INFO

Article history:

Received 30 September 2010

Received in revised form

29 November 2010

Accepted 2 December 2010

Available online 10 December 2010

Keywords:

Recycling policy

Waste management

Korea

Recycling behavior

Environmental attitude

NEP

ABSTRACT

The rapid industrial and economic development in the recent several decades has caused serious environmental problems in Korea. The country has very limited carrying capacity; the population density in Korea is 481 people per km², ranking the third-highest in the world [1]. In 1995, the Korean government implemented a volume-based waste fee system (unit pricing system) that required every household to purchase certified plastic bags for waste disposal [2]. Consequently, since the introduction of this regulation, household solid waste in Korea has been substantially decreased, and household recycling has been increased. This study is to examine current Korean household recycling and waste management behavior and explore factors that affect those behaviors. Data was gathered through a survey conducted in Seoul, Korea. For the data analysis, 196 responses were used. The impacts of several factors on recycling and waste management behaviors including NEP (New Environmental Paradigm), attitudes for recycling and waste management, and the respondents' demographic variables were examined. To analyze the data, correlations and multiple regression analyses were conducted using SPSS 16. The results showed that environmental attitudes affected recycling and waste management behaviors significantly along with several demographic variables.

© 2010 Elsevier Ltd. All rights reserved.

1. Introduction

As environmental concerns increase worldwide, there have been efforts to develop creative ways to manage and control Municipal Solid Waste (MSW) effectively. MSW is defined as garbage that comes mainly from homes. Some additions are when garbage from businesses is similar in its characteristics to household garbage. This definition follows the Korean government's MSW definition for the unit pricing system policy [3]. For delivering environmentally sustainable environment and housing, it is important to recognise the sustainable housing characteristics such as affordability, accessibility, energy efficiency, waste management, security, etc [4]. Designing and creating the conditions of environmental sustainability may facilitate the well-being of people and their attachment to their place of living [5].

Korea has been through rapid industrial and economic development, causing serious environmental problems including disposal of MSW. It is a particularly important issue in Korea due to its limited carrying capacity. The United States Environmental Protection Agency (EPA) described the status of the MSW generation and suggested the preferred order of waste management methods for the environmentally sound MSW management and control [6]. EPA

listed source reduction as the most preferred method, recycling and composting as the next, and disposal in combustion facilities and landfills as the last. See the waste management method hierarchy in Fig. 1 that was redrawn based on the EPA waste management hierarchy [6]. A study on the construction waste recycling system in Hong Kong showed that mandatory regulation and legislations implemented by the government is needed to control the waste recycling management and to control environment attitudes in the construction industry. The study stressed on the importance of the mature recycling environment as well [7].

In the 1990s, the Korean government recognized the pressing needs to reduce MSW at the source and foster the recycling of reusable materials as it becomes increasingly difficult to secure or procure properties to dump MSW or build facilities to dispose of it properly. It was mainly due to the prevalent Not-In-My-Back-Yard (NIMBY) syndrome and the stiff increase in land values. The volume-based waste fee system (unit pricing system) has been finally implemented in 1995 along with the previous establishments of related policies in order to alleviate the environmental impact and conditions that the issue of MSW brought about [2].

This pricing system requires every household to purchase certified plastic bags for waste disposal while the disposal of the separated recyclables can be disposed of free of charge. All recyclable packaging materials are required to be marked clearly, and recyclable wastes are supposed to be separated into paper, plastic, metal,

* Corresponding author. Tel.: +1 765 494 0556; fax: +1 765 496 2076.

E-mail address: Lee30@purdue.edu (S. Lee).

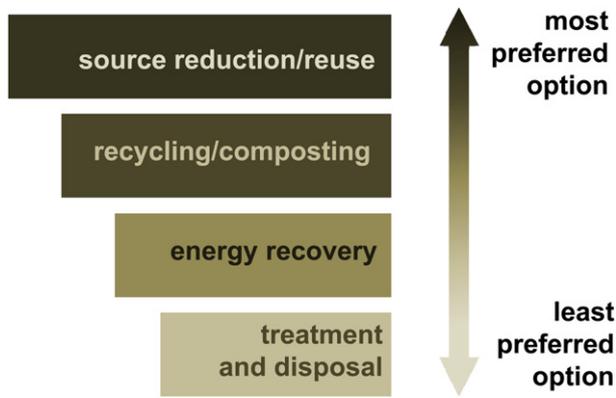


Fig. 1. Waste management method hierarchy.

and glass before disposal [8]. Please see the Fig. 2. Food wastes should be separated from household solid waste and thrown into a separate plastic bin without being charged. Please see the Fig. 3. Each community has a different fee system, and the price for a certified bag ranges from approximately 1.20–2.00 USD for a 100 L (22.7 gallon) bag.

Fig. 4 shows how the waste allocations in Korea have shifted from 1990 to 2008. It is interesting to note the trend before and after the implementation of the unit pricing system. The landfill method consists of 81.16% of the total waste in 1994 and recycling method was 15.36%. However, recycling has increased steadily and up to 59.8% in 2008 while landfill has decreased down to 20.3% [9]. After the implementation of the unit pricing system, the volume of MSW certainly stays around 50,000 tons in Korea, and it does not increase although the Korean economy has grown since then [9].

See Fig. 5. As shown in Figs. 4 and 5, the increase in recycling and the decrease in landfill waste have been critical improvements due to the unit pricing system. There were discussions about the seriousness of environmental pollution, the efficiency of energy use, and the reuse of resources initiated by environmental activists [10]. In this social context, the unit pricing system has been established.

As data above show and previous studies [11], [12], and [13] suggest, it is clear that environmental laws play a critical role in bringing about changes in waste management that will positively impact environmental sustainability.

This study is to examine current Korean household recycling policy and waste management behavior and explore factors that affect those behaviours.

2. Previous research

2.1. Household recycling and waste management

Even though there exists a lack of empirical studies that investigate both socio-economic and psychological determinants of environmental behavior, there are a substantial amount of studies that focus on household waste management policies and recycling and waste disposal behavior in response to those policies [14]. There are two major MSW management programs: the curb side recycling program and the unit pricing system. The unit pricing system is also called Pay-As-You-Throw (PAYT). It simply charges households more if they put out more trash for collection.

There have been studies to examine the positive impact of the unit pricing system on recycling and/or reduction in household wastes from different countries worldwide. A report from the U.S. showed that there are about 7100 communities in the US that have implemented this concept. It covers approximately 25% of the U.S.



Fig. 2. Recycling containers in the apartment complex in Seoul, Korea.



Fig. 3. Food waste, lamps, and clothing containers in the apartment complex in Seoul, Korea.

population and 26% of communities in the US [15]. The positive impact of the unit pricing or price incentives system on reduction in MSW or household recycling has been evidenced in some studies from various countries [11], [12], [13], and [16], while other studies found the impact unclear [17] or too small to consider it to be meaningful [18].

Another important issue in MSW is food waste management. A study in Taiwan showed that the integrated management system made it possible to turn food garbage into agricultural resources by composting. Its recycling rate was approximately 21.2% in 2006 [19].

In Korea, the total MSW per person per day has been stable in number for the last fifteen years after the enforcement of the unit pricing system. It changed from 2.3 kg per day per person in 1991 (before the enforcement of the unit pricing system) to 1.04 kg per day per person in 2008 as shown in Fig. 6 [20]. The MSW per person per day in Korea in 2007, for example was, 1.02 kg. This was less than that of many Organisation for Economic Co-operation and Development (OECD) countries' such as 1.62 kg in Germany, 2.00 kg in U.S., 1.59 kg in England, 1.12 kg in Japan, and 1.45 kg in France [20]. Besides the unit pricing system, the Korean government promotes various waste management methods to protect the environment including mandatory waste management planning for congregate

housing site developments and new waste treatment facility constructions. The waste management administration and support are implemented mainly at the local government level in Korea [21]. In addition, the government offers financial aids to support the energy cost for the bio fuel produced by incineration and landfill treatment. It is recommended to use a treatment process that implements basic initial treatment first and then incinerates rather than incinerating wastes without any treatments [21].

2.2. Environmental attitudes and behaviors

Many environmental studies examined environmental attitudes as a factor to explain environmental behavior. The New Environmental Paradigm (NEP) has been popularly used by environmental researchers as a tool to measure general environmental concern or a world view as well as environmental beliefs, attitudes, and values [22]. Also, in efforts to find factors to promote proenvironmental behaviors, many recent environmental studies have investigated the NEP as an attitudinal factor influencing proenvironmental behavior in the theoretical framework of attitude-behavior structure [23], [24], [25], & [26]. However, it is also true that many studies failed to find a strong linkage between this global measure of environmental concern and environmental behaviors [25], [27], & [28], while socio-economic variables play important roles in explaining environmental behaviors [28] & [29]. There is a weak linkage between attitude and behavior because: a) the attitudinal and behavioral measures are not congruent enough with each other, b) the attitudinal measure does not have a quality, and c) there are external factors to affect the behavior [30]. However, a more specific attitude showed a link to the behavior in environmental research. For example, the attitude about waste management such as not believing in unlimited waste disposal instead of the general environmental attitude showed significant relation to waste management behavior [28].

Along with the discussion about the predictive ability of the NEP to measure environmental behavior, there have been continuing discussions among researchers in several other issues. One of the major arguments about the scale is the issue of dimensionality [22]. Although the original study of Dunlap and Van Liere [24] treated the scale as a unidimensional factor, there have been many researchers who found the scale to be multidimensional [31], [32], [33], & [34]. In addition, it is important to note that some of the studies that obtained multiple factors out of the NEP using the factor analysis

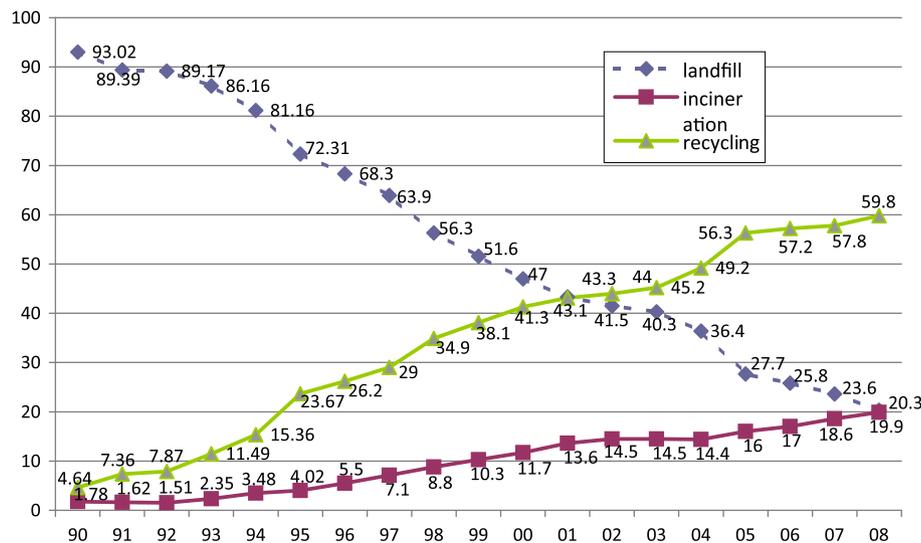


Fig. 4. Changes in waste allocations method from 1990 to 2008 (unit: percentage).

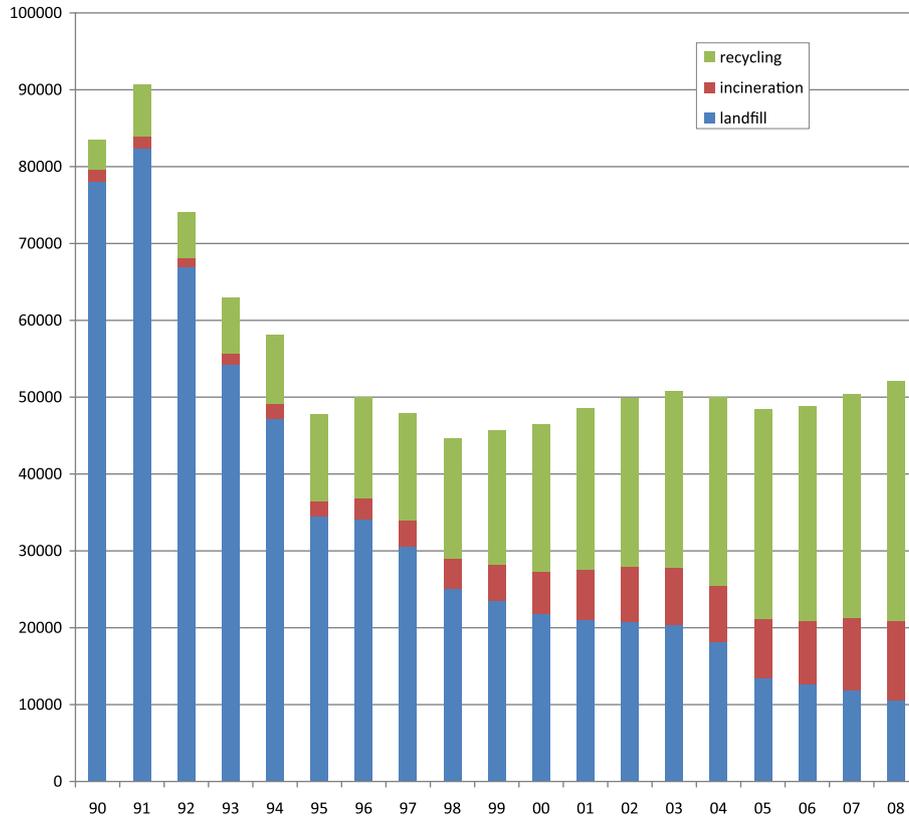


Fig. 5. Changes in volumes of MSW from 1990 to 2008 (unit: ton).

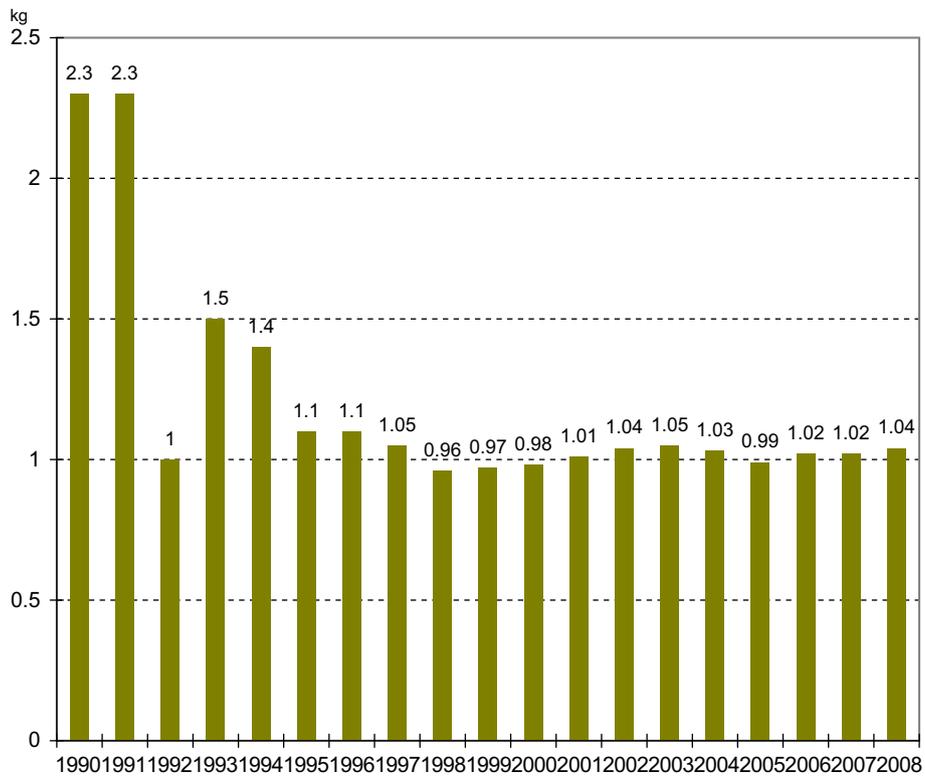


Fig. 6. MSW per person per day (unit: kg).

reduced those factors down to one-dimensional factor for subsequent analyses in their studies. For example, Meinhold and Malkus [35] found two factors from the NEP: the environmental factor and the technology factor, and their theoretical decision led them to exclude the technology factor in further analysis of the study because it was considered to have limited usefulness to the environmental attitude on which the NEP was regressed.

2.3. Recycling and waste management behaviors

Since the implementation of the mandatory volume-based waste fee system in Korea, there have been research efforts to study recycling and waste management behaviors. In general, it is considered that the Korean volume-based waste fee system is an effective tool to promote recycling and reduce waste disposals [36]. The amount of recycling has increased more apparently when people needed to pay more money to dispose of their waste [36].

In addition, there are studies that focused on the impact of residence types on waste management. Types of residences included apartments, detached single houses, studios, and single houses with multiple households [37] and [38]. Apartment residents generated the most amount of recycling followed by detached single houses and other types [37]. The apartment complexes have convenient collection systems for food separation activities and it leads to more active food separation behaviors [39]. The intervals for household waste collections, the existence of recycling bins near residences, and the availability of recycling and waste management staff seemed to impact recycling and waste management behaviors.

Recently, as designing the sustainable community becomes more important, Lee et al. (2010) suggested that the large lobby space which includes separate garbage recycling bins, mailbox, safety box for quick deliveries and bicycle parking space in the entrance of apartment building can serve as community space by expanding opportunities for neighbors to come together due to the installation of convenience facilities [5]. It premised that designing space for installation of recycling waste bins can affect the social behavior of residents as well as proenvironmental attitudes of residents. Waste management can be a factor for sustainable housing along with other factors such as affordability, accessibility and energy efficiency [4].

3. Methods

3.1. The data collection

A survey was conducted to examine Korean household recycling and waste management attitudes, behavior, and environmental attitudes. The data was collected in the Greater Seoul Area in June and July 2008. The snowball sampling method was used for the data collection. A total of 196 responses were used for data analyses. The questionnaire tool was developed in Korean and translated in English as shown in Appendix 1. The English version was approved through Purdue IRB.

3.2. The profile of participants

The population of this study consisted of household members who live in the Greater Seoul Area and participate in the mandatory unit pricing waste management system. Subjects who are 18 years and older are invited to complete the questionnaire survey.

The demographic information shows that this study's sample consists of more women (56.9%) than men (43.1%). In terms of age, the 40–49 years old category has the highest percentage (39.2%) of participants followed by the 30–39 years old category (27.3%). This study's participants have a high educational level; 90% of

the participants are college graduates or achieved higher levels of education. The monthly household income range shows that 23.6% have the income between 3,000,000–5000,000 Korean won, 23.6% between 5,000,000–7000,000 Korean won, and 22.6% between 1,000,000–3000,000 Korean won. The majority of participants (74.4%) lived in apartments, and 61.5% of participants owned their houses. As for the house size, 37.9% live in 30–39 pyeong houses, 23.1% in 20–29 pyeong houses, and 15.4% in 40–49 pyeong houses.

3.3. Variables

3.3.1. Predictor variables

Predictor variables in this study included waste management attitudes, the environmental attitude, and socio-economic variables. The waste management attitude was measured with five-item questions. It included attitudes about general household waste management, waste reduction, food waste separation, recycling, and difficulties to participate with the current mandatory unit pricing waste management system. Respondents were asked to indicate agreement or interest with items on a 5-point Likert scale in which response options range from strongly disagree or not interested at all (1) to strongly agree or very interested (5).

The revised NEP with 15 questions was used to measure the environmental attitude [22]. This revised NEP was designed to ask for the agreement or disagreement with pro- and anti-ecological worldviews. The questions were designed to examine the reality of limits to growth, antianthropocentrism, the fragility of nature's balance, rejection of exemptionism and the possibility of an ecocrisis. The same 5-point Likert scale was used to measure the level of agreement and disagreement.

Socio-economic variables included age, gender, educational level, income, occupation, house size, type of housing, and the ownership of the house.

3.3.2. Criterion variable

Waste management behavior was the criterion variable to explore its relationship with various predictor variables listed earlier. Five items were included to determine waste management behavior. The items are questions to explore respondents' self-reported level of participations with waste management behavior such as food separation behavior, food separation methods, and recycling behaviors for paper, cans, bottles, and clothes.

3.4. Model specification

This study estimated econometric models to identify attitudinal and socio-economic factors that influence the level of waste management behaviors. Multiple regression models were used in this study as the framework for estimation. There were three models estimated based on different types of waste management behaviors: 1) a model for food separation behavior, 2) a model for recycling behavior, and 3) a model for waste management behavior (combination of food separation and recycling). For each behavior type, j , a sample of N observed households $i = 1, \dots, N$ was considered for the relationship between a dependent variable y_{ji} , an observed level of waste management behavior, and a set of predictor variables $x'_{ji} = (x_{ji0}, x_{ji1}, \dots, x_{jik})$.

$$y_{ji} = b'_j x'_{ji} + e_{ji} = b_{j0} + b_{j1}x_{ji1} + \dots + b_{jk}x_{jik} + e_{ji}$$

where b'_j is a $(K + 1)$ -dimensional vector of coefficients, x'_{ji} is a $(K + 1)$ -dimensional vector, and e_{ji} is an error term. The vector x_{ji} includes NEP, attitudes toward waste management, and socio-economic factors for each household such as age, income, and education. The b s are estimated with Ordinary Least Square (OLS)

and represent the unique effect of the predictor variables on the dependent variable after partialling out the effect of all other variables. It is assumed that the errors are normally distributed, with an expected value of zero and constant variance. The errors are also assumed to be pairwise independent and not correlated with the predictor variables.

3.5. Data analyses

Prior to statistical analyses, descriptive statistics for each variable, including means and standard deviations, were calculated to examine the data.

To determine the dimensionality of NEP, a component analysis with varimax rotation was conducted and the Scree plot was produced. However, there was no clear indication that there is factorability because there were three extractions but there was not enough differentiation between loadings. Therefore, the decision to continue the statistical analyses treating the NEP as one variable was made.

First, correlations of all variables were conducted for the statistical analysis. Zero-order correlations were used to determine the bivariate relationships such as the strength and direction between each predictor and criterion variable.

The predictor variables that were correlated to any of the criterion variables were entered into multiple regression analyses to explore the effect of attitudes on waste management behaviors. Two kinds of attitudes were examined: 1) the attitude about the environment in general and 2) attitudes for specific waste management topics.

4. Results

4.1. Correlations

Table 1 People who showed higher concerns about the environment reported higher levels of participation with recycling. Attitudes with waste management were examined in four different aspects. Attitude variables in this study showed significant and positive relation to food separation behavior and recycling behavior. That means people who reported higher interests with waste management showed higher participation with food separation and recycling. Also, people who showed more agreement with food separations and recycling reported higher participation with both behaviors of food separation and recycling.

People who are older and have higher income reported higher participation with both food separation and recycling. People who live in bigger houses demonstrated higher participation with food separation. Socio-economic variables such as gender, number of family members, and educational level did not show any significant

Table 1 Correlations between variables.

Variables	Food Separation behavior	Recycling behavior
NEP	.120	.154*
Waste management attitude	.396**	.464**
Waste reduction attitude	.218**	.298**
Recycling attitude	.181*	.217**
Food separation attitude	.258**	.332**
Age	.222**	.192**
Gender	.104	.121
Education	.069	.032
Family number	.129	.125
Income	.248**	.202**
Area	.158*	.092
Waste management responsibility	-.047	.077

*p < .05; **p < .01.

Table 2 Multiple Regression Analyses Model 1 and Model 2.

Variables	Model 1 Food Separation R = .421, R ² = .178, Adjusted R ² = .164 F-Value (5170) = 8.152, p < .001	Model 2 Recycling R = .470, R ² = .220, Adjusted R ² = .203 F-Value (4171) = 12.117, p < .001
NEP	N/A	.009
Attitude	.293***	.389***
Age	.159**	.143**
Income	.61**	.111

*p < .05, **p < .01, ***p < .001Notes: β = standardized betas.

correlations to criterion variables. Being the person who has the major responsibility in a household for waste management does not show any relation to food separation and recycling behaviors.

4.2. Multiple regression analyses

Predictor variables that showed significant correlations with criterion variables were used for regression analyses.

Attitudes variables such as interests with general waste management, an agreement with waste reduction, recycling, and food separation were not individually analyzed to find their effects on food separation, recycling, and waste management. Rather, they were multiplied and treated as one variable to represent the overall attitude about waste management because the variables are highly correlated and may have a problem with multicollinearity.

Table 2 The findings suggested that agreement and interest in waste management such as needs for food separation, reduced wastes, and recycling were significant predictors of food separation and recycling behaviors. Although NEP was significantly related to recycling behavior, it does not seem to be able to predict the recycling behavior or food separation behavior. The income was correlated with both food separation and recycling behaviors, but it only appeared to be a predictor for recycling behavior.

In Model 1 for regression analysis for the food separation behavior, the attitude that measured the agreement and interests in waste management turned out to be the strongest factor to predict the food separation behavior, followed by the age and income. Food separation and disposal activity are considered to be some of the least favored house chores in Korea.

In Model 2 for recycling behavior, NEP was not shown as a predictor for recycling behavior. As it was argued [40], the relationship between general environmental concerns such as NEP and recycling appears to be decreasing as the recycling program develops over the years. It will be especially true in communities such as Korea where people are encouraged to recycle to avoid costs that will be generated by not doing so. In other words, people do recycling, regardless of their level of concern with the environment. However, when NEP was analyzed to measure its potential as a predictor for the general environmental behavior, it demonstrated its predictability [12].

Table 3 Multiple Regression Analyses Model 3: Food Separation x Recycling.

Variables	Model 3 Waste Management R = .497, R ² = .247, Adjusted R ² = .229 F-Value (4171) = 14.018, p < .001 (β)
NEP	.001
Attitude	.392***
Age	.163**
Income	.146**

*p < .05; **p < .01, ***p < .001Notes: β = standardized betas.

Table 3 In Model 3 for combined waste management behavior with food separation and recycling, similar results showed. Attitudes about waste management, age, and income appeared as predictors for general waste management behavior.

Attitude was a strong variable to predict waste management behavior as it explained 39.2% of the variance. Age and income demonstrated similar levels of predictability: 16.3% and 14.6% respectively.

5. Conclusion

This study examined current Korean household recycling policy and waste management behavior and explored factors that affect those behaviors. Results showed that waste management attitudes, age, and income affected recycling and waste management behaviors significantly. These positive relations support results from previous studies [38], [41], and [42]. Attitude for waste management was the strongest factor to predict food separation behavior and recycling behavior in this study. A previous study on waste management attitude and proenvironmental behaviors showed connections between two factors [42]. NEP is related with recycling behavior in correlation analysis in this study, but it was not a significant predictor for waste management behavior in regression model.

Since the introduction of the unit pricing system, the environmental concerns have been increased and the total amount of MSW has been decreased in Korea. However, the increase of food separation and separated recyclables does not necessarily mean that the environmental attitude has been intensified. It may simply foster people to separate the recyclables without enhancing their environmental attitudes [2]. Waste management behavior might have been motivated to avoid the cost for waste disposal, not due to the proenvironmental attitude.

Therefore, the mandatory law can play a critical role to control the waste management behavior to a certain level in terms of managing the governmental environmental policy. Research results from Hong Kong [7] suggested that strict regulation for waste management can impact on the waste management behavior while mature environmental attitude is more critical and continuous factor for delivering sustainable environment and housing. Considering attitude for waste management is the strongest factor that is related to waste management behaviors, there also should be an educational program and continuous policies for enhancing sustainable proenvironmental attitudes. Results from this study suggest that people who are older and wealthier participate in waste management to reduce waste and recycle more. It is interpreted that people who are older and wealthier are more aware of waste management by being more exposed and sensitive to social concerns and economic issues. Thus, more public education programs and policy advertisements will be needed for younger generations and low-income families.

Appendix. Supplementary material

Supplementary data related to this article can be found online at doi:10.1016/j.buildenv.2010.12.005.

References

- [1] The Korean Ministry of Environment. Overview of policies & efforts; 2006 [Korea].
- [2] Lee SD. Waste reduction and recycling law in Korea. International Environmental Law Committee - Newsletter Archive 2003;5(No.1).
- [3] The Korean National Archives and Records Services. The MSW unit pricing system, <http://contents.archives.go.kr/next/content/listSubjectDescription.do?id=003924>; 2010.
- [4] Maliene V, Malys N. High-quality housing – A key issue in delivering sustainable communities. Building and Environment 2009;44:426–30.
- [5] Lee Y, Kim K, Lee S. Study on building plan for enhancing the social health of public apartments. Building and Environment 2010;45:1551–64.
- [6] United States Environmental Protection Agency (EPA). Waste management options, <http://www.epa.gov/wastes/homeland/options.htm>; 2008.
- [7] Tam VVY, Tam CM. Evaluations of existing waste recycling methods: a Hong Kong study. Building and Environment 2006;41:1649–60.
- [8] The Korean Ministry of Environment. Extended Producer responsibility (EPR) system. White paper. The Korean Ministry of Environment; 2006.
- [9] The Department of Waste Management, The Korean Ministry of Environment. The report of National waste management survey from 1990–2008 in Korea. The Korean Ministry of Environment; 2009.
- [10] Park W. Massive consumption as the cause of environmental problems. Donga Daily News 1992;June 10, 1992.
- [11] Meinhold JL, Malkus AJ. Adolescent environmental behaviors: can knowledge, attitudes, and self-efficacy make a difference? Environment & Behavior 2005;37(No 4):511–32.
- [12] Hong S. The price factor for municipal solid waste reduction: the impact of unit pricing system. The Korean Economic Review 2001;49(No 1):203–21 [Korea].
- [13] Lu L, Hsiao T, Shang N, Yu Y, Ma H. MSW management for waste minimization in Taiwan; the last two decades. Waste Management 2006;26(No. 6):661–7.
- [14] Van den Bergh JCM. Environmental regulation of households: an empirical review of economic and psychological factors. Ecological Economics 2008;66(No. 4):559–74.
- [15] Skumatz L, Freeman D. Pay as you throw (PAYT) in US: 2006 update and analyses, prepared for US EPA and SERA, <http://www.epa.gov/epawaste/conservation/tools/payt/pdf/sera06.pdf>; 2006.
- [16] Hong S, Adams RM, Love HA. An economic analysis of household recycling of solid wastes: the case of Portland, Oregon. Journal of Environmental Economics and Management 1991;25:136–46.
- [17] Jenkins RR, Martinez SA, Palmer K, Podolsky MJ. The determinants of household recycling: a material-specific analysis of recycling program features and unit pricing. Journal of Environmental Economics and Management 2003;45(No.2):294–318.
- [18] Fullerton D, Kinnaman TC. Household response to pricing garbage by the bag. The American Economic Review 1996;86(No. 4):971–84.
- [19] Tsai W. Management considerations and environmental benefit analysis for turning food garbage into agricultural resources. Bioresources Technology 2008;99:5309–16.
- [20] The Korean Environmental Statistics Portal. MSW survey, http://www.index.go.kr/egams/stts/jsp/potal/stts_PO_STTS_idxMain.jsp?idx_cd=1477; 2008.
- [21] Oh J. Personal interview with an expert. Korea Land & Housing Corporation; 2010.
- [22] Dunlap RE, Van Liere KD, Mertig AG, Jones RE. Measuring endorsement of the new ecological paradigm: a revised NEP scale. Journal of Social Issues 2000;56(No. 3):425–42.
- [23] Barr S, Gilg AW, Ford NJ. A conceptual framework for understanding and analysing attitudes towards household-waste management. Environment and Planning 2001;33:2025–48.
- [24] Dunlap RE, Van Liere KD. The new environmental paradigm. Journal Environmental Education 1978;9:10–9.
- [25] Nooney JG, Woodrum E, Hoban TJ, Clifford WB. Environmental worldview and behavior: consequences of dimensionality in a survey of North Carolinians. Environment and Behavior 2003;35(No. 6):763–83.
- [26] Johnson CY, Bowker JM, Cordell HK. Ethnic variation in environmental belief and behavior: an examination of the new ecological paradigm in a social psychological context. Environment and Behavior 2004;36(No. 2):157–86.
- [27] Poortinga W, Steg L, Vlek C. Values, environmental concern, and environmental behavior: a study into household energy use. Environment and Behavior 2004;36(No. 1):70–93.
- [28] Scott D, Willits FK. Environmental attitudes and behavior: a Pennsylvania survey. Environment and Behavior 1994;26(No. 2):239–60.
- [29] Richardson RA, Haverick Jr J. Economic analysis of the composition of household solid wastes. Journal of Environmental Economics and Management 1978;1(No. 5):103–11.
- [30] Tarrant MA, Cordell HK. The effect of respondent characteristics on general environmental attitude-behavior correspondence. Environment and Behavior 1997;29(No. 5):618–37.
- [31] Albrecht D, Bultena G, Hoiberg E, Nowak P. The new environmental paradigm scale. Journal of Environmental Education 1982;13:39–43.
- [32] Geller JM, Lasley P. The new environmental paradigm scale: a re-examination. Journal of Environmental Education 1985;17:9–12.
- [33] Gooch GD. Environmental beliefs and attitudes in Sweden and the Baltic states. Environment and Behavior 1995;27(No. 4):513–39.
- [34] Luo Y, Deng J. The new environmental paradigm and nature-based tourism motivation. Journal of Travel Research 2008;46:392–402.
- [35] Meinhold JL, Malkus AJ. Adolescent environmental behaviors. Environment & Behavior 2005;37(No. 4):511–32.
- [36] Hong SH. Price effect for decreasing urban household solid waste: the effect of unit pricing system upon household solid waste management. Journal of Economics 2001;49(No. 1):203–21.
- [37] Yi G, Lee J, & Hong W. 2000. A study on the discharge properties and a unit of municipal solid wastes in residential area types: case study of Taegu City. Proceedings of Annual Conference of the Architecture Institute of Korea.

- [38] Yi G, Lee J, & Hong W. 2001, A Study on the discharge change and influence reason of municipal solid wastes in residential area: case study of Taegu City, Proceeding of annual conference of the Architecture Institute of Korea.
- [39] Park J, Park S, Kwon G. Generation characteristics of residential wastes according to house types by separated collection of food waste – in case of Kyungju City. *Korean Solid Wastes Engineering Society* 2000;17(No. 2):166–76.
- [40] Schultz P, Oskamp S, Maineri T. Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology* 1995;15:105–21.
- [41] Chong YS, Ahn GG, Lee KJ. Characteristics of active consumer participation in waste separation and recycling. *Korean Journal of Human Ecology* 1994;3(No. 1):95–106.
- [42] Baun SH, Kye SJ. The Urban housewives' consciousness and behavior for the environmental conservation and their concern of the household waste management. *The Journal of the Korean Home Management Association* 1995;13(No.3):88–101.