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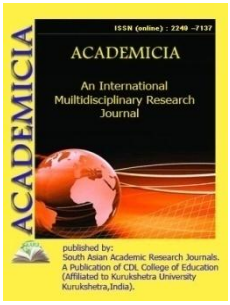


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# DETERMINANTS OF HOUSEHOLDS MUNICIPAL SOLID WASTE RECYCLING BEHAVIOUR IN MEKONG RIVER DELTA VIETNAM

**Thi Dan Xuan Huynh*; Tien Dung Khong**; Viet Khai Huynh*****

*Lecturer,
School of Economics, Can Tho University,
VIETNAM
Email id: htdxuan@ctu.edu.vn

** PhD, Lecturer and Researcher,
School of Economics, Can Tho University,
VIETNAM
Email id: ktdung@ctu.edu.vn

***Lecturer and Researcher,
School of Economics, Can Tho University,
VIETNAM
Email id: hvkhai@ctu.edu.vn

## ABSTRACT

*Households' participation in the initial act of municipal solid waste (MSW) recycling is drawing increasing attention from policymakers from developing countries. This paper aimed to analyze households' behaviour and determinants of MSW recycling in the Mekong River Delta (MRD) by employing ordinary least square (OLS) regression and Probit models. The data for this study were gathered through direct interviews with 578 MRD residents representing different levels of urbanization. This study reveals that the MSW recycling rate may increase up to seven times. Furthermore, results emphasize the importance of enhancing households' awareness and the roles of policymakers in monitoring recycling programs in the long term. Interestingly, while urbanization, environmental concerns, and members of organizations have a significant positive effect on recycling behaviour, households' education levels result in fewer recycling activities. Based on these results, this study proposes implementing an MSW recycling policy to encourage families to recycle by incentivizing the prices of recycled materials (such as plastic bags and*

*newspapers) and improving the livelihoods of itinerant waste buyers in informal recycling systems.*

**KEYWORDS:** *Awareness, Mekong River Delta, municipal solid waste management, recycling behavior, source-separation*

**Highlights**

Participation from the households may raise recycling rates by up to seven times.

Subsidies for recycled materials can encourage people to recycle more.

Quantity, rate, and decision to recycle are all influenced by the same factors.

Government intervention in the form of subsidies and propaganda is necessary to maximize recycling.

## 1. INTRODUCTION

Municipal solid waste (MSW) generation and recycling, implementation management policies are the primary responsibilities of local authorities in Vietnam and many other developing nations (Schubeler et al., 1996).Conversely, MSW recycling management is a complex endeavour that necessitates institutional capability and participation and collaboration from a wide range of corporate and public sector partners. Even though MSW management harms public health and the environment, it is still poorly managed in most developing-country cities due to a lack of government resources, financial investment, and insufficient technology and motivation. In addition, the growing amount of solid waste as a result of population growth and consumer demand has become a significant challenge for local governments, particularly in terms of waste management, with negative consequences for the environment now and in the future.

The majority of prior studies have focused on policies that have been put in place to manage MSW generation and recycling. For example, institutional and control mechanisms (Slack et al., 2009) set MSW regulations and have sanctions in place to deal with violations. On the other hand, several institutional initiatives have been enacted but have not resulted in increased compliance or better environmental quality (Stafford, 2002). Market-based approaches are more successful than institutional alternatives because they create incentives for people (Driesen, 2006).Negative incentives include sales tax, the "pay as you throw" policy, and fees based on the volume of MSW disposed of; positive incentives include subsidies or tax reductions for people and organizations whose activities minimize trash (Gellynck and Verhelst, 2007). Many countries have established policies that mix positive and negative incentives, such as deposit return systems (DRS) (Wagner and Arnold 2008; Mckerlie et al., 2006), and voluntary recommendations (e.g., voluntary involvement in recycling) (Werner et al., 1995; Palatnik et al., 2005). According to Zhuang et al. (2008). Segregation of MSW at the source is an effective approach for reducing trash.Germany, the United States, and Japan have implemented the classification of MSW as part of their waste management system. When Japan implemented a waste separation system, its overall volume of MSW dropped by 69% (Japan's Ministry of Environment, 2014).

Although numerous policies relating to MSW management have been implemented, the efficiency of these measures differs by country. For example, in some developing countries, a "pay as you throw" policy may fail due to an inability to estimate the quantity of MSW generated by families (Longe and Ukpebor, 2009).As a result, policy implementation or initiatives aimed at reducing household MSW should be tailored to the needs of particular nations. According to the findings, at-source MSW (reusing and recycling a significant portion of garbage) has reduced the amount of MSW discharged into the environment. Although MSW at-source classification in Vietnam in general, and the MRD in particular, has not been implemented on a large scale and must still be based on several rules, several households have classified MSW in their own way by recycling and selling scrap from the garbage, creating a favourable environment for recycling activities and reducing MSW in Vietnam. However, there is a dearth of study on recycling behaviour and the variables that influence it, particularly in developing countries like Vietnam. As a result, this study addressed this issue and provided ideas to assist local governments in better managing garbage and increasing recycling. In addition, households with MSW source separation are expected to improve the program's efficiency.

## 2. Literature review and research methodology

### 2.1 LITERATURE REVIEW

*Municipal solid waste current practices in Vietnam*

Because the existing landfills are all congested, recycling is a crucial method to minimize the growing volume of garbage. In Vietnam, there are around 660 landfills that receive 20,200 tons per day. However, only 30% of them are classified as sanitary landfills (World Bank, 2018). The recycling goal is outlined in Management Strategy Decision 2149/2009/QD-TTg, issued on December 7th, 2009.The Prime Minister of Vietnam issued Decision 491/QD-TTg on May 7th, 2018, requiring all cities categorized in a specified level and urban-level 1 cities to have recycling facilities adequate for household categorization. The said Decision also mentioned that the remaining 85% of cities offer recycling centers to sort recyclables at home. Moreover, 90% of total daily-life generated in urban areas is collected and treated to meet environmental protection requirements; increase the ability to recycle, reuse, treat with energy recovery, or produce organic fertilizers; and reduce the proportion of MSW treated by direct burial to less than 30% of the collected waste. However, only around 10% of MSW is recycled, and only about 4% of MSW is composted, with the informal sector handling this portion through itinerant junk buyers. As a result, meeting the government's target is challenging.

*The theoretical framework of research*

This research is based on Fishbein and Ajzen's famous theory of reasoned action (TRA) (1975), which proposes an intention-behaviour link, referred to as the "intent-action gap." TRA assumes that people's actions are dictated by their desire to carry out the behaviour, which is impacted by their attitude toward the act and subjective standards. Because the contrast between action intention and behaviour should be stressed, the Fishbein–Ajzen model argues that the intention-behaviour link is critical when addressing environmental action. As a result, environmental policymakers will always have to ensure that people do what they say.

Environmental values, situational characteristics, and psychological factors are the three primary groupings of elements identified by Barr (2017) as influencing the decision to engage in trash environmental behaviour. Environmental values are a person's perception of the environment; they constitute a fundamental perspective of the natural world, and environmentalists are more environmentally conscious. The second factor is situational features, which indicate a person's current circumstances and are crucial in determining their environmental activities. Furthermore, access to appropriate services (Ball and Lawson, 1990; Derksen and Gartell, 1993; Guagnano et al., 1994) or demographic parameters such as age, gender, education, and income are examples of situational characteristics (Hines et al., 1987; and Schultz et al., 1995).

Finally, while contemplating environmental action, psychological considerations are also taken into account. This broad term refers to an individual's personality and perceptual qualities as they relate to their behaviour. Intrinsic incentives to engage (such as behavioural gratification; De Young, 1986) and environmental dangers are examples of this element (threat to welfare from environmental problems, Baldassare and Katz, 1992). Contextual factors, personal capacities, attitudinal factors, and habitual factors, according to Söderholm et al. (2010), are four kinds of elements that influence environmental behaviour.Technical-organizational circumstances (external factors), socio-demographic (e.g., age, gender, income), and socio-psychological variables are among the three kinds of factors identified by Miafodzyeva & Brandt (2013). (e.g., attitude, motivation). In summary, past research has identified some characteristics that influence recycling behaviour, including convenience, knowledge, moral standards, and environmental concern (Becker, 2014).

### 2.2 Research methodology

#### 2.2.1 Methods of data collection

The research utilized a direct interview with householders in different Mekong River Delta cities on their plans to recycle or classify MSW at the source. Can Tho, Long Xuyen, Vi Thanh, and Vinh Long were studied using a stratified random sample approach. The demographic characteristics of the respondents, information regarding the respondents' recycling behaviour and goals, and the respondents' understanding of the MSW sorting program at the source were all included in the questionnaire's content.

#### 2.2.2 Data analysis methodology

According to Becker (2014), household recycling behaviour is frequently included in models by either the recycling rate variable (Miafodzyeva et al., 2013; Hage & Söderholm, 2008) or the decision to engage in recycling behaviour (Miafodzyeva et al., 2013; Hage & Söderholm, 2008) or the decision to engage in recycling behaviour (Miafodzyeva et al., 2013; Hage (De Feo and De Gisi, 2010). As a result, two variables were chosen as dependent variables in this study: recycl_rate and recycl_decision, representing recycling rate and recycling decision, respectively. In addition, recycl_qty, or the amount of recycled, was used to provide a broader picture of home recycling activities. To our best knowledge, this variable has rarely been employed in previous research because of lacking recycling data, then it is expected to contribute to the emerging literature on this topic. Thus, two OLS models and Probit regression were used to investigate the determinants influencing home recycling behaviour. All three models were analysed and combined as a foundation for comparison and to provide more relevant and feasible policy

responses in this study. First, a linear regression model is used to analyze the factors affecting the recycling amount of Recycl_qty household as following:

$$\text{Recycl\_qty} = z_0 + z_1\text{Dothi2} + z_2\text{Urban\_level3} + z_3\text{Assoc\_Ps} + z_4\text{Envi\_care} + z_5\text{Age} + z_6\text{Male} + z_7\text{Education} + z_8\text{Income} + u_1 (1)$$

Regression model analyzing factors affecting household recycling rate as below:

$$\text{Recycl\_rate} = \alpha_0 + \alpha_1\text{Urban\_level2} + \alpha_2\text{Urban\_level3} + \alpha_3\text{Assoc\_Ps} + \alpha_4\text{Envi\_care} + \alpha_5\text{Age} + \alpha_6\text{Male} + \alpha_7\text{Education} + \alpha_8\text{Income} + u_2 \ (2)$$

And then Probit regression model analyses the factors affecting the decision to implement recycling behaviour of households as follows:

$$\Pr(\text{Recycl\_decision} = 1) = F(x_i'\beta) = \int_{-\infty}^{x_i'} \frac{1}{\sqrt{2\pi}} e^{-x_i'\beta/2} dx \ (3)$$

Where the dependent variable Recycl_qty is the amount of scrap that households collect (grams/day), Recycl_rate is the household's recycling rate calculated by the amount of recycling of the household. Household (grams/day/household) divided by the household's amount of MSW (grams/day/household) and Recycl_decision is a dummy variable that takes two values, Recycl_decision = 1, the household does recycling, and otherwise.

The independent variables included in the model are urban_level2, urban_level3, assoc_Ps, Envi_care, age, male, education, and income. Variables urban_level2 and urban_level3 are variables representing convenience factors. An MSW management system (Miafodzyeva & Brandt, 2013) or a manifestation of improved garbage collection capacities can provide convenience (Becker, 2014). The infrastructure in Vietnam's grade 1 cities makes MSW collection easier. The MSW management system's collecting capacity is also higher in grade 1 cities than in the rest of the cities (Ministry of Natural Resources and Environment, 2020). Therefore, the urban-level element was used to represent the convenience element.In addition, the urban-levelcriteria were also used to describe the information element together with the variable Assoc_Ps. Social organizations and associations in Vietnam play an essential role in propagating and disseminating government programs. The Ministry of Natural Resources and Environment (2020)indicatesthat organizations are vital to providing information to households. Envi_care is a variable representing environmental concern, a dummy variable with two values, Envi_care = 1, if the household belongs to the group that recycles for environmental protection, and Envi_care = 0, if the household is not in the recycling group. Age, sex, education, and income are respondent's age (year), respondent's gender, respondent's years in school, and respondent's income per month.

## 3. RESULTS AND DISCUSSION

### 3.1 Respondents socio-economic characteristics

The program to improve management service quality was founded on the recycling principle, one of the most important ideas used to improve management quality in developed and developing nations. In order to recycle successfully, households should segregate rubbish at the source. According to the survey, around 82 percent of homes have MSW ranging from 2.5 kg per day to 1.83 kg per day on average and 0.49 kg per person per day. The city sanitation company

collects this amount regularly, once a day, except in congested areas; the collection period is every two days, three days, or four days.

The collecting duration varies depending on the ease with which the areas can be circulated. Usually, the region with the more frequent collection period is on the main road and vice versa. The collection period is less frequent in alleys away from the main road, and there are times when there is no collection service. Even though MSW management services are supplied to 98.5% of households, 1.5% do not get involved in this service.

### 3.2Households' awareness of recycling activities

Although local authorities in the MRD have not adopted a program of source classification, the study found that 64.71% undertake self-classification before local authorities collect the garbage. The majority of individuals do MSW separation at the source to sift and collect recyclable MSW components for the sale of household scrap. Recycling is done by 76.26% of households by collecting scrap to be sold to scrap collectors or scrap yards. Recycling is an excellent way to decrease the quantity of waste discharged into the environment, decreasing the negative impacts on human health. However, aside from those who recycle, 23.74 percent of the households have yet to conduct recycling operations. Table 1 shows the reasons why households were recycling or not recycling.

**TABLE 1. REASONS AFFECTING THE RECYCLING ACTIVITIES OF HOUSEHOLDS**

| Group | Reason | Most Important | Second Important | Third Important |
|---|---|---|---|---|
| Households carrying recycling activities | It does not take too much time | 101 (23.33%) | 80 (18.56%) | 101 (23.60%) |
| | It doesn't occupy much space | 58 (13.39%) | 79 (18.32%) | 74 (17.29%) |
| | It provides additional income | 121 (27.94%) | 85 (19.72%) | 94 (21.96%) |
| | It helps improve environment quality | 84 (19.40%) | 112 (25.99%) | 70 (16.36%) |
| | It does not affect health | 66 (15.24%) | 75 (17.40%) | 86 (20.09%) |
| Households not carrying recycling activities | It takes time to collect | 33 (24.26%) | 17 (12.59%) | 32 (23.88%) |
| | It takes up storage space | 26 (19.12%) | 35 (25.93%) | 30 (22.39%) |
| | I do not have storage containers | 11 (8.09%) | 31 (22.96%) | 23 (17.16%) |
| | I think money from scrap selling is not much | 51 (37.50%) | 31 (22.96%) | 27 (20.15%) |
| | I don't think scrap can be sold | 1 (0.47%) | 6 (4.44%) | 7 (5.22%) |
| | It affects my healthwhen recycling | 3 (2.21%) | 14 (10.37%) | 10 (11.19%) |

*Source: Survey data, 2020*

According to Table 1, 76.26% of the households are driven to recycle because it generates additional income, which respondents rank as the most significant reason for recycling, which includes classification, collection, storage, and scrap selling. Furthermore, separating and storing recyclable components from MSW is a short process. The respondents claim that if they can organize the garbage, the amount of scrap held does not take up much storage space.At the same time, if the scrap is cleaned before being kept, it does not pollute the environment. Furthermore, some responders engage in scrap collection because it helps to protect the environment.

Contrary to the views of those who currently recycle, 23.74% of non-recycling households say that, while collecting and sorting MSW takes much time and is carried in a larger residential area, the money earned from scrap sales is not significant. These considerations may be utilized to develop solutions to increase household recycling activities, thereby improving the quality of the MRD's recycling-oriented bio-waste management system. Table 2 shows the percentage of households that recovered materials through recycling activities.

**TABLE 2. TYPES AND PROPORTION OF SCRAP MATERIALS FROM RECYCLING ACTIVITIES**

| Type of scrap | Number of obs | Unit | Mean |
|---|---|---|---|
| Scrap sale period | 578 | Day/time | 28.08 |
| Amount of scrap metal | 578 | Gram/day | 6.84 |
| Amount of scrap glass | 578 | Gram/day | 2.59 |
| Amount of scrap plastic | 578 | Gram/day | 18.12 |
| Amount of scrap fabric | 578 | Gram/day | 0.11 |
| The amount of scrap paper | 578 | Gram/day | 14.37 |
| Total amount of scrap | 578 | Gram/day | 42.06 |
| Recycle ratio[1] | 578 | % | 2.91 |
| Potential recycling rate[2] | 417 | % | 22.99 |

*Source: Survey data, 2020*

*Note:[1]Calculated by [total waste (grams/day)/generated(grams/day)*100] and [2]Estimated by households*

According to Table 2, the average family sells junk once a month. Scrap is traded in a wide variety of forms. Because scrap is made up of components recovered from MSW, the amount collected and exchanged fluctuates depending on the scrap that makes up more or less of the MSW. Plastic and paper, for example, account for a bigger proportion of garbage than other components and are frequently generated in the household; therefore, the amount of trash in plastic and paper is larger than that of the other groups, scrap metal, glass, and fabric.

This data is consistent with the World Bank's (2018) survey, which shows that the proportion of plastic components ranges from 3.4% to 10.6%, while the ratio of plastic components ranges from 3.4% to 10.6%, metal parts range from 1.4% to 4.9%, and glass composition ranges from 0.5% to 2.0%.

Interestingly, the study's estimated recycling rate is 2.9%, whereas the estimated potential recycling rate for households is 22.99%. In other words, families are aware that MSW may be recycled in greater quantities than their existing recycling activities. This result and the reasons listed in Table 1 serve as a basis for proposing methods to increase MSW recycling rates in

households, in accordance with the goals of the central government's national policy for increasing recycling rates. If adopted, the suggested policy based on this research will significantly influence reducing present MRD environmental pollution.

### 3.3 The determinant of recycling behaviour of households in the Mekong River Delta

Factors that were influencing recycling behaviour are presented in Table 3.The estimation of models 1, 2, and 3 with Prob>chi2 = 0.000 less than 1% indicates that these modes are statistically significant and independent variables explain the dependent variable well.

**TABLE 3. THE DETERMINANTS OF HOUSEHOLDS' RECYCLING BEHAVIOR**

| Variables | Model 1 (OLS) | Model 2 (OLS) | Model 3 (Probit) |
|---|---|---|---|
| urban_level2 | -3.655*** | -78.807*** | 0.225ns |
| | (0.962) | (14.813) | (0.195) |
| urban_level3 | -2.491*** | -72.889*** | 0.177ns |
| | (0.847) | (13.157) | (0.172) |
| Assoc_Ps | 0.418ns | 13.220ns | 0.403*** |
| | (0.752) | (11.682) | (0.159) |
| Envi_care | 2,395*** | 24.193*** | 2.625*** |
| | (0.703) | (10.913) | (0.365) |
| Age | -0,018ns | -0.397ns | -0,003ns |
| | (0.029) | (0.448) | (0.006) |
| Male | -0,101ns | 8.669ns | -0.075ns |
| | (0.754) | (11.721) | (0.156) |
| Education | -0.297*** | -6.376ns | -0.040** |
| | (0.091) | (5.692) | (0.018) |
| Income | -0,040ns | 0.776ns | 0.007ns |
| | (0.099) | (1.538) | (0.020) |
| Constant | 7.401*** | 107.092*** | 0.362*** |
| | (1.974) | (30.970) | (0.408) |
| Dependent variable | Recycl_rate (%) | Recycl_qty | Recycl_decision |
| | Number of obs = 569 | (gram/day) | Number of obs = 569 |
| | Prob>F = 0.0001 | Number of obs = 566 | Log likelihood = -211,09955 |
| | R-squared = 0.0534 | Prob>F = 0.0000 | LR chi2(8) = 201.31 |
| | | R-squared = 0.0764 | Prob>chi2 = 0.0000 |
| | | | Pseudo R2 = 0.3229 |

*Source: Survey data, 2020*

*Note: *, **, and *** are statistically significant at 10%, 5%, and 1%, respectively, and ns are not statistically significant; The number in parenthesis is the standard error*

The investigation results show that respondents who identify as environmentally conscious recycle more, have a higher recycling rate, and are more likely to engage in recycling behaviour. This result contradicts the claim of Miafodzyeva et al. (2013), who found that environmental concerns have little influence on recycling decisions. Instead, environmental concern is a crucial aspect in defining households' efforts in MSW recycling programs according to Becker (2014)

and the theory of this study. Moreover, households in urban-type 2 and 3 cities recycle less MSW and recycle at a lower rate than households in urban-type 1 cities. Using urban-type criteria as a measure of convenience, infrastructure in level 1 cities is often more convenient than in other urban areas. As a result, families in urban-type 1 locations recycle at a faster rate and in greater quantities. However, because the variable in Model 3 is not statistically significant, there is insufficient evidence to conclude that urbanization influences the likelihood of engaging in recycling activities.

Furthermore, just one element connected to the respondent's demographic characteristics, education level, impacts the volume, rate, and likelihood of recycling activity. The coefficients of this variable are negative, indicating that respondents with lesser education had a larger volume of MSW recycling and a higher chance of recycling. Table 1 shows that respondents cited "not requiring much time" and "additional income" as reasons for recycling. Those with a higher education who can make a larger salary spend their time working to generate money rather than recycle with a small amount of money compared to their income. In this study, the information component is the union membership. Respondents who join the union have a higher likelihood of recycling. As a result, the association factor should be considered in recycling programs (Ministry of Natural Resources and Environment, 2020). As a result, mass communication and organization have a significant impact on SWM recycling behaviour in households. Therefore, any form of implementation of direct media, i.e. television, radio, propaganda, and participation in local association, increase recycling behaviour.

## 4. Conclusion and policy implications

The objectives of this paper was to understand more about households' recycling behaviors in MRD Vietnam regions, as well as the variables that impact their recycling behaviors. The study uses the idea of recycling behavior to create regression models with three dependent variables: recycling rate, and recycling decision. In addition, the amount of recycling is used, which is different from previous research. According to the results, more than 75% of respondent households engage in recycling activities.

It is important to note that, although households estimated a possible recycling rate of more than 22%, the quantity of recycling measured from this study is only approximately 3%. The disparity between actual and prospective recycling quantities shows that authorities should increase incentives and propaganda to encourage recycling, especially in developing countries like Vietnam. As a result, the government's implementation of policies to improve recycling incentives will have a significant impact on increasing recycling activities and, as a result, reducing pollution. The results of OLS and Probit model analysis are similar in certain ways.

Environmental concerns, degree of urbanization, education level, and participation in an organization are all factors that influence the recycling rate, quantity, and behaviour of responders. Joining the union and having a favourable attitude about environmental preservation increases recycling rates, quantity, and the likelihood of recycling. As a result, the Vietnamese government may strengthen MSW classification at the source through various forms of propaganda, such as mass media, leaflets, associations, and propaganda by sanitation workers collecting MSW locally to understand how to implement and realize the rewards of this program.In addition, the government can strengthen the implementation of projects supporting recycling by subsidizing the agencies involved in recycling collection, from increased prices for

recycled materials, encourage low-income and low-educated people to recycle more. This is proved by the results from the analysis of the reasons for selling scrap. The results show that economic reasons or other income generation are the primary motivation for people to collect, sort, and sell scrap (i.e. when there is a government subsidy policy on scrap such as plastic bags, then if the price of the scrap is higher, the household may sell more). Thus, the policymakers may formulate guidelines to motivate people to recycle besides investing in modern technology and related recycling activities. Financial assistance to local informal scrap collectors, such as itinerant garbage purchasers and back-bottle (a Vietnamese term for garbage company), to help them stabilize their livelihoods, sustain and develop their operations, and boost recycling efficiency through scrap sales. The study researchers are undertaking another analysis that will look into the scrap collectors' role and livelihood to make policy recommendations for this sector.

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