# ASSESSING COMMUNITY ATTITUDES AND WILLINGNESS TO PARTICIPATE IN URBAN PLASTIC WASTE MANAGEMENT IN VIETNAM: AN EMPIRICAL CASE OF HANOI CITY

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**Abstract.** Along with rapid economic development, Vietnam is facing serious environmental problems, including plastic waste pollution in urban areas. This study applied the Press- State - Response (PSR) analysis framework and logistic regression model to evaluate Hanoi residents' awareness of plastic waste as well as factors affecting households' behavior related to participating in plastic waste management. We collected primary information from a survey of 450 households in 3 urban districts of Hanoi. Research results showed that people were well aware of plastic waste and plastic pollution, but it was difficult for them to change their habits because of the popularity and convenience of plastic products. People also initially classified and recognized some types of plastic at a simple level and reused plastic products in daily life. Regression analysis indicated 8 factors affecting people's plastic waste management behavior, of which attitudes and awareness about plastic waste had the strongest impact. The study also discussed and proposed some management implications including raising people's awareness through social media, establishing grassroots environmental funds to attract community financial resources and initiating waste classification programs at community level with state supports.
**Keywords:** *plastic waste management, recycling, environmental pollution, community participation, environmental awareness, regression analysis, Hanoi, Vietnam*

## Introduction

Plastic pollution is one of the biggest challenges countries are facing (Bandara et al., 2007; Buerostro et al., 2011; Irwan et al., 2013; Dat and Truong, 2020). Every year, the amount of plastic waste (PW) generated by humans globally covers 4 times the earth's surface area, of which 13 million tons of PW is dumped into the ocean (Kaza et al., 2018). The overuse of plastic products, especially non-degradable nylon bags, has serious consequences for the environment. In the world, nearly 50% of plastic products are designed and manufactured for single use and then discarded. Only a portion of the total amount of PW is recovered for recycling, a portion is treated by incineration or landfilling, and the remainder is not thoroughly collected along the flow, causing the pollution of rivers, seas and oceans (Lavee et al., 2013; Jereme et al., 2016; Khan et al., 2016). The increasing amount of PW and plastic bags discharged into the environment poses a serious threat to the land, water, air and ocean environment now and in the future. Recently, the World Bank (2022) has reported that 90.5% of global PW has not been recycled. This means that 5.7 billion tons of PW accumulated over 60 years is still floating in oceans, rivers and streams, or buried (78.5%). If habits are not changed, by 2050, people will have to live with 12 billion tons of PW. Most disposable plastic products and


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plastic bags are only used once after production, equivalent to about 80 - 120 billion USD per year (World Bank, 2022).

To deal with issues related to PW, countries have been implementing integrated strategies to reduce, reuse and recycle the waste, including advanced technologies, 3Rs programs, economic incentives and other supports (Meneses and Palacio, 2015; Khan et al., 2016; Ojeda-Benítez et al., 2018). However, it is difficult to handle PW problems with single measures because the plastic waste management (PWM) system is very complex, consists of many parts, involves many social objects and is dynamic (De Feo et al., 2010; Astane and Hajilo, 2017). According to Babaei et al. (2015), an optimal PWM system should emphasize all stages of the management process including strategy, planning, capacity, coordination, resources and responsiveness. World Bank (2022) also emphasized that there are four important factors that determine the effectiveness of PWM including policy, people, infrastructure and resources as well as the adequate coordination of these factors. In addition, human participation plays an extremely important role, especially in developing countries where resources are limited. People's awareness, attitudes and behavior will be one of the deciding factors in the success and failure of PWM programs whether at the national or community level (Buenostro et al., 2011; Irwan et al., 2013; Khan et al., 2016).

Around the world, recent literature emphasizes the role of community behavior change and social inclusion such as key solutions for PWM (Sorkun, 2018; Le and Nguyen, 2019; Srun and Kurisu, 2019). These studies apply many different theoretical foundations such as the theory of planned behavior (TPB), the technology acceptance model (TAM), or the unified theory of acceptance and use of technology (UTAUT) to build empirical model allows analysis of factors affecting social behavior of PWM. The factors identified are very diverse, including behavioral psychological factors, economic and demographic characteristics, social support and promotion factors, or core values and subjective norms of customers (Afroz et al., 2011; Khan, 2016; Dat and Truong, 2020).

Vietnam is considered one of the four countries with the fastest increase in plastic waste in the world in the period 2005-2020 (World Bank, 2022). After decades of strong economic growth, Vietnam has moved into the group of middle-income and dynamic countries (Le and Nguyen, 2019; Dat and Truong, 2023). However, the price to pay is pollution and environmental degradation. PW pollution is one of the 5 most serious environmental problems in Vietnam along with air pollution, water pollution, biodiversity loss and climate change (Dat and Truong, 2020). Currently, Vietnam is facing many risks from plastic waste. The amount of plastic waste is increasing rapidly, in 2014 it was about 1.8 million tons/year, in 2016 it was about 2.0 million tons/year and currently it is about 2.8 million tons/year (World Bank, 2022). The volume of plastic waste dumped into the ocean each year is about 0.28 - 0.73 million tons/year (accounting for nearly 6% of the world's total amount of plastic waste discharged into the ocean). In Vietnam, on average each household uses about 1 kg of plastic bags/month, in the two big cities of Hanoi and Ho Chi Minh City alone, an average of about 80 tons of plastic waste and bags are discharged into the environment every day (Dat and Truong, 2020; Thanh et al., 2020) Despite the rapid increase in quantity, the classification, recovery, recycling and treatment of plastic waste is still limited. The amount of plastic waste and nylon bags accounts for about 8-12% of household solid waste, but only about 11-12% is processed and recycled; the remainder is mainly buried, burned and discharged into the environment. This can lead to environmental disasters, causing serious economic, social and ecological impacts,


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threatening the country's sustainable development (Trang et al., 2017; World Bank, 2022; MONRE, 2022).

Recognizing the importance of preventing and reducing PW, Vietnam has recently had many solutions using policy tools and specific actions. In 2020, the Law on Environmental Protection was amended, which legislated content related to PW such as management, reuse, recycling, treatment and development of a circular economy model for plastic. In 2019, the Government extended the National Action Plan on ocean PWM until 2030. Vietnam has also proactively and actively participated in building and accompanying the international community towards a global agreement to tackle plastic pollution. In 2017, Vietnam officially joined the list of 127 countries that passed the United Nations Environment Council Resolution of the United Nations Environment Program (UNEP) on ocean plastic and micro PW. In 2021, Vietnam will host the Environment Ministers' Conference on plastic pollution and ocean waste. At the Conference, 76 countries adopted the Joint Ministerial Declaration on the political determination of countries to solve the problem of plastic pollution. Vietnam has also issued the National Green Growth Strategy for the period 2021-2030 and vision to 2050 (2021) and the National Action Plan on Circular Economy (2022) (Dat and Truong, 2020, 2022; MONRE, 2022).

Although there are many efforts to reduce and manage PW, to date there have been very few studies on the awareness and behavior of stakeholders regarding PWM, especially assessment of community awareness and participation in PWM (Trang et al., 2017; Thanh et al., 2020; Dat and Truong et al., 2020). According to Kaze et al. (2018), PWM systems can be very complex and consist of many interacting parts. A successful system requires effective coordination between social groups and solutions specifically designed for management circumstances. This implies that we can only design satisfactory solutions if we identify the characteristics, properties and behaviors of communities in PWM (Khan et al., 2016; Jereme et al., 2016; Astane et al., 2017).

This study fills that gap with the goal of assessing the awareness and willingness to participate of people in Vietnamese urban areas in PWM programs aimed at reducing damage and impacts of PW. This waste is harmful to life and the environment. The study also provides input information for management agencies in improving institutions and policies for PWM in the context of promoting circular economy and green growth in Vietnam.

## Materials and methods

### *Analytical framework*

The study applies the Pressure - Status – Response (PSR) analysis framework to evaluate the current status of PW and people's awareness and attitudes about PW in Hanoi, Vietnam. Then, we used a logistic regression model to evaluate factors affecting people's participation in PWM in Hanoi.

The Pressure –State- Response framework was developed by the Organization for Economic Co-operation and Development (OECD) in 1999 to describe the interaction between environment and society. It analyzes and evaluates environmental problems by bringing together different scientific disciplines, managers and stakeholders and solves them while incorporating the sustainable development (OECD, 1999; Khan et al., 2019). First, the related indicators are categorized into “drivers” that “stress” the “state” of the system, thereby leading to certain “effects” that entail various “reactions” to maintain the


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system. Since its construction in the late 1990s, it has been widely adopted by international organizations for researches in various fields such as solid waste management, air and water pollution, climate change. Recently, this framework has been used in combination with other analytical models. It is used to assess environmental changes in ecosystems, identify pressures on the system, forecast challenges and suggest management solutions (Sorkun, 2018; Srun and Kurisu, 2019). The general applicability and flexibility of this framework made it a versatile tool which can be used in social, economic and institutional fields (OECD, 1999) (*Figure 1*).

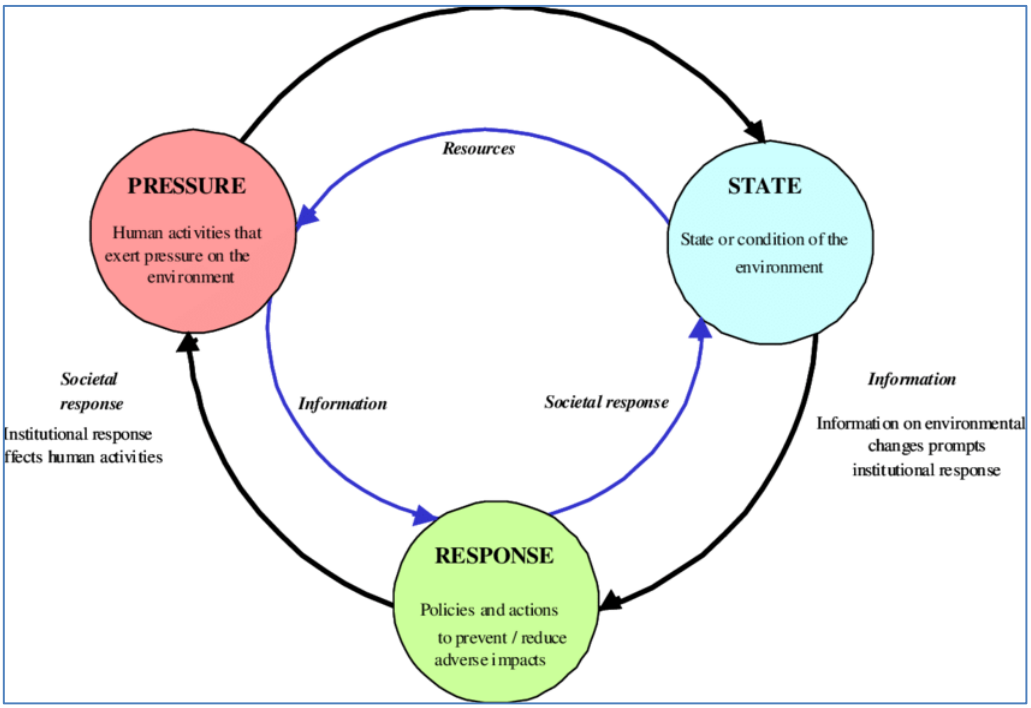


***Figure 1.*** *PSR model and components. Source: OECD (1999)*

*Pressure*

Pressure represents the consequences of motivation, which in turn affects the state of the environment (Dat and Truong, 2020). They are often portrayed as undesirable and negative, based on the idea that any change in the environment caused by human activity is harmful and degrading. Pressures can have short-term or long-term effects, which, if known with reasonable certainty, can be expressed as probabilities (OECD, 1999). They can be caused by humans, for example waste generation, but also by natural processes, such as solar radiation. Pressures can also be classified as managed endogenous pressures if they arise within the system and can be controlled and exogenous pressures if they cannot be controlled (Lavee and Nardiya, 2013).

*State*

The state refers physical, chemical and biological condition of the environment or changes over time in the system (Kumar and Samdder, 2017; Maskey, 2017). It can be related to natural systems, socioeconomic systems, or a combination of both. It covers a wide range of characteristics, such as the physicochemical properties of ecosystems, the


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quantity and quality of resources as well as the living conditions for humans and the level of exposure or impact of stress on people (Mattar et al., 2018; Dong et al., 2020). The term "state will impact" refers to how changes in the state of the system affect human well-being. It is often measured in terms of damage to the environment or human health, poverty and susceptibility to disease, but can also be identified and quantified without positive or negative meaning by indicating changes in environmental parameters. The impacts can also be ecological, socioeconomic or a combination of both (OECD, 1999).

*Response*

Response refers to the actions to correct the issues of the previous stages by changing the driving force, then reducing pressures on the systems, returning the systems the original states, and minimizing the impacts (Ekere et al., 2009; Sakhoh et al., 2012; Saphores et al., 2016). They may be explicitly linked to policies or to different aspects of the society, including individuals, firms, governmental or non-governmental units (OECD, 1999; Mattar et al., 2018). Response measures are often designed and implemented as policy measures to protect, mitigate, conserve or promote improved solutions. A combination of bottom-up social awareness and effective top-down policies and can also be developed in response, such as improved PW recycling rates.

***Model analysis of factors affecting households' decision of participation in PWM***

To identify and evaluate factors affecting the probability of participating in the PWM program in households, the study uses the following model (*Eq.1*) (Dwivedy and Mittal, 2018):

$$P_i(Y_i) = \frac{e^{X\beta}}{1+ e^{X\beta}} \quad \text{(Eq.1)}$$

in which:
$P_i$ is the probability of participating in the household's PWM program (Yi = 1: yes; Yi = 0: no participation)
β is the vector of marginal effect coefficients, and X is the vector of impacted factors.

Empirically, the model estimates factors affecting households' PWM participation in the following form (*Eq.2*):

$$\begin{aligned} P_i = \alpha + \beta_1 AGE + \beta_2 GENDER + \beta_3 EDU + \beta_4 MARRIED \\ + \beta_5 MEMBER + \beta_6 INCOME + \beta_7 IMPACT \\ + \beta_8 CONCERN + \beta_9 POLLUTION \\ + \beta_{10} CLASSIFICATION \\ + \beta_{11} COMMUNICATION + e_i \end{aligned} \quad \text{(Eq.2)}$$

where,
$\alpha$: intercept
$\beta_i$: coefficiences of influence factors
$e_i$: errors.

*Table 1* specifically presents the parameters in the regression model.


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***Table 1.*** *The independent variables in regression model*

| Variable | Symbol | Unit |
|---|---|---|
| Age | AGE | year |
| Gender | GENDER | 1 = male, 0= female |
| Education level | EDU | years of schooling |
| Married status | MARRIED | 1 = married, 0 = single |
| Household member | MEMBER | person |
| Monthly income | INCOME | million VND |
| Attitude about impact of PW | IMPACT | person |
| Concern level about PW | CONCERN | rate from 1 to 5 |
| Awareness about PW pollution | POLLUTION | rate from 1 to 5 |
| Classification of PW at home | CLASSIFICATION | 1 = classify PW, 0= not classify PW |
| Communication about PW | COMMUNICATION | 1 = heard about PW in media, 0 = did not hear about PW in media |

Source: Research design (2023)

### *Data collection*

Data for the study was collected through direct surveys of households in Hanoi. In this study, we apply the following formula (*Eq.3*) to calculate sample size to ensure reliability (Hair et al., 2010).

$$n = Z^2 * \frac{p*(1-p)}{e^2} \quad \text{(Eq.3)}$$

in which n is sample size, *z* is z-score, $e$ is margin of error, *p* is standard of deviation.

Supposed with a 90% confidence level, 50% standard of deviation and a 5% margin of error, the estimated sample for reliability were 443. The study collected information from 450 households in Hanoi to analyze the data. We have chosen 3 representative districts in Hanoi including Hoan Kiem (central district with people who have settled long term and have stable careers), Long Bien (new district with rapid development) and Nam Tu Liem (peri-urban district with mixed-occupation people including migrants). In each research district, 150 survey questionnaires were collected. We randomly drew a ward in each district, and then approached the local government to collect a list of households. In each direction, the study randomly selected 3 residential groups and randomly selected households to interview. The sampling process ensured reliability and representation of the research population.

Households were approached in the evening when the household had enough members or the head of the household was present. Households were introduced to the objectives of the survey and asked about their consent to participate in the interview. If there is no consensus, the next neighbor will be selected. The official investigation takes place in October and November 2023 in Hanoi. The corresponding regression models that have been analyzed include model 1 (overall), model 2 (Hoan Kiem district), model 3 (Long Bien district) and model 4 (Nam Tu Liem district) (*Table 2*).

The questionnaire included the following main contents: (i) socio-economic background of the households (ii) awareness and attitude about the status and impacts of PW, (iii) PW classification and, recycling of households, (iv) participation of households in PWM program at community level.


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***Table 2.*** *Sampling in districts and analysis models*

| Districts | Sampled households | Regression model |
|---|---|---|
| Total | 450 | 1 |
| Hoan Kiem | 150 | 2 |
| Long Bien | 150 | 3 |
| Nam Tu Liem | 150 | 4 |

Source: Research design (2023)

## Results

### *Plastic waste status in Vietnam*

According to MONRE (2022), the amount of PW and nylon bags in Vietnam is currently very high, accounting for about 8 - 12% of household solid waste, approximately 8 million tons/year. Calculating only plastic bags, it is estimated that on average each Vietnamese household uses 223 plastic bags/month, equivalent to 1 kg of plastic bags/household/month. It is estimated that each year Vietnam uses and disposes of more than 30 billion plastic bags into the environment (Thanh et al., 2020). If calculating the index of plastic products per capita, by 2022 it will be over 63 kg/person/year, while this index in 1990 was 3.9 kg/person/year. In 2020, Vietnam's plastic industry consumed about 5.9 million tons of virgin plastic materials, equivalent to the average plastic consumption rate per capita of 63 kg/person/year. Vietnam's average plastic consumption rate per capita grew by an average of 10.6%/year in the period 2010-2020. With the characteristics of low production cost and convenience, containing anything possible, plastic bags and disposable plastic products have become popular items in production, business and daily life, especially at large supermarkets, shopping centers, and traditional markets (World Bank, 2022) (*Figure 2*).

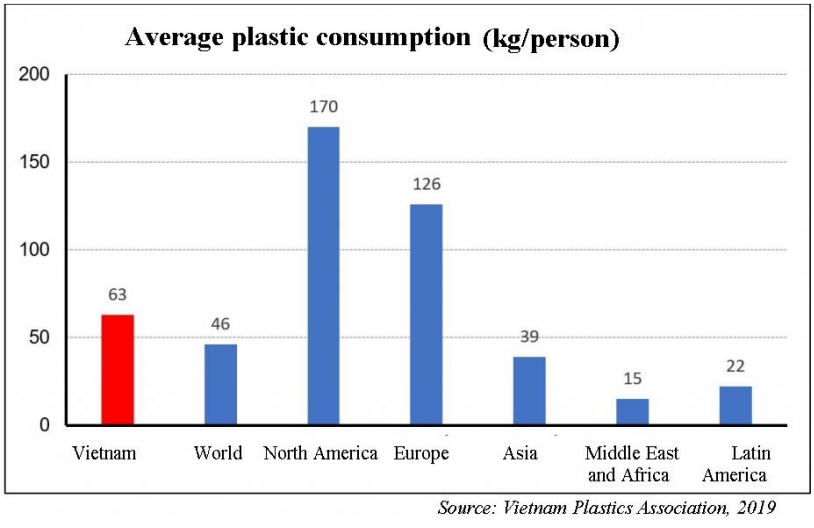


***Figure 2.*** *Plastic consumption of Vietnam compared with other nations*

In the structure of virgin plastic raw materials consumed by the Vietnamese plastic industry, the packaging plastic segment accounts for the largest proportion, the total volume of virgin plastic raw materials consumed in 2019 was 6.89 million tons, of which


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packaging plastic consumed is about 2.1 million tons, accounting for 36% (Vietnam Plastics Association - VPA, 2019). Output products of the plastic bottle packaging segment are divided into 04 main groups, including thin film packaging, complex film packaging, PET bottles and non-PET bottles. The packaging consumer market is mainly food and beverage manufacturing and processing enterprises, fast-moving consumer goods enterprises, retail enterprises (distributing to supermarkets, shopping centers, shops, traditional markets...) (MONRE, 2022). Currently, there are about 2,000 Vietnamese enterprises operating in the field of plastic packaging, of which the thin packaging segment mainly focuses on small businesses and households, with large businesses accounting for 31.7% of the market share (World Bank, 2022; MONRE, 2022).

Currently, the amount of plastic scrap generated is nearly 18,000 tons/day; the price of scrap is very low. Therefore, recycled plastic pellets from household PW have a much lower price than virgin plastic pellets. Currently, only about one-third of PW in Vietnam is recycled, causing the economy to waste between 2.2 billion and 2.9 billion USD each year. Each year, about 3.9 million tons of PET, LDPE, HDPE and PP plastic are consumed in Vietnam (Thanh et al., 2020). Of this, only 1.28 million tons (33%) were collected and recycled. Therefore, up to 2.62 million tons of plastic are discarded, leading to a loss of 75% of the material value of plastic, equivalent to 2.2 - 2.9 billion USD per year. If it were all collected and recycled into its most valuable products, the total value of materials liberated through recycling would theoretically be equivalent to $3.4 billion per year (World Bank, 2022) (*Figure 3*).

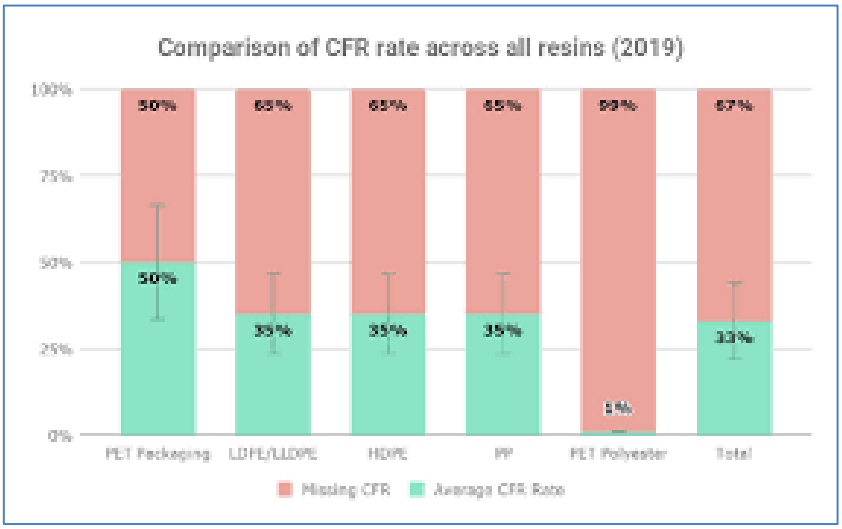


***Figure 3.*** *Collection and recycling rate (CFR) of various types of PW. Source: Word Bank (2022)*

The reasons leading to low plastic recycling rates in Vietnam include lack of sustainable demand for recycled plastic locally, and poor access to finance for recyclers, especially small and medium enterprises. In addition, there is also an uneven and risky supply from the informal sector, heavy dependence on imported plastic scrap, no design standards for recycling, and a waste management system that prioritizes collection process rather than recycling (VPA).


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VPA also believes that if businesses can use recycled plastic materials at a rate of 35-50% per year, they can reduce production costs by more than 15%. Non-recyclable PW can be used as input material for coal power plants by co-processing. However, the number of PW treatment plants in Vietnam is still too small, leading to the current waste of "waste resources".

Among PW, 80% of plastic bags are disposable, only 17% of plastic bags are reused; only about 10% of PW is recycled. The World Bank (2022) assessed PW pollution based on a survey of 24 river banks and beaches in 3 regions of North, Central and South of Vietnam. PW accounts for 69.7% of the quantity and 47.2% of the weight of trash dumped into the river. Single-use plastic items account for 72% of total PW. The average amount of PW in riverbank locations in urban areas is nearly 2 times higher than the average amount in riverbank locations in rural areas. Specifically, the number of riverside plastic pieces in Can Tho (34.5 pieces/unit), Ho Chi Minh City (33.4 pieces/unit) and Lao Cai (30.1 pieces/unit) is higher than other locations, while the number of plastic pieces on river banks in Soc Trang province is the lowest (4.3 pieces/unit).

Coastal pollution levels show that PW accounts for 95.4% of total solid waste, an average of 81 pieces per meter of coastline. Analyzes show that the overall pollution density in Thua Thien - Hue (141.1 pieces per meter of coastline), Ho Chi Minh City (135.6 pieces per meter of coastline) and Quang Nam (133.7 pieces per meter of shoreline), significantly higher than at other locations. Single-use plastic items accounted for 52% of the total amount of PW found at coastal survey locations. Measurement results of the Clean Coast Index (CCI) show that 10 locations (accounting for 71.4% of the total) are extremely dirty (CCI over 20), 2 locations are dirty (CCI 10 -20), and 2 other positions are at average level (CCI 5-10). The highest CCI index was recorded in Khanh Hoa, Soc Trang, Phu Quoc and Hai Phong provinces (World Bank, 2022).

### *Socio-economic characteristics of the study sample*

The total research sample is 450 households in Hanoi, of which the number of male and female respondents is relatively equal, 52.3% and 47.7%, respectively (*Table 3*). Regarding age, the number of people from 31-40 years old accounts for the highest proportion (32.8%), followed by people from 41-50 years old (30%), these are also the most common age groups in Vietnam's population structure and is also a common age for household heads when they are of working age. In the research sample, on average each family has 4.12 members (similar to the corresponding number of the Hanoi Statistics Office in 2022). The level of education in the study sample is quite high with the average number of years of schooling for respondents being 11.4 years. The reason is because Hanoi is the capital of Vietnam, and this is the city with the highest access to education in the country. Therefore, the education level of the people is significantly higher than the national average. Specifically, the number of respondents with a university degree accounts for 30.7%, the number who graduated from high school accounts for 27.3%, and only 2.3% of the respondents have just graduated from elementary school. The average income of a household in the research sample is 23.3 million VND/month. This number is quite similar to the average income per household in Hanoi (Hanoi Statistics Office, 2022). Of these, the middle income group (21-40 million VND/month) accounts for more than 70%. There are approximately 8% of households with low income (less than 10 million VND/month) and the number of households with high income (>80 million VND/month) is almost similar.


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***Table 3.*** *Socio-economic characteristics of the sample*

| Indicator | Number | % | Average |
|---|---|---|---|
| **Gender** | | | |
| Male | 235 | 52.3 | |
| Female | 215 | 47.7 | |
| **Age (years old)** | | | |
| 20 - 30 | 76 | 16.6 | 43.8 |
| 31 - 40 | 148 | 32.8 | |
| 41 - 50 | 135 | 30.0 | |
| 51 - 60 | 63 | 14.0 | |
| > 60 | 28 | 18.6 | |
| **Average people in household (person)** | | | **4.7** |
| **Education** | | | |
| Primary | 10 | 2.3 | 11.4 |
| Secondary | 179 | 39.7 | |
| High school | 123 | 27.3 | |
| University | 138 | 30.7 | |
| **Household monthly income (millions VND)** | | | |
| <10 | 33 | 7.4 | 23.4 |
| 11-20 | 202 | 44.9 | |
| 21-40 | 123 | 27.4 | |
| 40-80 | 56 | 12.4 | |
| >80 | 36 | 7.9 | |

1 USD= 24,000 VND. Source: Research results (2023)

## *Awareness and attitudes about PW and PWM*

### *Awareness and attitudes about PW*

According to interview results, plastic is a common material in daily life and accounts for the largest amount of daily household waste. Specifically, the average daily amount of waste per household is about 2.1 kg, of which PW accounts for about 20 - 40% and most plastic products are used in food processing and daily life and retail business. The average consumer spending on plastic items is about 92,000 VND/month/household. For common plastic items such as grocery bags, water bottles, shampoo, dishwashing liquid, people have to pay an average of about 65,000 - 350,000 VND/month/household.

Plastic products such as water bottles, cups, plastic spoons, shampoo bottles, food boxes, and plastic bags account for a large proportion of the total volume of plastic generated at the household level (about 80%). The remaining items such as plastic gloves and food wrap have a usage rate of less than 20% of the volume of PW. The results show that the plastic items used are very diverse, in which the group of household plastic items serving daily needs accounts for the highest proportion, followed by the group of plastic items serving dietary needs, drinking, and finally a group of plastic items serving the kitchen and other needs.

Most respondents said they could recognize and distinguish PW from other types of waste (97.8%). The number of people who recognize PW through shape accounts for 55.4% and through color accounts for 23.4%, the remaining 7.1% recognize through color and shape, the rest recognize through practical knowledge and emotions.


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Regarding attitude, 20.4% of households are very concerned about the harmful effects of PW on health and the environment, and 25.5% are concerned about this issue. The numbers of households that are not interested accounts for 31.4%, the remaining are households whose opinions are unclear. For the group that does not care, it is worth noting that 31.8% of people think that PW does not cause any harm, and 38% do not care about environmental problems caused by PW. Among households that care and are very concerned about the harmful effects of PW, 48% say they are most concerned about family health issues, 32% are concerned about environmental pollution where they live including landscape, the rest they care about for other reasons (long-term harm, deterioration of social image) (*Figure 4*).

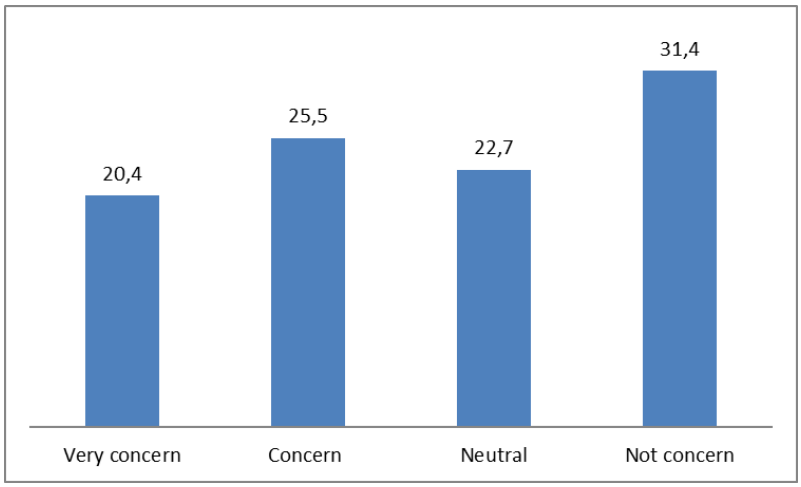


***Figure 4.*** *Level of concern about PW issues (%). Source: Study results (2023)*

Regarding the reason why they are aware of the harmful effects but still use PW, 42% of households think that plastic items are convenient, easy to use, and save time, 32% think that plastic items are cheaper than plastic products. For other items, 11% said there were no substitutes for the plastic items they were using and the remaining 15% said it was a habit and difficult to change (*Figure 5*).

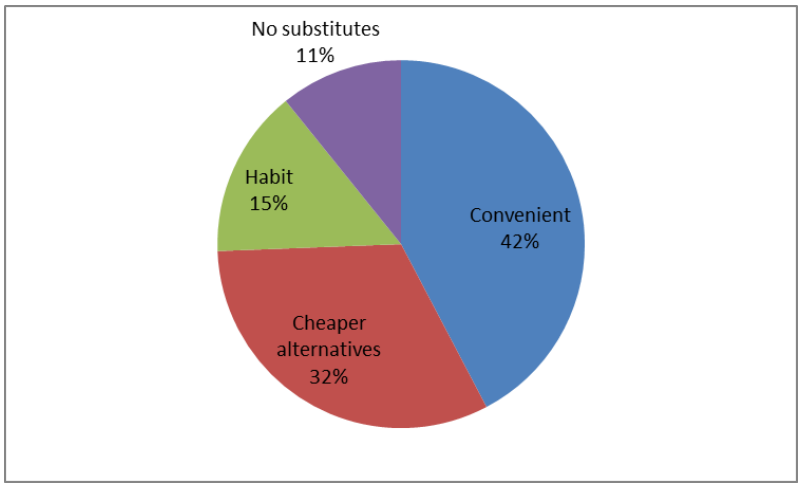


***Figure 5.*** *Reasons for using plastic at home (%). Source: Study results (2023)*


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Poor waste management and household plastic pollution lead to natural resources in rivers, canals and streams increasingly disappearing. Research results show that 65% of households interviewed believe that the water quality of rivers and canals is getting worse, especially the gradual decline in the number of shrimp, crab, and fish species in the last 3 to 5 years.

*Awareness and behavior of recycling PW*

Each type of plastic is represented by a letter or number, usually located between triangles with arrows, and can be found on the shell or on the bottom of plastic products. These plastic code symbols/labels indicate the composition, toxicity level and recyclability of the plastics that make them up. The number 1-PET is a symbol for a type of plastic that can only be used once; number 2 -HDPE is the symbol for a type of plastic that does not emit toxic substances and can be reused many times; number 3-PVC is good for health; number 4-LDPE is a safe plastic that can be reused several times; number 5 - PP is durable and lightweight, can withstand high temperatures and can be reused and microwaved; number 6-PS at high temperatures can release toxins; number 7 - PC or no symbol, is the most dangerous type of plastic, easily producing toxic substances such as Bisphenol. Up to 75.1% of respondents said that they saw the label but did not know the meaning of the types of plastic. The number of people who know how to distinguish between types of plastic accounts for 21.5% and the rest say they know a little bit but are not sure. Through the survey results, it can be seen that households' interest in plastic codes/labels is still classified as not high in recyclability.

Interviews showed that 62.5% of households collected PW for reuse or sale to recycling facilities, the rest did not keep it but dumped it with other household waste. Among recycling households, 82% said they reuse PET, HDPE, and PP plastics. PET plastic is often used in beverage bottles and water bottles containing spices such as soy sauce, cooking oil, and vinegar. HDPE plastic has opaque properties and is often used in cosmetic bottles, medicine containers, pharmaceuticals, milk bottles, and household goods. PP plastic includes food boxes, bottle caps, woven rice bags, pots and pans, plastic tables and chairs, and clear films.

PVC, LDPE, PS, PC, ABS plastic groups can also be recycled, but the collection and recycling rate is still low (about 24%). In particular, PVC plastic is often water pipes, door frames, electrical wire covers, gloves, medicine packaging, gloves or raincoats. LDPE plastic is the raw material for making nylon bags, zip bags, tissue packaging, and box lids. PS plastic is all kinds of containers, yogurt boxes, candy blisters, take-away coffee lids, foam boxes, and packing foam.

With reuse behavior, 70.5% of respondents chose to bring baskets or bags (cloth bags, paper bags, plastic bags) to the market, 18.3% did not bring anything, the rest chose other options such as online shopping delivered to home and no need to go to the market. Thus, people also have positive habits about reusing PW in life. When asked about prioritizing recyclable products to replace plastic products, 80.2% of households answered that they would prioritize choosing replaceable products available on the market, 12.8% would not prioritize them because of concerns about high prices. This shows that people have a positive attitude toward using recyclable plastic materials.

Regarding classification waste at source, 56.7% of interviewees chose to classify waste into inorganic waste and organic waste, 18.2% classified into inorganic waste, organic waste and recyclable waste. The remainders are unclassified. This shows that the community's awareness of waste classification is quite high. However, there are many


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reasons such as government support and inconsistent collection, leading to people even though they may be aware of classifying waste but actually do not classify it because they think it is ineffective. People also think that sorting is sometimes meaningless because the garbage is then gathered together when collected.

According to the survey, 39.4% of households do not know about the policies and campaigns being implemented to reduce plastic pollution in their area of residence, the remaining 45.5% said they are aware of the above policies. The rest know vaguely. Therefore, policies, education and training to raise people's awareness about PW need to receive more attention from local authorities.

*Factors affecting people's willingness to participate in PWM*

When investigating awareness of the responsibility to collect and treat PW, 75.4% believe that responsibility belongs to the entire society including the state, businesses and communities. 18.3% think that this responsibility should belong to the state and the rest think that the responsibility belongs only to the community because they are the ones causing PW so they need to participate in the management and treatment of this type of waste.

An important part of the study was to assess households' willingness to participate in a community-based PWM program to improve environmental quality and health. We built a hypothetical PWM program and asked residents about their participation. At the same time, evaluate the factors that affect households' willingness to participate with PWM. *Table 4* shows the regression results for the research models.

***Table 4.*** *Regression estimation results*

| Variables | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Intercept | 2.27*<br>(0.295) | 1.85<br>(0.107) | 2.21<br>(0.273) | 3.18<br>(0.241) |
| AGE | 0.012<br>(0.021) | 0.019<br>(0.038) | -0.025<br>(0.062) | -0.032<br>(0.043) |
| GENDER | -0.114*<br>(0.227) | -0.125*<br>(0.229) | -0.156*<br>(0.032) | -0.135*<br>(0.142) |
| MARRIED | 0.732<br>(0.147) | 0.638<br>(0.225) | 0.039<br>(0.027) | 0.244<br>(0.038) |
| EDU | 0.131**<br>(0.025) | 0.171**<br>(0.037) | 0.082**<br>(0.041) | 0.096**<br>(0.035) |
| MEMBER | 0.123<br>(0.055) | 0.143<br>(0.035) | 0.214<br>(0.068) | 0.132<br>(0.045) |
| INCOME | 0.146**<br>(0.018) | 0.119**<br>(0.025) | 0.124**<br>(0.013) | 0.116**<br>(0.027) |
| IMPACT | 0.076*<br>(0.021) | 0.083*<br>(0.032) | 0.095*<br>(0.018) | 0.062*<br>(0.023) |
| CONCERN | 0.131*<br>(0.218) | 0.162*<br>(0.092) | 0.149*<br>(0.115) | 0.123*<br>(0.148) |
| POLLUTION | 0.082*<br>(0.045) | 0.087*<br>(0.027) | 0.115*<br>(0.028) | 0.137*<br>(0.121) |
| CLASSIFICATION | 0.095*<br>(0.037) | 0.013<br>(0.042) | 0.119<br>(0.018) | 0.091<br>(0.045) |
| COMMUNICATION | 0.111*<br>(0.035) | 0.127<br>(0.027) | 0.184<br>(0.031) | 0.138<br>(0.025) |

Note: ***: significant at the 1% error level. **: significant at the 5% error level; in parentheses is the standard deviation. Source: Study results (2023)


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In all models, the variable INCOME was statistically significant at the 1% error level. As income increases, households are more willing to participate in PWM. The EDU variable was also significant at the 1% level in model 1 (overall) and 5% in models 2, 3 and 4. Thus, education level was important factor affecting participation behavior in PWM of households. Gender was a significant influencing factor in the models at the 5% significance level. Research showed that women are more likely to participate than men, the reason might be that women are the ones who interact more with PWs in the household when they are the ones shopping, cooking, using plastic materials, they had more interaction with PW can lead to a better understanding of PW and more readiness in PWM. Other household socio-economic variables such as age, marital status and number of household members did not have a significant influence on households' PWM.

With variables related to attitudes and awareness of PWM, the regression results showed that the variables IMPACT, CONCERN and POLLUTION had statistical significance and positively impact households' PWM in all 4 models at the same level of 5% error. Thus, when people have a higher awareness of the impact of PW and are more interested in PW, they are more likely to participate in PWM. The CLASSIFICATION variable was also significant at the 5% level in model 1 but not in the remaining 3 models. Thus, in the overall model, having a PWM classification also had a positive effect on households' PWM participation. The COMMUNICATION variable also had a significant influence at the 5% level in the overall model, which means that when people receive media messages in the community about PW, they might have a higher tendency to participate in managing this waste.

## Discussions

This study evaluated the awareness and willingness to participate in the SWM program of Hanoi residents. The results showed that there were 8 factors that influence participants' participation, in which attitude about PW was the variable with the strongest impact.

Research results indicated that most people were aware of PW, they knew how to distinguish PW from other waste such as organic waste, and at the same time people can also point out the PW that arises in most of the activities in their daily lives. Regarding attitudes towards PW, more than half of people were very concerned about this issue. They believed that PW causes environmental problems, degrades the landscape and was especially harmful to health. This result is similar to the study results of Kumar and Samadder (2017), Kurama et al. (2020), and Sorkun (2018) in developing countries that when people have relatively high awareness of the problem of plastic pollution. However, more than 70% of people said they must use plastics because of their convenience and superior characteristics compared to other materials. They also selected plastic because the price is lower than similar items. This is consistent with research results by Sujauddin (2008), Dangi et al. (2011), and Zhang et al. (2018). In developing countries, despite having a certain awareness of environmental pollution, people still have habits of behaviors that can cause pollution, partly due to the low cost of these behaviors compared to other friendlier behavior. Cost of use is still an important factor affecting the intention and behavior of consuming plastic utensils. At the household level, PW accounts for the largest proportion, especially in daily activities such as eating, shopping, and cooking. This showed that the group of household plastics used by people is very large, consistent


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with results by Kuamar and Samadder (2017), and Maskey and Singh (2017) on the structure of PW in total waste.

Regarding the behavior of classifying and recycling PW, more than 50% of households have been sorting PW for reuse or selling to recycling units. However, most households did not know how to classify plastic according to the labels on the items, but only classify plastic with other waste. This showed people's low understanding of the potential harmful effects of PWs as well as more appropriate classification methods. People also believed that classification is necessary because it creates both environmental benefits and benefits for households when selling recycled plastics and reusing some types of packaging and plastic boxes for their own purposes, shopping and cook. This is consistent with research findings by Sujauddin et al. (2008), Saphores et al. (2016) and Mattar et al. (2018) on the awareness and PW classification behavior of urban residents, and that a more specific communication program on plastic labels for people is needed. According to the World Bank (2022), Vietnam is recycling about 33% of all types of plastic, of which PET packaging has the highest recycling collection rate. In this study, 70.5% of opinions said that using plastic bags or plastic containers is harmful to health. This shows that people's reuse of plastic bags or plastic containers is due to the lack of access to waste collection services for disposal, as well as the convenience of plastic items that people have to reuse them many times even though they knew they can be harmful to your health. People also reported not knowing much about PWM programs initiated by central and local governments.

The results of regression analysis showed that among socio-economic variables, income and gender had a significant influence on the probability of participating in household PWM. In particular, income had a positive influence and is consistent with previous studies of Khan et al. (2019), and Thanh et al. (2020). Females were more likely to participate in PWM than males. This result is similar to the findings of Dwivedy and Mittal (2013), Zhang et al. (2018), and Alhassan et al. (2020) in that women interact more with PW in daily life, so they have better awareness, higher attitudes, and this leads to a high likelihood of participating in PWM. Other factors such as interest in PW, awareness of PW pollution and classification of PW also had a significant and positive influence on the community's willingness to participate in PWM. This result was found to be consistent with theory and previous studies of Sorkun (2018), Mattar et al. (2018), and Srun and Kurisu (2019). When people have higher education, their awareness of the environment is better; this might lead to improved environmental management behavior.

Finally, communication about PW also had a positive impact on people's PWM. This implies that when people are better informed about PW, they will be more willing to participate in PWM. The results are also consistent with previous researches by Afroz et al. (2011), Khan et al. (2016) and Adzawla et al. (2019).

## Conclusion and implications

This study fills the gap in the lack of research related to PWM awareness and behavior of people in urban areas in Vietnam. The study also contributes to the flow of literature on community PWM behavior in developing countries in Asia-Pacific, in which Vietnam can be a typical study because of its rapid growth rate, environmental pollution is increasing rapidly along with the lack of adequate institutions and PWM policies. The research results have the following implications:


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First, environmental management agencies need to increase communication about PW to people and communities to raise their awareness of this topic. Research results show that when awareness is higher, people will participate more in the PWM process. Communication can be through social networks because this tool is very developed in Vietnam, especially popular with young and middle-aged people. Traditional communication tools such as newspapers, radio and television are also effective but are more effective with the elderly group. In particular, communication about PW can be integrated into general training programs to improve students' knowledge about PW, ways to classify PW as well as the harmful effects of this waste.

Second, in localities, people can participate in public activities or contribute a certain portion of their income to PWM programs. Therefore, local governments can design PWM activities suitable for their locality and encourage people to participate directly or pay money. This will increase financial and human resources for PWM and is very necessary at the community level, when the state's budget for environmental protection is still limited.

Third, the government needs to initiate waste classification programs at the household level in urban areas. Currently, waste classification is spontaneous and not mandatory. People classify waste for their economic benefit. If the State initiates recycling programs, waste sorting and creates supportive policies, the recycling classification rate will be higher, thereby better contributing to the circular economy model in Vietnam as well as other sustainable development goals.

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## REFERENCES

[1] Adzawla, W., Tahidu, A., Mustapha, S., Azumah, S. B. (2019): Do socioeconomic factors influence households' solid waste disposal systems? Evidence from Ghana. – Waste Management & Research 37(1): 51-57.
[2] Afroz, R., Hanaki, K., Tudin, R. (2011): Factors affecting waste generation: A study in a waste management program in Dhaka City, Bangladesh. – Environmental Monitoring and Assessment 179(1-4): 509-519.
[3] Afroz, R., Tudin, R., Hanaki, K., Masud, M. M. (2011): Selected socio-economic factors affecting the willingness to minimise solid waste in Dhaka city, Bangladesh. – Journal of Environmental Planning and Management 54(6): 711-731.
[4] Alhassan, H., Kwakwa, P. A., Owusu-Sekyere, E. (2020): Households' source separation behaviour and solid waste disposal options in Ghana's Millennium City. – Journal of Environmental Management 259: 18-29.
[5] Astane, A. R. D., Hajilo, M. (2017): Factors affecting the rural domestic waste generation. – Global Journal of Environmental Science and Management 3(4): 417-426.
[6] Babaei, A. A., Alavi, N., Goudarzi, G., Teymouri, P., Ahmadi, K., Rafee, M. (2015): Household recycling knowledge, attitudes and practices towards solid waste management. – Resources, Conservation and Recycling 102: 94-100.
[7] Bandara, N. J., Hettiaratchi, J. P. A., Wirasinghe, S., Pilapiiya, S. (2007): Relation of waste generation and composition to socio-economic factors: A case study. – Environmental Monitoring and Assessment 135(1): 31-39.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2205_40054022

[8] Buenrostro, O., Bocco, G., Cram, S. (2011): Classification of sources of municipal solid wastes in developing countries. – Resources, Conservation and Recycling 32(1): 29-41.
[9] Dangi, M. B., Pretz, C. R., Urynowicz, M. A., Gerow, K. G., Reddy, J. (2011): Municipal solid waste generation in Kathmandu. Nepal. – Journal of Environmental Management 92(1): 240-249.
[10] Dat, T. T., Truong. D. D. (2020): Resource management, environment and climate change towards development sustainability in Vietnam from an economic perspective. – Journal of Economics and Development 278(2): 2-11.
[11] Dat, T. T., Truong, D. D. (2023): Cost–benefit analysis of organic and traditional rice production in Mekong River delta: the case of Ca Mau Province, Vietnam. – Applied Ecology and Environmental Research 16: 23-37.
[12] De Feo, G., De Gisi, S. (2010): Public opinion and awareness towards MSW and separate collection programmes: A sociological procedure for selecting areas and citizens with a low level of knowledge. – Waste Management 30(6): 958-976.
[13] Dong, X., Zhang, B., Wang, B. (2020): Urban households' purchase intentions for pure electric vehicles under subsidy contexts in China: Do cost factors matter? – Transportation Research 135: 183-197.
[14] Dwivedy, M., Mittal, R. (2013): Willingness of residents to participate in e-waste recycling in India. – Environmental Development 6: 48-68.
[15] Ekere, W., Mugisha, J., Drake, L. (2009): Factors influencing waste separation and utilization among households in the Lake Victoria crescent, Uganda. – Waste Management 29(12): 3047-3051.
[16] Hair, J., Black, W., Babin, B., Anderson, R., Tatham, R. (2010): Multivariate data analysis. – New Jersey: Pearson Education.
[17] Hanoi Statistics Office (2022): Statistics report of Hanoi 2022. – Hanoi, Vietnam.
[18] Irwan, D., Basri, N. E. A., Watanabe, K., Abushammala, M. F. M. (2013): Influence of income level and age on per capita household solid waste generation in Putrajaya, Malaysia. – Journal Teknologi 65(2): 12-24.
[19] Jereme, I. A., Siwar, C., Begum, R. A., Talib, B. A. (2016): Addressing the problems of food waste generation in Malaysia. – International Journal of Advanced and Applied Sciences 3(8): 68-77.
[20] Kaza, S., Yao, L., Bhada-Tata, P., Van Woerden, F. (2018): What a waste 2.0: A global snapshot of solid waste management to 2050. – The World Bank.
[21] Khan, D., Kumar, A., Samadder, S. R. (2016): Impact of socioeconomic status on municipal solid waste generation rate. – Waste Management 49: 15-25.
[22] Khan, F., Ahmed, W., Najmi, A. (2019): Understanding consumers' behavior intentions towards dealing with the plastic waste: Perspective of a developing country. – Resources, Conservation and Recycling 142: 49-58.
[23] Kumar, A., Samadder, S. R. (2017): An empirical model for prediction of household solid waste generation rate - A case study of Dhanbad, India. – Waste Management 68: 3-15.
[24] Kumara, A. S., Pallegedara, A. (2020): Household waste disposal mechanisms in Sri Lanka: Nation-wide survey evidence for their trends and determinants. – Waste Management 114: 62-71.
[25] Lavee, D., Nardiya, S. (2013): A cost evaluation method for transferring municipalities to solid waste source-separated system. – Waste Management 33(5): 1064-1072.
[26] Le, T. N. P., Nguyen, K. H. (2019): Impact of removing industrial tariffs under the European–Vietnam free trade agreement: A computable general equilibrium approach. – Journal of Economics and Development 21(1): 2-17.
[27] Maskey, B., Singh, M. (2017): Household waste generating factors and composition study for effective management in Gorkha municipality of Nepal. – Journal of Sustainable Development 10(6): 23-34.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2205_40054022

[28] Mattar, L., Abiad, M. G., Chalak, A., Diab, M., Hassan, H. (2018): Attitudes and behaviors shaping household food waste generation: Lessons from Lebanon. – Journal of Cleaner Production 198: 1219-1223.
[29] Meneses, G. D., Palacio, A. B. (2015): Recycling behavior: A multidimensional approach. – Environment and Behavior 37(6): 837-860.
[30] MONRE (2022): National environmental report: solid waste. – Hanoi, Vietnam.
[31] OECD (1999): Framework of OECD work on environmental data and indicators. – OECD Publishing, UK.
[32] Ojeda-Benítez, S., Armijo-de Vega, C., Marquez-Montenegro, M. Y. (2018): Household solid waste characterization by family socioeconomic profile as unit of analysis. – Resources, Conservation and Recycling 52(7): 992-999.
[33] Sankoh, F. P., Yan, X., Conteh, A. M. H. (2012): A situational assessment of socioeconomic factors affecting solid waste generation and composition in Freetown, Sierra Leone. – Journal of Environmental Protection 25: 34-46.
[34] Saphores, J.-D. M., Nixon, H., Ogunseitan, O. A., Shapiro, A. A. (2016): Household willingness to recycle electronic waste: An application to California. – Environment and behavior 38(2): 183-208.
[35] Sorkun, M. F. (2018): How do social norms influence recycling behavior in a collectivistic society? A case study from Turkey. – Waste Management 80: 359-371.
[36] Srun, P., Kurisu, K. (2019): Internal and external influential factors on waste disposal behavior in public open spaces in Phnom Penh, Cambodia. – Sustainability 11(6): 1518.
[37] Sujauddin, M., Huda, S., Hoque, A. R. (2008): Household solid waste characteristics and management in Chittagong, Bangladesh. – Waste Management 28(9): 1688-1695.
[38] Thanh, N. P., Matsui, Y., Fujiwara, T. (2020): Household solid waste generation and characteristic in a Mekong Delta city, Vietnam. – Journal of Environmental Management 91(11): 2307-2321.
[39] Trang, P. T. T., Dong, H. Q., Toan, D. Q., Hanh, N. T. X., Thu, N. T. (2017): The effects of socio-economic factors on household solid waste generation and composition: A case study in Thu Dau Mot, Vietnam. – Energy Procedia 107: 253-258.
[40] Vietnam Plastics Association (2022): Annual report of VPA. – Hanoi, Vietnam.
[41] World Bank (2022): Reduction of single-use plastics in Vietnam. – Policy report, Hanoi, Vietnam.
[42] Zhang, H., Duan, H., Andric, J. M., Song, M., Yang, B. (2018): Characterization of household food waste and strategies for its reduction: A Shenzhen City case study. – Waste Management 78: 426-433.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2205_40054022