

Doctoral Thesis

The Difference of Waste Separation Behavior based on Societal Elements

-A case study in Hanoi, Vietnam-

NGUYEN MY LINH

Student ID No. 4D20191001

Doctoral Program

Course of Regional Development Studies

Graduate School of Global and Regional Studies

Toyo University, Japan

AY 2022

## TABLE OF CONTENTS

<b>LIST OF FIGURES</b> .....	<b>III</b>
<b>LIST OF TABLES</b> .....	<b>IV</b>
<b>ACKNOWLEDGEMENTS</b> .....	<b>V</b>
<b>ABSTRACT</b> .....	<b>VI</b>
<b>1 INTRODUCTION</b> .....	<b>10</b>
<b>1.1 Research background</b> .....	<b>10</b>
1.1.1 Waste generation in Hanoi.....	11
1.1.2 Management of household waste.....	13
1.1.3 Past project on source separation.....	16
1.1.4 Obstacles to waste separation at source.....	19
<b>1.2 Research objectives</b> .....	<b>20</b>
<b>1.3 Research methodology</b> .....	<b>20</b>
<b>2 LITERATURE REVIEW</b> .....	<b>21</b>
<b>2.1 Overview of behavior change model</b> .....	<b>21</b>
<b>2.2 Definition of community and its role in waste management</b> .....	<b>24</b>
<b>2.3 Role of informal sector recycling</b> .....	<b>27</b>
2.3.1 Type of informal waste recycling.....	27
2.3.2 Economic factors that encourage informal recycling.....	28
2.3.3 Social and economic concerns.....	28
<b>2.4 Urban development in Hanoi</b> .....	<b>29</b>
2.4.1 Extension of Hanoi Capital Region.....	29
2.4.2 Economic industrialization and high-tech clustering.....	30
2.4.3 Key issue of Housing provision vs Housing sustainability.....	31
<b>3 THEORETICAL FRAMEWORK AND CASE STUDY DESCRIPTION</b> .....	<b>33</b>
<b>3.1 Theoretical framework</b> .....	<b>33</b>
3.1.1 Need, Opportunity, and Ability.....	33
3.1.2 Sense of Community and Trust in Authority.....	33

3.2	Data analysis tool.....	34
3.3	Study area .....	35
4	<b>CASE STUDY ON FACTORS INFLUENCING WASTE SEPARATION BEHAVIOR.....</b>	<b>37</b>
4.1	Questionnaire design and data collection.....	37
4.2	Socio-economic background of the respondents.....	38
4.3	Primary data analysis .....	40
4.4	Factors influencing waste separation behavior.....	47
5	<b>CASE STUDY ON THE IMPACT OF AGE ON WASTE SEPARATION.....</b>	<b>53</b>
5.1	Questionnaire design and data collection.....	53
5.2	Socio-economic background of the respondents.....	54
5.3	Primary data analysis .....	56
5.4	Factors influencing waste separation behaviors .....	59
6	<b>DISCUSSION.....</b>	<b>64</b>
6.1	Findings from the first case study.....	64
6.2	Comparison between two case studies .....	65
7	<b>CONCLUSION.....</b>	<b>67</b>
7.1	Conclusion and limitations .....	67
7.2	Implications and recommendations.....	67
	<b>REFERENCES.....</b>	<b>69</b>

## LIST OF FIGURES

Figure 1 Amount of MSW generated in Hanoi, Vietnam, 2000–2011 (Kawai et al., 2012).....	11
Figure 2 Overall structure of waste management policies in Vietnam (Chen et al., 2020).....	12
Figure 3 Sign showing penalty for littering in public space (photo taken in Thai Think ward) .	14
Figure 4 Xuan Son landfill (Ba Vi district).....	15
Figure 5 Relationship and Roles of Stakeholders in the Pilot Project (JICA, 2012).....	17
Figure 6 Community leaders at 3R workshop and collection point supervising separation bins (JICA, 2012).....	18
Figure 7 Waste was dumped together despite there being different waste bins for separation (JICA, 2012).....	19
Figure 8 Fishbein and Ajzen’s Theory of Reasoned Action (TRA), (1975).....	21
Figure 9 Ajzen’s Theory of Planned Behaviour (TPB), (1986).....	22
Figure 10 Vlek et al’s Needs Opportunities Abilities (NOA) Model (1997).....	23
Figure 11 Vietnam’s Administrative division and Political organization.....	25
Figure 12 Hanoi urban master plan up to 2030.....	30
Figure 13 Hypothesized model of factors influencing waste separation behavior.....	34
Figure 14 Map of Hanoi city with 30 subdivisions.....	35
Figure 15 Gender of the respondents.....	38
Figure 16 Age of the respondents.....	38
Figure 17 Occupation of the respondents.....	39
Figure 18 Education level of the respondents.....	39
Figure 19 Period of stay in current neighborhood.....	40
Figure 20 Type of house.....	40
Figure 21 Age distribution to the question ‘I feel connected to the community in my neighborhood’(SC1).....	43
Figure 22 Age distribution to the question ‘I often participate in public events and community activities in my neighborhood’(SC2).....	43
Figure 23 Age distribution to the question ‘I plan to stay in my current neighborhood for a long time’ (SC3).....	44
Figure 24 Age distribution to the question ‘I feel connected to the community leaders in my neighborhood’(TA1).....	44
Figure 25 Age distribution to the question ‘I trust that the local authority is capable of facilitating waste collection’ (TA2).....	45
Figure 26 Age distribution to the question ‘I trust that the local authority is capable of treating separated waste’ (TA3).....	45
Figure 27 Age of the respondents considering their living period in the current neighborhood.	46
Figure 28 Urban and rural population of the respondents.....	46
Figure 29 Factors influencing waste separation behavior for newcomers.....	52
Figure 30 Factors influencing waste separation behavior for old residents.....	52
Figure 31 Income of the respondents.....	55
Figure 32 Period of stay in current neighborhood.....	55
Figure 33 Type of house.....	55
Figure 34 Recyclable waste separation.....	56
Figure 35 Organic waste separation.....	56
Figure 36 Age of the respondents considering their living period in the current neighborhood.	59



Figure 37 Factors influencing waste separation behavior for newcomers .....	63
Figure 38 Factors influencing waste separation behavior for old residents .....	63

### **LIST OF TABLES**

Table 1 Waste composition in Hanoi (Vietnamese Department of Natural Resources and Environment, 2011).....	12
Table 2 Hanoi MSW volume (Khanh, 2016) .....	14
Table 3 Demographic information of JICA pilot project areas (JICA, 2012).....	17
Table 4 The amount of waste collected from pilot project areas that was brought to Cau Dien compost plan (JICA, 2012) .....	18
Table 5 Study area (General Statistics Office of Vietnam, 2019).....	36
Table 6 Questionnaire items for the first survey .....	37
Table 7 Response composition.....	41
Table 8 Crosstabs summary .....	42
Table 9 Average and standard deviation of each age category .....	44
Table 10 Average and standard deviation of each age category .....	45
Table 11 Recyclable separation in urban and rural Hanoi .....	46
Table 12 Organic separation in urban and rural Hanoi .....	47
Table 13 Validity and reliability results of measurement models for newcomers (residents of 9 years or less).....	48
Table 14 Validity and reliability results of measurement models for old residents (residents of 10 years or more) .....	49
Table 15 Fornell-Larcker’s criteria for newcomers .....	50
Table 16 Fornell-Larcker’s criteria for old residents .....	50
Table 17 Significance testing results of the structural model path coefficient for newcomers...	51
Table 18 Significance testing results of the structural model path coefficient for old residents.	51
Table 19 Questionnaire items for the second survey .....	53
Table 20 Socio-economic background of the respondents.....	54
Table 21 Response composition.....	57
Table 22 Crosstabulation for age and recyclable waste separation.....	58
Table 23 Crosstabulation for age and organic waste separation .....	58
Table 24 Crosstabulation for income and recyclable waste separation.....	58
Table 25 Validity and reliability results of measurement models for newcomers .....	60
Table 26 Validity and reliability results of measurement models for old resident.....	61
Table 27 Fornell-Larcker’s criteria for newcomers .....	62
Table 28 Fornell-Larcker’s criteria for old resident.....	62
Table 29 Path coefficient for newcomers.....	63
Table 30 Path coefficient for old residents.....	63

## ACKNOWLEDGEMENTS

This dissertation is the culmination of a challenging but undeniably enriching journey during which I have received a great deal of a support and assistance.

First, I would like to express my sincere appreciation and earnest thanks to my supervisor, Professor Aramaki Toshiya, without whom this research work would not have been possible. Through him I have gained competence, confidence and learned the importance of perseverance and hard work. From my first day at Toyo University, Professor Aramaki has shown me continuous support, wise guidance and unwearied patience not only on an academic level but also on a professional and personal level.

I wish to also thank Professor Kitawaki Hidetoshi who always provided me with pertinent comments and constructive advice. As co-supervisor for this research, Prof. Kitawaki brought a broader perspective and helped make it a better research work from an academic standpoint.

I would like to thank all the professors at Toyo University's graduate school of regional development studies, and staff of Toyo University who have been supportive, flexible and encouraging, especially in these times of global pandemic.

I would also like to thank my fellow students in Toyo University and friends as well as my family for their encouraging words and unflinching patience.

Finally, this work is supported by Grant-in-Aid for Scientific Research (20K12289), Japan Society for the Promotion of Science, and Center for Sustainable Development Studies of Toyo University.

## ABSTRACT

Graduate School of Global and Regional Studies

Course of Regional Development Studies

Doctor's Thesis (Academic Year 2022)

The Difference of Waste Separation Behavior based on Societal Elements

-A case study in Hanoi, Vietnam-

NGUYEN MY LINH

(4D20191001)

### **Introduction**

A frequently sought-out solution to municipal solid waste management is the separation of waste at the source. In 2018, Hanoi city generated 3,149,723 tons of solid waste, which equals to 8,629 tons per day. Furthermore, the effects of urbanization and lifestyle changes also lead to drastic changes in the MSW's quantity and quality. With such circumstances, in 2009 the Prime Minister approved the National Strategy of Integrated Solid Waste Management up to 2025, vision towards 2050. This decision emphasized the priority of waste separation as a long-term strategy for waste management in Vietnam.

Source separation demands strictly promulgated regulations and adequate infrastructures that can support the handling of waste from collection, through transportation, to disposal. Household waste is currently not separated at the source and is collected daily then discarded in landfills. Alternative waste management technologies such as waste-to-energy technologies are being introduced in Vietnam, but they require waste separation into correct classification. Source separation heavily depends on the cooperation of the public so understanding the factors that influence people's behavior toward waste separation will play an important role in the future when source separation legislation is adopted.

Hanoi with the transitions in social backgrounds due to urbanization and economic development of the capital city led to a change in people's values. The "village culture", where everyone dwelling in the same neighborhood or "village" knows each other and sees each other like family, is gradually changing as people move into big cities. Their perception of the surrounding environment also shifts when people move to a new place and not yet consider the neighborhood to be their "home". This affects their attitude towards waste management as well. At the same time, the variety of stakeholders in the local authority results in a complex decision-making process, consequently affecting collective action initiatives and local waste management. For that reason, this study of the social impact on waste separation behavior will provide many suggestions

to develop municipal solid waste sorting strategies for not only Hanoi but also other cities in similar situation.

## **Objectives**

In order to productively boost participation in source separation, it is crucial to understand what drives households to take part in waste separation. Especially in the area where extensive changes in demographic and lifestyle are happening, a study to examine the factors, not only in individual aspects but also regarding societal elements, is indispensable. The insufficiency in literature encouraged this study to explore the social impact on waste separation behavior.

For that purpose, the main objective of this research is to examine how the social bond between an individual and the neighborhood impact the behavior for waste separation, especially in the context of developing countries.

The result of this research can provide meaningful implications to not only waste management policies but also city planning policies which should be considered simultaneously for a sustainable impact.

## **Methodology**

This study hypothesized that the behavior model N-O-A and the societal elements Sense of Community and Trust in Authority affect waste separation behavior. Predictor variables are categorized into five factors: Sense of Community (SC – measured by willingness to engage in community activities and to stay long-term), Trust in Authority (TA – measured by relationships with community leaders and confidence in the authority’s capability), Need (N – measured by concern for the surrounding environment and cleanliness), Opportunity (O – measured by responses to incentives), and Ability (A – measured by the understanding of waste separation and the practical capability to separate waste).

Data collection was done through online survey. This study adopted a structured questionnaire for the survey. Multiple choice methods and Likert rating scales were used for the questionnaire design. The first part is a set of questions to collect general household information on socio-economic characteristics and living situation including years of residence in the community, types of houses and house ownership situation. The second part are Likert-scale items used to assess the predictor variables of the model. In this section, respondents were requested to grade their level of agreement with the given statements from 1 to 4, with 1 being “strongly disagree” and 4 being “strongly agree”. Data was collected through two surveys. The first survey in 2020 collected 778 samples to study the factors influencing waste separation behavior. The second survey in 2022 collected 750 samples to study the impact of age on waste separation behavior.

This study used PLS-SEM run by smartPLS version 3.0 software to explore the causal relationship between the respondents’ behavior of waste separation and Need, Opportunity, Ability (the three factors from the existing behavior model), and Sense of Community and Trust in Authority.

## **Results and Discussion**

Sense of Community, Ability, and Opportunity are proved to be significant predictors towards people’s waste separation behavior. Among these constructs, Opportunity is the strongest

predictor among newcomers (people who have lived in the neighborhood for 9 years or less) with  $f^2$  effect size at 0.219. This indicates that reward mechanisms, convenient waste collection locations and frequent pick-up schedules encourage participation in source separation, especially for new residents in the area, who are not as influenced by Sense of Community or Ability.

Another construct that predicts waste separation behavior is Trust in Authority with  $f^2$  effect size at 0.16 leaning toward stronger relationship. However, it only influences old residents or people who have lived in the neighborhood for 10 years or more, and it is also the strongest predictor among this group.

With P-value at 1%, data analysis result also indicates that Sense of Community affects the waste separation behavior. The sense of community is measured by the respondents' feeling of belonging, the desire to settle and live in the neighborhood for a long time, and the frequency in which the respondents take part in public activities held within the community.

Ability is shown to have an effect on separation behavior at 1% level significant. This result suggests that respondents who have the time and space in the house to sort out their waste, and people who know the difference between organic and recyclable waste are more likely to participate in source separation.

Need from the original model of "Needs-Opportunities-Abilities" Model of Consumer Behavior by Vlek appears to not affect waste separation behavior in this case. This means that the respondents of the study do not think that segregating household waste can improve the cleanliness in the neighborhood, and the current collection of mixed garbage is acceptable, hence no waste separation at the source.

While this is the result from the first case study in 2020, according to the data analysis of the survey that was conducted in 2022 the only factors that have significant correlation with separation behavior in the second case study are Ability and Sense of Community in the group of residents who have been living in the same neighborhood for more than 15 years. This second case study also shows that the behavior pattern is different for the older demographic among newcomers and old residents. This means that both age and living period has an effect on waste separation behavior.

Data analysis also shows major contrast between the two case studies in the response composition of the Likert-scale question. The second survey has much higher rate of strongly agree than somewhat agree, with the highest rate of strongly agree at 66.4% in the second survey. On the other hand, the highest rate of strongly agree in the first survey is 47%. After the period from 2020 to 2022, the average of the responses increased substantially, around 0.3 point. However, the average score of A3. "I have the space to store separated waste in the house" shows the least difference, at 3.17 in the survey in 2020 and 3.23 in the survey in 2022.

## **Conclusion**

The study aimed to explore the social impact on waste separation behavior by examining how the social bond between an individual and the neighborhood impact the behavior for waste separation. This relationship was reflected by the socio-demographic characteristics of the respondents such as age and the living situation. Data analysis has highlighted the behavioral difference between

people who have lived in their current place for less than 10 years (newcomers) and people who have settled down for 10 years or more (old residents). It is found that while Sense of Community, Trust in Authority, Ability and Opportunity make up four predictors of separation behavior for old residents, Trust in Authority does not affect the decision-making regarding waste separation for people who newly move into a neighborhood.

This study result reaffirms the effect on waste separation behavior of internal factors including Ability (the capacity to carry out source separation) and Opportunity (responsiveness to incentives and convenience). Based on these analyses, policy implications have been proposed including a social platform to receive frequent feedback from Hanoi citizens regarding waste management issues, environment education, and reviewing the current waste collection system. Reward mechanisms are also recommended to enhance the willingness to participate in waste separation.

Data analysis also sheds light on the influence of the societal elements Sense of Community with P-value at 1% level on the decision making to participate in waste segregation. Sense of community is measured by the connection with the community leaders and active involvement in communal activity. With the objective of examining how the social bond between an individual and the neighborhood impact the behavior for waste separation, this result confirms the importance of communication and sense of belonging among members of the community. The more a person feel attached to their neighborhood, the more they perceive communal issue such as waste management as a shared responsibility, and actively participate in the initiative. Therefore, community-engagement approach should be incorporated into waste management.

The feeling of belonging in a community is also influence by the time living in the same neighborhood. While the tendency for the elder generation to have a long period of staying in one place is strong, data analysis has also show that the senior demographic's separation behavior differs from that of old residents and newcomers. This indicates that the behavior of waste separation is influenced by both age and living period. In the context of Hanoi where the majority of residential land will become new urban areas in 2030, the living period of people in these areas will be relatively short compares to areas where the relationship between individual and the community is more established. Consequently, the behavior of residents in these different parts of the city will also be diverse.

This study acknowledges that the samples have a higher ratio of people in university and graduate school, possibly because of the tendency of internet use and familiarity with internet survey among people with higher education. Data analyses were carried out with the available samples collected, and we will focus on possible effect of sampling bias in future studies.

**Keywords:** waste separation, behavior change, societal elements, sense of community, trust in authority, Hanoi

---

## 1 INTRODUCTION

### 1.1 Research background

Located in the most eastern side of the Indochina Peninsula, Vietnam has an estimated population of 95.5 million inhabitants as of 2017 (World Bank, 2017). Hanoi is the capital of Vietnam and the country's second largest city by population. The population in 2015 was estimated at 7.7 million people. The urban area of Hanoi includes 12 districts of 233.56 square kilometers.

Until 1986, Vietnam as a newly established country remained in poverty and politically isolated. When the Communist Government initiated a series of reforms in the field of economic and politic, Vietnam had gradually integrated into the world economy. By 2010, Vietnam had established diplomatic relations with 178 countries. Based on statistics by the World Bank, Vietnam's GDP growth rate has been among the highest in the world since 2000.

Growing population and urbanization in Vietnam are putting pressure on urban areas that are already struggling with limited land resource and under-developed infrastructures like Hanoi city. This results in the increasing amount of municipal solid waste (MSW), which accounted for about 80% of waste generation in Vietnam in 2003 (Thanh, 2011). While MSW management is carried out by government agencies, part of the responsibility lies within the citizen.

A frequently sought-out solution to municipal solid waste management is the separation of waste at the source. In Hanoi, the capital of Vietnam, rapid urbanization has resulted in the increase of the MSW amount. In 2018, the city generated 3,149,723 tons of solid waste, which equals to 8,629 tons per day. The rate of waste discharge in Hanoi rises by 5% annually as the city grows in population and its economy (World Bank, 2018). Furthermore, the effects of urbanization and lifestyle changes also lead to drastic changes in the MSW's quantity and quality (Huong et al., 2012). Under such circumstances, in 2009 the Prime Minister approved the National Strategy of Integrated Solid Waste Management up to 2025, vision towards 2050. This decision emphasized the priority of waste separation as a long-term strategy for waste management in Vietnam.

Source separation demands strictly promulgated regulations and adequate infrastructures that can support the handling of waste from collection, through transportation, to disposal. Household waste is currently not separated at the source and is collected daily then discarded in landfills. Waste collection can be summarized by a two-step process. Primary collection is made up of the pushcart system that gathers garbage from each household then brings to transfer points (residents can also bring wastes straight to these transfer points if they prefer). In secondary collection, compaction trucks carry waste gathered at transfer points to disposal sites including Xuan Son landfill and Nam Son landfill (Hoang et al., 2020).

Alternative waste management technologies such as waste-to-energy technologies are being introduced in Vietnam, but they require waste separation into correct classification (Kawai et al., 2016). In the period of 3 years starting from 2006, in an initiative to promote 3R (Reduce, Reuse, Recycle) supported by the Japan International Cooperation Agency (JICA), a pilot program to separate organic waste from the rest of household's waste was implemented in four central wards of Hanoi city. Regrettably, as the funding from the project ran out, local authority could not afford the transportation for the different types of garbage. The separated waste ended up being mixed

in the same collection truck, which led to the citizens from the pilot area gradually stopping their participation in source separation. However, in a follow up study by JICA, at the time the source separation pilot program came to a stop, it was indeed recorded that the project succeeded in raising people’s awareness of 3R and significantly enhancing the amount of organic waste to be composted (Taniguchi et al., 2011).

As a matter of fact, source separation heavily depends on the cooperation of the public (Afroz et al., 2011). For this reason, understanding the factors that influence people’s behavior toward waste separation will play an important role in the future when source separation legislation is adopted.

### 1.1.1 Waste generation in Hanoi

Municipal Solid Waste - more commonly known as trash or garbage - consists of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. This comes from residential houses, schools, hospitals, and businesses.

According to Vietnam Ministry of Environment and Natural Resources (MONRE), MSWs in urban areas account for more than 50% of the whole country every year. By 2019, with the population of 8.093 million, the total amount of MSW in Hanoi has reached 6,50 tons / day (General Statistics Office of Vietnam, 2019). Urban municipal solid waste volume analysis of Hanoi and Ho Chi Minh cities revealed a generation rate of 0.98– 1.0 kg/person/day for the urban area and an average of 0.73–0.85 kg/person/day for whole cities during the years 2008–2009 (Ngo & Pham, 2011).

The high rate of urbanization means areas in the suburban are expanding fast and the volume of MSW from these districts are building up severely. As shown in the figure below, the amount of MSW generated in the suburban districts in Hanoi dramatically increased in the 11-year period between 2000 and 2011. Meanwhile, the waste collected in the center of the city was relatively steady in quantity because the population was also comparably stable.

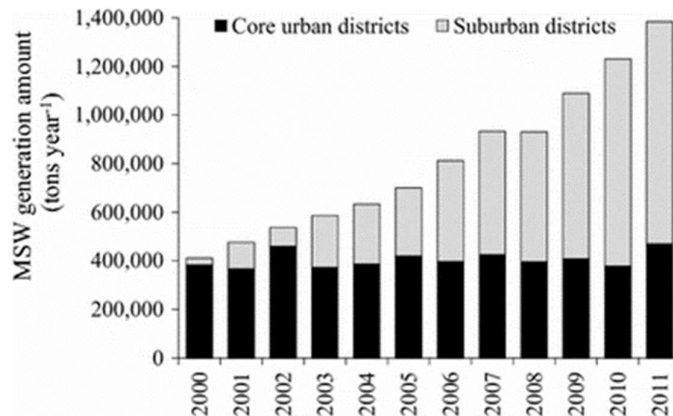


Figure 1 Amount of MSW generated in Hanoi, Vietnam, 2000–2011 (Kawai et al., 2012)

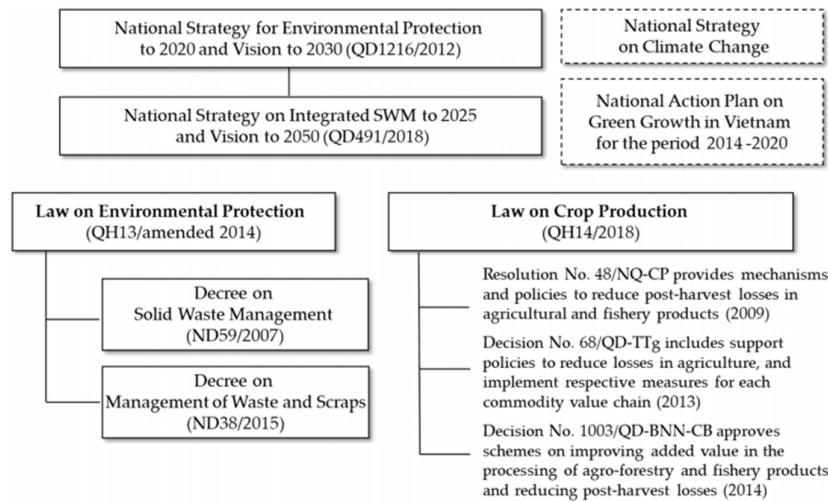


MSW is generated from many different sources, which can be categorized as household, street, office, market and commercial waste. Solid waste can be divided into 2 most basic components that are organic waste and non-organic waste. MSW in Hanoi consisted of around 51.9% organic matter, including left-over or spoiled food, green waste like fallen leaves or branches, animal excrements or dead bodies. Non-organic waste includes recyclable matters such as paper, plastic, metal, etc., and other materials.

**Table 1 Waste composition in Hanoi (Vietnamese Department of Natural Resources and Environment, 2011)**

No.	Type	Percentage
1	Organic	51.9
2	Paper	2.7
3	Plastic	3.0
4	Leather, rubber, wood	1.3
5	Textiles	1.6
6	Glass	0.5
7	Rock, clay, porcelain	6.1
8	Metal	0.9
9	Other	32
<b>Total</b>		<b>100</b>

The overall structure of waste management policies in Vietnam is summarized in figure 2. This organizational structure demonstrates that there are no specific laws, policies, or strategies in Vietnam that address the problem of food waste. In addition, there are two distinct aspects of food loss and waste: the first is a policy on lowering post-harvest loss, and the second is a strategy on managing food waste as standard municipal solid waste. At the policy level, it is believed that food waste and organic waste are comparable in that MSW plans include source segregation, waste reduction, community composting, and integrated waste treatment facilities at disposal locations.



**Figure 2 Overall structure of waste management policies in Vietnam (Chen et al., 2020)**

---

In recent years, the use of plastic bag has become a serious issue. According to rough statistic, Hanoi and Ho Chi Minh City discharge around 80 tons of plastic daily. The lifestyle of urban inhabitants has changed swiftly with the development of the economy. People are spending more money especially in food and clothes, which means plastic packaging also increase in quantity.

### **1.1.2 Management of household waste**

The latest legislation regarding source separation in Hanoi categorized waste into 3 groups (biodegradable organic, reusable and recycled, and others) and should be separated and collected accordingly. However, this is not strictly abided as it appears the current situation shows that only 57% of households are separating at least one type of recyclable wastes such as glass bottles, PET bottles, etc. Separated materials are provided to informal junk buyers with or without monetary compensation (Yokoo et al., 2018). At the same time, less than 50% of the urban and rural population sort out food waste and kitchen waste, then dispose or reuse them by feeding to pet or livestock according to a study in 2020 (Liu et al, 2020).

The Law on Environmental Protection No. 55/2014/QH13 promulgated by the National Assembly on June 23, 2014, held the municipal authorities responsible for the disposal of domestic waste. In pursuant to the provisions in Chapter 6, article 96 of the Law on Environmental Protection, Hanoi People's Committee is the government agency that is providing waste collection and disposal service to the public.

The Law on Environmental protection also directed owners of manufacturing and business establishments, organizations, households, and individuals that produce conventional solid wastes are responsible for classifying them at source to facilitate their recycling and processing. However, guidelines for source separation and resource productivity with 3R practices have not been established. Source segregation is currently not a legal obligation for Hanoi citizen.

Collection and transportation of MSW in 4 inner districts of Hanoi is carried out by Urban Environment Company (URENCO), a public corporation under the direct jurisdiction of the Hanoi People's Committee. Based on reports by Hanoi Promotion Agency (2017), the 4 inner districts include Hoan Kiem (area: 5.29km<sup>2</sup>; population: 155,900), Ba Dinh (area: 9.25km<sup>2</sup>; population: 242,800), Dong Da (area: 9.96km<sup>2</sup>; population: 401,700), Hai Ba Trung (area: 10.09km<sup>2</sup>; population: 315,900). Waste collection in 8 other urban districts is overtaken by private company through bidding. In total there are 26 units participating in collection, transportation and treatment of waste as reported by the official magazine by Vietnam Ministry of Environment.

According to the decision by the People's Committee, any individual or organization that received waste collection service must pay collection and treatment fee every month. For household, the rate is at 6,000 VND (approximately 30 JPY). In some neighborhoods in Hanoi, there are penalty for littering in public space, though most often these are initiatives led by the local authority.



**Figure 3 Sign showing penalty for littering in public space (photo taken in Thai Thịnh ward)**

In general, the collection rate in urban cities is high (about 98% in urban districts of Hanoi). However, the collection process is still rudimental and primitive.

**Table 2 Hanoi MSW volume (Khanh, 2016)**

	<b>MSW volume (tons/day)</b>	<b>Collection rate (%)</b>
<b>12 urban districts</b>	3,388	98
<b>17 rural districts</b>	2,127	89
<b>Total</b>	5,515	-

The solid waste collection consists of three stages: gathering manually, picking by vehicles at collection points, and transporting–dumping at the landfill. The first stage is when waste is gathered from households or business establishments by handcart and taken to the designated gather sites (collection point). The handcarts are operated by waste collection staff; however, households can also bring waste directly to the collection points by themselves.

In the second stage, a specialized truck with a hydraulic loading/unloading device arrives at the collection point and loads up all the waste. After a pick-up, the truck leaves for the next gather sites following a pre-determined sequence until having a full or almost full load. Finally, the full-loaded truck goes to dump the garbage at the landfill outside the city, completing one route of waste collection.

In 2011, there were 5 sanitary solid waste management facilities in operation, including Nam Son landfill (3500 tons/day), Kieu Ky, and Xuan Son landfill (100 tons/day), Cau Dien, and Son Tay composting plant (50–140 tons/day). Vietnam has issued landfill technical standard TCVN 6696-2000 and TCXDVN 261: 2001 on domestic landfill waste design and requirements. Technical regulation QCVN 02: 2008 covers emission outlet gas from medical solid waste incinerators, QCVN 07: 2009 establishes technical regulations for hazardous waste thresholds, and QCVN 25:

---

2009 details technical standard requirements and characteristics of leachate from MSW landfills (Ngo & Pham 2011).

Until now, Nam Son is still the main landfill site for the majority of municipal solid waste from Hanoi city. After its second phase of development started in 2011, Nam Son landfill expanded its area to 73.73ha with the expected lifetime to last till 2021. With the total capacity almost reaching its limit, there have been many demonstrations by local citizens in Soc Son Province attempting to stop waste transportation trucks from bringing waste into the landfill. The most severe case at the beginning of 2019 had stopped the waste flow from Hanoi for 4 days consecutively.



**Figure 4 Xuan Son landfill (Ba Vi district)**

Beside Nam Son, a small part of the waste generated in Hanoi is disposed of in Xuan Son landfill in Son Tay Commune, about 55km from the center of Hanoi, with the capacity of approximately 1,000 ton/day as reported in Kinh Te Do Thi (a Vietnamese newspaper), much smaller than Nam Son landfill. If the amount of municipal solid waste from Hanoi continues to increase with the growth of the population, both these landfills will shortly reach its limit. Under such circumstances, the reduction of waste going to these dumping sites is a fundamental step to extend their lifetime.

The technical standards and requirements on solid waste disposal technology have been detailed, however, not strictly apply comprehensively. There is also a lack of regulation regarding waste collection and transportation, especially for the private businesses that are in charge of waste collection and disposal in suburban areas. This is to avoid the scenario where companies withdrawing the process or not complying with regulations on environmental sanitation for garbage collection in order to reduce labor days, etc. because of business competition reasons, leading to environmental pollution.

---

Another problem Hanoi is facing is the inefficient of land use hence the shortage of waste collection points. Current collection points are becoming overload with the increasing amount of waste. Moreover, most of these stations are located inside residential areas, and few of them meet the environmental standards. This means that everyday people are facing air pollution and water pollution. Old and rudimental machinery systems at most of these stations have slowed down the treatment process, resulting in stagnant odors and the leakage of sewage into the soil causing groundwater pollution. In rainy season, the stagnant garbage encounters large volume of rain, causing widespread flooding and waste to float uncontrollably. Dirty water from the collection point can quickly spread into residential areas, which may pose the danger of epidemics.

### **1.1.3 Past project on source separation**

#### **a) Overview of 3R Initiative**

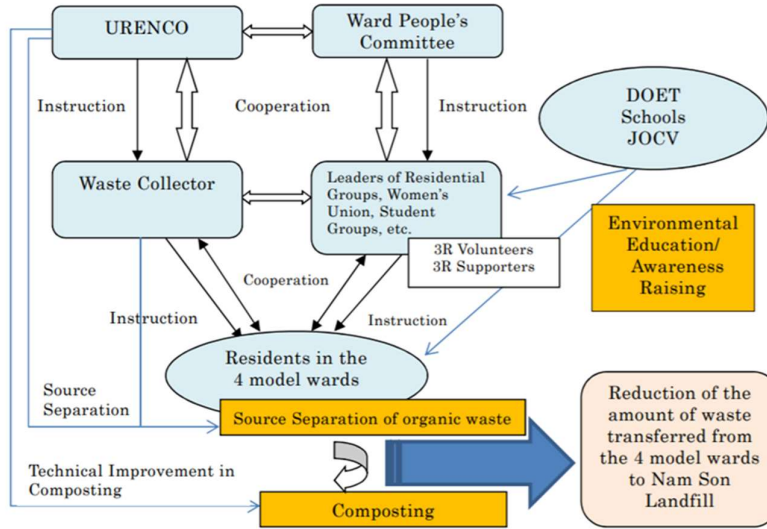
Waste separation at source campaign in the past was only in the form of pilot-program and has not been replicable elsewhere or in large scale. In 2006, 3R Initiative was implemented in Hanoi with the support of JICA as a response to Vietnamese government revising environmental protection laws and Vietnam Agenda 21, a program fixated on sustainable development with responsibility for the environment.

In Hanoi, the reduction of solid waste and recycling are being promoted as part of a national strategy. In order to turn the city into a recycling community, the citizens of Hanoi must adequately understand the 3Rs and the issues of waste. Furthermore, an urban garbage management system must be created whose basic functions are the collection and separation of waste. Under these circumstances, the main purpose of the project was to introduce source separation of organic waste to Hanoi citizen.

Direct outputs of the project include the improvement of waste collection condition, increase in awareness level of the residents, and the implementation of environmental education program as well as development of strategy for next steps of improving waste collection system. The project took place from September 2006 to September 2009 with a budget of 493 million yen. Implementing agency is comprised of Hanoi People's Committee, in which Department of Transportation and Urban Public Works Service is the main department responsible for administration of solid waste management; and Urban Environment Company (URENCO) which is responsible for waste collection, transportation, treatment and disposal for the urban part of the city.

#### **b) Project implementation**

The implementation of the project involved a wide range of stakeholders in all the process of policy recommendation and decision making. In this project, URENCO and representatives of the people's committee in the four model wards and four districts in center Hanoi were the main authorities giving out instructions. Community leaders, Women's Union, Student's Union were the intermediaries between the main authorities and residents in the four model wards. Research institutes, universities, private companies, organizations concerned, public funds, and mass media also played an important role in the public promotion campaign.



**Figure 5 Relationship and Roles of Stakeholders in the Pilot Project (JICA, 2012)**

The main outputs of the project were to improve the waste collection condition, raise awareness of residents, and implement educational program. To that, the activities included field survey, preparation of guidebook, and training of collection staff. Separated collection program were implemented at targeted areas as well as educational program regarding 3R. Finally, Cau Dien compost plant was improved in order to provide efficient service for the organic waste collected through the program.

**Table 3 Demographic information of JICA pilot project areas (JICA, 2012)**

	Household (approx..)	Population
Phan Chu Trinh	2,000	8,224
Nguyen Du	2,000	11,140
Thanh Cong	7,000	24,872
Lang Ha	7,300	28,584

The four model wards were selected for the pilot project with the agreement from all stakeholders in the Project based on several criteria. These areas had common characteristics which could be used as a model for the expansion to entire Hanoi City. High level of commitment to the pilot project among local stakeholders could also be recognized in these areas.

**c) Outcome of the project**

In general, the 3R Initiative had well achieved its original goals. The project effectively illustrated the adequacy of the different methodologies utilized for the advancement of the 3R. This included the active participation of numerous stakeholders in the source separation program, environmental education and large-scale public interest.

**Table 4 The amount of waste collected from pilot project areas that was brought to Cau Dien compost plan (JICA, 2012)**

Year	Targeted areas (tons)				Total
	Phan Chu Trinh	Nguyen Du	Thanh Cong	Lang Ha	
2007	594	675	-	-	1,269
2008	803	1,022	1,642	1,277	4,744
2009	424	1,043	1,734	1,380	4,581
2010	405	923	1,325	1,022	3,675
2011	413	773	1,137	1,095	3,418
2012	407	733	1,095	1,010	3,245

The amount of waste collected and disposed of at landfill was reduced by 30% as the result of high level of cooperation by residents of pilot areas. According to the post project evaluation by JICA, the average household waste volume reduction rate by August 2009 after the implementation of the pilot project was 45.4% for Phan Chu Trinh Ward, 41.6% for Nguyen Du Ward, 42.1% for Thang Cong Ward and 31.2% for Lang Ha Ward.

Regarding the awareness of residents, more than 80% citizen in targeted areas was well informed about the project according to a survey by JICA in 2009. Mass communication played an important role as the project was covered on the media more than 300 times. Volunteer organizations have been springing up such as the 3R Volunteer Club made up of students and young workers in their twenties. Their works included producing “ecobag” made from recycled canvas and holding information session to high school and university students.

A successful establishment of a group comprising of all representatives from all stakeholders of the projects was recorded. The members held regular meeting and workshop to promote 3R program using the participatory approach.



**Figure 6 Community leaders at 3R workshop and collection point supervising separation bins (JICA, 2012)**

At the time of project completion, the URENCO and residents of all four model wards continued to practice source separation. However, Hanoi People’s Committee did not clearly indicate its intention to finance the expansion of the source separation operation. As a result, there were no



---

additional budget allocated for the expansion of the source separation program and environmental education for the stakeholders, such as district and ward people's committees, community leaders and women's unions, which would play a guidance as well as educational role in these activities.



**Figure 7 Waste was dumped together despite there being different waste bins for separation (JICA, 2012)**

Not only the expansion of source separation operation to the rest of Hanoi city was not realized, the separation practice in model areas at that time also gradually deteriorated. The lack of budget hindered the procurement of containers for collection point, as well as the collection of separated waste.

#### **1.1.4 Obstacles to waste separation at source**

As a result of the project 3R Initiative, the concept of source separation has been widely introduced in Hanoi, however not excessively practiced then and now. Survey outcome in chapter 4 has shown that the biggest obstacle for ordinary citizens to separate household waste is the lack of infrastructure, especially spaces. According to Hanoi Promotion Agency, 12 urban districts of Hanoi with a total area of 303.92 km<sup>2</sup> are currently accommodating 3259.9 million people. The average living space per capita in Hanoi was 25.8m<sup>2</sup> in 2016, however, there is a large gap between different types of housing.

At the moment, Hanoi still has close to 1,500 apartment complexes that were built since the 70s and 80s; among them, a lot of building has deteriorated severely (label D according to Ministry of Construction). In these complexes, a moderate apartment is approximately 30 to 40 square meters where a family of 3 will have an average living space person of more than 10 square meters. It is extremely hard to have space inside the house for different kinds of waste in this situation, especially when waste separation is not the top priority for the majority of normal people.

Another factor hindering the application of source separation scheme is the unsatisfactory collection service. From 2006 to 2009, the implementation of 3R Initiative had achieved an astonishing level of cooperation from residents in pilot areas. People took part in the project by



---

separating organic waste and non-organic at their home before bringing to collection point; during this period, the rate of participation was close to 100%.

However, after JICA concluded its involvement with 3R Initiative, the lack of funding prevented local collection service from providing enough facilities to collect organic and non-organic waste separately. As a consequence, people lost their willingness to separate when different types of waste got mixed altogether as they were loaded into collection trucks.

## **1.2 Research objectives**

In order to productively boost participation in source separation, it is crucial to understand what drives households to take part in waste separation. Especially in the area where extensive changes in demographic and lifestyle are happening, a study to examine the factors, not only in individual aspects but also regarding societal elements is indispensable. The insufficiency in literature encouraged this study to explore the social impact on waste separation behavior.

For that purpose, the main objective of this research is to examine how the social bond between an individual and the neighborhood impacts the behavior for waste separation, especially in the context of developing countries.

The result of this research can provide meaningful implications to not only waste management policies but also city planning policies which should be considered simultaneously for a sustainable impact.

## **1.3 Research methodology**

This research adopted the descriptive approach in order to illustrate a comprehensive picture of the waste management situation in Hanoi from the viewpoint of the citizens. For such purpose, data collection from both primary and secondary sources was needed to describe the circumstances completely.

The second chapter of this thesis reviewed existing literature to establish a theoretical background for the research. Secondary data from local authorities and international organizations, namely JICA, also provided an overview of the situation of MSW in Hanoi, including major interventions to the waste management system and the outcomes.

The third chapter presented the theoretical framework of the study, as well as describing the case study on waste separation behavior of Hanoi citizens. Chapter 4 and chapter 5 showed the design and data analysis of two case studies. The first survey in 2020 studied the factors influencing waste separation behavior. The second survey in 2022 studied the impact of age on waste separation behavior.

From there on, chapter 6 discussed the findings from the first case study and the comparison between two case studies. Finally, chapter 7 presented the conclusion and limitations of the research, as well as implications and recommendations for future research and policy makers.

---

## 2 LITERATURE REVIEW

### 2.1 Overview of behavior change model

Human behavior is influenced by a wide range of factors, which are well documented in the literature. Expectancy Value (EV) Theory is the most basic type of social-psychological model of behavior. According to this theory, attitudes are the outcome of a calculation in which one weighs their opinions of an item's (or behavior's) features against the importance they place on them. While attitudes are still the result of linear deliberation, EV is fundamentally a rational choice theory but is treated from the perspective of psychology. The distinction is that this theory investigates the antecedent causes influencing attitudes.

In many social psychology models of behavior, the attitudinal component based on an EV calculation is a common element. It predominates in some of the early models, such as Ajzen's Theory of Reasoned Action (TRA). According to the TRA, a person's attitudes about the behavior are determined by their ideas about behavioral consequences and how they rates those results. The construct of "intentions" is then introduced by the TRA, which maintains that intentions cause behavior to occur. This closes the gap between attitudes and behavioral results. However, "subjective norms" in the context of the TRA are another component that influences intentions in addition to attitudes. Such models are categorized as "modified expectancy value" models when additional elements are taken into account.

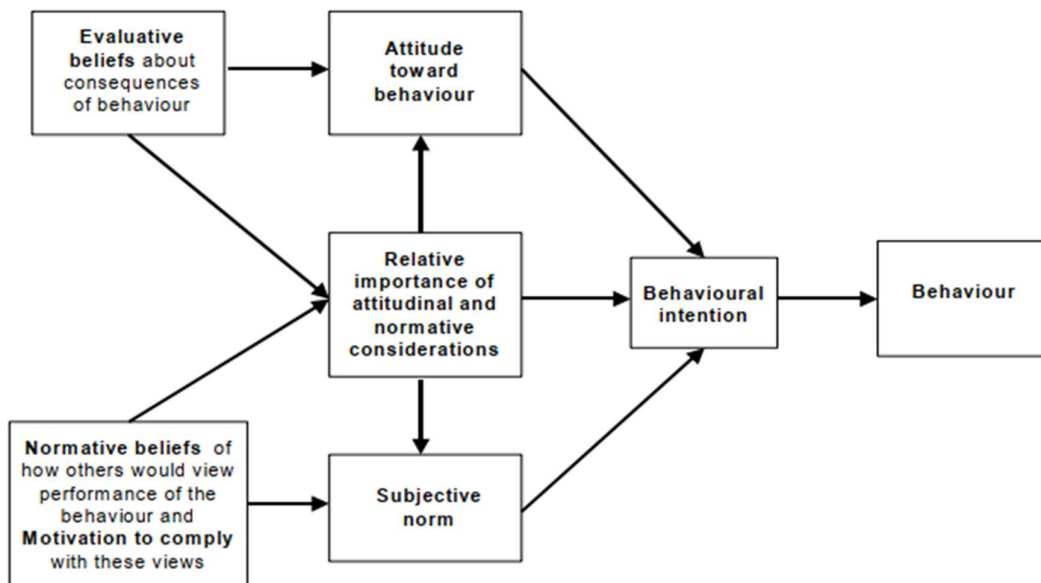
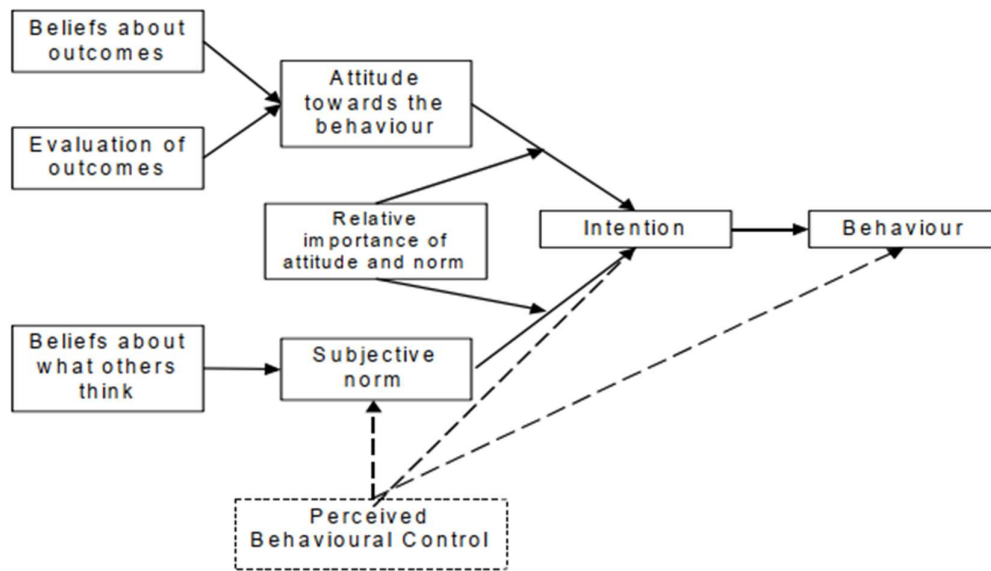


Figure 8 Fishbein and Ajzen's Theory of Reasoned Action (TRA), (1975)

The relative importance of attitudes in predicting behavioral outcomes decreases when EV models are extended by the addition of new variables. As Ajzen expanded the TRA into the much more popular Theory of Planned Behavior, a pattern emerged that may be seen today. This eventually becomes one of the most common models used in many studies to examine the relationship between different factors that influence waste management behavior. Probably one of the most popular models is the Theory of Planned Behavior (TPB) proposed by Icek Ajzen (1991). The theory states that attitude, subject norms, and perceived behavioral control, together shape an individual's intentions and behaviors.

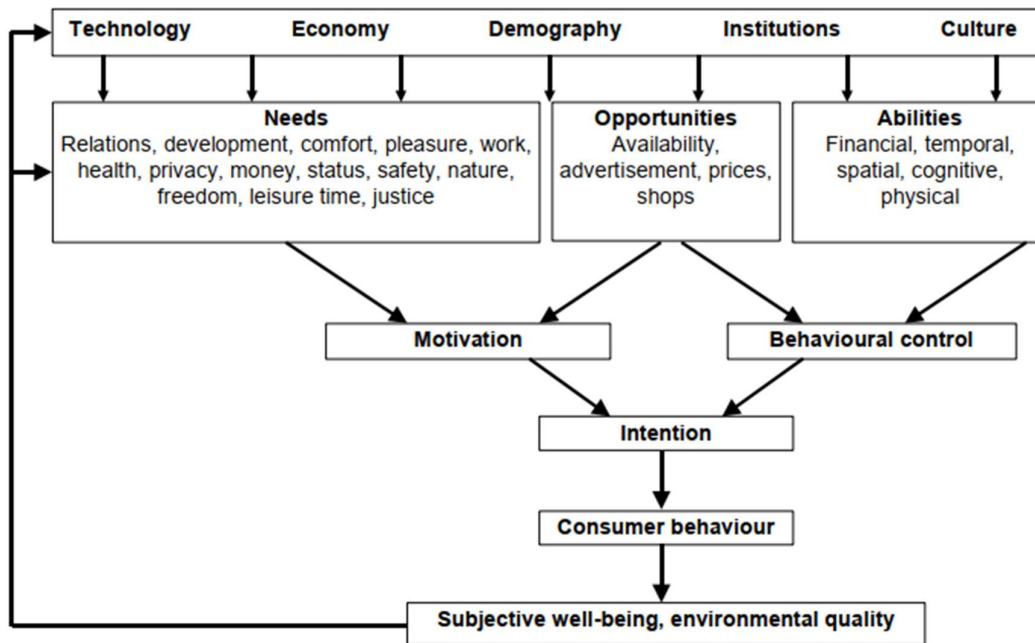


**Figure 9 Ajzen's Theory of Planned Behaviour (TPB), (1986)**

On another note, the earlier version of TPB was the Theory of Reasoned Action which did not consider perceived behavioral control, but it has inspired other model developments in the waste management field. One notable example is the Conceptual Framework of Environmental Behavior (Barr, 2007) that has been cited in other studies afterward, for example, one by Wenzel and Süßbauer (2021).

However, in the context of behavior change, the above-mentioned methods of exploring the attitude-behavior model tend to analyze how an individual's own psyche influences their behavior, and overlook the expansive societal change brought on by urbanization and the development of the economy (James et al., 2019). Hanoi is currently active in high-rise construction in the midst of the real estate market growth. The landscape of the city has been altered drastically with the planning of skyscrapers in the previously suburban villages, where people were used to the agricultural way of life (Leducq et al., 2018). In designing behavior change interventions, this study is taking into account factors that are beyond an individual's control, more specifically urbanization and the development of the economy that affect people's lifestyles and relationships with the community.

While the majority of social-psychological models focus on the internal psychological forces that shape an individual's behavior, some models also take larger-scale forces into account. These models integrate macro-level social elements like technology and the economy as forces. So, these may be referred to be "societal" models. These models are crucial for people creating policy because frequently it is required to explicitly address the contextual constraints restricting behavioural alternatives; merely altering how a person perceives these material variables (such as cost) won't be enough to permit change.



**Figure 10** Vlek et al's Needs Opportunities Abilities (NOA) Model (1997)

Urbanization and economic development as societal factors are best illustrated by the "Needs-Opportunities-Abilities" Model of Consumer Behavior by Vlek (1991). The three constructs (Need, Opportunity, Ability) are shaped by five societal factors (Technology, Economy, Demography, Institutions, Culture). In the NOA model, "opportunities" refer to elements outside of an individual, while "abilities" refer to factors inside an individual; nevertheless, "cost" encompasses both sets of factors, since it combines price (referred to as "opportunities") and available money (referred to as "abilities"). When such evidence is considered, it is more reasonable to see barriers as constructions that represent people's views of external constraints. Kersty Hobson describes hurdles not as impediments to be removed but as possibilities for "deep moral discussions" in a review of studies on the Global Action Plan's (GAP's) Action at Home initiative (which aids homeowners in implementing pro-environmental behavior changes) (Hobson 2001). Many obstacles are not "solidly exterior" but rather created by the way people engage with the outside world on a daily basis. This has consequences for treatments that try to eliminate external behavioral obstacles since both the physical environment and how people perceive it need to be addressed.

---

When apply this concept to the environment field, “Need” in the context of waste management demonstrates an individual’s desire for a better neighborhood environment and waste treatment. “Opportunity” is the incentive and convenience which are often reported to be crucial in behavior change (Struk, 2017; Xu et al., 2018). “Ability” showcases one’s understanding and personal capability regarding waste separation, which has been proved to be impactful toward separation behavior by previous literature (Zhang et al., 2020).

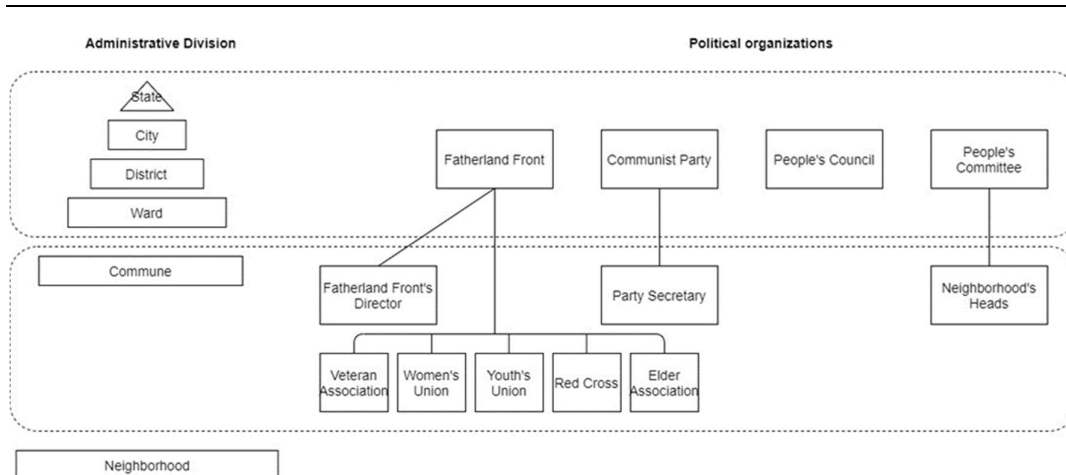
The demographic characteristics of the homes are taken into consideration in a number of prior research to examine the behavior toward recycling. A participant's intention to take part in MSW sorting and recycling programs is significantly shaped by the psychological predictors of MSW recycling. Research is increasingly focusing on understanding the psychological factors that motivate recycling behavior in order to create large initiatives that will encourage home recycling. Many studies indicate that Trust in Authority has an effect on waste separation behavior. Nguyen et al. (2015) discovered that people positively cooperated with waste separation programs when they believed in the legitimacy of the legal framework or in the ability of the waste collection and treatment authority. Similarly, affirmative reactions can also come from trust in a policy measure’s effectiveness (Wan et al., 2014). The study by Loan et al. again confirmed that if an individual deeply believes in the capability of the local authority, they will be more inclined to perform waste separation (Loan et al., 2017).

Based on Peck (1987)’s theory of the Sense of Community, the higher sense of community one possesses, the higher chance for them to understand their part in the collaboration for community initiatives. It is proposed in past research that even though many people do not perceive waste as an urgent problem, they are still more likely to make personal sacrifices if they have a strong sense of community. Furthermore, inhabitants in different types of communities have different levels of sense of community (Hughes et al., 1999; Halamova et al., 2018). Therefore, it is important to consider this factor when deciding approaches to community waste management.

The scarcity in literature of the social impact, especially the Sense of Community regarding source separation is urging new studies to emerge recently. Jin et al. discussed the critical role of community guidance in encouraging proactive waste separation among urban residents (Jin et al., 2021). Not to mention, Nguyen claimed to be the first to investigate household waste separation using a sociological perspective (Nguyen, 2021). Following this trend, this study aims to discuss the factors affecting waste separation behavior with societal elements, such as Sense of Community and Trust in Authority, from the survey for citizens of Hanoi, the capital city of Vietnam. The result of this study can provide meaningful implications to not only waste management policies but also city planning policies which should be considered simultaneously for a sustainable impact.

## **2.2 Definition of community and its role in waste management**

To better define the term “community” in this thesis, an explanation about the administrative division of Vietnam is needed. Starting at the top with the state government, follows by city, district, ward, then commune which is the smallest division with an authority figure assigned by the upper administration. This authority figure, who is also referred to as the “community leader” or “neighborhood’s head”, acts as an intermediary between the governmental order and the ordinary citizen, thus maintaining a close relationship with every community member.



**Figure 11 Vietnam's Administrative division and Political organization**

This decentralization of administration has been observed in past literature. According to Scott (2006), Vietnam is already significantly financially decentralized at the provincial level, as evidenced by the fact that the proportion of the economy under the jurisdiction of the national government is not extraordinarily large. Over the course of the transitional years, all local levels' (mainly provincial) portion of the budget has mostly stayed consistent at over 40% of total government spending and well over 55% of spending in the social sectors (World Bank, 2000). This matches the percentage in numerous nations that aren't regarded as having very centralized fiscal systems, like the United States (39%) and India (52%). This means that even the smallest administrative division has its own autonomy. Furthermore, since it is the closest to the people, the commune is the cornerstone of public administration. If the commune level functions, then all initiatives will go well.

This is indeed applied to waste management in a neighborhood. As pointed out by Nhung (2014), the community leaders play an important role in promoting, direct, monitor and remind people to participate in classification, collection, and disposal of garbage in accordance with regulations. Neighborhoods that receive interest and encouragement from the community leaders regularly will get results in a positive direction. On the contrary, if this group of community leaders is not interested in environmental sanitation and waste classification and collection activities, the operation will not be able to achieve high efficiency.

The author also stated that there is a positive correlation between the level of participation of the people and the leader of the residential community in waste collection. If the community leaders participate more actively, the level of people's participation in waste collection activities is also higher. If they have a high reputation in the community, they can certainly mobilize people's active participation in common activities such as garbage collection. This activity requires a high degree of self-discipline and is mainly based on mobilizing the entire population to participate together.

Figure 11 also introduced the socio-political organizations such as the Fatherland Front, Women's Union, Youth Union, Farmers' Union, etc., formed in the residential community with the main

---

members being people in the community. If the head of the residential group has the role of directing, planning and issuing requirements and regulations to implement the policy of the city/district/district, the social unions have a role to motivate people to perform. Also according to Nhung (2014), the Women's Union, Veterans' Association, Fatherland Front and Elderly Association are social organizations that have more active activities than other organizations in mobilizing people to participate in classification, collection and treatment of waste. Meanwhile, the Youth Union does not have many activities to mobilize youth union members in residential areas to participate regularly and effectively in waste management activities. The consequence is the lack of participation of youth union members in waste management activities in the ward, in which the reasons for this absence are pointed out to the time factor and busy working schedule to earn extra income. It is also due to the limitation of the youth group's collective consciousness and environmental protection consciousness.

With many emphases on the important of community leaders and social groups on facilitating waste management in a neighborhood, it is once again pointed out very often in literature that waste is a shared responsibility in a community. Instead of, for example, being a socio-ethical issue needing democratic discourse on concerns of overconsumption and economics predicated on unrelenting development, waste management is essentially framed as a question of catering to individual residents' trash "needs" through industry and technology. This is a crucial realization that should be taken into account when developing best practices aimed at comprehending residents' motivations for recycling and waste disposal (or not), as well as supporting participatory approaches towards a sense of shared responsibility and ongoing engagement between community leaders and the inhabitants they serve (Hird, 2017).

The greatest way to achieve shared responsibility for waste management is not through industry-organized public awareness sessions and presentations, which are frequently done in collaboration with the government and promote individual level accountability in a mostly top-down manner. By incorporating project participants in the "domains of action" around waste management and governance to jointly produce knowledge outputs, methods of knowledge cocreation are likely to provide better results (Paul et al., 2018).

According to a number of recent studies, while waste management and finding effective ways to get rid of waste while causing the least amount of harm to our health and the environment are important, the ultimate goal should center on preventing waste creation, resource management, and sustainability for future generations, where the main challenge is to combat overconsumption. Planning and defining project objectives and activities, as well as engaging in their implementation and assessment, are examples of action domains (Cornish, 2006). People are better equipped to execute alternatives to existing systems when they are part of a participatory waste management program, which allows for reflection on and understanding of present systems. Participants need to be able to recognize and apply their agency in daily settings that branch out from exclusive areas and become common spaces (Gutberlet, 2015).

Early on in the establishment of an illegal dumping program, working partnerships with stakeholders and community organizations are established and maintained to guarantee ownership of the program, which is more likely to lead to support and promotion of the program. Projects

---

that involve the community in prevention and cleanup operate best when they are backed by engaged community involvement. (Hird et al., 2014)

### **2.3 Role of informal sector recycling**

In the context when the public sector cannot afford to meet the requirements for waste management services, the emergence of private recyclers and private garbage collection companies is inevitable. The group of people who buy and sell second-hand goods is considered an informal group participating in waste management activities. They are the people who buy and sell scrap iron, bottles, plastic bags, beer cans, aluminum copper, or tools such as radios, televisions, computers... Their job is to buy things. from households, individuals and agencies, then resell them to dealers, scrap shops. Most of these shops or agents are also informal private groups.

Poor and marginalized socioeconomic groups engage in informal garbage recycling as a means of generating cash and, in some cases, even daily survival. This is common in developing-nation metropolitan settings, and it is estimated that up to 2% of the population in Asian and Latin American cities depends on rubbish picking for a living (Medina, 2000). Disadvantaged communities are adapting to shortages in this way.

#### **2.3.1 Type of informal waste recycling**

Depending on the location and how material recovery occurs, at least four primary forms of informal trash recycling may be recognized in cities with a municipal garbage collection and disposal mechanism (Wilson et al., 2006). Waste collectors who often knock on doors to collect sorted dry recyclables from homeowners or housekeepers, which they then buy or barter and transfer to a recycling facility of some type. In addition to their labor, they spend money to buy and maintain a car. Worldwide, this behavior is quite common. This type of informal recycling is quite important in China (Li, 2002).

Street waste picking is the second type of informal waste recycling where mixed garbage that has been dumped on the ground or in community bins is used to recover secondary raw materials prior to collection. The third type involved the municipal waste collection crew collecting secondary raw materials during the delivery of MSW to a disposal location by transporting vehicles.

The last type of informal waste recycling is waste picking from dump. Prior to being covered, garbage is sorted by rubbish pickers or scavengers. This is frequently related to neighborhoods where residents reside in shacks made from leftover building materials on or close to the landfill. In cities all across the economically developing globe, such as Manila, Mexico City, Cape Town, Bangalore, Guadalajara, Rio de Janeiro, Dar es Salaam, Guatemala City, and many others, scavenging at landfills is a common occurrence (Bernache, 2003).

According to Wilson et al. (2006), the organization of informal recycling operations has significant effects on social standing, conditions for workers, and money production. The persons working in the informal recycling industry are typically less able to add value to the secondary raw materials they gather and more susceptible to being taken advantage of by middlemen the less organized the sector is.



---

The recycling network is organized in a hierarchical fashion. A secondary raw material's added value increases with how much it is exchanged. The bottom of the secondary materials trade hierarchy is typically where informal recyclers are confined, which considerably lowers their potential revenue. Waste pickers working alone are the most vulnerable because they lack a formalized support system. They are readily abused and have little capacity for material processing or storage. Scavenging at dumps and instances where garbage collection is handled by the informal sector sometimes involve family-organized activities. This frequently affects weak people, such women, kids, and the elderly, and exposes them to higher health risks. Additionally, it frequently keeps kids from getting a formal education. Family-organized activities, on the other hand, lessen personal vulnerability by offering a certain amount of social and financial support.

### **2.3.2 Economic factors that encourage informal recycling**

The unofficial recycling industry is frequently quite adept at spotting garbage with possible value. They gather items that have been thrown as garbage and add value to them by cleaning, sorting, changing the physical shape of the materials to make them easier to transport, or aggregating the materials into an amount that is economically feasible. The primary selection criterion for materials is their potential profit margin, while accessibility, practicality, handling, and transportability are all important considerations. Unofficial recycling programs may be quite effective. Due to their proficiency in separating valuable waste from garbage, intense hand sorting, and high recovery rates, the Zabbaleen in Cairo are able to do this (Iskandar, 2003).

Plastics, paper, cardboard, aluminum, steel, other metals, glass, and textiles are among the items that are frequently gathered. Given that they are utilized as animal feed, soil conditioners, and fuel, organic wastes can also be valuable in terms of money, nutrients, or energy (Dulac, 2001). Income levels, the presence of national and regional markets, the demand for secondary raw materials, the extent of governmental financial and regulatory engagement, the cost of virgin resources, international commerce in secondary raw materials, and pertinent international agreements all affect how much a given commodity is recycled. Major industries in several nations, like India and China, are heavily reliant on the supply of secondary raw materials, both domestically produced and imported.

Despite not necessarily being the lowest members of society, scavengers and rubbish pickers typically earn very little money (Medina, 2000). Their poor standing in the trade hierarchy for recycled materials is the cause of their low revenue. They are frequently unfairly exploited and paid extremely little for the materials gathered. This is especially true in marketplaces with just one buyer. Such circumstances frequently exist for rubbish gathered from landfills, when the distance to the city prevents transit for underprivileged waste pickers. In other instances, the pickers must pay for the privilege of accessing the rubbish and may also be required to sell their items to the same person or business.

### **2.3.3 Social and economic concerns**

In poor nations, informal recycling networks can have a positive economic impact. From a macroeconomic standpoint, they are perfectly suited to the current circumstances, which include an abundance of labor but a dearth of capital: they minimize capital expenditures and maximize human and animal labor (Scheinberg, 2001). They are able to give the local manufacturing sector

---

a consistent, dependable supply of secondary raw materials that can take the place of more expensive imported raw materials. This encourages the production of inexpensive, accessible items manufactured from recycled materials.

Many poor nations already have informal trash recycling systems in place, which lower the cost of official waste management systems by reducing the amount of rubbish that has to be collected, which saves time and money on collection and transportation. As recycled materials are redirected for reuse, empty space at disposal sites is maintained and solely used for trash with little future value. Most of the time, the taxpayers bear no direct expense in achieving these economic advantages (Wilson et al., 2006).

## **2.4 Urban development in Hanoi**

### **2.4.1 Extension of Hanoi Capital Region**

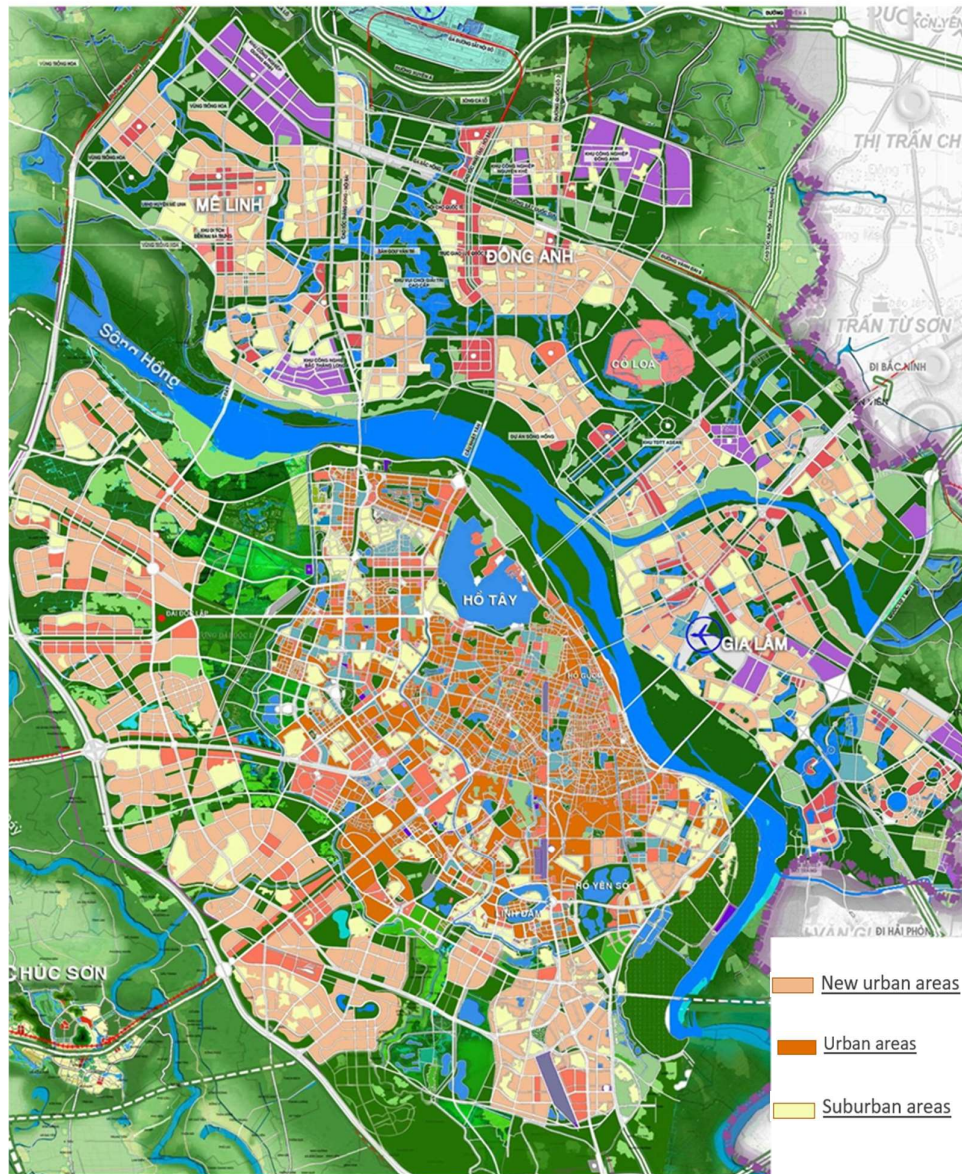
Nearly 90 kilometers from the coast, Hanoi is situated in the Red River delta in northern Vietnam. The development of New Hanoi is more than just a case of spatial expansion; it involves the creation of an entire city-region in a location that is significantly influenced by water. By deciding to include Ha Tay Province, Vinh Phuc Province, Me Linh District, and four communes of Luong Son District in the Hanoi metropolitan region in 2008, the prime minister essentially tripled its size to 3344 km<sup>2</sup>, added 29 subdivisions, and added about 7 million people to its population. Hanoi expanded its boundaries by adding communities with dual uses and agricultural areas (Fanchette, 2015). Aside from aggravating pre-existing issues like clogged irrigation channels and uneven access to irrigation water for agriculture (Labbé, 2016; Labbé et al., 2014), the extensive building and infrastructures in the peri urban sprawl have had serious negative effects on water management (Friedmann, 2016; Leaf, 2002), particularly inadequate drainage networks and increased flooding risks.

With a surface area of 13,436 km<sup>2</sup> and a population of 15 million in 2020, New Hanoi, which is under the jurisdiction of Hanoi and six bordering provinces, raises the issue of how to administer such a big region. Although governmental authorities still tend to approach urban development from the top down, they are no longer the only parties participating in the process. Decentralized multi-party planning strategies including new private or semi-private players have increasingly supplanted centralized planning, organized by the Government and administered by the People's Committee (Leducq et al., 2018).

The urban cluster concept, which has molded many Asian growing cities, serves as the foundation for Hanoi's urban spatial growth (Choe et al., 2008; Phelps et al., 2014). Its purpose is to meet the current and future economic and urban development needs of the Hanoi Capital Region. It consists of a central core and small and medium satellite urban areas linked by ring roads and radial axes, with connections to the Capital Region and the national road system (JICA et al., 2007). By guaranteeing that activities of the urban center, such as industry, services, commerce, and education, would relocate to satellite urban regions and establish new centers (hyper-cities), this model offers opportunities for transforming the urban structure from single-pole to multi-pole. The buffer space should protect natural, cultural, and leisure places since it is attached to an agricultural ecological landscape region (rivers and lakes, bio-diversity, existing and craft

villages). The Hanoi People's Committee also aims to prevent the out-of-control development that other cities, like Lagos or Mexico City, have encountered.

**QUY HOẠCH CHUNG THỦ ĐÔ HÀ NỘI ĐẾN NĂM 2030 VÀ TẦM NHÌN ĐẾN 2050  
ĐỊNH HƯỚNG PHÁT TRIỂN KHÔNG GIAN ĐÔ THỊ TRUNG TÂM**



**Figure 12 Hanoi urban master plan up to 2030**

**2.4.2 Economic industrialization and high-tech clustering**

Urban and peri-urban area development has been fully privatized after decades of totalitarian planning, similar to other nations in the region, with urban megaprojects and flagship projects being carried out by private enterprises. In actuality, the Japan International Cooperation Agency

---

(JICA, 2007) carried out the Hanoi Master Plan in response to contradictory proposals from Japan, Korea, and the United States. International aid was granted to the Vietnamese government, and one of the outcomes was the Greater Hanoi Metro Plan, which faced strong resistance, particularly from the retailing and renting industries.

Hanoi is constructing 16 small and medium-sized industrial clusters in addition to the eight industrial parks that already exist. Within 20 to 30 kilometers of the city center, these new industrial locations are connected to one another and the city center by a vast motorway network. The majority of industrial occupations and high-skill jobs are concentrated there. Hoa Lac Hi-tech Park (HHTP) is one of the Vietnamese government's first initiatives among the new creative clusters with the goal of advancing the country's R & D and high-tech sector (Leaf, 2015; Nguyen, 2016). This project has a total area of 15.52 km<sup>2</sup>, and its five major features are education and training, software-related research and development, utilities, residential and office structures, hotels and facilities for experts and workers, and a sports and recreation center.

### **2.4.3 Key issue of Housing provision vs Housing sustainability**

Similar to Ho Chi Minh City's economic hub, Hanoi is now undergoing high-rise expansion and is enjoying a construction boom. The real estate market has expanded quickly since mid-1990s (Nguyen et al., 2017). Urban models of good practices and urban forms adopted from other Asian countries including Indonesia, Japan, South Korea, and Singapore provide a major foundation for the urban growth of Hanoi (Anwar et al., 2011). The government's strategy for building homes for low-income households has evolved as a result of the engagement of property developers with short-term objectives. Skyscrapers have been built in new urban areas away from the old city, most prominently in the west portion of the city in the Tu Liem, Cau Giay, and Thanh Xuan districts, radically altering the cityscape. The two tallest structures in Vietnam are located in Hanoi, which listed it among the "world cities" (Kam Ng et al., 2003) with skyscrapers over 100 m. These structures are the Hanoi Lotte Center and Keangnam Landmark72 and Residential Tower, both of which stand at 336 meters, just shy of Kuala Lumpur's Petronas Twin Towers (272 m).

In addition, more than 700 real estate projects received licenses under the most recent Master Plan (2008-2011), mostly in Hanoi's southern and western suburbs, including Gia Lam's "Vincom village" (DiGregorio, 2011). The opulent Manor, Ecopark, Ciputra, and Times City, which are situated in the districts of Tay Ho Westlake, Truc Bach, and Ba Dinh, are notable examples of newly urbanized areas. There are several gated communities with titles that appeal to people's aspirations of modernity, more frequently than not, artificially satisfy their need for a clean environment. They frequently make references to the previous state of the land, such as "Riverside", "Riverview", "ParkCity".

The architecture of the nearby villages has undergone a drastic alteration as a result of the development of these new urban areas on agricultural land (Thapa et al., 2016), which has also disturbed water and communications systems (Fanchette, 2015). Additionally, the new zones frequently ignore pre-existing towns and have no relationship to them, as is the case with Tay Ho Westlake and Ciputra International City. These new communities are being built between the third and fourth districts and along major thoroughfares, such Splendor, which is close to the Lang Hoa Lac expressway.

---

The apartment buildings in urban areas and the characteristic three- to five-story "tube" residences contrast with the villas and semi-detached homes. The same is true for the new zones, which are frequently built adjacent to the local cemetery, which results in land conflicts with the people (Kerkvliet, 2005). Preventing these new areas from turning into dormitory towns is another difficulty, as they lack local character in terms of design and lifestyle, are cut off from urban areas, and have limited economic activity.

The new housing zones investigated by Gough and Tran (2009) and Luan Duy (2014) provide additional housing options for the growing middle class and may help equalize the concentrations between the city's core and periphery. However, they significantly increase strain on rural areas and nearby settlements (Fanchette, 2015). Underlying market inefficiencies, a low level of investment, subpar management, and corruption lead to a host of other problems. Conflicts over the payment given to farmers are also brought on by acquiring land and alterations in how that land is used.

---

### **3 THEORETICAL FRAMEWORK AND CASE STUDY DESCRIPTION**

#### **3.1 Theoretical framework**

##### **3.1.1 Need, Opportunity, and Ability**

In the “Needs-Opportunities-Abilities” (NOA) model by Vlek, intention, which leads to behavior, is formed from two paths: motivation (Need and Opportunity) and behavioral control (Opportunity and Ability). The Need, Opportunity, and Ability constructs are shaped by five societal elements (Technology, Economy, Demography, Institutions, and Culture).

In the NOA model, "opportunities" relate to things outside of a person, while "abilities" refer to things inside a person; yet "cost" covers both sets of criteria because it combines pricing (referred to as "opportunities") and available money (referred to as "abilities"). When such information is taken into account, it makes more sense to regard barriers as creations that mirror people's perceptions of outside restrictions. In a study of research on the Global Action Plan's (GAP's) Action at Home project (which assists homeowners in making pro-environmental behavior changes), Kersty Hobson refers to obstacles not as obstructions to be overcome but as opportunities for "deep moral dialogues" (Hobson 2001).

When this idea is applied to the environment, "Need" in the context of waste management shows a person's desire for improved waste management and neighborhood environments. Opportunity is the convenience and inducement that are frequently cited as being essential for behavior change (Struk, 2017; Xu et al., 2018). Ability displays one's grasp of and personal capacity with relation to waste separation, which has been shown in prior literature to have an influence on separation behavior (Zhang et al., 2020).

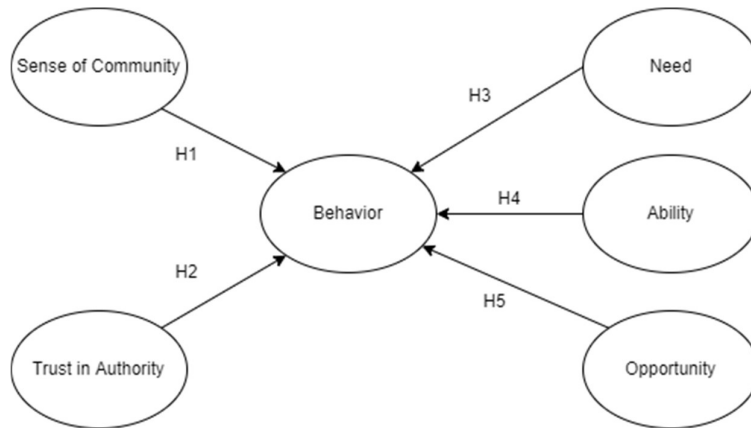
##### **3.1.2 Sense of Community and Trust in Authority**

Numerous studies show that behavior related to trash separation is influenced by trust in authority. Nguyen et al. (2015) found that when individuals had confidence in the authority of the trash collection and treatment authority or in the legality of the legal framework, they positively collaborated with waste separation programs. Similar to this, positive responses can also result from confidence in the efficacy of a policy initiative (Wan et al., 2014). According to the study by Loan et al., people are more likely to execute waste separation if they have a strong faith in the local authority's abilities (Loan et al., 2017).

According to Peck's (1987) idea of the sense of community, a person has a greater probability of understanding their role in collaboration for community projects if they have a stronger sense of community. Previous studies have suggested that even while many individuals do not see waste as an urgent issue, they are nevertheless more inclined to make sacrifices on their own behalf if they feel strongly about their community. Additionally, the sense of community among residents of various kinds of communities varies (Hughey et al., 1999; Halamova et al., 2018).

For these reasons, this study hypothesized that the societal elements in the NOA model also influence Sense of Community and Trust in Authority which in turn affects behavior. Predictor

variables are categorized into five factors: Sense of Community (SC – measured by willingness to engage in community activities and to stay long-term), Trust in Authority (TA – measured by relationships with community leaders and confidence in the authority’s capability), Need (N – measured by concern for the surrounding environment and cleanliness), Opportunity (O – measured by responses to incentives), and Ability (A – measured by the understanding of waste separation and the practical capability to separate waste). These factors formulated the following five research hypotheses which can be visualized by the figure below.



**Figure 13 Hypothesized model of factors influencing waste separation behavior**

Hypothesis 1 (H1) Sense of Community has an effect on waste separation behavior.

Hypothesis 2 (H2) Trust in Authority has an effect on waste separation behavior.

Hypothesis 3 (H3) Need has an effect on waste separation behavior.

Hypothesis 4 (H4) Ability has an effect on waste separation behavior.

Hypothesis 5 (H5) Opportunity has an effect on waste separation behavior.

### **3.2 Data analysis tool**

In a wide range of academic disciplines, including the environment field, Structural Equation Modelling (SEM) has grown in popularity. SEM unquestionably possesses a number of traits that have drawn the attention of researchers and set it apart from regression techniques from the first generation. In instance, by concurrently modeling the interactions among several independent and dependent components (the structural model), research hypotheses may be addressed in a single, systematic, and thorough way (Gefen et al., 2000; Hair et al., 2010). Additionally, SEM examines both the structural model and the measurement model in the same study. The predictions supplied by SEM are superior to those generated by linear regression as a result of this integrated analysis, which allows measurement errors of the observed variables to be examined as an integral element of the model (Gefen et al., 2011).

SEM can be applied using covariance-based approaches (Covariance-Based SEM, CB-SEM) or variance-based approaches (Partial Least Square-SEM, PLS-SEM) (Astrachana et al., 2014). As



opposed to CB-SEM, which attempts to reproduce the theoretical covariance matrix, PLS-SEM maximizes the explained variance of the dependent constructs. There are two sub-models in the PLS-SEM: the measurement model and the structural model. The measurement models represent the relationships between the observed data and the latent variables which are the hypothesized factors influencing waste separation behavior in this study. The structural model represents the structural relationship among latent variables.

PLS-SEM is also useful for secondary data analysis when seen through the lens of measurement theory. Measures employed in secondary data sources are frequently not established and improved with time for confirmatory studies, in contrast to survey instruments, which are normally designed to validate a well-formed theory (Sarstedt et al., 2019). Therefore, when utilizing CB-SEM in most research contexts, establishing model fit using secondary data measures is improbable. Additionally, while employing secondary sources, researchers are unable to edit or improve the measurement model in order to attain fit. The use of formative measurements is another significant benefit of PLS-SEM in this setting (Hair et al., 2017). The PLS-SEM methodology allows for the unlimited use of single-item, reflective, or formative measures since it is centered on ordinary least squares regression (Hair et al., 2014)

This study used PLS-SEM run by smartPLS version 3.0 software to explore the causal relationship between the respondents' behavior of waste separation and Need, Opportunity, Ability (the three factors from the existing behavior model), and Sense of Community and Trust in Authority which are newly added constructs. Since the hypothesized model of this research is at the experimental stage, PLS-SEM is adopted based on a recommendation by Astrachana et al. (2014) that suggested PLS-SEM for theory development in the case of non-normal distribution (usually observed in social science). PLS-SEM is less stringent compared to CB-SEM, however, past literature has found similar results obtained from both approaches (Amaro, 2015).

### 3.3 Study area

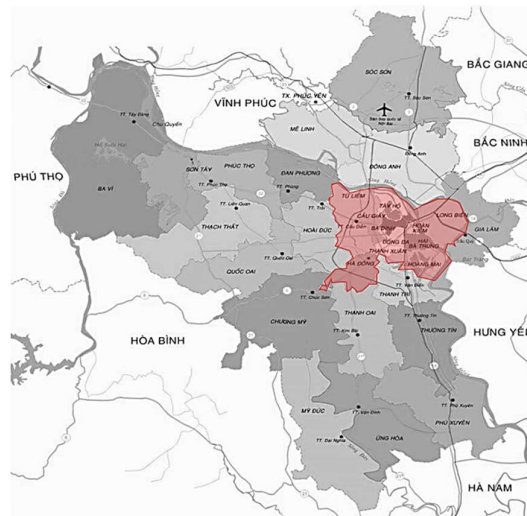


Figure 14 Map of Hanoi city with 30 subdivisions



Statistics from 2019 show that Hanoi has an area of 3,358.59km<sup>2</sup> and a population of 8.093 million, including an urban population of 4 million and suburban population of 4 million, and the population density is particularly high in the 12 urban districts (United Nation, 2019). This survey targeted both the very center of the city as well as the suburb that make up the Hanoi Metropolitan Area.

**Table 5 Study area (General Statistics Office of Vietnam, 2019)**

	Urban districts	Rural districts	Total
Population (million)	4,000	4,093	8,093
Area (km <sup>2</sup> )	305	3,053	3,358
Waste generation (ton/day)	3,000	3,500	6,500

According to the “General planning on construction of Hanoi Capital”, by 2030, the majority of residential land will be new urban areas with social houses or middle/high class high-rise apartment compounds. The central part of Hanoi is still home to older types of apartment buildings, which are no higher than five floors, and mostly detached houses. In this area, residential and commercial purposes are often mixed. Lastly, the suburban areas only take a small portion, but they are also going through a lot of changes in demographics in the face of urbanization.

Under these circumstances, Hanoi became an appropriate target to study how societal elements influence waste separation behavior. The transitions in social backgrounds due to urbanization and economic development of the capital city led to a change in people’s values. The “village culture”, where everyone dwelling in the same neighborhood or “village” knows each other and sees each other like family, is gradually changing as people move into big cities. Their perception of the surrounding environment also shifts when people move to a new place and not yet consider the neighborhood to be their “home”. This affects their attitude towards waste management as well. At the same time, the variety of stakeholders in the local authority results in a complex decision-making process, consequently affecting collective action initiatives and local waste management. For that reason, this study of the social impact on waste separation behavior will provide many suggestions to develop municipal solid waste sorting strategies for not only Hanoi but also other cities in similar situation.

## 4 CASE STUDY ON FACTORS INFLUENCING WASTE SEPARATION BEHAVIOR

### 4.1 Questionnaire design and data collection

A survey was carried out from October 2nd, 2020 to October 16th, 2020. Before that, a pre-test was conducted to make sure the questions were understandable linguistically. This study adopted a structured questionnaire for the survey. Multiple choice methods and Likert rating scales were used for the questionnaire design.

**Table 6 Questionnaire items for the first survey**

Latent Variable	Item
Sense of Community	SC1. I feel connected to the community in my neighborhood.
	SC2. I often participate in public events and community activities in my neighborhood.
	SC3. I plan to stay in my current neighborhood for a long time.
Trust in Authority	TA1. I feel connected to the community leaders in my neighborhood.
	TA2. I trust that the local authority is capable of facilitating waste collection.
	TA3. I trust that the local authority is capable of treating separated waste.
Need	N1. I am unsatisfied with the current waste collection system in my neighborhood.
	N2. I want separated waste to be treated accordingly.
	N3. I want to see improvement in the neighborhood environment (cleaner streets, etc).
Ability	A1. I know the difference between organic waste, recyclables and others.
	A2. I have the time to separate organic waste and recyclables every day.
	A3. I have the space to store separated waste in the house.
Opportunity	O1. I am more willing to separate waste if there is money incentive.
	O2. I am more willing to separate waste if I do not have to travel far for disposal.
	O3. I am more willing to separate waste if there is frequent collection.
Behavior	B1. I often separate recyclable waste
	B2. I often separate organic waste

The first part is a set of questions to collect general household information on socio-economic characteristics and living situation including years of residence in the community, types of houses and house ownership situation. The second part are Likert-scale items used to assess the predictor variables of the model. In this section, respondents were requested to grade their level of agreement with the given statements from 1 to 4, with 1 being “strongly disagree” and 4 being “strongly agree”. In the case of Opportunity, it was also clarified in the questionnaire sheet that these statements were under the assumption of a source separation program implemented by local government.

Regarding the measurement for waste separation, the behavior is broken down into organic and recyclable waste separation in this study. The questionnaire raises the statement “I always separate organic waste” and “I always separate recyclable waste”, and the Likert-scale ranging from 1 to 4 allowed the respondents to self-assess the degree to which they are sorting out household waste. For that reason, the data from this question shows the level of separation in each household (Meaning, separating all recyclables waste is different from separating just cardboard or metal, for instance), instead of demonstrating the source separation ratio in the population. This reflects the respondents’ intention to separate waste in the context of Hanoi where source separation is not strictly adopted.

The online questionnaire survey was conducted by Macromill Inc., an internet research company which has more than 380 thousand panels in Vietnam. Trap questions and other measures were applied to filter out indiscriminate answers and to assure a set of random samples among Hanoi citizens. Furthermore, the target population was divided into ten groups using five age and two gender categories, and an equal number of samples from ten groups was requested to the survey conductor. However, there is a deficit of elder panels from the internet research company, hence sample size is small in elder age groups more than 50 years old. This also results in a bias in the education level of the respondent. In total, 778 samples were collected.

#### 4.2 Socio-economic background of the respondents

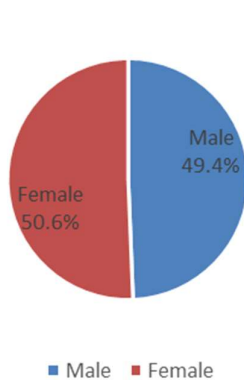


Figure 15 Gender of the respondents

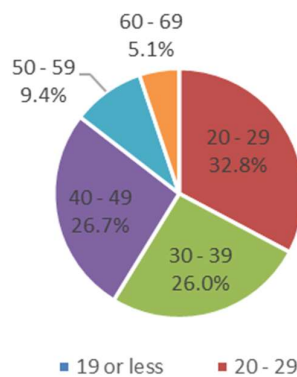
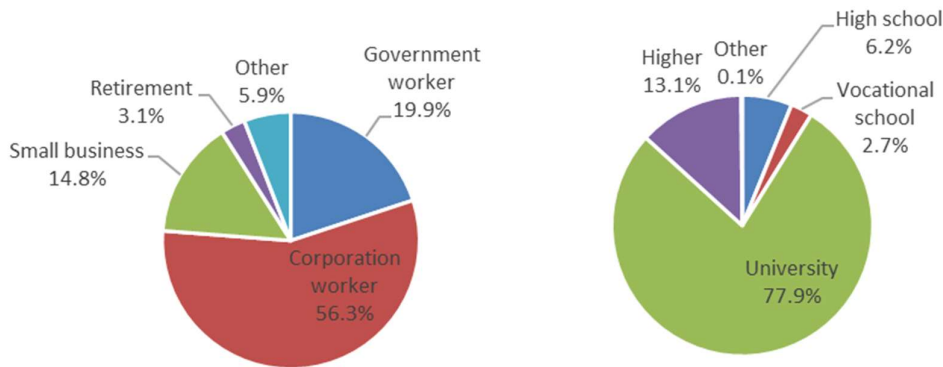


Figure 16 Age of the respondents

The number of male respondents and female respondents are approximately equal, with the female ratio slightly higher at 50.6% and male ratio at 49.4%. The survey targets people who are 20-year-old and above to narrow the respondents to those who can be responsible for waste disposal in a household. The elder demographic takes up a smaller portion of the survey population compared to younger one (less than 20% for people over 50). This is less than the percentage of people over 50 in the census in 2019 conducted by the United Nations (28.3%).

On the other hand, the majority of survey respondents is from the 20 – 29 age group (32.8%), followed by people from 40 to 49-year-old at 26.7% and people from 30 to 39-year-old at 26.0%. Meanwhile, Vietnam’s population in 2019 saw the ratio of people from the 20 – 29 age group, 30 – 39 age group, 40 – 49 age group at 25.2%, 25.3% and 21.2%, respectively (United Nations, 2019).

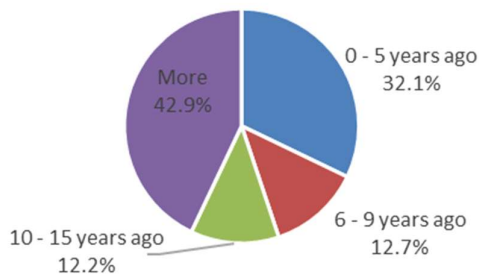
More than 50% of the survey population is employed as corporation workers. Government workers take up about 20% and small business owners take up 14.8% of the total respondents. The number of people receiving higher education is quite large, with 77.9% respondents with a university degree and 13.1% respondents with a higher degree. Only 6.2% of the survey population stopped their education at high school. For reference, the national level of university enrollment records shows 30% of both sexes enrolled in university in 2014 and this trend is rising as the Education Development Strategic Plan for the years 2008 to 2020 was established (Rebecca, 2018).



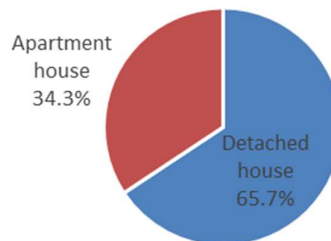
**Figure 17 Occupation of the respondents**

**Figure 18 Education level of the respondents**

This study acknowledges that the samples lean toward the younger population with higher education because of the elder demographic has limited access to the internet survey. Data analyses were carried out with the available samples collected, and we will focus on possible effect of sampling bias in future studies.



**Figure 19 Period of stay in current neighborhood**



**Figure 20 Type of house**

Besides socio-demographic questions, there are three questions in the survey that targeted the living situation of the respondents. The first question asked about the period the respondents spent in their current place based on an estimate range of time with a 5-year interval. The number of people newly moved to the neighborhood (less than 5 years) took up to 32.1% of the survey population. The next two group of people who had been living in their current neighborhood from 5 to 9 years and 10 to 14 years are almost the same, at 12.7% and 12.2% respectively. Most people had been living in their current houses for more than 15 years (42.9%). In perspective, 10 year is a median that divides the survey population into half and half, making it possible to compare the behavior of these two groups.

When comparing detached house and apartments (including high-rise apartment building), the majority of respondents is living in separate single houses, with the ratio being 65.7% to 34.3%. The rate of home ownership is rather high with 83.7% of the respondents currently living in their own home or family home, while only 16.3% of the respondents are living in rental places.

### 4.3 Primary data analysis

Table 7 show the composition of all the response for the Likert-scale section of the questionnaire survey. The first three questions are indicators for Sense of Community, which reflects the sense of belonging in the neighborhood of each individual. The majority of respondent agree to these statements to different degree, with highest percentage at 63% somewhat agree.

Trust in Authority is measured by asking about people's perception of the community leader's capability, and there are significantly more people who disagree, with 36% respondent do not feel connected to the community leaders.

More than half of the survey population agree with questions regarding concerns about neighborhood's cleanliness as well as the treatment of waste. Similarly, the agreement ratio is high for Ability to spend time, space, and knowledge on waste separation, and there is also positive response to money incentives and convenience.

Finally, the target behavior in this model is the voluntary separation of both organic waste and recyclables, which makes up the majority of municipal solid waste composition. For the result, recyclable waste is sorted out more, and one reason being that it can be traded for some amount of money.

**Table 7 Response composition**

Questions	Strongly disagree (1)	Somewhat disagree (2)	Somewhat agree (3)	Strongly agree (4)	Ave.	StD.
SC1. I feel connected to the community in my neighborhood.	3%	14%	63%	20%	2.98	0.68
SC2. I often participate in public events and community activities in my neighborhood.	4%	23%	54%	18%	2.85	0.75
SC3. I plan to stay in my current neighborhood for a long time.	3%	15%	58%	24%	3.02	0.72
TA1. I feel connected to the community leaders in my neighborhood.	5%	36%	46%	13%	2.66	0.76
TA2. I trust that the local authority is capable of facilitating waste collection.	3%	11%	69%	17%	2.97	0.66
TA3. I trust that the local authority is capable of treating separated waste.	3%	14%	66%	17%	2.95	0.68
N1. I am unsatisfied with the current waste collection system in my neighborhood.	3%	20%	57%	20%	2.93	0.73
N2. I want separated waste to be treated accordingly.	2%	2%	51%	44%	3.24	0.85
N3. I want to see improvement in the neighborhood environment (cleaner street).	2%	22%	59%	17%	3.29	0.85
A1. I know the difference between organic waste, recyclables and others.	1%	7%	66%	27%	3.16	0.61
A2. I have the time to separate organic waste and recyclables every day.	2%	21%	61%	15%	2.77	0.69
A3. I have the space to store separated waste in the house.	3%	27%	57%	12%	3.17	0.58
O1. I am more willing to separate waste if there is money incentive.	1%	4%	69%	25%	3.18	0.56
O2. I am more willing to separate waste if I do not have to travel far for disposal.	1%	8%	68%	23%	3.12	0.58
O3. I am more willing to separate waste if there is frequent collection.	2%	14%	66%	18%	3.00	0.62
B1. I often separate recyclables.	2%	1%	49%	47%	2.90	0.67
B2. I often separate organic waste.	1%	18%	61%	20%	2.98	0.65

Table 8 presents the Chi-squared crosstabulation results between age, gender, education, housing situation, and factors of the hypothesized model. Bold letter shows significant relationship, and the cross means the result cannot be used because of invalid expected counts.

**Table 8 Crosstabs summary**

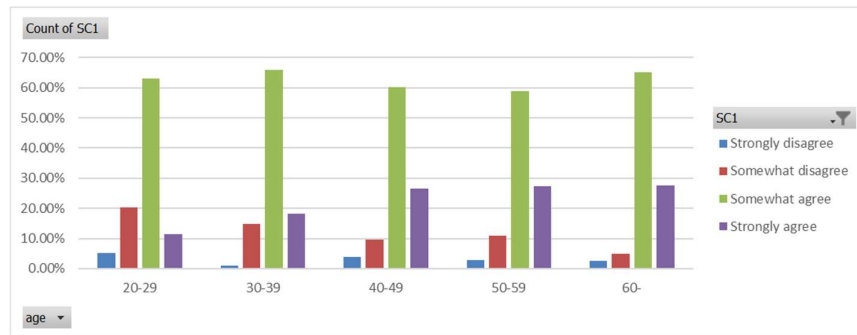
	Age	Gender	Education	House period	House type	House ownership
SC1	<b>0.002</b>	0.337	/	<b>0.005</b>	0.088	<b>&lt;0.001</b>
SC2	<b>&lt;0.001</b>	<b>0.002</b>	/	<b>0.005</b>	0.247	<b>&lt;0.001</b>
SC3	<b>&lt;0.001</b>	0.767	/	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>
TA1	<b>&lt;0.001</b>	<b>0.030</b>	<b>0.015</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>
TA2	0.204	0.869	/	0.147	0.897	0.083
TA3	0.076	0.871	/	<b>0.041</b>	0.732	0.054
N1	<b>0.034</b>	0.689	/	<b>0.039</b>	0.058	<b>0.024</b>
N2	/	0.937	/	/	0.817	0.327
N3	/	0.512	/	/	0.474	/
A1	/	0.215	<b>0.007</b>	0.076	0.908	0.244
A2	<b>0.028</b>	0.651	<b>0.049</b>	0.153	0.392	<b>0.037</b>
A3	<b>0.035</b>	0.940	/	0.574	0.250	<b>0.004</b>
O1	/	0.308	/	0.885	0.311	0.731
O2	/	<b>0.014</b>	/	0.736	0.429	0.718
O3	0.723	0.97	/	<b>0.002</b>	0.876	0.909
B1	0.722	0.931	/	0.808	0.777	0.621
B2	0.324	0.962	/	0.568	0.166	0.973

Gender does not seem to have strong correlation with factors influencing behavior considering significant P-value only shows with SC2, TA1 and O2. Similar situation happens to education where it only correlates significantly with TA1, A1 and A2. However, age appears to have strong correlation with Sense of Community since P-value for all three indicators are significant at 0.002 and <0.001. This means that the elder residents are more likely to develop higher sense of

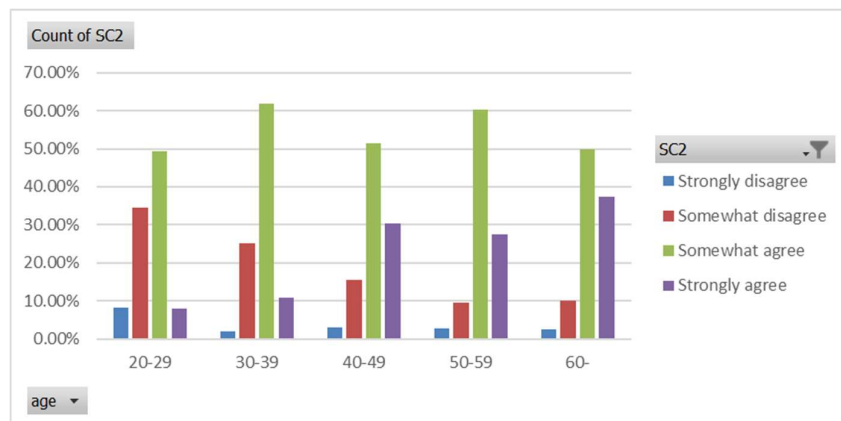
community compared to younger generation. Age also correlated with TA1, N1, A2 and A3 with significant P-value.

The period respondents are living in their current house and the ownership status are strongly correlated to Sense of Community, as the P-value of Chi-square test are all under the accepted range. This confirms that those who own a house and live longer in the neighborhood have higher sense of community. Significant correlation can also be observed with Trust in Authority, particularly TA 1 with House period, House type and House ownership, with P-value all under 1%.

The next section will continue to explore what influence waste separation behavior.

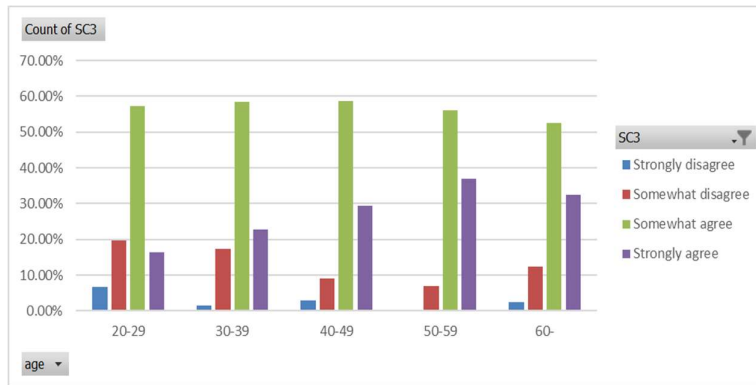


**Figure 21 Age distribution to the question ‘I feel connected to the community in my neighborhood’(SC1)**



**Figure 22 Age distribution to the question ‘I often participate in public events and community activities in my neighborhood’(SC2)**



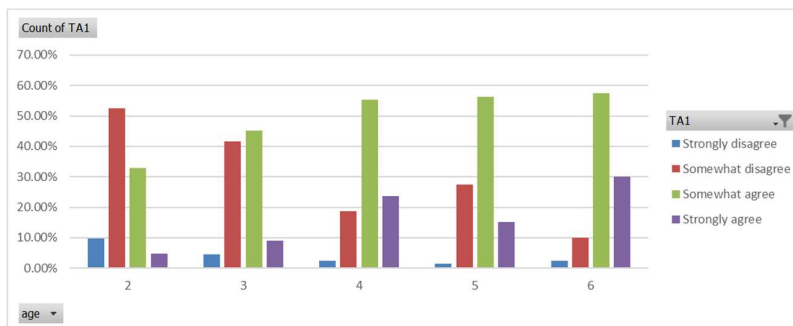


**Figure 23** Age distribution to the question ‘I plan to stay in my current neighborhood for a long time’ (SC3)

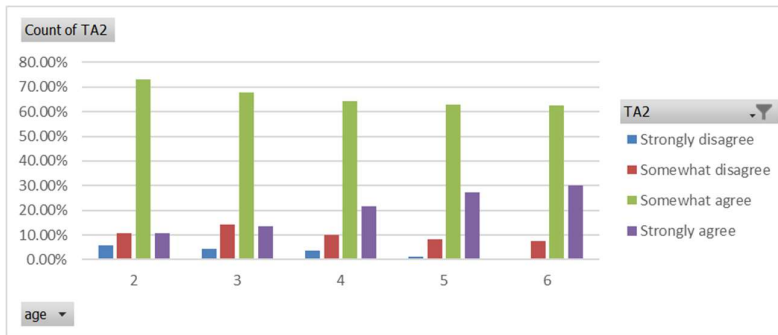
**Table 9** Average and standard deviation of each age category

	SC1		SC2		SC3	
	Ave.	StD.	Ave.	StD.	Ave.	StD.
20-29	2.80	0.69	2.56	0.75	2.83	0.77
30-39	3.01	0.60	2.81	0.63	3.02	0.67
40-49	3.09	0.71	3.09	0.75	3.14	0.69
50-59	3.10	0.69	3.12	0.68	3.30	0.58
60-	3.17	0.62	3.22	0.72	3.15	0.72

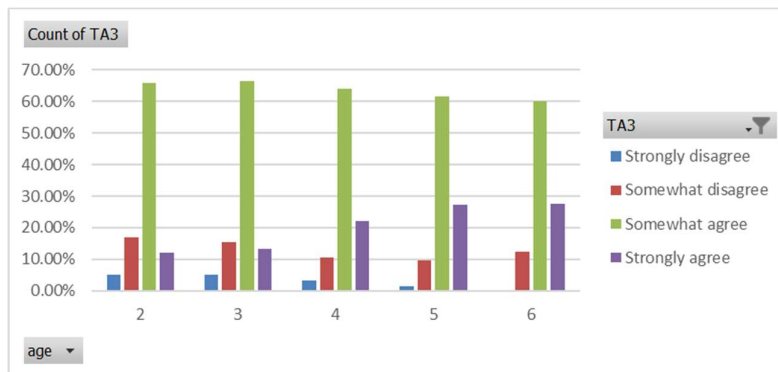
Looking closer at the age distribution of the respondents in regard to three questions measuring Sense of Community, it is clear that the percentage of disagreement is the highest for SC2. Somewhat disagree ratio takes up to 35% among people from 20 to 29-year-old. On the other hand, highest percentage of strongly agree can be seen among people over 60-year-old. This suggest that the older the respondents, the more they participate in community activities.



**Figure 24** Age distribution to the question ‘I feel connected to the community leaders in my neighborhood’(TA1)



**Figure 25** Age distribution to the question ‘I trust that the local authority is capable of facilitating waste collection’ (TA2)

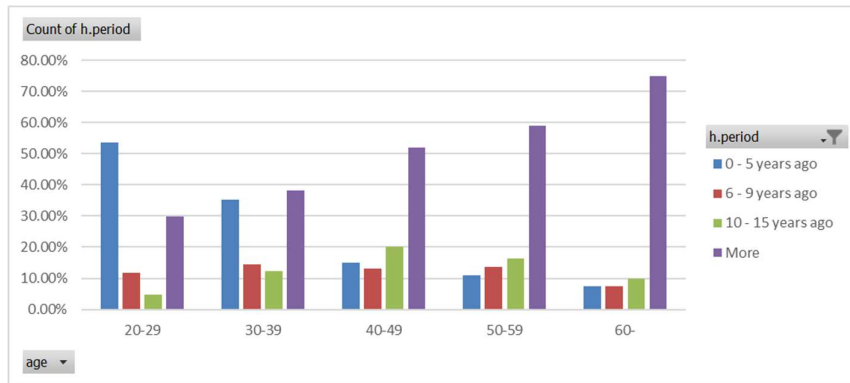


**Figure 26** Age distribution to the question ‘I trust that the local authority is capable of treating separated waste’ (TA3)

**Table 10** Average and standard deviation of each age category

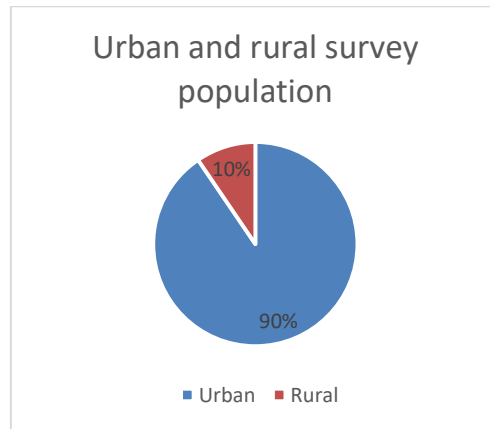
	TA1		TA2		TA3	
	Ave.	StD.	Ave.	StD.	Ave.	StD.
20-29	2.32	0.71	2.88	0.65	2.85	0.68
30-39	2.58	0.71	2.90	0.66	2.88	0.68
40-49	3	0.72	3.03	0.68	3.04	0.67
50-59	2.84	0.67	3.16	0.61	3.15	0.63
60-	3.15	0.69	3.22	0.56	3.15	0.61

For Trust in Authority, the main difference can be seen in TA1 where there are more people who disagree with the question “I feel connected to the community leaders in my neighborhood” among younger generation compares to older ones. This shows that the bond between the community leaders and members get stronger with elder residents.



**Figure 27 Age of the respondents considering their living period in the current neighborhood**

The percentage of people in their 20s is the highest (more than 50%) among newcomers of less than 5 years, and gradually decrease as their age increase. The opposite trend is observed with people older than 60-year-old. More than 70% of this age demographic has been living in their current neighborhood for more than 15 years.



**Figure 28 Urban and rural population of the respondents**

Of 778 sample of the survey, 90% of the respondents live within the 12 urban districts in the city center. The other 10% resides in adjacent areas such as Dong Anh, Thuong Tin, Soc Son, Thanh Tri etc.

**Table 11 Recyclable separation in urban and rural Hanoi**

Recyclable	No separation	Separation
Urban	24.43%	75.57%
Rural	22.97%	77.03%

---

**Table 12 Organic separation in urban and rural Hanoi**

Organic	No separation	Separation
Urban	20.17%	79.83%
Rural	14.86%	85.14%

It can be observed that the rate of separation for recyclable materials is approximately the same in both urban and rural areas of Hanoi, at 75.57% and 77.03% respectively. For organic materials, however, a difference of about 5% is noticeable as more people living in rural Hanoi are more active in separating food waste and kitchen waste. Considering the agricultural practice in this area it is understandable that organic waste is separated more to make compost or animal feed.

#### **4.4 Factors influencing waste separation behavior**

Sense of Community, Trust in Authority, Need, Ability, and Opportunity are five factors that are assumed to have influence on waste separation behavior of Hanoi citizen. The relationship between these factors and behavior is examined in two groups of respondents: the first group of residents of 9 years or less (newcomers) and the second group of residents of 10 years or more (old residents). This division provides comparable number of respondents for each group (44.9% and 55.1%, respectively). The purpose of these two groups is to test the effect of living period to different constructs of the model, thus examining the impact of the social shift in the background of Hanoi citizen on waste behavior. The structural model and the measurement model included in PLS-SEM analysis are analyzed respectively and the results are reported in the following subsections.

##### **Measurement Model**

Convergent reliability, composite reliability, and discriminant validity are three values that are used to check the validity and reliability of the measurement model. Table 13 and Table 14 present the validity and reliability results for the newcomers group and the old residents group respectively.

The convergent reliability, a subtype of construct validity, relies on the indicator reliability and the average variance extracted (AVE) value to be examined. The indicator reliability is ruled by the outer loading of an indicator. Outer loadings (a.k.a loadings) are the estimated relationships in the measurement model, which, if value above 0.7 proves that the indicator is correlated with its corresponding latent variable. As shown in Table 13 and Table 14, loadings of TA1, N1 and A2 in the measurement models of both newcomers and old residents, and loading of SC3 in the measurement model of old residents are between 0.4 and 0.7. However, according to Hair et al., they can be accepted since the removal of those items does not raise the value of the composite reliability and AVE above their threshold value (Hair et al., 2014). Additionally, AVE is a measure of the amount of variance that is captured by a construct in relation to the amount of variance due to measurement errors. Fornell and Larcker suggested that AVE value should be higher than 0.5 (Table 13 and Table 14) (Fornell et al., 1981).

**Table 13 Validity and reliability results of measurement models for newcomers (residents of 9 years or less)**

<b>Latent Variable</b>	<b>Items</b>	<b>Loadings</b>	<b>Indicator Reliability</b>	<b>Composite Reliability</b>	<b>AVE</b>
<b>Behavior</b>	B1	0.904	0.537	0.904	0.825
	B2	0.913	0.564		
<b>Sense of Community</b>	SC1	0.867	0.425	0.872	0.694
	SC2	0.853	0.413		
	SC3	0.777	0.36		
<b>Trust in Authority</b>	TA1	0.688	0.432	0.84	0.638
	TA2	0.853	0.442		
	TA3	0.844	0.386		
<b>Need</b>	N1	0.587	0.359	0.834	0.634
	N2	0.868	0.339		
	N3	0.897	0.552		
<b>Opportunity</b>	O1	0.852	0.385	0.88	0.71
	O2	0.824	0.332		
	O3	0.852	0.468		
<b>Ability</b>	A1	0.892	0.353	0.857	0.668
	A2	0.689	0.48		
	A3	0.857	0.413		

Composite reliability is a method to measure the internal consistency in scale items. A value between 0.7 and 0.9 is considered satisfactory by Nunally and Bernstein (1994). While the values above 0.9 is not desirable, the threshold for problematic result is 0.95 according to Hair (2019). Therefore, the result for Behavior in both group is still acceptable at 0.904 and 0.903. The composite reliability for the other constructs also has good reliability.

**Table 14 Validity and reliability results of measurement models for old residents (residents of 10 years or more)**

<b>Latent Variable</b>	<b>Items</b>	<b>Loadings</b>	<b>Indicator Reliability</b>	<b>Composite Reliability</b>	<b>AVE</b>
<b>Behavior</b>	B1	0.898	0.525	0.903	0.824
	B2	0.917	0.577		
<b>Sense of Community</b>	SC1	0.794	0.404	0.821	0.605
	SC2	0.838	0.511		
	SC3	0.695	0.36		
<b>Trust in Authority</b>	TA1	0.664	0.416	0.833	0.627
	TA2	0.842	0.429		
	TA3	0.855	0.424		
<b>Need</b>	N1	0.423	0.112	0.818	0.622
	N2	0.916	0.513		
	N3	0.92	0.525		
<b>Opportunity</b>	O1	0.826	0.401	0.857	0.667
	O2	0.857	0.453		
	O3	0.764	0.367		
<b>Ability</b>	A1	0.906	0.378	0.874	0.701
	A2	0.687	0.446		
	A3	0.9	0.39		

Finally, Fornell-Larcker's criterion is used to measure discriminant validity and AVE should have the highest square root compared to the other latent variables (Fornell, 1981). The result is shown in Table 15 and Table 16. The square root of the average variance extracted for each latent construct surpasses its correlation with the other constructs, thereby granting evidence to support the discriminant validity (Fornell, 1981).

**Table 15 Fornell-Larcker's criteria for newcomers**

Latent Variables	Ability	Behavior	Need	Opportunity	Sense of Community	Trust in Authority
Ability	<b>0.818</b>					
Behavior	0.379	<b>0.908</b>				
Need	0.314	0.196	<b>0.796</b>			
Opportunity	0.447	0.486	0.304	<b>0.843</b>		
Sense of Community	0.37	0.398	0.224	0.37	<b>0.833</b>	
Trust in Authority	0.334	0.275	0.123	0.314	0.545	<b>0.799</b>

\*Figures in bold are the square root of AVE.

**Table 16 Fornell-Larcker's criteria for old residents**

Latent Variables	Ability	Behavior	Need	Opportunity	Sense of Community	Trust in Authority
Ability	<b>0.838</b>					
Behavior	0.51	<b>0.907</b>				
Need	0.367	0.252	<b>0.788</b>			
Opportunity	0.553	0.469	0.269	<b>0.817</b>		
Sense of Community	0.446	0.463	0.331	0.426	<b>0.778</b>	
Trust in Authority	0.487	0.514	0.271	0.45	0.532	<b>0.792</b>

\*Figures in bold are the square root of AVE.

Based on these results, it can be concluded that the measurement model met the validity and reliability measurement criteria.

### Structural Model

As stated above, the structural model is also tested by dividing the respondents into 2 groups of newcomers and old residents. Three values are used to evaluate the structural model include path coefficients, t-statistics, and coefficient of determination (R2 value). First, the path significance is determined after the bootstrapping resampling procedure, with 349 cases and 5,000 subsamples for the newcomer groups, and 429 cases and 5,000 subsamples for the old residents group. Table 17 and Table 18 show the result of path coefficients, t-statistics and effect size (f2).

**Table 17 Significance testing results of the structural model path coefficient for newcomers**

<b>Path</b>	<b>Path Coefficients</b>	<b>t Value</b>	<b>f<sup>2</sup> Effect size</b>	<b>Hypothesis Test Result</b>
<b>Sense of Community→Behavior</b>	0.317	2.950	0.142	H1: supported
<b>Trust in Authority→Behavior</b>	0.012	0.208	0.000	H2: rejected
<b>Need→Behavior</b>	0.006	0.117	0.000	H3: rejected
<b>Ability→Behavior</b>	0.242	2.208	0.121	H4: supported
<b>Opportunity→Behavior</b>	0.436	5.885	0.219	H5: supported
Note: the value of effect size (f <sup>2</sup> ) is determined by small (0.02), medium (0.15) and large (0.35) (Cohen, 1988)				

**Table 18 Significance testing results of the structural model path coefficient for old residents**

<b>Path</b>	<b>Path Coefficients</b>	<b>t Value</b>	<b>f<sup>2</sup> Effect size</b>	<b>Hypothesis Test Result</b>
<b>Sense of Community→Behavior</b>	0.265	3.445	0.129	H1: supported
<b>Trust in Authority→Behavior</b>	0.341	4.889	0.160	H2: supported
<b>Need→Behavior</b>	0.010	0.235	0.000	H3: rejected
<b>Ability→Behavior</b>	0.323	4.176	0.148	H4: supported
<b>Opportunity→Behavior</b>	0.265	3.032	0.129	H5: supported
Note: the value of effect size (f <sup>2</sup> ) is determined by small (0.02), medium (0.15) and large (0.35) (Cohen, 1988)				

For the old residents group, out of five hypotheses proposed in this study, H3 is the one that is rejected. Meanwhile, three hypotheses are supported while two are rejected (H2 and H3) for the newcomers group.

The path coefficient for H1 is significant for both two groups. The practical significance in terms of the magnitude of the effect is measure by effect size. A larger effect size indicates a stronger relationship between two variables, which, in this case, reaches medium of 0.142 and 0.129 respectively. This confirms that Sense of Community has an effect on waste separation behavior for resident of all periods of stay.



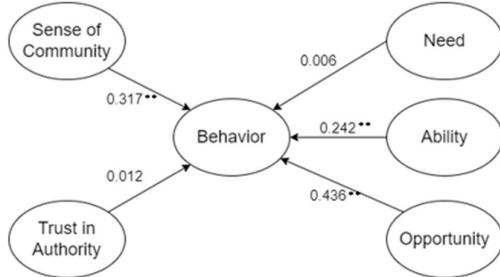
H2 is supported in the old resident, but rejected for the newcomers group based on the insignificant value. This suggests that Trust in Authority has an effect on waste separation among old residents and not the newcomers.

H3 is rejected in both study groups due to insignificant results, which means Need in the sense of the concern for the neighborhood cleanliness does not affect the decision to separate waste of the people living in that area.

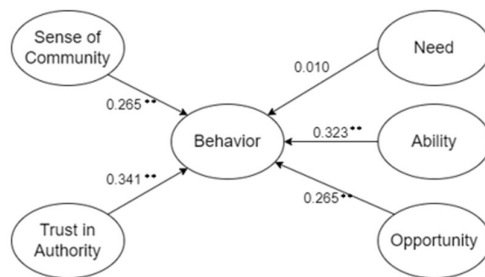
The path coefficient for H4 is significant for both groups. It can be referred by this result that Ability has influence on people when they decide to sort out garbage at home.

Finally, H5 is also supported in both groups. This result implies that Opportunity in term of money incentive and convenience influence the decision to separate waste at home of all respondents. The effect of this path is large on the first group (0.219) and medium on the second group (0.129), meaning that Opportunity has a stronger effect on newcomers than old residents.

The last evaluation criteria is the R2 value. According to Hair et al. (2011), R2 values of 0.25, 0.50 and 0.70 can be translated as weak, moderate and substantial. The R2 values of separation behavior of the newcomers group (R2=0.409; adjusted R2=0.399) and the old residents group (R2=0.495; adjusted R2=0.488) suggest that a moderate amount of variance in waste separation can be defined by the hypothesized factors.



**Figure 29 Factors influencing waste separation behavior for newcomers**



**Figure 30 Factors influencing waste separation behavior for old residents**

## 5 CASE STUDY ON THE IMPACT OF AGE ON WASTE SEPARATION

### 5.1 Questionnaire design and data collection

The survey was carried in February 2022 which adopted a structured questionnaire. The majority of the survey design is similar to the previous one, with several exceptions. Behavior is measured by multiple choice question instead of Likert-scale questions. Furthermore, SC4 and SC5 is added to the measurement of Sense of Community, and the choice of word and phrasing is different for Trust in Authority, based on further literature review.

**Table 19 Questionnaire items for the second survey**

Latent Variable	Item
Sense of Community	SC1. I feel that I am one of the community members in this residential area
	SC2. I often participate in public events and community activities in my neighborhood.
	SC3. I value my neighbor's/community's views or comments
	SC4. People in this community care about each other
	SC5. I plan to stay in my current neighborhood for a long time.
Trust in Authority	TA1. I trust that the local authority has the ability to treat sorted waste.
	TA2. I trust that the local authority strictly implements reward/punishment for participant.
	TA3. I trust the guidance of the community leaders.
Need	N1. I am unsatisfied with the current waste collection system in my neighborhood.
	N2. I want separated waste to be treated accordingly.
	N3. I want to see improvement in the neighborhood environment (cleaner streets, etc).
Ability	A1. I know the difference between organic waste, recyclables and others.
	A2. I have the time to separate organic waste and recyclables every day.
	A3. I have the space to store separated waste in the house.
Opportunity	O1. I am more willing to separate waste if there is money incentive.
	O2. I am more willing to separate waste if I do not have to travel far for disposal.
	O3. I am more willing to separate waste if there is frequent collection.

The online questionnaire survey was conducted by GMO Research Company. In order to weed out indiscriminate responses and ensure a set of random samples among Hanoi residents, trap questions and other techniques were used. The target population was divided into ten groups using five age and two gender categories, and an equal number of samples from ten groups was requested to the survey conductor. In total, 750 samples were collected.

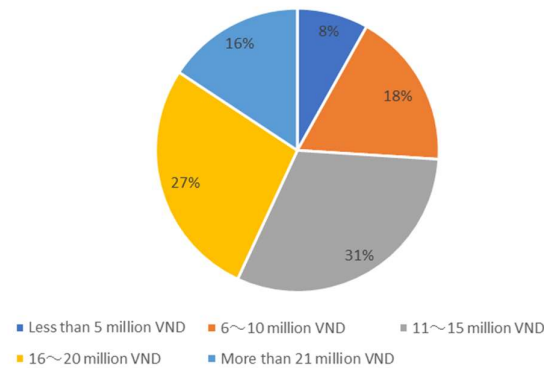
## 5.2 Socio-economic background of the respondents

**Table 20 Socio-economic background of the respondents**

<b>Socio-economic characteristics</b>	<b>Description</b>	<b>No of respondents</b>	<b>Percentage (%)</b>
Gender	Male	321	42.8
	Female	429	57.2
Age	20 - 29	150	20
	30 - 39	150	20
	40 - 49	150	20
	50 - 59	150	20
	60 - 69	150	20
Occupation	Government worker	152	20.3
	Corporation worker	315	42
	Small business	90	12
	Retirement	122	16.3
	Student	46	6.1
	Other	25	3.3
Education	High school	52	6.9
	Vocational school	83	11.1
	University	608	81.1
	Other	7	0.9

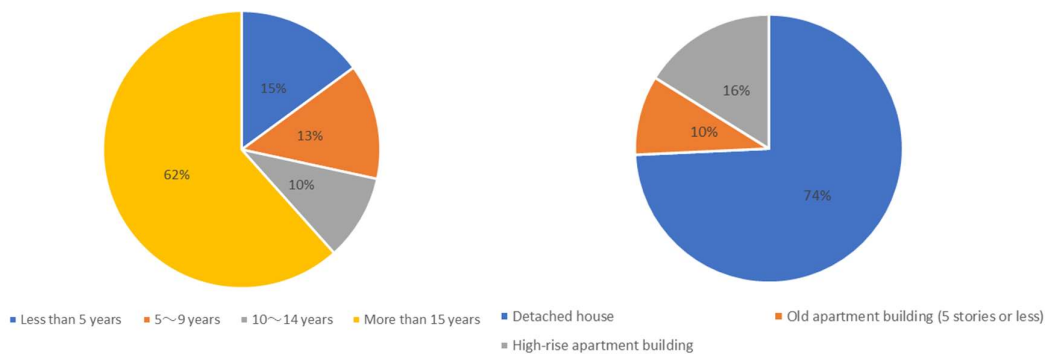
The survey population has slightly higher ratio of female at 57.2% and the male ratio being 42.8%. The study only accepts respondents who are at least 20 years old in order to focus on individuals who can manage home garbage disposal. Equal number of samples were collected from five different age group from 20 to more than 60-year-old.

More than 40% of the survey population is employed as corporation workers. Government workers take up about 20% and small business owners take up 12% of the total respondents. The number of people receiving higher education is quite large, with 81.1% respondents with a university degree. Only 6.9% of the survey population stopped their education at high school.



**Figure 31 Income of the respondents**

At 31%, most of the survey population earn around 11 to 15 million VND per month, follows by higher income group of 16 to 20 million VND/month at 27% (1 million VND roughly equal 5 thousand JPY). People who make less than 5 million VND a month share the least portion at 8%.



**Figure 32 Period of stay in current neighborhood**

**Figure 33 Type of house**

14.9% of the respondents to the study were recent arrivals to the area (less than 5 years). With 13.5% and 10% respectively, the following two groups of residents had resided in their present

---

area for between 5 and 9 and between 10 and 14 years. The majority of people (61.6%) have resided in their current homes for over 15 years.

The majority of respondents live in detached homes, at 74.3%, outnumbering apartment dwellers (including those in high-rise apartment buildings). With 92.4% of respondents now residing in their own house or family home and only 7.6% in rented housing, the rate of home ownership is relatively high.

### 5.3 Primary data analysis

In this survey, waste separation is observed by asking the respondents if they do not separate waste, or separate waste for different purposes. There is a smaller portion of the respondents who do not separate recyclable compared to organic waste. The main reason for separating recyclable waste seems to be the income from selling it to private collectors (37%). On the other hand, at 32%, sorting out food waste to make compost is the major motivation for the separation of organic materials.

How do you treat recyclable waste?

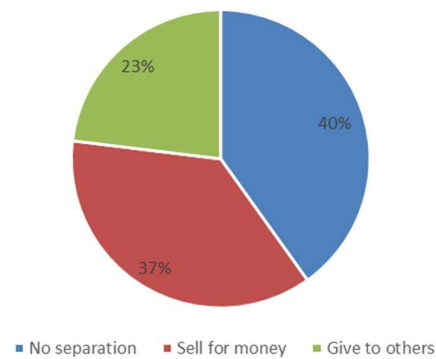


Figure 34 Recyclable waste separation

How do you treat organic waste?

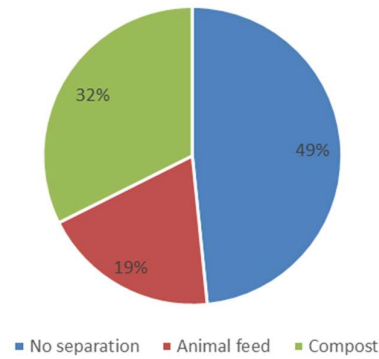


Figure 35 Organic waste separation

The breakdown of every response for the Likert-scale component of the questionnaire survey is shown in Table 21. The first three questions serve as gauges for sense of community, which expresses each person's sense of place in their community. The majority of respondents somewhat agree with these assertions to varying degrees, with 53.6% being the biggest percentage.

When asked about their opinion of the community leaders' competence, which is how trust in authority is determined, a considerable majority of respondents—53.1%—state that they trust that the local authority has the ability to treat sorted waste.

More than half of those surveyed concur with statements made addressing worries about neighborhood cleanliness and garbage management. Similar to this, there is strong support for the ability to devote time, space, and expertise to waste separation. There is also strong support for financial incentives and convenience.

**Table 21 Response composition**

Questions	Strongly disagree (1)	Somewhat disagree (2)	Somewhat agree (3)	Strongly agree (4)	Ave.	StD.
SC1. I feel that I am one of the community members in this residential area	5.6%	5.2%	35.6%	53.6%	3.37	0.82
SC2. I often participate in public events and community activities in my neighborhood.	5.6%	9.1%	42.9%	42.4%	3.22	0.83
SC3. I plan to stay in my current neighborhood for a long time.	1.7%	4.9%	40.1%	53.2%	3.33	0.74
SC4. I value my neighbor's/community's views or comments	1.3%	5.6%	44.9%	48.1%	3.44	0.67
SC5. People in this community care about each other	2.7%	8.9%	40.8%	47.6%	3.39	0.65
TA1. I trust that the local authority has the ability to treat sorted waste.	3.3%	7.1%	36.5%	53.1%	3.39	0.76
TA2. I trust that the local authority strictly implements reward/punishment for participant.	2.5%	9.9%	49.6%	38.0%	3.23	0.72
TA3. I trust the guidance of the community leaders.	1.7%	7.3%	39.6%	51.3%	3.40	0.70
N1. I am unsatisfied with the current waste collection system in my neighborhood.	2.1%	11.5%	39.7%	46.7%	3.30	0.75
N2. I want separated waste to be treated accordingly.	1.7%	2.1%	37.5%	58.7%	3.53	0.62
N3. I want to see improvement in the neighborhood environment (cleaner street).	0.4%	3.3%	29.9%	66.4%	3.62	0.57
A1. I know the difference between organic waste, recyclables and others.	0.8%	3.2%	35.3%	60.7%	3.55	0.59
A2. I have the time to separate organic waste and recyclables every day.	2.1%	10.9%	43.5%	43.5%	3.28	0.74
A3. I have the space to store separated waste in the house.	3.6%	12.3%	40.9%	43.2%	3.23	0.80
O1. I am more willing to separate waste if there is money incentive.	2.1%	6.9%	40.4%	50.5%	3.39	0.71
O2. I am more willing to separate waste if I do not have to travel far for disposal.	1.3%	6.8%	40.8%	51.1%	3.41	0.67
O3. I am more willing to separate waste if there is frequent collection.	2.8%	7.9%	44.4%	44.9%	3.31	0.73

**Table 22 Crosstabulation for age and recyclable waste separation**

AGE	Newcomers				Old residents			
	No separation	Selling	Giving away	Total	No separation	Selling	Giving away	Total
20-29	37.97%	49.37%	12.66%	100%	40.85%	50.70%	8.45%	100%
30-39	31.75%	41.27%	26.98%	100%	36.78%	44.83%	18.39%	100%
40-49	51.72%	41.38%	6.90%	100%	35.54%	42.15%	22.31%	100%
50-59	40.00%	35.00%	25.00%	100%	39.23%	25.38%	35.38%	100%
>60	59.09%	27.27%	13.64%	100%	46.88%	21.09%	32.03%	100%
<b>Total</b>	<b>40.38%</b>	<b>42.25%</b>	<b>17.37%</b>	<b>100%</b>	<b>40.04%</b>	<b>34.64%</b>	<b>25.33%</b>	<b>100%</b>

**Table 23 Crosstabulation for age and organic waste separation**

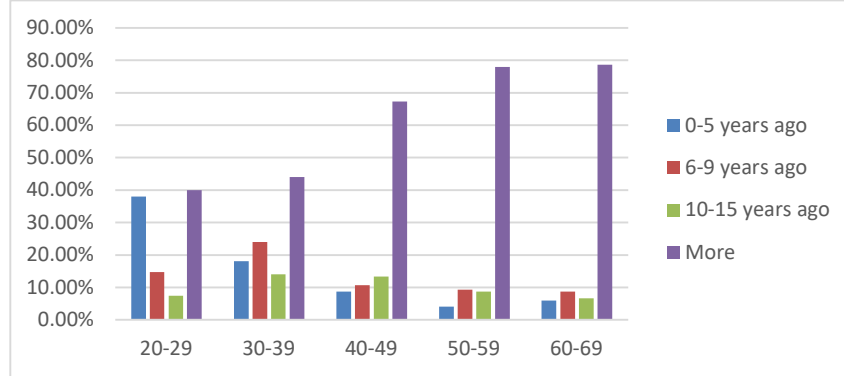
Age	Newcomers				Old residents			
	No separation	Animal feed	Compost	Total	No separation	Animal feed	Compost	Total
20-29	49.37%	24.05%	26.58%	100%	45.07%	30.99%	23.94%	100%
30-39	41.27%	15.87%	42.86%	100%	40.23%	22.99%	36.78%	100%
40-49	55.17%	27.59%	17.24%	100%	39.67%	19.83%	40.50%	100%
50-59	55.00%	15.00%	30.00%	100%	47.69%	16.15%	36.15%	100%
>60	81.82%	13.64%	4.55%	100%	59.38%	10.94%	29.69%	100%
<b>Total</b>	<b>51.64%</b>	<b>20.19%</b>	<b>28.17%</b>	<b>100%</b>	<b>47.11%</b>	<b>18.81%</b>	<b>34.08%</b>	<b>100%</b>

For both recyclable and organic waste separation, the rate of no separation is the highest in the two oldest group (including people above 50 years old). There is a similar tendency in separation of recyclable across different age categories among newcomers and old residents. The biggest discrepancy between newcomers and old residents is the rate of No separation for organic waste (81.82% vs 59.38%) and the rate of separation for Compost (4.55% vs 29.69%).

**Table 24 Crosstabulation for income and recyclable waste separation**

INCOME (VND)	No separation	Selling	Giving away	Total
<5 mil	45.90%	44.26%	9.84%	100%
6-10 mil	38.81%	46.27%	14.93%	100%
11-15 mil	33.19%	41.81%	25.00%	100%
16-20 mil	47.32%	32.20%	20.49%	100%
>20 mil	39.83%	20.34%	39.83%	100%
<b>Total</b>	<b>40.13%</b>	<b>36.80%</b>	<b>23.07%</b>	<b>100%</b>

People who separate cardboard, glass, plastic and so on can trade these materials with informal junk buyers for monetary compensation, hence the rate of selling recyclable waste is the highest among the two groups with lowest income.



**Figure 36 Age of the respondents considering their living period in the current neighborhood**

The percentage of people in their 20s is the highest (38%) among newcomers of less than 5 years, and gradually decrease as their age increase. The opposite trend is observed with people older than 60-year-old. Almost 70% of this age demographic has been living in their current neighborhood for more than 15 years.

#### 5.4 Factors influencing waste separation behaviors

Similar to the previous case study, the respondents in this survey are also divided into 2 groups of newcomers and old residents. PLS-SEM analysis was carried out to examine the factors influencing waste separation behavior. In this survey, behavior was measured by multiple choice questions, so data was input using binary code.

##### Measurement Model

Convergent reliability, composite reliability, and discriminant validity are three values that are used to check the validity and reliability of the measurement model. Table 25 and Table 26 present the validity and reliability results for the newcomers group and the old residents group respectively.

The convergent reliability, a subtype of construct validity, relies on the indicator reliability and the average variance extracted (AVE) value to be examined. The indicator reliability is ruled by the outer loading of an indicator.

AVE is a measure of the amount of variance that is captured by a construct in relation to the amount of variance due to measurement errors. Additionally, composite reliability is a method to measure the internal consistency in scale items. A value between 0.7 and 0.9 is considered satisfactory by Nunally and Bernstein (1994).



Finally, Fornell-Larcker's criterion is used to measure discriminant validity and AVE should have the highest square root compared to the other latent variables (Fornell, 1981).

**Table 25 Validity and reliability results of measurement models for newcomers**

<b>Latent Variable</b>	<b>Items</b>	<b>Loadings</b>	<b>Indicator Reliability</b>	<b>Composite Reliability</b>	<b>AVE</b>
<b>Behavior</b>	B1	0.813	0.422	0.901	0.817
	B2	0.824	0.471		
<b>Sense of Community</b>	SC1	0.731	0.128	0.849	0.533
	SC2	0.901	0.551		
	SC3	0.703	0.231		
	SC4	0.602	0.210		
	SC5	0.679	0.178		
<b>Trust in Authority</b>	TA1	0.803	0.404	0.819	0.606
	TA2	0.891	0.598		
	TA3	0.618	0.232		
<b>Need</b>	N1	-0.325	-0.490	0.348	0.362
	N2	0.878	0.908		
	N3	0.458	0.093		
<b>Opportunity</b>	O1	0.849	0.454	0.864	0.679
	O2	0.808	0.334		
	O3	0.815	0.423		
<b>Ability</b>	A1	0.412	0.123	0.725	0.487
	A2	0.717	0.438		
	A3	0.882	0.720		

**Table 26 Validity and reliability results of measurement models for old resident**

<b>Latent Variable</b>	<b>Items</b>	<b>Loadings</b>	<b>Indicator Reliability</b>	<b>Composite Reliability</b>	<b>AVE</b>
<b>Behavior</b>	B1	0.768	0.463	0.870	0.716
	B2	0.854	0.541		
<b>Sense of Community</b>	SC1	0.798	0.180	0.848	0.530
	SC2	0.829	0.423		
	SC3	0.574	0.263		
	SC4	0.697	0.294		
	SC5	0.716	0.209		
<b>Trust in Authority</b>	TA1	0.623	0.122	0.796	0.574
	TA2	0.935	0.765		
	TA3	0.676	0.308		
<b>Need</b>	N1	0.456	0.180	0.746	0.509
	N2	0.785	0.516		
	N3	0.838	0.612		
<b>Opportunity</b>	O1	0.810	0.460	0.819	0.603
	O2	0.690	0.304		
	O3	0.823	0.508		
<b>Ability</b>	A1	0.597	0.265	0.805	0.584
	A2	0.807	0.434		
	A3	0.863	0.570		

**Table 27 Fornell-Larcker's criteria for newcomers**

Latent Variables	Ability	Behavior	Need	Opportunity	Sense of Community	Trust in Authority
Ability	<b>0.698</b>					
Behavior	0.239	<b>0.825</b>				
Need	0.056	0.046	<b>0.602</b>			
Opportunity	0.644	0.224	0.248	<b>0.824</b>		
Sense of Community	0.496	0.179	0.013	0.439	<b>0.730</b>	
Trust in Authority	0.399	0.144	0.199	0.509	0.512	<b>0.779</b>

\*Figures in bold are the square root of AVE.

**Table 28 Fornell-Larcker's criteria for old resident**

Latent Variables	Ability	Behavior	Need	Opportunity	Sense of Community	Trust in Authority
Ability	<b>0.764</b>					
Behavior	0.260	<b>0.901</b>				
Need	0.371	0.136	<b>0.714</b>			
Opportunity	0.645	0.185	0.468	<b>0.776</b>		
Sense of Community	0.601	0.253	0.365	0.549	<b>0.728</b>	
Trust in Authority	0.521	0.153	0.329	0.503	0.558	<b>0.757</b>

\*Figures in bold are the square root of AVE.

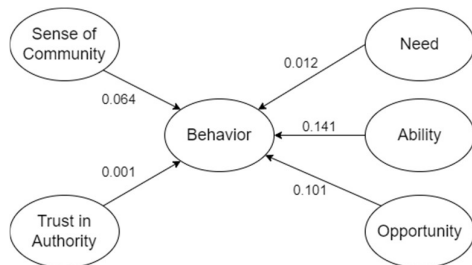
### Structural Model

For the structural model, the path significance is determined after the bootstrapping resampling procedure, with 213 cases and 5,000 subsamples for the newcomers groups, and 537 cases and 5,000 subsamples for the old residents group.

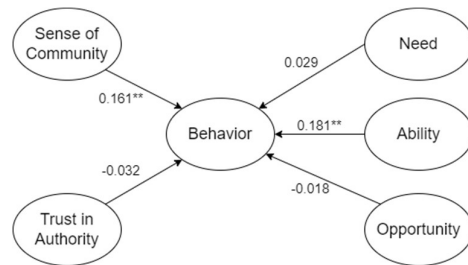
	<b>Original Sample</b>	<b>Sample Mean</b>	<b>Standard Deviation</b>	<b>T Statistics</b>	<b>P Values</b>
<b>Ability → Behavior</b>	0.141	0.147	0.086	1.645	0.1
<b>Need → Behavior</b>	0.012	-0.051	0.121	0.103	0.918
<b>Opportunity → Behavior</b>	0.101	0.111	0.091	1.117	0.264
<b>Sense of Community → Behavior</b>	0.064	0.089	0.083	0.767	0.443
<b>Trust in Authority → Behavior</b>	0.001	0.02	0.079	0.007	0.995

	<b>Original Sample</b>	<b>Sample Mean</b>	<b>Standard Deviation</b>	<b>T Statistics</b>	<b>P Values</b>
<b>Ability → Behavior</b>	0.181	0.174	0.059	3.062	<b>0.002</b>
<b>Need → Behavior</b>	0.029	0.041	0.049	0.591	0.555
<b>Opportunity → Behavior</b>	-0.018	-0.015	0.057	0.311	0.756
<b>Sense of Community → Behavior</b>	0.161	0.162	0.059	2.749	<b>0.006</b>
<b>Trust in Authority → Behavior</b>	-0.032	-0.015	0.07	0.453	0.65

With P values of 0.002 and 0.006, only Ability and Sense of Community have significant correlation with Behavior in the old residents group. The R2 values of separation behavior of the newcomers group (R2=0.378; adjusted R2=0.359) and the old residents group (R2=0.415; adjusted R2=0.401) suggest that a moderate amount of variance in waste separation can be defined by the hypothesized factors.



**Figure 37 Factors influencing waste separation behavior for newcomers**



**Figure 38 Factors influencing waste separation behavior for old residents**

---

## 6 DISCUSSION

### 6.1 Findings from the first case study

Overall, Sense of Community, Ability, and Opportunity are proved to be significant predictors towards people's waste separation behavior. Among these constructs, Opportunity is the strongest predictor among newcomers (people who have lived in the neighborhood for 9 years or less) with  $f^2$  effect size at 0.219. In the context of this study, Opportunity emphasized the motivation to separate waste by monetary incentive and convenience. This finding is consistent with that of Lange et al., which revealed how the residents' waste sorting and recycling behavior is dependent on the distance to the waste disposal area nearby the household (Lange et al., 2014). This indicates that reward mechanisms, convenient waste collection locations and frequent pick-up schedules work well to build up the willingness to participate in source separation, especially for new residents in the area, who are not as influenced by Sense of Community or Ability.

Another construct that predicts waste separation behavior is Trust in Authority with  $f^2$  effect size at 0.16 leaning toward stronger relationship. However, it only influences old residents or people who have lived in the neighborhood for 10 years or more, and it is also the strongest predictor among this group. In the previous pilot source separation program in Hanoi, a significant increase in awareness among people and a high level of waste separation was recorded. Community leaders are found to be crucial to facilitating the program and achieving such results. This initiative ended in 2009, which means most of the group of old residents has experienced source separation led by the local authority, hence the belief in the capability of the community leaders has a great effect on the behavior of these residents. This is also in line with Loan et al. who established that if an individual deeply believed in the capability of the local authority, they would be more inclined to perform waste separation (Loan et al., 2017).

With P-value at 1%, data analysis result also indicates that Sense of Community affects the waste separation behavior. Respondents who exhibit a high sense of community are more likely to separate waste at home. The sense of community is measured by the respondents' feeling of belonging, the desire to settle and live in the neighborhood for a long time, and the frequency in which the respondents take part in public activities held within the community. This finding agrees with Nguyen, who proposed that participants were more likely to practice waste separation if they were involved in neighborhood activities (Nguyen, 2021).

Ability is shown to have an effect on separation behavior at 1% level significant. This result suggests that respondents who have the time and space in the house to sort out their waste, and people who know the difference between organic and recyclable waste are more likely to participate in source separation. This is supported by Owusu et al. (2013) who concluded that the physical infrastructure of waste (namely waste storage space, etc.) in a household should be considered to ensure a feasible waste separation program. Another researcher also stated that the longer and more inconvenient distance to the garbage bin decreases waste collection (Leeabai et al., 2019).

Need from the original model of "Needs-Opportunities-Abilities" Model of Consumer Behavior by Vlek appears to not affect waste separation behavior in this case. This means that the respondents of the study do not think that segregating household waste can improve the

---

cleanliness in the neighborhood, and the current collection of mixed garbage is acceptable, hence no waste separation at the source.

Looking at the societal changes following the footsteps of economic development in Hanoi, we can observe the growth of new urban areas in the previous suburban villages within the past 10 years. Furthermore, there are immigrant workers from other adjacent provinces searching for job opportunities in the heart of the city, resulting in a large portion of the citizens belonging to the “newcomers” group, as opposed to the “old residents” group. It has been shown that this set of demographic behaves differently from people who have settled down for a long time when it comes to waste separation. The disparity can be boiled down to Trust in Authority, which greatly affects the decision making to separate waste at home.

Trust in Authority increases with the period of time that one stays in the same neighborhood, which implies that in order to encourage waste separation for “old residents”, the role of local authority must be reaffirmed. Learning from the past experience of the source separation pilot program in 2006, the achievement of the 3R initiative could not be attained without the involvement of the community leader in facilitating the program and encouraging community members to sort (Taniguchi et al., 2011). In the context of waste management, the community leader is often regarded as a role model for the local residents where their commitment to waste separation or waste collection initiatives will positively impact the cooperation from the community (Nhung, 2014). Furthermore, for the community members to have confidence in the local authority’s competence in waste management, financial support from the government is essential because it heavily influences the MSW separation capability as Xi et al. (2022) discussed.

On the other hand, “newcomers” of 9 years or less, who have not yet established faith and expectation for the local authority to an adequate level, are more motivated to do separation based on personal merits. Reward mechanism and convenience regarding waste separation and collection are found to be strongly affecting household waste segregation for this demographic group. This translates to money incentives being given as reward for people who sort out waste correctly, and a frequent collection schedule for the separated organic and recyclable waste. This is supported by a recent study which showed one of the positive factors influencing separation behavior included incentives brought about by recycling (Tran et al., 2019). In particular, the local government can offer a communal fund or daily necessities if people in one community gather their recyclable waste as a collective recycling action. However, the current Master plan on solid waste disposal of Hanoi capital to 2030, with a vision to 2050 only focuses on investment in solid waste collection, transportation and disposal activities (Vietnam Prime Minister, 2014). With that in mind, national and local authorities are urged to consider funding and administrative support to promote source separation as well.

## **6.2 Comparison between two case studies**

The first case study in 2020 and second case study in 2022 have almost similar design except for some slight differences. Instead of using Likert scale questions to assess behavior, multiple choice questions are used. Further literature review led to the addition of SC4 and SC5 to the measurement of Sense of Community, and altered wording and phrasing for Trust in Authority.

---

The survey samples have a considerable difference in the Age category. In particular, the first case study has a deficit of older survey participants, resulting in less than 15% of people 50-year-old and above. On the other hand, the second case study has gathered an equal number of respondents from each age group, from 20-29, 30-39, 40-49, 50-59, and more than 60-year-old.

In such circumstance, the data analysis shows major contrast between the two case studies. First of all, when looking at the response composition of the Likert-scale question, it is obvious that the second survey has much higher rate of strongly agree than somewhat agree, with the highest rate of strongly agree at 66.4% in the second survey. On the other hand, the highest rate of strongly agree in the first survey is 47%. After the period from 2020 to 2022, the average of the responses increased substantially, around 0.3 point. However, the average score of A3. "I have the space to store separated waste in the house" shows the least difference, at 3.17 in the survey in 2020 and 3.23 in the survey in 2022.

Secondly, the analysis of factors influencing waste separation also results in a noticeable difference between the two case studies. The first case study shows all hypothesized factors influencing waste separation behavior are valid except for Need which does not influence behavior, and Trust in Authority which is not a deciding factor for people who are new to the neighborhood to separate their waste. In contrast, the only factors that have significant correlation with separation behavior in the second case study are Ability and Sense of Community in the group of residents who have been living in the same neighborhood for more than 15 years.

The equal number of samples collected from each age category in the second survey also allowed for crosstabulation analysis between age and waste separation behavior. This analysis is done for both newcomers group and old residents group, and the result shows that there is a similar tendency in separation of waste across younger generation among newcomers and old residents. However, the behavior pattern is different for the older demographic among newcomers and old residents. This means that both age and living period has an effect on waste separation behavior.

---

## 7 CONCLUSION

### 7.1 Conclusion and limitations

The study aimed to explore the social impact on waste separation behavior by examining how the social bond between an individual and the neighborhood impact the behavior for waste separation. This relationship was reflected by the socio-demographic characteristics of the respondents such as age and the living situation. Data analysis has highlighted the behavioral difference between people who have lived in their current place for less than 10 years (newcomers) and people who have settled down for 10 years or more (old residents). It is found that while Sense of Community, Trust in Authority, Ability and Opportunity make up four predictors of separation behavior for old residents, Trust in Authority does not affect the decision-making regarding waste separation for people who newly move into a neighborhood.

This study result reaffirms the effect on waste separation behavior of internal factors including Ability (the capacity to carry out source separation) and Opportunity (responsiveness to incentives and convenience). Based on these analyses, policy implications have been proposed including a social platform to receive frequent feedback from Hanoi citizens regarding waste management issues, environment education, and reviewing the current waste collection system. Reward mechanisms are also recommended to enhance the willingness to participate in waste separation.

Data analysis also sheds light on the influence of the societal elements Sense of Community with P-value at 1% level on the decision making to participate in waste segregation. Sense of community is measured by the connection with the community leaders and active involvement in communal activity. With the objective of examining how the social bond between an individual and the neighborhood impact the behavior for waste separation, this result confirms the importance of communication and sense of belonging among members of the community. The more a person feel attached to their neighborhood, the more they perceive communal issue such as waste management as a shared responsibility, and actively participate in the initiative. Therefore, community-engagement approach should be incorporated into waste management.

The feeling of belonging in a community is also influence by the time living in the same neighborhood. While the tendency for the elder generation to have a long period of staying in one place is strong, data analysis has also show that the senior demographic's separation behavior differs from that of old residents and newcomers. This indicates that the behavior of waste separation is influenced by both age and living period. In the context of Hanoi where the majority of residential land will become new urban areas in 2030, the living period of people in these areas will be relatively short compares to areas where the relationship between individual and the community is more established. Consequently, the behavior of residents in these different parts of the city will also be diverse.

This study acknowledges that the samples have a higher ratio of people in university and graduate school, possibly because of the tendency of internet use and familiarity with internet survey among people with higher education. Data analyses were carried out with the available samples collected, and we will focus on possible effect of sampling bias in future studies.

### 7.2 Implications and recommendations



---

Analysis results indicate that Sense of Community is a crucial factor influencing waste separation behavior. In a neighborhood, initiatives that draw individuals together by a shared interest, such as keeping the street clean of garbage, are what Sense of Community is made of (Neal et al., 2014). As one of the fastest growing cities in the world up to 2025, Hanoi is building many industrial clusters that attract migrant workers, shifting the demographic of the city (Leducq et al., 2018) and diluting the community bond in previous neighborhood. As such, increasing communication and interaction inside each residential area is a starting point to ignite the local bond, through which waste can be considered a shared responsibility and leading way to a more refined waste management system. Furthermore, policies focusing on long-term city planning also play an important role in securing stable neighborhoods and boosting the sense of community.

As the data points out, the decision to segregate household rubbish is influenced by the know-how regarding waste separation. Currently in Vietnam, it is reported in the Resource and Environment magazine (2019) that environment education including waste management is not a compulsory subject in junior high and high schools. Besides strengthening waste education for children, the importance of intergenerational influence on increasing environmental awareness has been emphasized in literature. For example, Maddox saw a positive impact from a waste education model that focused on young people educating their household members (Maddox et al., 2011).

Policy makers should also make use of different information channels in a neighborhood (information boards, radio broadcasts, etc.) with the cooperation of community leaders in communal activities such as workshops to increase information publicity which has positive effect on residents' intention to separate waste (Wang et al., 2019). Community leaders should ideally concentrate on interacting with communities as groups of people cohabiting in a location, in order to foster a view of waste management as a community obligation.

A higher rate of source separation can be achieved by an increase in convenience for waste separation and collection through planning the collection schedule of different types of waste. That way people do not have to store undesired matters inside the house for too long.

From the discussion that people do not link waste separation with the improved neighborhood environment, it can be implied that the majority of Hanoi citizen do not fully comprehend the underlying issue in urban solid waste management. Without source separation and proper waste treatment facilities, the large amount of waste going into landfills exceeded the capacity of Hanoi's two major dumping sites (Xuan Son and Nam Son) in 2021, leading to a crisis where household waste was stuck without collection for weeks, deteriorating the city's environment. This shows the importance of waste education to the public, not just on surface issues such as littering, but deeper phenomena including the effect of source separation on waste reduction.

---

## References

1. Afroz R, Hanaki K, Tudin R (2011) Factors affecting waste generation: a study in a waste management program in Dhaka City, Bangladesh. *Environ Monit Assess* 179:509–519. doi:10.1007/s10661-010-1753-4
2. Ajzen I (1991) The theory of planned behavior. *Organizational Behav Hum Decis Process* 50:179–211. doi:10.1016/0749-5978(91)90020-T
3. Amaro S, Seabra C, Abrantes JL (2015). Comparing CB-SEM and PLS-SEM Results: An empirical example. 2nd International Symposium on Partial Least Squares Path Modeling, Seville (Spain). doi:10.3990/2.357
4. Anwar S, Nguyen LP (2011) Foreign direct investment and trade: The case of Vietnam. *Res. Int. Bus. Finance* 25(1) 39–52
5. Astrachana CB, Patel VK, Wanzenried G (2014) A comparative study of CB-SEM and PLS-SEM for theory development in family firm research. *J Fam* 5 116–128. doi: 10.1016/j.jfbs.2013.12.002
6. Barr S (2007) Factors Influencing Environmental Attitudes and Behaviors: A U.K. Case Study of Household Waste Management. *Environ Behav* 39(4):435-473. doi:10.1177/0013916505283421
7. Bernache G (2003) The environmental impact of solid waste management: The case of Gaudalajara metro area. *Resour Conserv Recycl.* 39(3) 223–237
8. Choe K, Laquian A (2008) City cluster development: Toward an urban-led development strategy for Asia. Mandaluyong City: Asian Development Bank
9. DiGregorio M (2011) Into the land rush: Facing the urban transition in Hanoi's western suburbs. *Int. Dev. Plan. Rev.* 33(3) 293–319
10. Dulac N (2001) The organic waste flow in integrated sustainable waste management. Tools for decision-makers. Experiences from the Urban Waste Expertise Programme.
11. Fanchette S. (Ed.) (2015). Ha Noi: future métropole? Rupture dans l'intégration urbaine des villagesMarseille: IRD Editions (198 p).
12. Fornell C, Larcker DF (1981) Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *J Mark Res* 18(1):39-50. doi:10.1177/002224378101800104
13. Friedmann J. (2016) The future of periurban research. *Cities* (53) 163–165
14. Gefen D, Rigdon EE, Straub D (2011) An Update and Extension to SEM Guidelines for Administrative and Social Science Research. *MIS Quarterly*, 35(2), III-XIV
15. Gefen D, Straub DW, Boudreau MC (2000) Structural Equation Modeling and Regression Guidelines for Research Practice. *Commun. Assoc. Inf. Syst.* 4(7) 2-77
16. Gough KV, Tran HA (2009) Changing housing policy in Vietnam: Emerging inequalities in a residential area of Hanoi. *Cities* 26(4) 175–186
17. Gutberlet J. (2015) More inclusive and cleaner cities with waste management production: Insights from participatory epistemologies and methods. *Habitat Int.* (46), 234–43
18. Hair JF Jr, Risher JJ, Sarstedt M, Ringle CM (2019) When to use and how to report the results of PLS-SEM. *Eur Bus Rev* 31 (1), 2-24. doi:10.1108/EBR-11-2018-0203

- 
19. Hair JF Jr, Sarstedt M, Hopkins L, Kuppelwieser VG (2014) Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *Eur Bus Rev* 26 (2):106-121. doi:10.1108/EBR-10-2013-0128
  20. Halamová J, Kanovsky M, Naništová E (2018) Development and Psychometric Analysis of the Sense of Community Descriptors Scale. *Psychosoc Interv* 27(1) 44-55. doi:10.5093/pi2018a8
  21. Hird M.J. (2017) Waste, environmental politics and dis/engaged publics. *Theory Cult Soc.* (34) 187–209
  22. Hird M.J., Loughheed S., Rowe R.K. and Kuyvenhoven C. (2014) Making waste management public (or falling back to sleep). *Soc. Stud. Sci.* 44(3) 441–65.
  23. Hoang NH, Fogarassy C (2020) Sustainability Evaluation of Municipal Solid Waste Management System for Hanoi (Vietnam)—Why to Choose the ‘Waste-to-Energy’ Concept. *Sustainability* 12(3):1085. doi:10.3390/su12031085
  24. Hobson K (2001) Sustainable Lifestyles: rethinking barriers and behaviour change, Chapter 11 in Cohen and Murphy (eds) *Exploring Sustainable Consumption: environmental policy and the social sciences.*
  25. Hughey J, Speer P, Peterson NA (1999) Sense of community in community organizations: Structure and evidence of validity. *J Community Psychol* 27(1):97-113. doi: 10.1002/%28SICI%291520-6629%28199901%2927%3A1%3C97%3A%3AAID-JCOP7%3E3.0.CO%3B2-K
  26. Huong LT, Kawai K, Thai NT (2012) Physical Composition Analysis of Household Waste in Hanoi, Vietnam. [http://www.gels.okayama-u.ac.jp/management/up\\_load\\_files/gakkan/2012\\_en/2012\\_en\\_3-14.pdf](http://www.gels.okayama-u.ac.jp/management/up_load_files/gakkan/2012_en/2012_en_3-14.pdf). Accessed 2 September 2021
  27. Iskandar LK (2003) Integrating local community-based waste management into international contracting. In proceedings of solid waste collection that benefits the urban poor, 9–14 March, Dar Es Salaam, Tanzania. Switzerland: The SKAT Foundation
  28. James P, Lopes AM, Martín-Valdéz S, et al. (2019) Closing the Loop on Waste. Institute for Culture and Society, Western Sydney University
  29. Japan International Cooperation Agency (JICA) — Hanoi People's Committee (2007). The comprehensive urban development programme in Hanoi capital city of the Socialist Republic of Vietnam (HAIDEP study team)
  30. Jin Y, Chen F, Chen H, Long R (2021) Influence of regulatory focus on proactive waste separation behavior by urban residents’ mediating effect of anchoring breakthrough. *Sustain Cities Soc* 70:102884. doi: 10.1016/j.scs.2021.102884
  31. Kam Ng M, Hills P (2003) World cities or great cities? A comparative study of five Asian metropolises. *Cities* 20(3) 151–165
  32. Kawai K, Huong LTM, Yamada M et al. (2016) Proximate composition of household waste and applicability of waste management technologies by source separation in Hanoi, Vietnam. *J Mater Cycles Waste Manag* 18:517–526. doi:10.1007/s10163-014-0348-5
  33. Kerkvliet, B. (2005). *The power of everyday politics: How Vietnamese peasants transformed national policy.* Ithaca: Cornell University Press
  34. Labbé D. (2016) Critical reflections on land appropriation and alternative urbanization trajectories in periurban Vietnam. *Cities* (53) 150–155

- 
35. Labbé D., & Musil C. (2014) Periurban land redevelopment in Vietnam under market socialism. *Urban Stu.* 51(6) 1146–1161
  36. Lange F, Brückner C, Kröger B, et al. (2014) Wasting ways: Perceived distance to the recycling facilities predicts pro-environmental behavior. *Resour Conserv Recycl* 92:246–254. doi:10.1016/j.resconrec.2014.07.008
  37. Leaf A. (2002) Tale of two villages: Globalization and peri-urban change in China and Vietnam. *Cities* 19 (1) 23–31
  38. Leaf M. (2015) New urban frontiers: Periurbanization and (re)territorialization in Southeast Asia. In M. Leaf, C. Loeb, & A. Luescher (Eds.), *The design of frontier spaces: Control and ambiguity* (pp. 193–212)
  39. Leducq D, Scarwell HJ (2018) The new Hanoi: Opportunities and challenges for future urban development. *Cities* 72:70-81. doi:10.1016/j.cities.2017.08.003
  40. Leeabai N, Suzuki S, Jiang Q, Dilixiati D, Takahashi F (2019) The effects of setting conditions of trash bins on waste collection performance and waste separation behaviors; distance from walking path, separated setting, and arrangements. *J Waste Manag* 94:58–6759. doi:10.1016/j.wasman.2019.05.039
  41. Li S (2002) Junk-buyers as linkage between waste sources and redemption depots in urban China: The case of Wuhan. *Resour Conserv Recycl.* 36(4) 319–335
  42. Liu C, Nguyen TT (2020) Evaluation of Household Food Waste Generation in Hanoi and Policy Implications towards SDGs Target 12.3. *Sustainability* 12:6565. doi: 10.3390/su12166565
  43. Loan LTT, Nomura H, Takahashi Y, Yabe M (2017) Psychological driving forces behind households' behaviors toward municipal organic waste separation at source in Vietnam: a structural equation modeling approach. *J Mater Cycles Waste Manag* 19:1052–1060. doi:10.1007/s10163-017-0587-3
  44. Luan Duy L (2014) Living in “new urban areas”: Towards sustainable urban communities in Hanoi. *Vietnam Transactions on Ecology and the Environment*, 181
  45. Maddox P, Dorana C, Williams ID, Kus M (2011) The role of intergenerational influence in waste education programmes: The THAW project. *J Waste Manag* 31:2590–2600. doi:10.1016/j.wasman.2011.07.023
  46. Medina M (2000) Scavenger cooperatives in Asia and Latin America. *Resour Conserv Recycl.* 31(1) 51–69
  47. Neal ZP, Neal JW (2014) The (In)compatibility of Diversity and Sense of Community. *Am J Community Psychol* 53:1–12. doi:10.1007/s10464-013-9608-0
  48. Nhung NTK (2014) Influence of stakeholders on people's participation in waste management activities in Hanoi (in Vietnamese). University of Social Sciences and Humanities, Hanoi.
  49. Nguyen TB, van der Krabben E, Spencer JH, Truong KT (2017) Collaborative development: Capturing the public value in private real estate development projects in Ho Chi Minh City, Vietnam. *Cities* in press
  50. Nguyen TKN (2021) Individuals' waste separation practice in a relationship with social bonds: a case study of Hanoi, Vietnam. *Int J Sociol Soc Policy.* doi:10.1108/IJSSP-07-2021-0184

- 
51. Nguyen TTP, Zhu D, Le NP (2015) Factors influencing waste separation intention of residential households in a developing country: evidence from Hanoi, Vietnam. *Habitat Int* 48:169–176. doi: 10.1016/j.habitatint.2015.03.013
  52. Nunally JC, Bernstein IH (1994) *Psychometric Theory*. McGraw Hill, New York.
  53. Owusu V, Adjei-Addo E, Sundberg C (2013) Do economic incentives affect attitudes to solid waste source separation? Evidence from Ghana. *Resour Conserv Recycl* 78:115-123. doi:10.1016/j.resconrec.2013.07.002
  54. Peck S (1987) *The different drum: Community making and peace*. Simon & Schuster, New York
  55. Phelps N. A., Bunnell T., Miller M.-A., Taylor J. (2014) Urban inter-referencing within and beyond a decentralized Indonesia. *Cities* (39) 37–49
  56. Rebecca L (2018) Higher education in Vietnam shows steady improvement. The Borgen Project. <https://borgenproject.org/higher-education-in-vietnam/>. Accessed 12 September 2021
  57. Resource and Environment (2019) Taiwan - Vietnam: Sharing experiences in environmental education (in Vietnamese). Electronic newspaper of the Ministry of Natural Resources and Environment. <https://baotainguyenmoitruong.vn/dai-loan-vietnam-chia-se-kinh-nghiem-giao-duc-moi-truong-292479.html>. Accessed 10 September 2021
  58. Scheinberg A (2001). Financial and economic issues in integrated sustainable waste management. Tools for decision-makers. Experiences from the Urban Waste Expertise Programme. The Netherlands: WASTE.
  59. Smith D. W., Scarpaci J. L. (2001) Urbanization in transitional societies: An overview of Vietnam and Hanoi. *Urban Geogr.* 21(8) 745–757.
  60. Struk M (2017) Distance and incentives matter: The separation of recyclable municipal waste. *Resour Conserv Recycl* 122:155-162. doi:10.1016/j.resconrec.2017.01.023
  61. Taniguchi Y, Yoshida M (2011) Public involvement and mobilization for promoting 3R initiative in Hanoi city e lessons from 3R initiative project in Hanoi city 2006e2009. In Proceedings of the 8th expert meeting on Solid Waste Management in Asia and Pacific Islands (SWAPI) Tokyo, 21e23 February, 2011. <http://www.geocities.jp/epcowmjp/papers/Taniguchi2011-8SWAPI.pdf>. Accessed 27 August 2021
  62. Thapa RB, Murayama Y (2016) Land evaluation for peri-urban agriculture using analytical hierarchical process and geographic information system techniques: A case study of Hanoi. *Land Use Policy* (25) 225–239
  63. Tran VCM, Le HS, Matsui, Y (2019) Current status and behavior modeling on household solid-waste separation: a case study in Da Nang city, Vietnam. *J Mater Cycles Waste Manag* 21:1462–1476. doi:10.1007/s10163-019-00899-1
  64. United Nations (2019) Department of Economic and Social Affairs, Population Division. *World Population Prospects: The 2019 Revision*. <https://population.un.org/wpp/>. Accessed 12 September 2021
  65. Vietnam Prime Minister (2009) Decision on approving the National Strategy of Integrated Solid Waste Management up to 2025, vision towards 2050. Government portal [http://vanban.chinhphu.vn/portal/page/portal/chinhphu/hethongvanban?class\\_id=1&mode=detail&document\\_id=92301](http://vanban.chinhphu.vn/portal/page/portal/chinhphu/hethongvanban?class_id=1&mode=detail&document_id=92301) (in Vietnamese). Accessed 1 May 2021

- 
66. Vietnam Prime Minister (2014) Decision on approving the master plan on solid waste disposal of Hanoi Capital to 2030, with a vision to 2050. FAOLEX Database <https://www.fao.org/faolex/results/details/en/c/LEX-FAOC167778/>. Accessed 1 August 2022
  67. Vlek CAJ (1998) Household consumption, quality-of-life and environmental impacts: a psychological perspective and empirical study. Earthscan Publications, London
  68. Wan C, Shen GQ, Yu A (2014) The role of perceived effectiveness of policy measures in predicting recycling behaviour in Hong Kong. *Resour Conserv Recycl* 83:141–151. doi:10.1016/j.resconrec.2013.12.009
  69. Wang S, Wang J, Zhao S, Yang S (2019) Information publicity and resident's waste separation behavior: An empirical study based on the norm activation model. *J Waste Manag* 87:33–42. doi:10.1016/j.wasman.2019.01.038
  70. Wenzel K, Süßbauer E (2021) Exploring Domestic Precycling Behavior: A Social Identity Perspective. *Sustainability* 13(3):1321. doi:10.3390/su13031321
  71. World Bank Group (2018) Solid and Industrial Hazardous Waste Management Assessment. <http://documents1.worldbank.org/curated/en/352371563196189492/pdf/Solidand-industrial-hazardous-waste-management-assessment-options-and-actions-areas.pdf>. Accessed 31 August 2021
  72. Xi H, Li Z, Han J, Shen D, Li N, Long Y, Chen Z, Xu L, Zhang X, Niu D, Liu H (2022) Evaluating the capability of municipal solid waste separation in China based on AHP-EWM and BP neural network. *J Waste Manag* 139:208–216. doi:10.1016/j.wasman.2021.12.015
  73. Xu L, Ling M, Wu Y (2018) Economic incentive and social influence to overcome household waste separation dilemma: A field intervention study. *J Waste Manag* 77:522–531. doi:10.1016/j.wasman.2018.04.048
  74. Yokoo H, Kawai K, Higuchi Y (2018) Informal recycling and social preferences: Evidence from household survey data in Vietnam. *Resour Energy Econ* 54: 109–124. doi: 10.1016/j.reseneeco.2018.08.001
  75. Zhang Z, Wang X (2020) Nudging to promote household waste source separation: Mechanisms and spillover effects. *Resour Conserv Recycl* 162:105054. doi:10.1016/j.resconrec.2020.105054

---

## ANNEX

### List of questions for the survey on waste separation habit in the area of Hanoi, Vietnam.

Conducted by: Macromill Inc.

1. Gender

- Male                       Female

2. Age Group

- 19 or less     20-29     30 - 39     40 - 49     50 - 59     60 - 69     Above 70

3. How many members are there in your household? (including you)

- 1                       2                       3                       4  
 5                       6                       More than 6

4. Which district are you living in?

- Ba Dinh             Bac Tu Liem         Cau Giay             Dong Da  
 Ha Dong             Hai Ba Trung        Hoan Kiem           Hoang Mai  
 Long Bien           Nam Tu Liem         Tay Ho                 Thanh Xuan  
 Other (            )

5. When did you start living in your current neighborhood?

- 0 - 5 years ago                       6 - 9 years ago  
 10 - 15 years ago                       More

6. What kind of housing you are living in?

- Detached house                       Apartment house

---

7. What is the status of house ownership?

Your or your family's house

Tenant

8. What is your occupation?

Government worker

Corporation worker

Small business

Retirement

Other ( )

9. What is your education level?

High school

Vocational school

University

Higher

Other ( )

10. How much do you agree or disagree with the following statements, regarding your current situation and neighborhood community?

		Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
1	I feel connected to the community in my neighborhood.	1	2	3	4
2	I often participate in public events and community activities in my neighborhood.	1	2	3	4
3	I plan to stay in my current neighborhood for a long time.	1	2	3	4
4	I feel connected to the community leaders in my neighborhood.	1	2	3	4
5	I am unsatisfied with the current waste collection system in my neighborhood.	1	2	3	4
6	I wish waste would be separated and treated accordingly.	1	2	3	4
7	I want to see improvement in the neighborhood environment (cleaner street).	1	2	3	4
8	I often separate recyclables (plastic, glass, metal, etc.).	1	2	3	4
9	I often separate organic waste (kitchen/food waste).	1	2	3	4



11. There is currently no waste separation scheme in Hanoi city. However, suppose the government is issuing an order for every household to separate organic waste and recyclables, how much do you agree or disagree with the following statements?

		Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
1	I trust that the local authority is capable of facilitating waste collection.	1	2	3	4
2	I trust that the local authority is capable of treating separated waste.	1	2	3	4
3	I know the difference between organic waste, recyclables and others.	1	2	3	4
4	I have the time to separate organic waste and recyclables every day.	1	2	3	4
5	I have the space to store separated waste in the house.	1	2	3	4
6	I am glad to engage in government waste separation plan.	1	2	3	4
7	I am glad to follow the guidance of the community leaders.	1	2	3	4
8	I am glad to incorporate waste separation into my daily life.	1	2	3	4
9	I am willing to separate waste regardless of whether there is money incentive.	1	2	3	4
10	I am willing to separate waste regardless of whether disposal is convenient.	1	2	3	4
11	I am willing to separate waste regardless of whether there is frequent collection.	1	2	3	4

---

## Danh sách câu hỏi khảo sát về tình hình phân loại rác thải sinh hoạt ở Hà Nội, Việt Nam.

Thực hiện bởi: Macromill Inc.

### 1. Giới tính

Nam  Nữ

### 2. Tuổi

19 or less  20-29  30 - 39  40 - 49  50 - 59  60 - 69  Above 70

### 3. Số thành viên trong hộ gia đình (bao gồm người trả lời câu hỏi)

1  2  3  4

5  6  Nhiều hơn 6

### 4. Nơi ở hiện tại

Ba Đình  Bắc Từ Liêm  Cầu Giấy  Đống Đa  
 Hà Đông  Hai Bà Trưng  Hoàn Kiếm  Hoàng Mai  
 Long Biên  Nam Từ Liêm  Tây Hồ  Thanh Xuân  
 Khác ( )

### 5. Thời gian cư trú tại địa chỉ hiện tại

5 năm trở lại  9 năm trở lại  
 15 năm trở lại  Hơn 15 năm trở lại

### 6. Loại nhà ở

Nhà riêng/Biệt thự  Nhà chung cư/Nhà tập thể

7. Hình thức sở hữu nhà

- Nhà của bạn hoặc của gia đình bạn                       Nhà thuê/mượn

8. Lĩnh vực công tác

- Cơ quan nhà nước     Doanh nghiệp     Hộ kinh doanh  
 Nghi hưu                       Khác (                      )

9. Trình độ học vấn

- Trung học phổ thông     Trung cấp chuyên nghiệp     Cao đẳng/Đại học  
 Sau đại học                       Khác (                      )

10. Xin cho biết mức độ đồng ý của bạn đối với các câu dưới đây liên quan đến địa phương và các hoạt động hiện tại.

		Rất không đồng ý	Không đồng ý	Đồng ý	Rất đồng ý
1	Tôi cảm thấy gắn bó với hàng xóm xung quanh.	1	2	3	4
2	Tôi thường xuyên tham gia các hoạt động cộng đồng của khu phố.	1	2	3	4
3	Tôi dự định sống ở nơi ở hiện tại trong thời gian dài.	1	2	3	4
4	Tôi quen biết hầu hết các cán bộ chính quyền của khu phố (tổ trưởng tổ dân phố, hội phụ nữ, ...)	1	2	3	4
5	Tôi cho rằng hệ thống thu gom rác thải hiện tại ở nơi tôi sống còn thiếu sót.	1	2	3	4
6	Tôi cho rằng rác thải cần được phân loại và xử lý có hiệu quả hơn.	1	2	3	4
7	Tôi muốn môi trường khu phố được cải thiện hơn (đường sá sạch đẹp hơn).	1	2	3	4
8	Tôi thường phân loại rác tái chế (nhựa, thủy tinh, kim loại, ...)	1	2	3	4
9	Tôi thường phân loại rác hữu cơ (rác thải từ nhà bếp, đồ ăn thừa)	1	2	3	4

11. Hiện nay thành phố Hà Nội không có cơ chế phân loại rác tại nguồn. Tuy nhiên, giả sử nếu có chỉ thị chính thức yêu cầu tất cả các hộ dân phân loại rác hữu cơ (rác thải nhà bếp, đồ ăn thừa)

và rác tái chế (nhựa, thủy tinh, kim loại,...), xin cho biết mức độ đồng ý của bạn với các câu dưới đây.

		Rất không đồng ý	Không đồng ý	Đồng ý	Rất đồng ý
1	Tôi tin rằng chính quyền địa phương có khả năng xây dựng hệ thống thu gom rác thải hợp lí.	1	2	3	4
2	Tôi tin rằng chính quyền địa phương có khả năng xử lý rác thải sinh hoạt đúng cách.	1	2	3	4
3	Tôi hiểu sự khác biệt giữa rác hữu cơ, rác tái chế và các loại rác khác.	1	2	3	4
4	Tôi có thời gian để phân loại rác hàng ngày.	1	2	3	4
5	Tôi có chỗ chứa rác phân loại trong nhà.	1	2	3	4
6	Tôi sẵn sàng tham gia các dự án phân loại rác của chính quyền địa phương.	1	2	3	4
7	Tôi sẵn sàng tuân theo chỉ đạo của chính quyền địa phương.	1	2	3	4
8	Tôi sẵn sàng phân loại rác như một thói quen hàng ngày.	1	2	3	4
9	Tôi sẽ phân loại rác dù không có khích lệ về tài chính.	1	2	3	4
10	Tôi sẽ phân loại rác dù khá mất công sức và thời gian.	1	2	3	4
11	Tôi sẽ phân loại dù rác phân loại không được thu gom hàng ngày (vd. rác hữu cơ 3 lần/tuần, rác tái chế 1 lần/tuần).	1	2	3	4