PLASTIC WASTE MANAGEMENT AND POLICY IN THE FAST FOOD INDUSTRY IN VIETNAM

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The work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Signature: [redacted]

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"I can no other answer make but thanks, and thanks, and ever thanks."

William Shakespeare

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Abstract

The fast food industry (FFI) has been rapidly developing over the past few decades due to economic development and an increase in the "on the go" consumption culture. This industry consumes a considerable number of single-use items (SUIs), including single-use plastic items (SUPIs) and single-use paper items (SUPaIs), for the takeaway culture, which treats plastics as waste rather than a valuable resource. The frequent use of SUPIs leads to a significant amount of plastic waste ending up in the ocean. Within this context, Vietnam is one of the focus countries contributing considerably to plastic ocean (Akenji et al., 2019b). While regulations and policy interventions related to plastic packaging waste or SUPIs in the FFI have been limited, research into SUPIs in the FFI also has not been undertaken in Vietnam. This research aims to improve plastic waste management and the use and disposal of SUPIs in the FFI in Vietnam.

First, the research reviewed intervention policies on the management of SUPIs in selected regions (the EU, Singapore, India, Indonesia) to recommend policy measures to manage plastic waste in the FFI in Vietnam. Second, this research determined the components and weight of SUPIs consumed and disposed of in the FFI in Ho Chi Minh City (HCMC), Vietnam. The results show that six fast food companies (Lotteria, KFC, Jollibee, Popeyes, Texas Chicken, and McDonald's) in HCMC generated approximately six tons of waste per day. Among them, SUPIs presented from 1.1 t/d to 2.2 t/d and SUPaIs were around 1.4 t/d to 1.6 t/d. Third, the research also surveyed 273 customers and 77 managers on their Knowledge, Attitude, and Practice (KAP) about the use and the disposal of SUPIs in the FFI in HCMC, with the results showing that the knowledge of

customers and managers about the impacts of the use of SUPIs on the environment is positive but still limited.

The next step, the research examined key stakeholders' choices on the recommended policy measures for SUPIs in the FFI, which were implicated from the first, second, and third objectives of the thesis. This fourth objective of the thesis was carried out by interviewing 37 people in five stakeholder groups (customers, restaurant managers in FFI, plastic manufacturers, and policymakers). Finally, the research also calculated the impacts of the two recommended policy interventions, including ceasing the use of the identified unnecessary SUPIs in the six studied FFCs and standardising the weight of each type of SUPI in the FFI. Consequently, the study is optimistic that by adopting the policy recommendations, a substantial amount of plastic waste which is currently being generated by the FFI and released into the environment each year will be prevented.

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List of Abbreviations

DRS	Deposit Refund Scheme
EC	European Commission
EPR	Extended Producer Responsibility
EU	European Union
FFCs	Fast Food Companies
FFI	Fast Food Industry
FFRs	Fast Food Restaurants
HCMC	Ho Chi Minh City
HDPE	High-Density Polyethylene
ISPONRE	Institute of Strategy and Policy on Natural Resource and Environment
KAP	Knowledge, Attitude, and Practice
LDPE	Low-Density Polyethylene
MONRE	Ministry of Natural Resource and Environment
MSW	Municipal Solid Waste
PE	Polyethylene
PET	Polyethylene terephthalate
PROs	Producer Recycling Organizations
PP	Polypropylene
PPW	Plastic Packaging Waste
PS	Polystyrene
PVC	Polyvinyl chloride
SUEFIs	Single-Use Environmentally Friendly Items
SUIs	Single-Use Items
SUPaIs	Single-Use Paper Items
SUPIs	Single-Use Plastic Items
SUPs	Single-Use Plastics
USD	United States Dollar
VND	Viet Nam Dong
VPA	Vietnam Plastic Association

Chapter 1: Introduction

1.1 BACKGROUND

Plastic pollution is now considered and accepted by the global community as a growing environmental problem. According to the United Nations report on single-use plastics (SUPs) (2018), the world produces approximately 400 million tons of plastic annually, and thus about 300 million tons of plastic waste is generated globally every year (United Nations Environment, 2018). There were about 141 million tonnes of total plastic packaging waste created worldwide in 2015 and 79% of the plastic waste goes to landfills, dumps, or into the environment (United Nations Environment, 2018). The report indicated that plastic packaging, including grocery bags, food packaging, bottles, straws, containers, cups, and cutlery, accounted for 47% of the globally generated plastic waste, with half of that coming from Asia (United Nations Environment, 2018). These single-use plastic items represent 43% of all marine litter items found on European beaches by counting them (European Commission, 2018). If the current consumption patterns continue, there will be about 12 billion tons of plastic litter sitting in landfills and the natural environment by 2050 (United Nations Environment, 2018). More importantly, the future costs of removing all SUPs (accumulating in the environment are estimated to be higher than the costs of preventing littering today. In Europe alone, approximately €630 million per year is used for cleaning shores and beaches, and the estimated cost of damage caused by the plastic impact on the world marine ecosystem is at least $13 billion (European Commission, 2018).

The majority of post-consumer plastic waste is mixed with municipal solid waste (MSW), and this accounted for 84% of MSW in Finland (Dahlbo et al., 2018). Among which, the most popular plastic types appearing in the MSW were Polypropylene (PP) and Low-Density Polyethylene (LDPE), followed by High-Density Polyethylene (HDPE) and Polystyrene (PS), all of which can be recycled for raw materials (Dahlbo et al., 2018). In Vietnam, in terms of waste composition, plastic bottles presented roughly 73% of domestic waste in households in Da Nang city (Tran et al., 2019) and plastic packaging waste accounted for nearly 95% of plastic waste in households in Can Tho (Thanh et al., 2011).

The fast food industry (FFI) uses a considerable number of single-use items (SUIs), including packaging, cutlery, and containers, which are made of paper or plastic to enable food to be taken away. Therefore, these SUIs are recognised as a convenient choice of food for the urban lifestyle. However, all of these SUIs become waste after being used only once, therefore, they are identified as a type of packaging waste. Thus, the FFI generates a large amount of solid waste which has a high potential for recycling (Aarnio, Teija and Hamalainen, 2008). According to Aario et al. (2008), the theoretical recovery potential of packaging waste in this industry was 93%, but only 29% of this waste was recovered. In 2017, there were 18,567 fast food chain restaurants in Vietnam and this figure has been increasing by 2% every year (Food & Industry, 2017). Therefore, solid waste, including plastic waste and paper waste, generated by the FFI in Vietnam, also will continue to increase. While the European Commission has banned several single-use plastics (SUPs) (European Commission, 2018), where many countries over the world have learnt from these countries. In Aisa, Singapore has the Singapore Packaging Agreement (Paul M. Muchinsky, 2017) that has limited the usage of plastic packaging between manufactures or producers and the government size and the weight of packaging. This country also has a packaging benchmarking database for each industry (*NEA*

Launches Packaging Benchmarking Database to Encourage Businesses to Reduce Waste [Press Release] | Zero Waste Singapore, n.d.), which policies enable Singapore to achieve specific success in toward Zero waste manufacturing (Kerdlap et al., 2019). In addition, in India where started banning SUPIs in October 2020 (*India Tables Ban on Single-Use Plastic | Earth Day*, n.d.) and several states in this country has established the Central Pollution Control Board to recover plastic waste effectively (Shahnawaz et al., 2019) (Chand, 2018). However, in Vietnam regulations and policies to deal with the growing generation of plastic waste are still limited. Therefore, it is necessary to conduct research into solid waste in the FFI to identify its components and improve the current practice of waste management in this industry regarding resources efficiency.

According to the Vietnam General Statistics Office (2019), HCMC's population was approximately 9 million in 2018 and increasing. The population was projected to grow by about 2.65% between 2016 to 2030 (General Statistics Office of Vietnam, 2016) and thus, HCMC increasingly attracts many fast food companies to satisfy the growing demands for fast food products. The average amount of MSW generated in HCMC was approximately 8,900 tons (Department of Natural Resources and Environment, 2016). Food waste accounted for approximately 60% of waste, followed by plastic waste, (approximately 20%) and paper waste (about 10%). Waste management practice in HCMC shows that roughly 86% of MSW goes into landfills, including solid waste from the FFI, which mainly consists of food, plastic, and paper (Verma et al., 2016). The dumping of plastic waste is wasting resources, devastating the environment and endangering to marine animals due to its persistency in the environment. In addition, HCMC lacks land for building landfills because of the population density of around 5000 people square kilometre (Vietnam General Statistics Office, 2016). Additionally, the current dumping ground in HCMC has caused many environmental issues, such as its wastewater and air pollution due to odour and greenhouse gas emissions (Verma et al., 2016).

In Vietnam, there were approximately 18,500 outlets of fast food chain outlets in 2017 (Food & Industry, 2017). This number has grown considerably every year due to an increase in the urban population. Thus, poor waste management practice in general and especially in the FFI can lead to more pressing environmental issues for this city. Therefore, it is essential to research solid waste generation in the FFI and its waste management practice in HCMC to use resources efficiently and to minimise the potential risks of environmental problems in the future. In addition, research on solid waste management in the FFI in the academic world is very limited (Aarnio, Teija and Hamalainen, 2008; Shokri et al., 2014) and it is also even more limited in Vietnam due to the difficulties in transparency and data collection (Shokri et al., 2014).

In terms of enforcement framework, regulations and laws on plastic waste in Vietnam have been very limited and insufficient to manage plastic waste in an effective way (V.-T. Nguyen & BeiPing, 2019). The legal frameworks for plastic waste and SUPIs in Vietnam. Most of the laws or regulations focused on preventing oil pollution caused by ships, rather than for plastic waste or garbage released into the ocean (V.-T. Nguyen & BeiPing, 2019). Besides, the Decision 582/QD-TTg on a masterplan for the plastic sector to 2020 with a vision to 2025, which allowed plastic waste to be treated as domestic materials. On the other hand, the demand for feedstock for plastic products was high and depended on the import, including the primary and scrap. Notably, in 2013, the Minister approved projects which aim to improve the environmental pollution control caused by the use of non-biodegradable plastic bags, with the target being to reduce plastic bags by 65% of plastic bags in 2020 with the baseline of 2010. More importantly, the Decision 1746/QD-TTg was signed on the 4th of December 2019 to introduce an action plan for the management of marine plastic litter by 2030. These legal documents have not enough effects to reduce a huge amount of plastic waste released into the ocean each year.

This study focuses on recommending policy measures to improve plastic waste management and the use and disposal of SUPIs in the FFI in Vietnam (Figure 1.1). It also analyses the potential implementation outcomes of the recommended policy measures based on the statistical data and literature review.

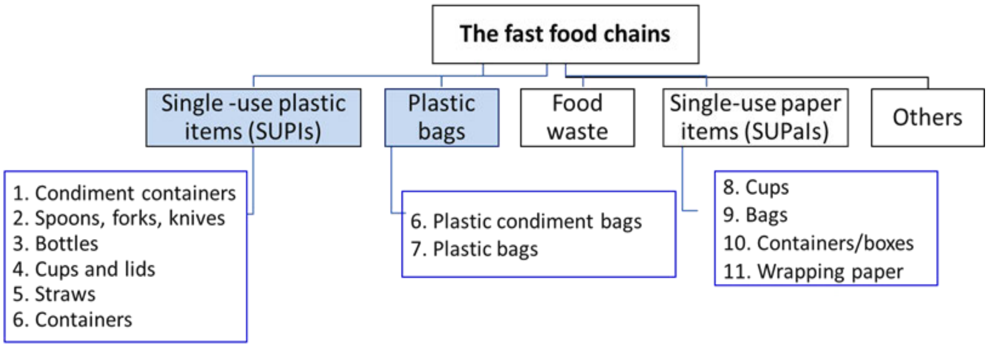

Figure 1.1 Research focus

This research is necessary for the practitioners, researchers, and especially policymakers who play a vital role in creating make policy measures to improve the current plastic waste generation and management in the FFI in Vietnam. It will also assist them to introduce and estimate a framework or a strategy or action plan to reduce the amount of plastic waste generated in Vietnam in both the short term and the long term.

1.2 RESEARCH AIMS, OBJECTIVES

This research aims to improve plastic waste management and the use and disposal of SUPIs in the FFI in Vietnam. Plastic waste in the FFI comes from the use and the disposal of SUPIs and plastic bags. Therefore, this research will examine the factors influencing plastic waste generation in the FFI and then recommend policy measures to reduce this. The factors being focussed on include current policies related to plastic waste or SUPIs, the behaviours of plastic waste producers (customers and the FFI), and the plastic recycling activities. In order to achieve the aforementioned research aim, five objectives (see Figure 1.2) are identified:

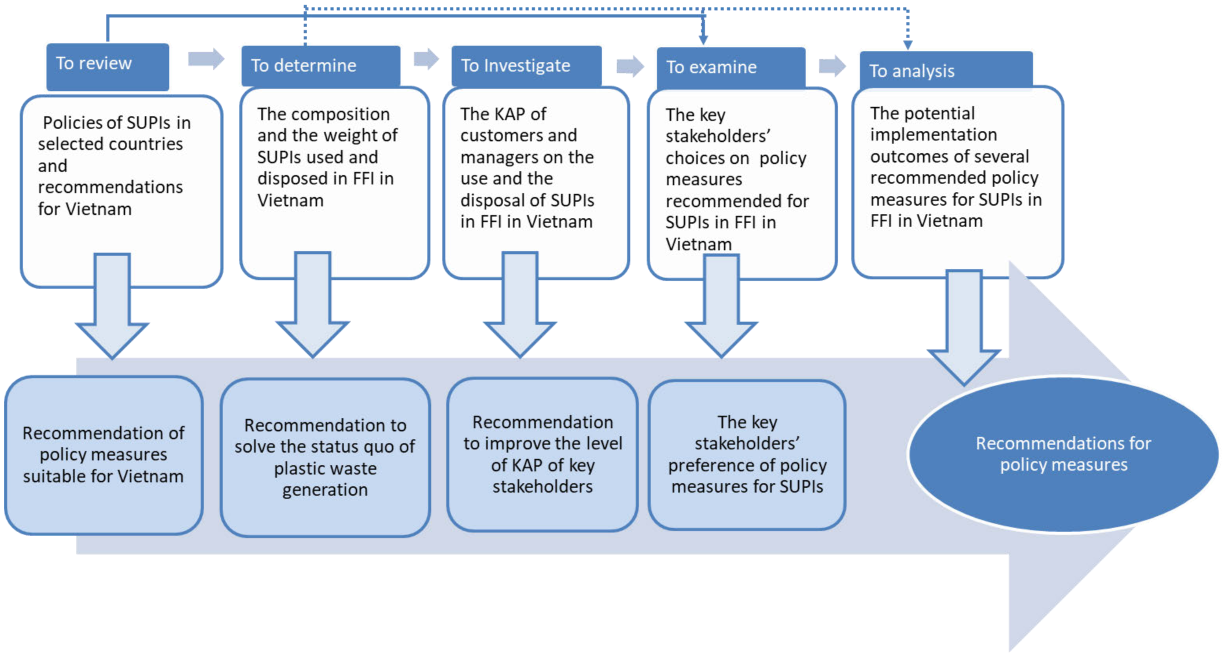

Figure 1.2 The research process

1. *To review the policies on single-use plastics in selected countries*.

   This objective is to review all policy measures on the control of SUPIs and plastic bags both globally and in selected countries. It also reviews the current policies on plastic waste, SUPIs, and plastic bags in Vietnam in order to recommend policy measures for Vietnam.

2. *To determine the components and weight of SUIs consumed and disposed of in the FFI in Vietnam (a case study in HCMC).*

This objective is to estimate the number and the weight of SUPIs and plastic bags generated and consumed per day by six common fast food companies (FFCs) in HCMC, Vietnam. The result will indicate how the FFI consumes and disposes of SUPIs.

3. *To investigate the Knowledge, Attitude, and Practice (KAP) of customer, restaurant managers about the use and disposal of SUPIs in the FFI.*

   This is to examine the level of the knowledge, attitude, and practice of customers and restaurant managers in the use and disposal of SUPIs because their KAP level influences the amount of plastic waste generated in the FFI. The result will show that how necessary it is to improve their KAP level.

4. *To examine key stakeholders' choices on the policy recommendations for SUPIs in the FFI in Vietnam*.

   Based on the objectives one, two and three, the research will recommend the policy measures for Vietnam to control plastic waste generation in the FFI. Then, these recommended policy measures will be used to interview the main stakeholders (policymakers, customers, restaurant managers, and plastic manufacturers and experts on plastic waste) to examine their choices and priorities for these policies. The interview results will inform the policy recommendations for Vietnam.

5. *To analyse the potential implementation outcomes of several recommended policy measures for SUPIs in the FFI in Vietnam*.

   This objective is to analyse the potential impacts that can be identified of the policy recommendations to improve the plastic waste management in the FFI in Vietnam. The recommended policy measures that will be analysed include stopping the use of the identified unnecessary SUPIs and standardising the weight of SUPIs in the FFI in Vietnam.

1.3 SIGNIFICANCE OF THE RESEARCH

The increasing consumption of plastic products and the poor management of their disposal lead to an increase in the amount of plastic waste found on beaches and in oceans. To be more specific, the rising use of single-use plastics (SUPs) in the "on the way" consumption culture contributes significantly to the ultimate disposal of plastic waste due to their low recyclability (Gallego-Schmid et al., 2019; Williams & Rangel-Buitrago, 2019b). Consequently, many marine animals as well as terrestrial and marine environments have been adversely impacted by this ultimate disposal (Karbalaei et al., 2018a; Yates et al., 2019). Therefore, measuring the policy intervention response to this increasing situation of plastic waste has been concerning policymakers, researchers, and the public (Toussaint et al., 2019). In particular, policy measures to lessen the use of SUPs and the amount of plastic waste discarded into the environment has been enacted in all continents around the world, from developing countries to developed countries, and especially island countries. Unlike developed countries, the use of SUPIs has become increasingly in Vietnam where the regulations and legislations on plastic products and SUPs has been limited.

This study will conduct an investigation on the use and disposal of SUPIs and plastic waste in the FFI in Vietnam. In addition, this research also examines factors influencing the amount of plastic waste in the FFI, which are the knowledge, attitude and practice of plastic waste producers and the current policy interventions involved in the control of the plastic waste generation. The research results will give recommendations of policy measures to deal with the plastic waste in the FFI in Vietnam as shown in Figure 1.3. More importantly, these recommendations of policy measures will be built based on literature review, the real investigation into the FFI and suggested by main stakeholders (customers, fast food restaurant managers, policymakers, plastic manufacturers, experts) involved in the FFI.

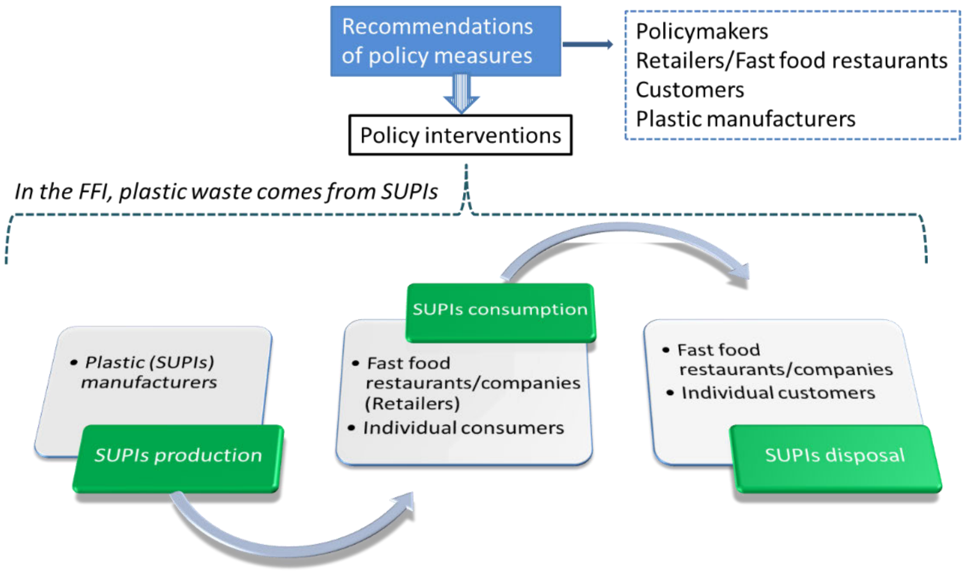

Figure 1.3 The research contribution

This study will further provide recommended policy measures that can be applied in the similar circumstances of management, control of plastic waste and plastic packaging to other developing countries, such as Thailand, Indonesia, and the Philippines.

1.4 OVERVIEW OF RESEARCH METHODOLOGY

The research aims to improve plastic waste management and the use and disposal of SUIs in the FFI in Vietnam. Therefore, this study uses a mixed method that enables researchers to examine the current situation and identify the critical gap in plastic waste management in order to achieve the research objectives. Qualitative and quantitative approaches have been applied in different forms due to different research objectives. To achieve the research aim, five research methods are adopted in this thesis, including literature reviews, structured questionnaires, measuring the weight of the waste composition, semi- structured interviews, and analysing the amount of preventable plastic based on the statistical data (see Table 1.1).

Table 1.1 Research methods are used to address the research objectives

Research methods / Research objectives	Literature reviews	Structure-questionnaire	Measuring the weight of waste compositions	Semi-structure Interview	Analysing based on the statistical data
To review policies of single-use plastics in selected countries	x				
To determine the components and weight of SUIs consumed and disposed of in FFI in Vietnam		x	x		
To investigate the Knowledge, Attitude, and Practise (KAP) of the customers, restaurant managers the use and the disposal of SUPIs in FFI in HCMC		x			
To examine choices of policies by stakeholders on the management of SUPIs in the FFI in Vietnam				x	
To analyse the potential implementation outcomes of the recommended policy measures					x

In the preliminary stage, a comprehensive review of the literature on the historical development, packaging waste generation and management, and the environmental impacts of plastic packaging in the FFI was carried out. Additionally, a systematic quantitative and qualitative review of the peer-reviewed literature on policies to control plastic packaging and SUPs over the world were conducted. The main sources that have been used in this research included Elsevier Science, the Institute for Science Information Web of Knowledge, Google Scholar, etc. using Griffith University Library sources. In the next objective of the research, a structured-questionnaire (Appendix B) was used to survey 126 restaurant managers in six common fast food companies (FFCs) including Lotteria, KFC, Jollibee's, Popeyes, Texas Chicken, and McDonald's in HCMC from January to April 2017. The sample size was followed by Solvin's formula (Perdana, 2018). In addition, during the survey with restaurant managers, this study also collected 30 waste bins from 30 different fast food restaurants (FFRs) belonging to the studied FFCs. The thirty collected bins were then separated into different waste compositions and the weight of the separated waste compositions were measured by an electrical scale (see Chapter 3 for more details).

Furthermore, a structured– questionnaire was also used to conduct a survey on the KAP of 273 customers and 77 restaurant managers about the use and disposal of SUPIs in the FFI (see Appendix C, D and Chapter 4 for more details). The survey was conducted in April 2017. The customers who participated in the research had visited and eaten fast foods in the FFRs of the six selected FFCs. The restaurant managers who participated in the study were responsible for the general management in their FFRs. On the other hand, semi-structured interviews with five stakeholder groups were undertaken from December 2019 to January 2020. These stakeholder groups who participated in the interviews included the 25 customers who visited the studied six FFCs, six policymakers (half of whom were at national and the other half at local levels), one plastic manufacturer and two experts on plastic waste management in Vietnam (see Chapter 5 and Appendix G for more details). These interviews were administered online and face-to-face. Finally, the research also analysed the potential impacts resulting from implementation of the recommended policy measures based on the statistical data which was collected from the second objective of this research (see Chapter 6). These analysed policy measures included reduction measures (for the FFI) and general measures to control plastic waste in the FFI (for the government).

The following sources which were used to review current policies which have been announced or implemented in other countries: policy documents, archival records, books, peer-review articles, websites, reports, and newspapers. The calculations of the weight and the number of SUPIs consumed and disposed of was conducted in Excels spreadsheets. SPSS version 25 (offered by Griffith University) was used to code and analyse the descriptive statistics. Finally, the data was visualised into tables, figures, and charts.

1.5 SCOPE AND LIMITATIONS OF THE RESEARCH

There are several types of limitations in this research. Firstly, this research concentrates on plastic waste management in the FFI and its management practice in Vietnam. Plastic waste is a sensitive environmental issue in Vietnam since Vietnam was recognised as the fourth highest country in the world for contributing to plastic ocean problem (UNEP, 2018a). The research is designed to survey the FFRs which use a large number of SUPIs; therefore, the restaurant managers were unwilling to participate in the research, especially in the interviews in January 2020 because the Decision 1746/QD-TTg on reducing plastic ocean pollution in Vietnam was announced on the 19th December 2019. Secondly, restaurant managers who were exceptionally busy repeatedly rearranged the survey participation time. Restaurant managers who undertook the survey and interviews were likely to not want their restaurants to consume a large number of SUPIs, thus, they tended to provide a smaller number rather than what was an accurate reflection of reality.

All the structured – questionnaires were carried out in the six selected FFCs in HCMC. The interviews with the three national policymakers were conducted online using social media (Zalo app). The respondents of the questionnaire and interview surveys had different backgrounds and played various roles in plastic waste management in the FFI in Vietnam.

1.6 STRUCTURE OF THE THESIS

This thesis is structured in accordance with the Griffith University guidelines for philosophy doctoral as a series of published and unpublished papers. These guidelines indicate philosophy doctoral candidates must include their papers that are prepared for submission, submitted to, or accepted by peer reviewed journals or books. As a result of this format, the thesis does not have a separate methodology chapter; however, in each chapter, a methodology section and introduction section are included. A reference section is at the end of the thesis.

The thesis consists of seven chapters: **Chapter 1** – Introduction and a conclusion chapter (**Chapter 7**), as well as five chapters which address the results of the five research objectives (**Chapters 2-6**). Chapter 3 is a paper which has been accepted and the other chapters will be restructured to be submitted to peer-review journals.

Table 1.2 provides an overview of the chapters of the thesis including title chapter, research gap, research objectives, data sources, data collection methods, and data analysis.

Table 1.2 Overview the Chapters of the Thesis

	CHAPTER 2	CHAPTER 3	CHAPTER 4	CHAPTER 5	CHAPTER 6
Chapter Title	Literature review	The current use and disposal of SUPIs in the FFI in HCMC, Vietnam.	The KAP of customers and restaurant managers on the use and disposal of SUPIs in the FFI in HCMC, Vietnam.	The key stakeholders' choices of the policy recommendations for SUPIs in the FFI.	The analysis of the potential implementation outcomes of the policy recommendations.
Research gap	Lack of plastic waste management policies and legislations for plastic recycling	The large number and the high weight of SUPIs in FFI are released into the environment.	The limitation of research into KAP of customers about plastic waste and SUPIs in the FFI in Vietnam.	Lack of key stakeholders' participation in plastic waste management in the FFI.	The limitation in the policy on management of SUPIs and plastic waste in the FFI, in Vietnam.
Research objectives	To review policies and lessons learnt for Vietnam.	To determine the number and the weight of SUPIs consumed and disposed of a day	To investigate the KAP of key stakeholders about the use and disposal of SUPIs in FFI, HCMC.	To examine the key stakeholders' choices on management of SUPIs in FFI.	To analyse the potential impacts of several recommended policies.
Data sources	Journal articles; Books and book chapters; policy documents; Archival records; Theses and reports	Structured-questionnaires; Policy documents; Journal articles	Structured questionnaires Journal articles	Semi-structured interviews; Journal articles; The policy measures recommended from chapters 2, 3, and 4	The policy recommendations from the research results of chapters 2, 3, 4, and 5.
Data collection methods	Literature review	Structured questionnaire Measuring the weight of the waste composition.	Structured questionnaire	Semi-structure interviews	Calculating the weight of SUPIs that would be preventable based on the statistical data
Data analysis	Selection of relevant literature Analysis of the literature	Excel and visualising data using tables, figures, charts	SPSS version 25 provided by Griffith University	Qualitative content analysis	Excel and visualising data by tables, figures, charts.

Chapter 2 provides a literature review on the historical development, packaging waste generation and management, and its environmental impacts of plastic packaging in the FFI. This chapter also reviews policy measures to control SUPIs and plastic packaging waste over the world and in selected countries (the European Union - EU, Indonesia, Singapore, India, and Vietnam). The primary policy recommendations for Vietnam are drawn from this chapter.

Chapter 3 investigates the current use and disposal of SUIs and waste management in the FFI in HCMC. This chapter uses the results from 126 structure-questionnaire surveys in the six selected FFCs in HCMC to determine the weight and the number of SUPIs consumed. It also presents the findings of collecting, separating, and measuring thirty waste bins from thirty different FFRs to estimate the weight of plastic waste generated by six selected FFCs in HCMC.

Chapter 4 investigates the KAP of customers and restaurant managers about the use and the disposal of SUPIs in the FFI. It also provides the findings of 273 customer and 77 restaurant manager surveys in six FFCs in HCMC, Vietnam.

Chapter 5 presents the results of thirty-six semi-structured interviews with twenty-five customers, six policymakers, two restaurant managers, one plastic manufacturer and two experts on their choices of the recommended policy measures. These measures mentioned the control of plastic waste from the use and disposal of SUPIs in the FFI in Vietnam.

Chapter 6 indicates the analysis results of the potential implementation outcomes of the recommended policy measures. These policy recommendations that were used in the analysis include ceasing the identified unnecessary SUPIs in the FFI and standardising the weight of SUPIs in the FFI in Vietnam.

1.7 CONCLUSION

This chapter presented an overview of the thesis. First, it revealed the research background and motivation for carrying out this research. Second, it provided research aims, objectives and the significance of the research. Additionally, it indicates research methods used to achieve the research objectives. Finally, the scope and limitation of the research, and its structure were subsequently revealed.

Chapter 2: Literature Review

2.1 ABSTRACT

Research into the generation of waste in the FFI has been limited. While many developed countries have decided to ban the use of SUPIs (straws, cups, containers), the consumption of SUPIs has been widespread in developing countries. As a result, plastic ocean pollution is largely caused by the developing world (China, Indonesia, Philippine, Vietnam). Documents used in this research included peer-review articles, policy documents, archival records, books, and reports on plastic waste management and SUPIs over the world and in Vietnam. This review focused the development history of the FFI and plastic waste generation and management in the FFI. Furthermore, the research also studied the environmental impacts of SUPIs and the factors influencing on the waste generation in the FFI. Notably, this study discussed the policy measures which are currently in effect to control the use of SUPIs in selected countries and Vietnam. Finally, the research then recommends the policy measures for Vietnam.

Keywords: the fast food industry, single-use plastic items, plastic waste management, policy measures.

2.2 FAST FOOD INDUSTRY

The FFI has the easily and time-efficiently attainable characteristics. These fast food products are sold in fast food chains but consumed elsewhere. They are becoming more readily available and more popular in today's busy world. Therefore, this industry utilises cheap and lightweight materials for packaging and convenience. Consequently, the waste generated by the FFI has increased substantially in recent years.

2.2.1 Development of the fast food industry

2.2.1.1 Development of the fast food industry over the world

Ready-cooked food can be traced back to Ancient- Rome, but it really became popular in the urban areas of Britain in the 19th century in the form of "fish and chips" and fast food also started as an automat (a fast food restaurant in which food and drink is served via vending machines) in New York City in 1902 (*History of Fast Food - Development of Fast Food Industry*, n.d.). The FFI has been rapidly developing for many decades due to the increasing "on the go" consumption culture. The global fast food market is growing at a compound annual growth rate of 4.2% and is estimated to be worth more than US$690 billion in 2022 (Zion Market Research, 2017). Globally, the fast food market is forecast to rise by 5.6% in the period from 2019 to 2026 and the two main factors affecting the increasing rate are the availability of fast food products (Fraser et al., 2010; Jekanowski et al., 2001) and the rapidly growing population (*Global Fast Food Market Analysis, Size, Share Forecast 2019–2026 | Straits Research*, n.d.).

This rise in fast food consumption can be seen in Asia and the Americas. In Asia, the food and drink area is projected to rise by 6% in 2019, reaching 3.3 trillion USD and will make annual average growth of 8.9% by 2023 (FitchSolutions, 2019). In China, young adults in China are the primary consumers of fast food products (*Global Fast Food Market Analysis, Size, Share Forecast 2019–2026 | Straits Research*, n.d.) with adolescents, aged from 12 to 18, reportedly consuming fast foods 1.5 times per week on average (Ma et al., 2016). Meanwhile, in America, the popularity of fast food can be seen by the statistics stating that on average approximately 37% of American adults consumed fast food products during 2013 - 2016 (*Global Fast Food Market Analysis, Size, Share*

Forecast 2019–2026 | Straits Research, n.d.). The mean number of meals per week was 2.8 reported for fast food restaurants or pizza places (Garza et al., 2016). At least one in four adults eats fast food in America (Bowman & Vinyard, 2004). Adults have to take responsibility as parents and workers; thus, this affects the consumption of convenience foods, such as ready-prepared meals as well as fast food products (Jabs & Ã, 2006)..

Another factor for the global spread of fast food is fast food companies' capacity. Many fast food companies have succeeded in developing their marketplace due to exploring innovation appealing to a vast range of their customers (Lichtenberg et al., 2012). The introduction of online food ordering and home delivery using mobile devices has resulted in a sharp increase in SUIs consumption in the FFI (Zion Market Research, 2017). It is estimated that more 69% of customers have ordered food using mobile devices over the world (Gupta, 2019). The use of delivery apps to order fast foods, instead of eating in, leads to an increase in the consumption of SUIs. Globally, among the variety of fast food products consumed, burgers and sandwiches accounted for the largest market share (*Global Fast Food Market Analysis, Size, Share Forecast 2019–2026 | Straits Research*, n.d.).

Fast food company often plan not only to succeed in a local target market, but also develop widely over the world. For instance, McDonald's Corporation, founded in 1955, was considered the largest FFC in the world, accounting for 0.2% of 19 million outlets worldwide (Washington, 2018). The McDonald's corporation focuses on six priority products: beef, chicken, coffee, fish, fibre-based packaging and palm oil (*Our Food | McDonald's*, n.d.). In 2018, the company recycled approximately 10% of consumer packaging around the world and nearly 60% of its guest packaging came from renewable, recycled or certified sources; this figure is expected to be 100% by 2025 (McDonald's, 2019). In contrast, KFC, established 75 years ago, and now has over 23,000 outlets in more than 140 countries (*About - KFC.Com*, n.d.). The company has committed to using 100% fibre-based packaging from certified or recycled sources by 2020 and plastic packaging used in its restaurants around the world will be reusable or recoverable by 2025 (*About - KFC.Com*, n.d.).

2.2.1.2 Development of the fast food industry in Vietnam

In Vietnam, there were approximately 18,500 outlets of fast food companies in 2017 (Industry, 2018). Vietnamese FFI growth rate was 17% in 2013 and increased to 18% for the 2013-2017 period (Ehlert, 2016). The FFI revenue increased by 9% in 2014 and reached VND 16,679 billion (USD 747.2 million) in 2015 (Australian Trade and Investment Commission (Austrade), 2016). Vietnam is a market with a wide diversity of fast food chains, with a high potential for this industry because it has a population of 92 million. There were about 7,000 fast food restaurants in Vietnam in 2014 (Vietnam Supply Chain, 2014). Most Vietnamese people like fast food products and about 47% of them regularly consume these products (Vietnam Supply Chain, 2014). It is indicated that KFC and Lotteria are the two most frequently visited fast food chains due to their reasonable prices, location and promotion (*Leading Fast Food Brands in Vietnam Report Consecutive Losses*, n.d.; *Restaurant Brands International Inc. Reports Full Year and Fourth Quarter 2018 Results*, n.d.). Table 2.1 presents the characteristics of FFCs in Vietnam in 2020.

Table 2.1 Characteristics of FFCs in Vietnam, retrieved from websites of FFCs in Vietnam, 2020 (*About - KFC.com*, n.d.; *Cửa hàng - Lotteria Viet Nam*, n.d.; *Our Food | McDonald's*, n.d.; *Popeyes Stores*, n.d.; *Texas Chicken Vietnam*, n.d.; *Về Jollibee - Jollibee Vietnam*, n.d.)

Fast food companies	**Main products**	**The number of restaurants in Vietnam**
Lotteria	Fried chicken, burgers, rice, desserts, and drinks.	210
KFC	Fried chicken, hamburgers, rice, and drinks.	140
Jollibee's	Fried chicken, hamburgers, rice, spaghetti, snacks, desserts, and drinks.	100
Popeyes	Fried chicken, burgers, rice, seafood, deserts, and drinks.	26
Texas Chicken	Fried chicken, burgers, rice, desserts, and drinks.	22
McDonald's	Fried chicken, burgers, rice, desserts, snacks and drinks	23
Total		521

In 2017, the number of McDonald's restaurants in Vietnam was only nine, but this figure reached 23 in March 2020 according to the information from McDonald's website in Vietnam (*Fried Chicken - McDonald' s™ Vietnam*, n.d.). There are 18 McDonald's restaurants in HCMC. KFC has been in Vietnam since 1997 and it has currently owned over 140 restaurants in the country. Among these 140, 49 KFC restaurants ware located in HCMC at the time of this survey (*Hệ Thống Nhà Hàng KFC | KFC Việt Nam*, n.d.). Jollibee, which comes from the Philippines had approximately 100 restaurants in Vietnam in 2019 (*Về Jollibee - Jollibee Vietnam*, n.d.). In HCMC, there were 14 Jollibee restaurants in 2017. The American company Popeyes started its business in Vietnam in

2013 and it currently has 26 restaurants in Vietnam and 11 restaurants in HCMC (*Popeyes Stores*, n.d.). Texas Chicken, also from America, opened its first restaurant in Vietnam in 2012. In 2016, when this research started, there were only ten Texas Chicken restaurants in HCMC; however, this fast food company now owns 22 restaurants in Vietnam, with 19 restaurants in HCMC (*Vietnamese Fast Food*, n.d.). Lotteria, which came from Korea to Vietnam in 2004, and has 90 Lotteria restaurants in HCMC (*Cửa Hàng - Lotteria Viet Nam*, n.d.). At the moment, this FFC has currently about 210 restaurants across Vietnam.

2.2.2 Type and Composition of Packaging Materials

In the food industry, the type of materials used are lightweight, inexpensive and easily shaped (Foodservice Packaging Institute, 2007; Marsh & Bugusu, 2007a). The primary functions of food packaging are frequently discussed in research studies (Arvanitoyannis, 2012; Popphd et al., 2014; Robertson & Group, 2013; Roper & Parker, 2013), and its classification of functions depends on the characteristics of goods/products as well as the life of those products, including the following core roles:

- Protection
- Food waste reduction
- Communication (including marketing and information)
- Convenience

In the FFI, apart from the safety factor, convenience is a priority because this industry serves the demand of customers who consume their takeaway products. Therefore, the type of material used in this service is expected to be lightweight and easily shaped, as well as affordable, which is why paper and plastics are prioritised in this sector (Aaarnio, 2006). Compositionally, there are four main kinds of materials used commonly in the food industry: wood/paper; plastics; metal; and glass (Aaarnio, 2006; Foodservice Packaging Institute, 2007; Marsh & Bugusu, 2007a; Wyrwa & Barska, 2017).

The first material, wood-based paper, is the most popular material used in the FFI due to an acceptable price, lightweight, recycling capacity and the use of renewable resources (Aaarnio, 2006) (Marsh & Bugusu, 2007). By 2021, it is anticipated that the amount of paper used worldwide would be 273.31 million tons (*General OneFile - Document - Grand View Research_ Paper Packaging Materials Market to Hit $391*, n.d.). According to the Grand View research (2019), paper, the most popular worldwide packaging material in the FFI, was manufactured from raw material like paper, pulp, and other inorganic fibre. The primary function of the paper material in packaging is to protect the products during transportation. In 2014, 195,72 million tons of paper were consumed globally and this is expected to reach 273.31 million tons by 2022 (Moon, 2014). The Asia Pacific led the regional market and Vietnam was one of the countries expected to witness the highest growth of 4.8% in the usage of paper from 2015 to 2022 in the usage of paper. Rationally, the public's growing concerns on the environmental issues related to plastic usage in packaging have resulted in a shift in consumer preference towards paper-based products (Onefile et al., 2019). Figure 2.1 indicates that the FFI took the second position, only after beverages, in the usage of paper at the global level.

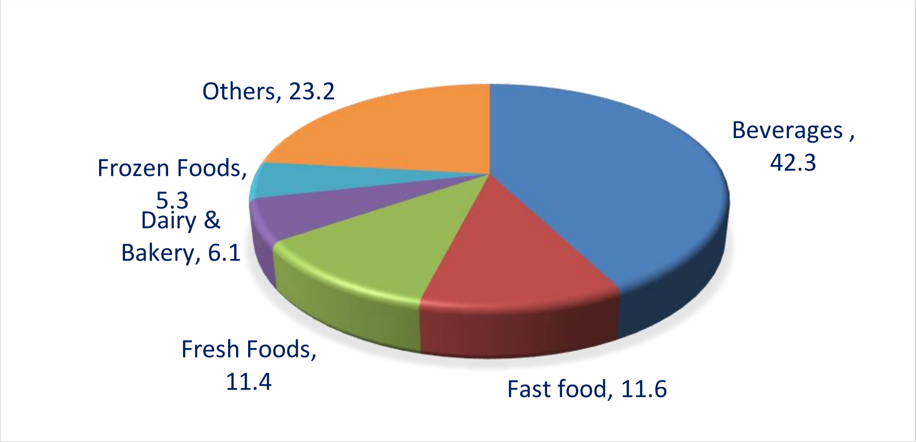

Figure 2.1 Global paper packaging material market share, by application in 2015 (%), adapted from (*Paper Packaging Materials Market Worth $391.17 Billion By 2022*, n.d.)

The wood-based paper has been formed as paperboard, cardboard, or paper which is made of pulp and is the fibrous raw material coming from plant fibre (Robertson & Group, 2013) as presented in Table 2.2.

Table 2.2 Types, characteristics and applications of papers in food packaging (Marsh & Bugusu, 2007b)

Type of papers	Characteristics	Types	Application
Paper	- Poor barrier to gases, moisture and light. - Tears easily to decorate. - Recyclable and degradable.	- Kraft paper (bags, wrapping, such as packaging materials for flour, sugar, dried fruits). - Sulfite paper (resistant to oils; wrapping cookies). - Greaseproof paper (resistant to oils; wrapping candy, oily foods, cookies, snack foods) - Glassine (smooth, a liner for fast foods, baked goods, cooking fats) - Parchment paper (smooth, resistant to oil, water, and air; butter or lard packaging).	A lot of applications in food packaging.
Paperboard	- Thicker or has multiple layers. - Heavier. - No contact with food.	- Whiteboard (inner layer of a carton, contact with food) - Solid board (fruit juices, soft drinks) - Chipboard (recycled paper; outer layers of cartons for foods) - Fiber board (solid; packaging for shipping bulk foods).	Popularly used to make take away containers (boxes, trays, cartons).
Paper laminates	- Resistant to oil, air, gases, moisture and contact directly with food.	- Types of kraft and sulfide pulp coated or laminated using plastic or aluminium	Packaging for sensitive foods such as spices, soups.

In terms of paper composition, most pulp products came from the cell walls of softwoods, containing 40% - 44% cellulose, 25%-29% hemicelluloses and 25%-31% lignin by weight moisture (K. Marsh & Bugusu, 2007b). In the FFI, paperboard and cardboard has been preferred due to their recycling capacity and their low cost. Cartons are commonly used to prevent fast food products from spreading oil left on the surface of the products to surrounding containers or others. Cardboard is often a favourite material to make containers, such as boxes, bags, and wrapping paper to take fast food (products) away. To inhibit leaking oil or to prevent containers from becoming wet, this material is often laminated with aluminium or polyethylene that prevents it from absorbing gases and moisture (Marsh & Bugusu, 2007b); thus this kind of paper is called paper laminates.

The second material used commonly in the FFI is plastic. This material is the next most widely selected due to low cost, recoverability and functional benefits (Aaarnio, 2006; Marsh & Bugusu, 2007a). However, plastic is becoming a less popular choice because of its adverse impact on the environment and the possible risk that it may contaminate the food with certain chemicals (Gallego-Schmid et al., 2018; Hurley et al., 2014; Schaider et al., 2017; E. Thackston, 2013). The main components of plastics are polymers which are formed from molecular, structure, degree of crystallinity and chemicals. Regardless of the chemical composition, two broad types of polymers have been identified: homopolymers and heteropolymers. The heteropolymers are polymers that have two or more different building-blocks, while the homopolymers have the same building-block unit. In the packaging sector, there are more 30 types of plastics used for packaging; however, the two of them that are commonly used are polyolefins and polyesters (Marsh & Bugusu, 2007b). There is a list of plastics which is coded and used in packaging, as shown in Table 2.3. Particularly, Polyethylene terephthalate (PET or PETE) is used widely in food products because of its lightweight, shatter resistance, transparency, and good barrier for gases and moisture (Marsh & Bugusu, 2007b).

Table 2.3 Resin identification codes for plastic recycling, summarising from (Leal Filho et al., 2019; Marsh & Bugusu, 2007; UNEP, 2018a).

Resin	Code	Characteristics and applications
Polyethylene terephthalate (PET)	1	It is lightweight and shatterproof. It prevents gases and moisture from being absorbed and is resistant to solvents, acids, mineral oils, and heat. It is used commonly for bottles of beverages, and mineral waters or biscuit trays. It is easy to recycle.
High-density polyethylene (HDPE)	2	It is stiff, easy to shape and resistant to moisture, and chemicals, and is suitable for containers of milk, juices, water, margarine, trash, groceries or ice cream containers. It is recyclable.
Polyvinyl chloride (PVC)	3	It is heavy, medium strong, ductile, stiff and transparent, and is barrier to chemicals, oil, and grease. It is used in bottles and packaging films or cosmetics, toys, and medical devices. It is difficult to recycle.
Low density Polyethylene (LDPE)	4	It is very flexible, resistant to moisture, and transparent. It is mainly applied in flexible lids, squeezable food bottles, and frozen food bags, food packaging film. It is recyclable.
Polypropylene (PP)	5	It is hard, dense, and transparent, as well as resistant to water vapour and chemicals. It is used in yogurt containers, margarine tubs, and bottle caps. It is easy to recycle.
Polystyrene (PS)	6	It is clear, hard and brittle, rigid, and lightweight. It is mixed with other plastics to make a range of products. It is used for cutlery, egg boxes, lids, cups, disposal plastic silverware, plates, and food trays. It is difficult to recycle but can be incinerated.
Other resins	7	-

Despite the above benefits for the food industry, plastic waste can adversely impact the environment due to their longevity and persistence. Therefore, in many countries, the use of SUPIs has been prohibited in recent times, particularly in the European Union (European Commission, 2013; "Interim Review of the Plastic Shopping Bags Ban," 2008). In addition, to the environmental impact, research also shows the side effects on human health, especially Bisphenol A, which was said to be absorbed into food from the plastic containers in certain conditions. (Rayne, 2008; US Food and Drug Administration, 2013). Recently, research has shown that migration of mercury from food paper-plastic packaging containers to food stimulants can occur at a certain temperature and time (Peng et al., 2020). However, the application of this material has continued to increase due to its advantages. The list of the most popular SUPIs used in the FFI include spoons, forks, knives (cutlery), cups, containers, straws, and bags. Among these SUPIs, cutlery, and straws are normally made of PP or PS, while cups and containers are often made from PET, PP, PS or paper and PE lining (European Commission, 2018b). Each kind of plastic is coded by a number from 1 to 7 which relates to the temperature at which it is recycled (Luijsterburg & Goossens, 2014). Therefore, to achieve a circular plastic packaging system, the separation of each kind of plastic is required for recycling. However, if the mixed plastic waste, especially containing PVC, is used for recycling, its application will be more limited (Jacobsen et al., 2018).

The third material is glass, which is odourless, durable, reliable, transparent, and recyclable, an excellent barrier to moisture and gas, and resistant to high temperatures. However, it is not greatly preferred in this industry due to its range of drawbacks, such as breakability, weight, and expense (Aaarnio, 2006). Nowadays, despite the development of lightweight glass, this type of material is not commonly used in the FFI because of its high price. However, the usage of this material is better for the environment due to its reusability and recyclability.

The final material typically used in the FFI is metal. Metal is excellent in all packaging forms due to its versatility (Marsh & Bugusu, 2007a). There are several types of metals used in the packaging service: steel, aluminium, tin, and chromium. The advantages of this material in packaging is its capacity for heat tolerance, durability, resistance to odour and recyclability.

2.2.3 Waste Generation and Management of Packaging Materials

Currently, the core materials used for packaging in the FFI include plastic and paper, which consume a huge amount of resources because they become waste after being used only once. According to Start and Culture (2016), there were three main issues in the FFI, including the environmentally friendly products which often are associated with a high cost; the balance between society's expectations and the economic burden of protecting the environment; and health-related issues (obesity) (E. Thackston, 2013). To deal with these issues, many large FFCs have applied the Corporate Responsibility and Sustainability practice to improve the usage of natural resources and attract their educated customers. In particular, upon observing the websites of FFCs, it can be seen that famous companies like KFC and McDonald's publish their sustainability reports, namely the Corporate Responsibility and Sustainability report for McDonald's (McDonald's Scale for Good, 2017) and the Corporate Social Responsibility for KFC (Bediako, 2018a).

Historically, the FFI has rapidly developed over the recent decades due to economic development and an increase in the "on the go" consumption culture, which in turn has created an increase in plastic waste and the issue of its disposal. The global fast food market is increasing at a compound annual growth rate of 4.2% and it is estimated to be worth more than $690 billion in 2022 (Zion Market, 2017). SUPIs are commonly used in

FFRs, small packaging industries and in grocery shops for the takeaway culture, which treats plastics as waste rather than a valuable resource. Thus, the FFI generates a considerable amount of packaging waste or SUIs, including cups, containers, cutlery, straws, lids, and bags. In 2015, this kind of plastic packaging accounted for 47% of the globally generated plastic waste, with more than 50% originating from Asia (UNEP, 2018c). It was estimated that food delivery packaging waste accounts for 1% of the annual municipal solid waste generated in China (Song et al., 2018a). Most packaging waste in the FFI ends up in landfills. This is evidenced by a study which found that the theoretical recovery potential of the packaging waste was 93%, but only 29% of this was recovered (Aarnio & Hämäläinen, 2008). The disposal of the packaging waste, especially plastic waste, has been considered as a waste of resources, a cause of the environmental pollution, and an adverse effect on marine life due to its persistence in the environment (Leal Filho et al., 2019; Moharir & Kumar, 2019). Therefore, addressing SUPIs and plastic packaging in the FFI should be considered as one of the priorities to deal with ocean pollution. Figure 2.2 presents the waste composition in the FFI in Vietnam.

[redacted]

Figure 2.2 The waste composition in the FFI in Vietnam

The consumption of SUIs, including SUPIs and SUPaIs, has increased due to the development of the FFI over the world (Gautam & Caetano, 2017). With the introduction of online food ordering and home delivery, especially through the use of mobile devices, a sharp increase in consumption of SUIs in the FFI has been reported (Gautam & Caetano, 2017). It was estimated that more than 69% of customers who ordered food via mobile devices (Gupta, 2019). Notably, plastic packaging waste accounted for one-third of the total plastic production, much of which was used for the production of SUPIs (UNEP, 2016). Globally, 360 million tons of plastic were produced in 2018 with 51% of the total plastic production originating from Asia (Plastics, 2019) and nearly 40% of plastic was discarded after a single use (Ocean Conservancy, 2019). It has been estimated that 12,000 Mt of plastic waste will be disposed of in landfills or in the natural environment by 2050 (Geyer et al., 2017). More importantly, 146 Mt of primary non-fibre plastics was used in the packaging industry, and these were mainly composed of polypropylene (PP), polystyrene (PE), and polyethylene terephthalate (PET) which contributed significantly to plastic packaging waste (Geyer et al., 2017). In particular, in the FFI, it was estimated that plastic packaging waste accounted for 11% of the waste generated in McDonald's restaurants in Finland (Aarnio & Hämäläinen, 2008). Additionally, plastic containers made of PP and polystyrene (PS) accounted for approximately 75% of the total packing waste in high-populated megacities in China (Song et al., 2018a), which is one of the major countries contributing to global marine plastic pollution (Ocean Conservancy, 2019).

The important issues in the FFI are waste management (Shokri et al., 2014) and reduction in the environmental impacts caused by the FFI, which were likely to be complex due to both a lack of awareness and a lack of data on the waste generated in this industry (Shokri et al., 2014). Therefore, research into sustainability and waste management in the FFI should be encouraged.

2.2.4 The environmental impacts of plastic packaging waste

This section focuses on the adverse impacts of the use of SUPIs, including the negative effects of plastic waste caused by the use and the disposal of SUPIs and plastic packaging. While the impacts of SUPIs on human health are not clearly demonstrated clearly or are insufficient (Toussaint et al., 2019), much research undeniably indicates the impacts of plastic waste on the animals and the environment due to its long persistence (Arvanitoyannis, 2012; Barnes et al., 2009; Davies & Konisky, 2000; Karbalaei et al., 2018a, 2018b; Leal Filho et al., 2019, 2019; Li et al., 2016; Luijsterburg & Goossens, 2014; Macur & Pudlowski, 2009; Madival et al., 2009; Marsh & Bugusu, 2007; Marsh & Bugusu, 2007b). These impacts include the following issues. 1) Plastic debris in the ocean harms animals. The debris is a threat to the wildlife through choking and starving or absorbing toxic chemicals (Barnes et al., 2009) (Yates et al., 2019). 2) The presence and accumulation of microplastics and other plastics affect the terrestrial and aquatic environments, and then enter the human food chain (Karbalaei et al., 2018a). 3) The bioaccumulation of plastic waste by organisms has led to the human food chain (Li et al., 2016). Particularly, plastics accumulated in ocean sediments as their ultimate destination and they then released additives, and environmental contaminants, which many marine species inevitably ingest them (Hale et al., 2020). According to Marsh & Bugusu (2007), the impacts of SUPIs include landfill (groundwater, air, and microplastics) and incineration (halogens, dioxins, heavy metals, acidic gases). The improper disposal of plastic packaging has been attributed to its low monetary value; thus, waste pickers do not choose it (Marsh & Bugusu, 2007b). The problems related to landfill include contaminating the air and groundwater through improper design and construction (Marsh

& Bugusu, 2007b). The most significant issue surrounding SUPIs, such as plastic food containers, is their negative effects on marine organisms (Gallego-Schmid et al., 2019).

2.2.5 Factors influencing on the waste generation in the fast food industry

One of the significant issues in the FFI has been waste management and recycling (Shokri et al., 2014). The research into the solid waste generation in the FFI has been limited due to difficulties with the data collection and its transparency (Shokri et al., 2014). According to Aaarnio (2006), the factors influencing the recovery of packaging waste in the FFI include (1) packaging waste legislation; (2) the type of SUIs material; (3) waste producers' behaviours; and (4) existing solid waste infrastructure.

The FFI includes one-way sales packaging and then releasing them on the market. Thus, the amount of plastic waste generation is attributed to the following factors:

- Policies or legislation related to the plastic waste generation and management in the FFI and overall (the role of the government)
- Behaviour of waste producers (the role of customers and fast food companies)
- The plastic waste collection system (the role of the government)
- The plastic recycling technologies (the role of plastic manufacturers/recyclers)

2.3 OVERVIEW OF POLICY MEASURES ON SINGLE-USE PLASTIC ITEMS OVER THE WORLD

Globally, ocean plastic is one of the most pressing concerns; thus, many countries have enacted a vast number of measures to improve plastic litter in the ocean. Reducing the number of SUPIs by issuing policy instruments or evaluating existing measures are effective methods that many countries have been using (Xanthos & Walker, 2017). Many countries have applied a variety of different types of measures to prevent the release of plastic waste into the marine environment.

Applying integrated policy measures is preferred by most countries. In particular, there is encouragement for popular measures to be applied, including information campaigns, mandatory labels, voluntary agreements or voluntary commitments, extended producer responsibility (EPR), deposit refund scheme (DRS), mandatory recycling, and specific requirements on product design, ban, and taxes or levies. Many countries have enacted integrated measures to phase out SUPs (European Commission, 2018b).

The use of information campaigns, which is a policy measure that targets to customers to enhance their understanding about the adverse impacts of plastic litter or marine plastics, aims to improve their behaviour regarding SUP disposal and encourages them to consider single-use non-plastic, alternatives or multiple items, instead (European Commission, 2018b; *The Seductive Power of Single Use Plastics*, n.d.). This approach may include general information for the general public or it may target specific customers, and the content and methods are varied depending on the different audiences (*A Running List of Action on Plastic Pollution*, n.d.). Information campaign can be considered a type of public awareness strategy which focuses on the reuse and recycling of resources (UNEP, 2018b). This measure is proven to be very effective during the preparation period for a new ban on a type of SUPs (UNEP, 2018a).

Mandatory labels to discourage littering is a policy measure that provides direct information to customers about the recycling potential of a type of packaging material (European Commission, 2018b). The message on labelled items plays a vital role in encouraging customers to undertake appropriate actions to reduce plastic litter (European Commission, 2018b). This method assists customers to recognise the packaging material more easily because it indicates to the customers whether the product can be recycled or not (*Bring in Laws to Force Companies to Make Recycling Labels Simpler, MPs Told*, n.d.).

Volunteer agreements are taken by industrial sectors to bring changes without applying policies (European Commission, 2018b). Volunteer agreements can be made between producers/retailers and the government as a public-private collaboration to gain a specific target for recycling or alternatives (UNEP, 2018b). Some researchers have come to believe that the global plastics agreement plays an essential role in the industry and it is important to connect this with the global design standards and the voluntary national finance plans (Raubenheimer & Urho, 2020). Although this is a new idea, it should be considered for a circular economy. Voluntary agreements (also known as voluntary commitments) have been utilised by both industrial and individual firms (Watkins et al., 2019). This measure enables producers to build trust among their customers regarding their environmental protection strategies. This has proven to be an effective measure in several countries, such as Singapore and countries in Europe (Paul M. Muchinsky, 2017).

The EPR is a policy instrument in which the responsibility for the use and disposal of the material extends to the product's entire life cycle. This includes beginning from producers, manufacturers, retailers, distributors to the post-consumer stage of a product's life cycle, including clean-up, recycling or other methods of disposal, requiring producers to organise and pay for the treatment and recycling of the waste generated by their products on the market (European Commission, 2018b; UNEP, 2018a). Globally, there are approximately 63 countries which have used the EPR as a mandate for SUPIs (UNEP, 2018a); of which, 38 countries are in the EU, nine are in the Asia-Pacific region, nine are in Latin America and the Caribbean, and seven are in Africa. The effective use of the EPR has brought significant results for European countries where 35% of e-waste and 65% of packaging waste have been recycled in this way (Kunz et al., 2018).

The DRS is a policy measure which brings economic benefits to customers when they return their empty containers (European Commission, 2018b). This measure encourages others to collect and return SUPs because they have a high economic value; therefore, it prevents SUPs from ending up in the ocean either directly or indirectly. It has been successfully applied in 23 countries over the world, including 15 European countries, five Asia-Pacific countries and three countries in the Caribbean and America (UNEP, 2018a). This approach has gained a higher recycling rate of the SUPs which have a high economic value, such as bottles and cans. European countries have achieved a recycling rate of over 90% for drinks bottles, caps and lids (UNEP, 2018a). Figure 2.3presents a supply chain of the DRS. In the system, firstly, the producers/importers sell the filled containers (water bottles, food containers, etc.) to the retailers who pay for the food or drink, including the money for the deposit. In the next step, the consumers buy the food or the drink, paying the deposit to the retailers. Consequently, consumers will receive the deposit back when they return the empty containers to the retailers or redemption centres or depots. The retailers also have to manage these empty containers before returning them to the recyclers as well as provide data information about the recycling rate. The retailers then receive their deposit back upon returning the collected empty containers to the recyclers. Finally, the recyclers process the empty containers into the second raw materials which are then delivered to producers or importers. Notably, the recyclers receive an administrative fee from the producers/importers for managing this waste supply chain (Cottafava et al., 2019).

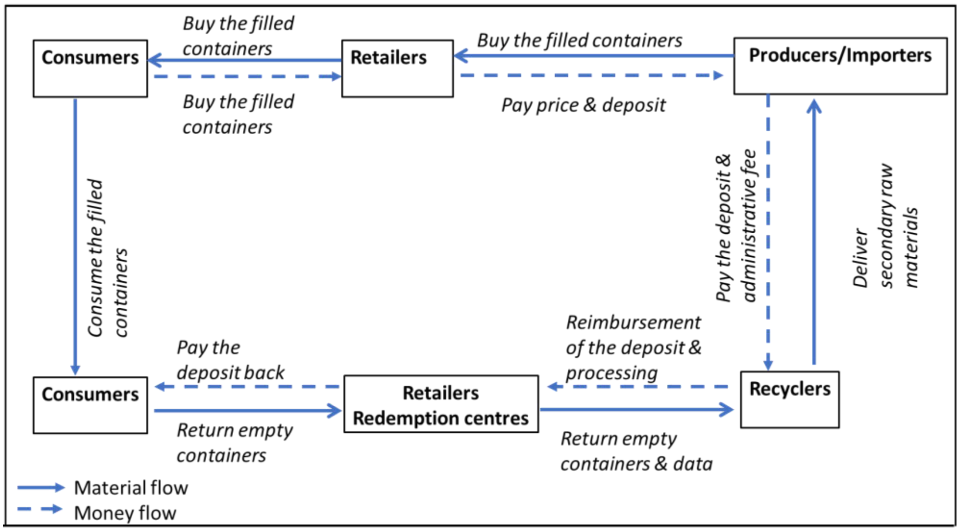

Figure 2.3 The supply chain of a Deposit Refund System for single-use containers, adopted from (Cottafava et al., 2019).

A recycling mandate, which is being applied in over 50 countries around the world, requires the recycling of SUPs post-consumer use (UNEP, 2018a). These policy measures generally are required as laws or regulations in which plastic recycling for SUPs is mandatory or as a component of the EPR in many countries. For instance, India is requiring plastic producers, importers and brand owners to phase out their non-recyclable multilayered plastic in two years (UNCRD, 2019). In European countries, the EU Directives on Packaging and Packaging Waste stipulates recycling as a constituent of packaging and packaging waste recovery (UNEP, 2018a).

A ban may focus on specific products or restrictions on the manufacture, use, distribution, import, and sale of SUPs, but most have focused on food delivery and service (UNEP, 2018a) (UNCRD, 2019). The regulations can be compulsory at a subnational or national level. Banning is one of the popular policy instruments to be used by most governments to control SUPIs in their countries (Schnurr et al., 2018).

Taxes on plastics inevitably lead to an increase in the price of plastics; therefore, customers tend to shy away from such plastic products. Taxes can apply to manufacturers, producers or importers or retailers to reduce the use of, or to increase the recovery rate of SUPs (UNEP, 2018a). Twenty-nine countries, including eight countries in Asia and the Pacific region, have introduced an environmental tax, waste disposal fees or charges on SUPs (UNEP, 2018a) (UNCRD, 2019). In the UK, by applying a charge on plastic bags, consumption of these has decreased to 83% of plastic (Watkins et al., 2019).

Apart from the above-mentioned policies, many other policy measures to control the use of SUPs have been adopted around the world. More specifically, they are specific sales restrictions, requirements on product design, green public procurement, standards for wastewater treatment works and combined sewer overflows or consumption levies. All these legal instruments have been applied effectively in the reduction of SUPs (European Commission, 2018b). In fact, it has been suggested that each country should use integrated policy measures and monitor their performance to ensure the positive impacts on the management of plastic waste.

2.3.1 Overview of policies on plastic bags over the world

Policy measures to control the use of plastic bags globally is indicated in Figure 2.4. According to this figure, a variety of measures have been applied to control consuming of plastic bags over the world. Most countries prevent the use of plastic bags by banning (black colour) and pricing mechanism (dark grey) or countermeasure (light grey colour).

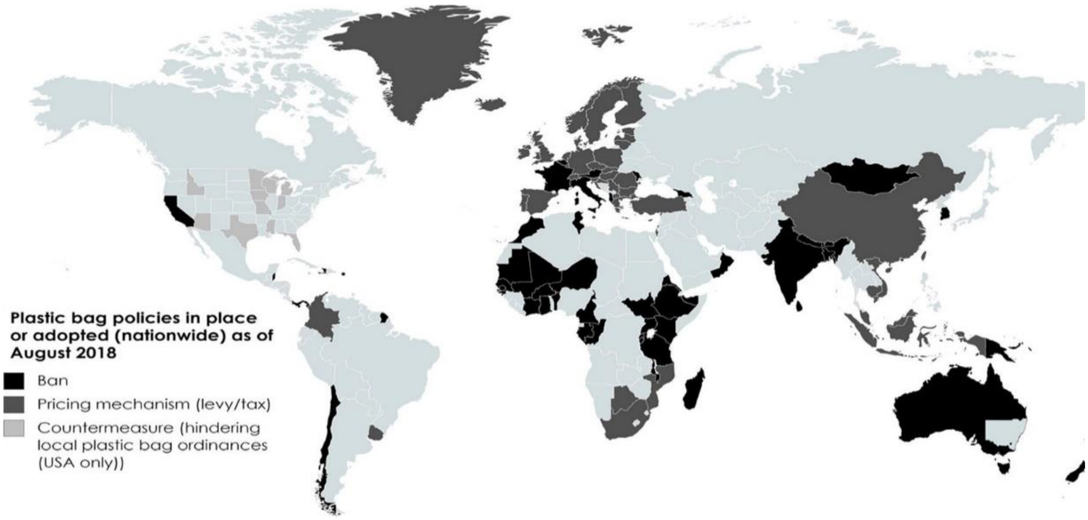

Figure 2.4. Policies of lightweight plastic bags over the world (Nielsen et al., 2019a).

Regarding legislation interventions, there were approximately 50 different forms of legislation to control the use of plastic bags over the world (see Figure 2.5) (Nielsen et al., 2019b). Among which, EU countries had the largest number of legislation interventions, with 16 forms of legislation; in contrast, Oceania and South America had fewer legislation, with three and five regulations, respectively. Nielsen and his colleague (2019) also indicated that banning was one policy measure that has been most commonly adopted (56%), followed by levy or tax (32%) (Nielsen et al., 2019b) as shown in Figure 2.6.

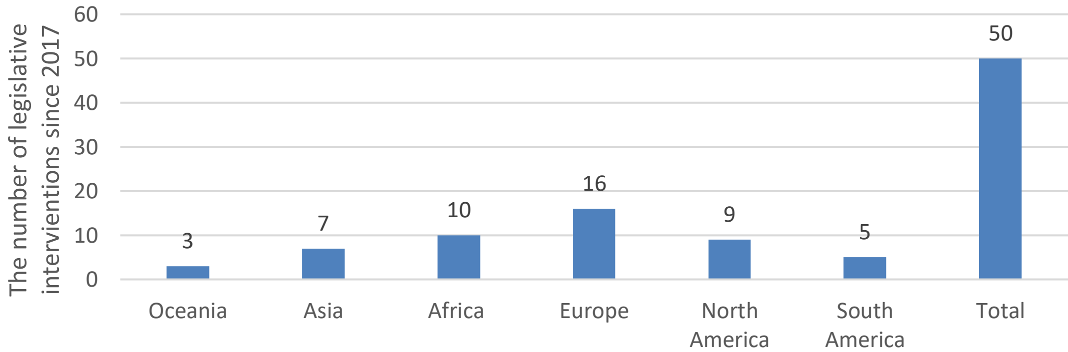

Figure 2.5 Legislation interventions for plastic bags since 2017 (Schnurr et al., 2018).

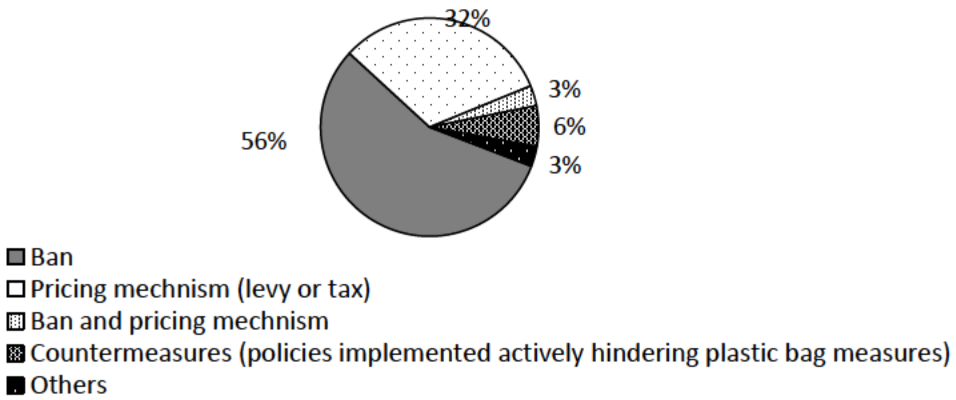

Figure 2.6 Percentage of types of plastic bag policy measures being implemented worldwide, adapted from (Nielsen et al., 2019b).

However, according to UNEP (2018), there were 127 countries which adopted national legislation to ban plastic bags in 2018 (UNEP, 2018a). Among of those 127 countries, 91 countries have enacted to prohibit plastic bags, which included banning the manufacture, import and retail distribution (55 countries). The remaining countries have opted to ban only retail distribution (19 countries), only retail distribution import (10 countries), and manufacture, import and retail distribution both (7 countries) (UNEP, 2018a) (see Figure 2.7).

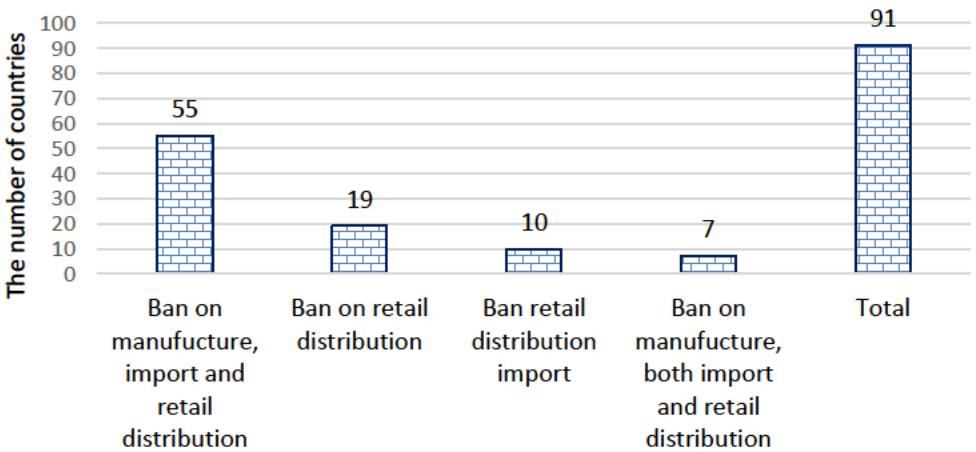

Figure 2.7 The number of countries restrictions or bans on plastic bags worldwide, adapted from (UNEP, 2018a).

In terms of fees or levies on plastic bags, 49 countries have applied fees as presented in Figure 2.8 (UNEP, 2018a). According to Nielsen and his colleagues (2019), the fees on plastic bags accounted for approximately 32% in comparison with other policy interventions (Nielsen et al., 2019b).

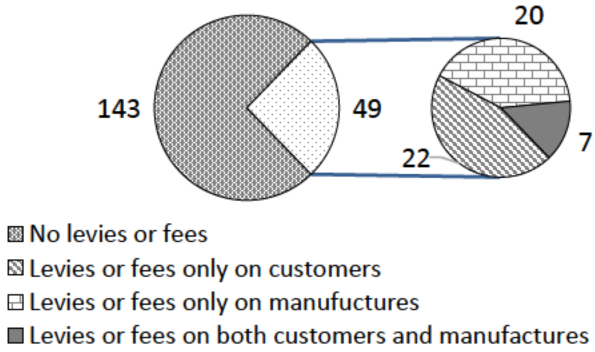

Figure 2.8 Countries with levies and fees according to type, adapted from (UNEP, 2018a).

According to Figure 2.8, among the aforementioned, 49 countries, 22 of them have applied levies or fees to only customers, while 20 have forced only manufacturers to pay fees for their plastic bags. The remaining seven countries have applied fees or levies to both of these groups.

2.3.2 Overview of policies on single-use plastic items in the world

According to UNEP, there were 27 countries which have enacted a ban on SUPIs, including specific products or materials or product limits (see Figure 2.9) (UNEP, 2018a). Among these 27 countries, island countries accounted for approximately 37% (10 countries), and14 of them have banned specific products materials, nine of them ban specific products only, two countries ban specific materials and two have prohibited only production volume restriction (Figure 2.9). However, Schnurr and his colleagues (2018) showed numbers of legislative interventions on straws, cutlery, and polystyrene at regional levels since 2018: Asia (2), Africa (1), Oceania (1), Europe (6), South America

(1), and North America (33) (Schnurr et al., 2018). In addition, , according to UNCRD (2019), there were eight countries that had have national bans and restrictions on SUPs in the Asia-Pacific region (UNCRD, 2019).

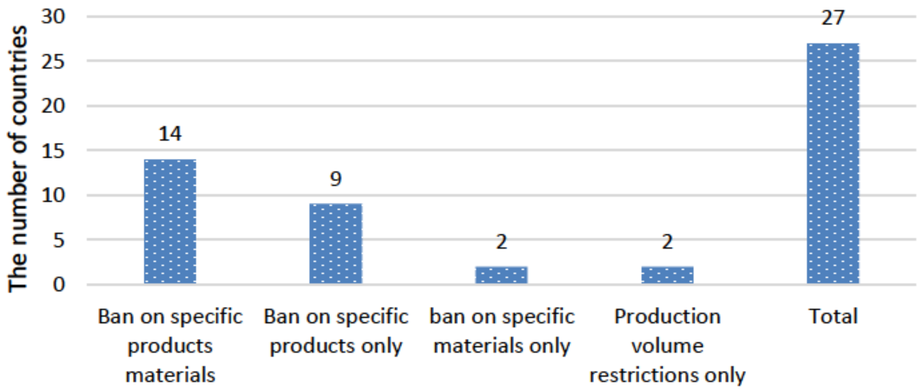

Figure 2.9 Countries which have enacted bans on SUPIs or materials or production levels, retrieved from (UNEP, 2018a).

As drawn in Figure 2.10, the Asia & Pacific region, Europe and Latin America and the Caribbean areas have higher numbers of countries which have enacted bans on manufacturing, free distribution and importing plastic bags. Notably, the Asia & Pacific region has had the highest number of countries banning the import (six countries) and free distribution (six countries) of plastic bags worldwide (UNEP, 2018a).

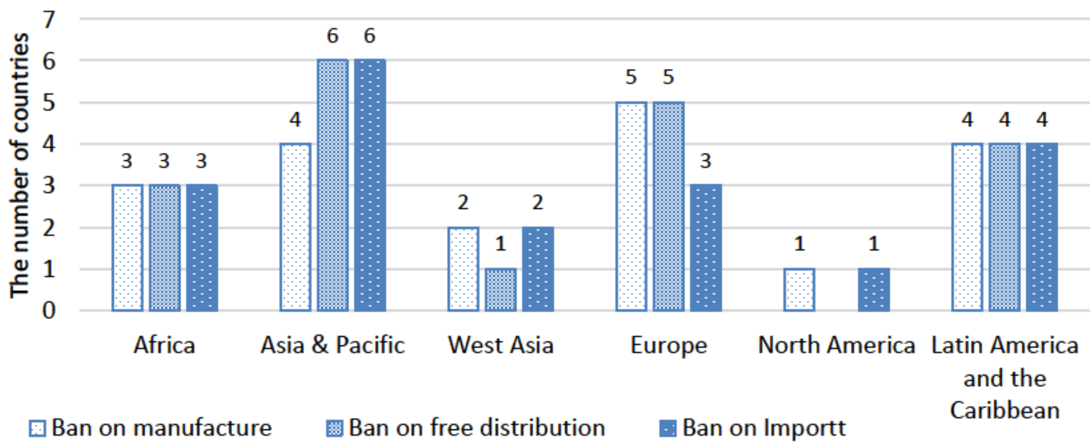

Figure 2.10 Bans and restrictions by region, adapted from (UNEP, 2018a).

There is a vast difference in waste management policies between developed countries and developing countries, which is also related to SUPIs policies (Mmereki et al., 2016). In terms of these differences, these policies have not been established well and the waste management system is inefficient. The factors contributing to their inefficiencies are: the lack of stakeholder cooperation, institutional structural weaknesses, lack of legislated recycling, and ad hoc and uncoordinated approaches (Mmereki et al., 2016).

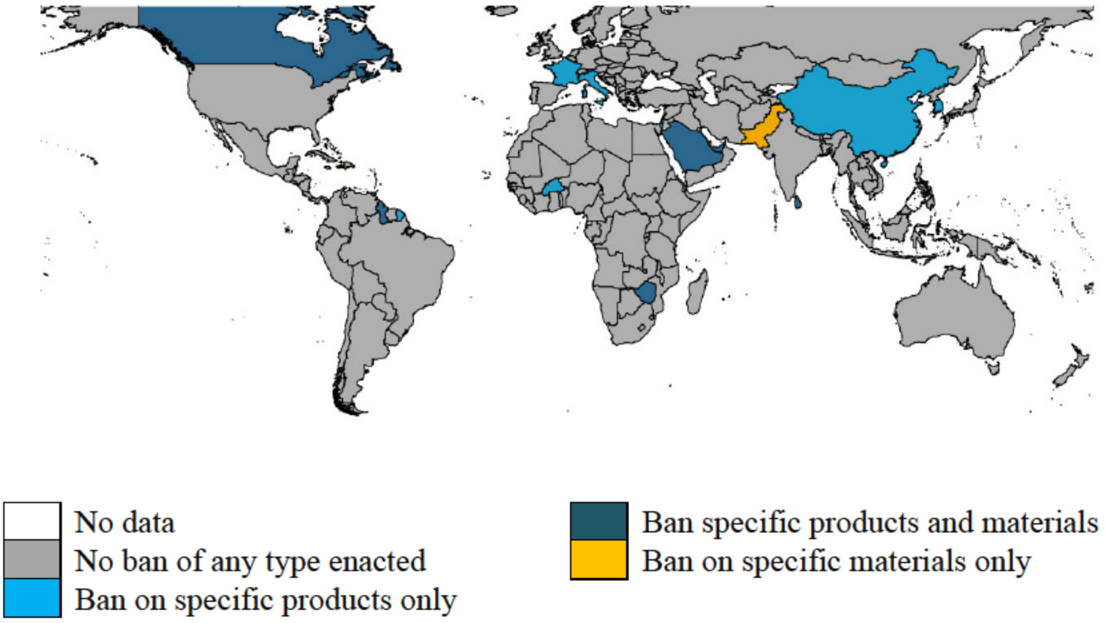

Figure 2.11 Ban of SUPIs on specific products worldwide (Excell et al., 2018).

Figure 2.11 provides policies on prohibition of SUPIs. From this Figure, it can be seen that most countries over the world have not forbidden any kinds of SUPIs. Among the countries, the most have banned specific products and materials and only Pakistan has banned specific materials, while only Pakistan has banned specific materials (UNEP, 2018a). Four countries, including China, France, Italy, and Burkina Faso prohibited only specific products (UNEP, 2018a).

The EU is one of first areas issuing policies on SUPIs over the world. The success in and lessons learnt from applying these policies in these countries encourages other countries to pursue the same policies. Therefore, the EU has been selected to review in this chapter.

2.4 POLICIES ON SINGLE-USE PLASTIC ITEMS IN EUROPEAN COUNTRIES

European countries generated about 8.4 million tons of plastic waste in 2017 and approximately 40% of this was plastic packaging (PlasticsEurope, 2018). Most of this plastic waste was made of PP, PE or PS; thus, these countries have tried to reduce ten of the most common popular SUPs to end up on beaches (cotton buds; cutlery, plates, straws and stirrers; sticks for balloons and balloons; food containers; cups for beverages; beverage containers; cigarette butts; bags; crisp packets/sweet and sanitary items) (Commission & Juncker, 2017). In these countries, approximately 80% of marine litter was plastic (European Commission, 2018c); among of which, SUPIs accounted for 50% (Directive (Eu) 2019/904, 2019). However, currently, these countries have experienced a certain success in increasing the rate of plastic packaging recycling (75%) (PlasticsEurope, 2018). Data from recycling centres in Denmark in 2019 showed that impurities appeared about 28% of plastic waste; of which, 75% of the plastic waste was considered as low-quality characteristics (Faraca & Astrup, 2019).

The EU introduced the European Strategy for Plastics in 2018, which prioritised the development of its economy toward a circular economy for plastics (European Commission, 2018a). The strategy focused on the following four goals: (1) Improving the economics and quality of plastic recycling; (2) Curbing plastic waste and littering; (3) Driving investment and innovation; (4) Harnessing global actions (European Commission, 2019) as presented in Appendix A. According to this strategy, a 2030 Voluntary Commitment was born to prevent the leakage of plastics into the environment and to enhance resource efficiency, as well as to utilise plastics in a circular method (PlasicsEurope, 2019). The Voluntary Commitment aims to reuse and recycle 60% of plastic packaging by 2030 and has a target to achieve 100% reuse, recycling, or recovery of all plastic packaging by 2040 (PlasicsEurope, 2019).

Following the above strategies, the European Commission (EC) has issued many regulations and directives on SUPIs aiming to require the member states to be responsible for the marine plastic problem as presented in Table 2.4. Notably, the EC has issued the Directive 2019/904 on the reduction of the environmental impacts of certain plastic products (Directive (Eu) 2019/904, 2019). The Directive has required the member states to prohibit selected SUPIs, including cotton buds, cutlery, plates, straws, stirrers, sticks for balloons, cups, and food and beverage containers made of expanded polystyrene. In addition, the Directive also has required the member states to adopt measures to reduce the consumption of plastic beverage cups and plastic food containers, as well as to mark and label certain products in the market. Also, in EU countries, EPR schemes pay the costs associated with waste collection, litter clean-up and data collection and the reporting of wet wipes, tobacco and balloons. 70% of PET bottles are required to be separated and collected for recycling by 2025, and this is to be 90% by 2030 (Directive (Eu) 2019/904, 2019).

Generally, the EC issued Directive (EC) No. 2015/720 which addresses the reduction in the consumption of lightweight plastic carrier bags as a part of an effort to phase out SUPIs in 2015 (EEA, 2015). Recently, in the EU, most SUPIs have been restricted by regulations related to the following actions: (1) Consumption restriction; (2) Market restriction; (3) Product design requirement; (4) Marking requirements; (5) EPR; (6) Separate collection objective; (7) Awareness-raising measures (Table 2.4).

Table 2.4. The European Regulations for types of SUPIs, modified Foschi and Bonoli, modified from (Foschi & Bonoli, 2019).

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]		[redacted]		[redacted]		[redacted]
[redacted]	[redacted]		[redacted]		[redacted]		[redacted]
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[redacted]			[redacted]		[redacted]		[redacted]
[redacted]			[redacted]		[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]		[redacted]	[redacted]		[redacted] 2019/904 EC

2.4.1 Extended Producer Responsibility (EPR) in the EU

The EPR scheme in European countries (see Figure 2.12) enacted under the support of the Producer Recycling Organizations (PROs) which were responsible for providing a vital interface for organizing financial transactions, collections, and communications among stakeholders (Kunz et al., 2018; Study, 2007). The stakeholders who participated in the EPR scheme consisted of governments, producers, waste companies, retailers, and municipal authorities (Study, 2007). Thus, the PROs were created on behalf of producers or the industry to take on the financial management responsibility relating the established EPR system. In the EU, there were many the PROs at the national or the union levels (Kunz et al., 2018). The scheme has achieved a certain amount of success in the management of electrical waste and packaging waste since the 1990s (Cahill et al., 2011). In 2018, with the contribution of EPR schemes, 9.4 million tons of plastic post-consumer waste were collected in Europe; of which, 32.5% was recycled and its recycling rate has doubled since 2006 (PlasticsEurope, 2019).

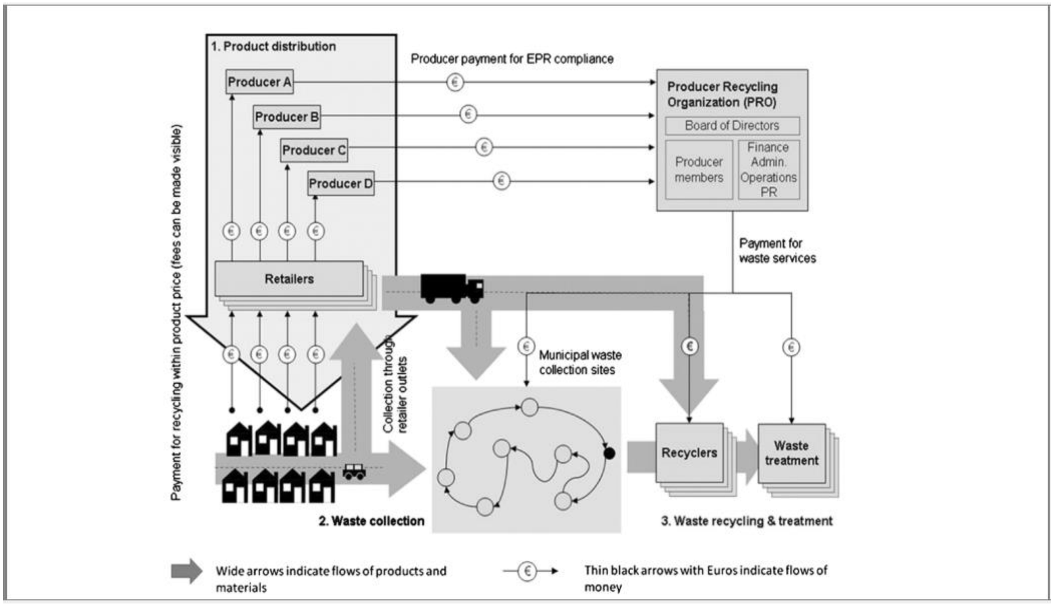

Figure 2.12 EPR system in Europe (Study, 2007).

In European countries, the Producer Recycling Organizations may be introduced as single national schemes working within a specific industry or multiple competing schemes within a country (sector) (Study, 2007). The EU's EPR regulations or directives have required producers to increase their collection targets and the recycling costs of their products over the years. These regulations have aimed to encourage plastic producers to improve their product design and reduce the volume of new products on the market, as well as encourage the producers to use materials which are easier to recycle, recover, or treat (Kunz et al., 2018).

EPR has been a popular policy tool used to increase the recycling rate of post-consumer plastic waste in the EU. Through the EPR scheme as regulations by every State Member in the EU, producers have been required to take responsibility for their packaging waste, including plastic packaging. Thus, the EPR has been one of the methods to make moves toward a circular economy for plastic products (Leal Filho et al., 2019). According to EPR schemes in the EU countries, fees vary based on the types of plastics (Watkins et al., 2019). An example of the application of the EPR for PET bottles is presented in Table 2.5.

Table 2.5 Summary of producer fees for PET bottles in the EU, retrieved from (European Commission, 2018b).

Summary of producer fees for PET bottles, EU (€ Euro)					
Country	Small clear	Larger clear	Small coloured	Larger coloured	International barcode
Sweden	0.022	0.052	0.027	0.057	
Norway		0.0198		0.0286; 0.0363	0.0033
Finland	0.0172	0.0344	0.02459	0.03934	0.005
Estonia	0.002 - 0.0286	0.007	0.002	0.007	
Denmark		0.0299-0.0403	0.0299-0.0403	0.0299 - 0.0403	
Lithuania	0		0	0.03	

Despite its success in plastic waste management in the EU, the implementation of the EPR for plastic waste in these countries has also shown its drawbacks, such as the lack of binding mechanisms and incentives for enterprises to participate. Thus, it is necessary to redesign the EPR framework so that there will be an efficient method for dealing with SUPIs in these countries (Cai & Choi, 2019; Leal Filho et al., 2019).

2.4.2 Policies on plastic bags in the European countries

A list of policy measures to control the use of plastic bags, which have been adopted by European countries, is presented in Table 2.6. It can be seen that in 2015,the Directive (EC) No. 2015/720 on reducing the consumption of lightweight plastic carrier bags in an effort to phase out SUPIs to protect the marine environment was enacted in the EU (EEA, 2015). The UK applied a "5p plastic bag" charge in 2015 and Wales started 5p plastic bag charge in 2011 (*The 5p Plastic Bag Charge: All You Need to Know - BBC News*, n.d.).

2.4.3 Policies on SUPIs in the European countries

A list of policy measures to control SUPIs in Europe is presented in Table 2.6. As the table shows, Belgium introduced a ban on straws in 2020 (*Belgium: The Last Plastic Straw | Focus on Europe - Spotlight on People | DW | 19.07.2018*, n.d.). Meanwhile, Norway planned to forbid plastic cutlery, plates, and straws in 2020 (*Norway to Fast Track Single-Use Plastics Ban*, n.d.). Regarding policies on SUPIs, most of them focus on cutlery, straws, and polystyrene (Schnurr et al., 2018). Germany was one of the first countries to phase out SUPIs by law (*Germany: Draft Bill to Ban Plastic Bags on the Way | News | DW | 06.09.2019*, n.d.; *Tübingen to Be First Town in Germany to Tax Disposable Coffee Cups, Pizza Boxes | News | DW | 22.12.2018*, n.d.). Additionally, France has a list of banned SUPIs, including plates, cups, and cotton buds (*France to Phase out Single-Use Plastics Starting January 1*, n.d.-a). The UK has enacted to prohibit straws, cotton buds, stirrers in 2020 (Environmental Protection, 2020).

Table 2.6 Policy measures for plastic bags in the EU

Countries/ Regions	Year	Types of ban or restriction	Types of SUPIs	Impact/Effect/Targets	Reference
All State Members of the EU	2015	Tax or pricing mechanism or other measures	Lightweight plastic bags	**Targets:** By 2018, all state members had their own measures to reduce plastic bags (less than 50 microns consumption) and by 2019, the reduction to 90 bags per citizen and to 40 by 2025. By 2017, all State members shall implement to recognizing label for all bags used to provide the information for customers.	(UNEP, 2018b)
Ireland	2002	Tax	Plastic bags "Plastax"	Dropped by more than 90% after 1 year applied. 328 bags/person --> 21/person/year.	(UNEP, 2018b) (Bell et al., 2018)
Austria	2016	Voluntary Agreements	EU Plastic Bags Directive 90 bags/person/year by 2019	Maximum 25 bags/person/year (any materials). Supermarkets stop providing free or charge reusable bags.	(UNEP, 2018b)
Belgium	2003	Tax	Plastic bags	60%-80% reduction in the consumption	(Nielsen et al., 2019b)
	2007	Tax	Plastic bag	60%-80% reduction in the consumption	(Nielsen et al., 2019b)
Belgium (Wallonia)	2016	Ban	Lightweight plastic bags		(Nielsen et al., 2019b)

Countries/ Regions	Year	Types of ban or restriction	Types of SUPIs	Impact/Effect/Targets	Reference
Belgium, (Brussels)	2018	Ban	Ultra-lightweight plastic bags	Ban on using at supermarkets in 2017 and to all retailers in 2018.	(European Commission, 2018b), reviewed in (Schnurr et al., 2018)
Denmark	1994	Tax	Plastic bags	Reduced 66% in the consumption	Reviewed in (Nielsen et al., 2019b)
France	2016	Ban	Lightweight plastic bags		(*Belgium: The Last Plastic Straw | Focus on Europe - Spotlight on People | DW | 19.07.2018*, n.d.)
France	2017	Ban	Ultra-lightweight plastic bags used to pack fruit and vegetables, meat, and fish.		(*Belgium: The Last Plastic Straw | Focus on Europe - Spotlight on People | DW | 19.07.2018*, n.d.)
Italy	2019	Ban	Ultra-lightweight bags were used to pack fruit and vegetables, meat and fish, being replaced with biodegradable or compostable alternatives charged.		(Xanthos & Walker, 2017)
Scotland	2018	Ban (proposed)	Plastic cotton buds (proposal to introduce a ban will be put to public consultation)		(UNEP, 2018b)

Countries/ Regions	Year	Types of ban or restriction	Types of SUPIs	Impact/Effect/Targets	Reference
Argentina	2008 2012	for tax; for ban	1.05 billion plastic bags were delivered to Buenos Aires annually.	After two years, supermarkets had to replace single-use plastic bags with biodegradable bags.	(UNEP, 2018b)
Germany	1991	Plastic bag tax	Plastic bag		(UNEP, 2018b)
	2015	A voluntary commitment	Plastic bags	Reduced 64% since 2015	(*Germany: Draft Bill to Ban Plastic Bags on the Way | News | DW | 06.09.2019*, n.d.; Nielsen et al., 2019b; UNEP, 2016, 2018a, 2018b)
	2016	Tax	Plastic bags		(*Germany: Draft Bill to Ban Plastic Bags on the Way | News | DW | 06.09.2019*, n.d.; Nielsen et al., 2019b; UNEP, 2016, 2018a, 2018b)
	2020	Law (ban - bill)	Plastic shopping bags		(*Germany: Draft Bill to Ban Plastic Bags on the Way | News | DW | 06.09.2019*, n.d.)
UK	2009	Voluntary targets by supermarkets to reduce 50%	Plastic shopping bags		(*Germany: Draft Bill to Ban Plastic Bags on the Way | News | DW | 06.09.2019*, n.d.; Nielsen et al., 2019b; UNEP, 2016, 2018a, 2018b) (*Single-Use Plastic Carrier Bags Charge: Data in England for 2017 to 2018 - GOV.UK*, n.d.)
Wales (UK)	2011	Charge/fee Under "5p per bag"	Shopping bags	Dropped 71% in the number of bags used in the same year	(*The 5p Plastic Bag Charge: All You Need to Know - BBC News*, n.d.)

Countries/ Regions	Year	Types of ban or restriction	Types of SUPIs	Impact/Effect/Targets	Reference
Northern Ireland (UK)	2013	Fee/charge	Shopping bags	Dropped 18% in the first year	(*The 5p Plastic Bag Charge: All You Need to Know - BBC News*, n.d.)
UK	2015	Fee/charger - 5p plastic bag charge	Plastic bags	1.75 million bags in 2017-2018 and 19 bags/person - 86%, 24 bags/person and 2.12 million bags used in 2016-2017	(*Single-Use Plastic Carrier Bags Charge: Data in England for 2017 to 2018 - GOV.UK*, n.d.)
Netherland	2016	Ban or a levy of 25 Euro cents	Distribution of free plastic bags		Reviewed in (Xanthos & Walker, 2017)
Sweden	1974	Voluntary agreements	Plastic bags		(UNEP, 2018a)
Luxembourg	2004	Information campaign	Plastic bags	85% reduction over 9 years applied	Reviewed in (Xanthos & Walker, 2017)
Portugal	2015	Tax	Plastic bags	The reduction of 90% in consumption at supermarkets and stores	(Schnurr et al., 2018) (Xanthos & Walker, 2017)
Bulgaria		Fee	Plastic bags		(UNEP, 2018a)

Table 2.7 The European countries have enacted to ban SUPIs, not including plastic bags

Countries	Year	Types of ban or restriction	Types of SUPIs	Reference
Belgium	2020	ban	Straws	(*Belgium: The Last Plastic Straw | Focus on Europe - Spotlight on People | DW | 19.07.2018*, n.d.)
France	2018	ban	Plastic cotton buds	(European Commission, 2018b)
	2020	ban	Cups, plates, cutlery, plastic coffee cups which will instead be delivered in compostable containers	(Schnurr et al., 2018) (Xanthos & Walker, 2017)
	2021	ban	Plastic straws, cutlery, stirrers, takeaway cups, Lids, styrofoam containers,	(*France to Phase out Single-Use Plastics Starting January 1*, n.d.-b)
	2022	ban	Distribution of free plastic bottles disposal dishes in FFRs (onsite)	(*France to Phase out Single-Use Plastics Starting January 1*, n.d.-b)
Italy	2019	ban	Non-biodegradable cotton buds	(Xanthos & Walker, 2017)
	2018	ban (a bill)	The import and placing on the market of disposable plastic utensils.	(Xanthos & Walker, 2017)
Scotland (UK)	2018	ban (proposed)	Plastic cotton buds (proposal to introduce a ban will be put to public consultation)	(UNEP, 2018b)
	2018	ban (proposed)	Plastic straws	(UNEP, 2018b)
	2030	ban	SUPs - ensure plastic is reusable or recyclable by 2030.	(Schnurr et al., 2018) (Xanthos & Walker, 2017)
Spain (Balearic Islands)	2020	ban	All SU consumer plastics items will have to become easily recyclable or switch to biodegradable alternatives	(UNEP, 2018b)
	2020	law	Wet wipes will be required to be clearly labelled so as to prevent flushing	
	2018	law in discussion	Requiring restaurants to provide tap water free of charge	
Germany (Tubingen)	2018	tax	Coffee cups, pizza boxes and other food delivery containers	(*Tübingen to Be First Town in Germany to Tax Disposable Coffee Cups, Pizza Boxes | News | DW | 22.12.2018*, n.d.)
United Kingdom	2020	law – draft (regulation)	Plastic straws, stirrers	(Environmental Protection, 2020)
Norway	2020	ban (proposed)	Disposable plastic cutlery, straws and plates	(*Norway to Fast Track Single-Use Plastics Ban*, n.d.)

2.5 OVERVIEW OF POLICIES ON SINGLE-USE PLASTIC ITEMS IN ASIAN COUNTRIES

As with Vietnam, Indonesia is also one of the countries which is significantly responsible for the issue of plastic ocean pollution in the Asia and the Pacific region (UNCRD, 2019). Therefore, this section will concentrate on reviewing the policies of SUPIs in these countries. Indonesia, in comparison with Vietnam, has the same situation in terms of both geographical position with a huge square of coastal areas and ranked to be the top five of countries released plastic waste into the ocean (UNCRD, 2019). In addition, Singapore is one of leading countries in East-Asia region that has issued the priority policies on plastic waste management. Therefore, Vietnam can learn from these countries and that is why these countries were selected to review in the research

2.5.1 Policies on single-use plastic items Singapore

Singapore lacks land for dumping waste; thus, plants turning waste into energy have been installed effectively in this country. These plants transferred approximately 8000 tons of waste into energy every day in the 2000s (Bai & Sutanto, 2002; This et al., 2018). In the period of 15 years from 2000 to 2015, the amount of solid waste generated increased from less than 2 million tons to about 7.6 millions of tons and it was roughly 7.2 million tons of solid waste in 2019 (*NEA | Waste Statistics and Overall Recycling*, n.d.). Data of waste composition and recycling rate of each type of waste has been published annually in the website of the National Environment Agency (*NEA | Waste Statistics and Overall Recycling*, n.d.). In this island country, approximately 1313 waste recycling centres were established in 1996 (Seik, 1997)and these centres were responsible for the collection of the separated waste. However, in 2018, approximately 900,000 tons of plastic waste was generated in Singapore, from with a population of only 5.6 million.

Notably, only 4% of this plastic waste in this country was recycled (Akenji et al., 2019b; *NEA | Waste Statistics and Overall Recycling*, n.d.). The problem appears to stem from the fact that most plastic waste was generated by the over-packaging and the usage of plastic bags; on average, one Singaporean used 13 plastic bags per day in 2018 (Akenji et al., 2019b). In an effort to deal with this plastic waste, Singapore exported it to other countries (China, Vietnam, Indonesia, Malaysia), accounting for 5% of the total plastic waste generated and roughly 81% plastic recycled (Kerdlap et al., 2019). However, 50% of plastic waste collected was incinerated in this country (Prata et al., 2019). In this country, the waste composition was suitable for incineration technology, especially Refuse Derived Fuel technology, which has been utilised effectively in the land-scare country (Akenji et al., 2019b; Zhao et al., 2016).

Data from the website of the National Environment Agency indicates that companies could access 3R guidebooks for each industrial sector, including hotels, schools, supermarkets, and retail food establishments (*NEA | Guidelines*, n.d.). Therefore, waste was sorted everywhere, which led to an increase in the recycling rate of each kind of waste composition. In addition, during the period of 15 years, from 2003 to 2018, the percentage of recycled waste increased by 23% while the volume of disposed waste reduced by 13% (Kerdlap et al., 2019).

Remarkably, the Singapore Packaging Agreement has been in effect since 2007, and aims to reduce packaging waste from consumer products, and raising public awareness on packaging waste minimisation. As indicated in this agreement, the lifecycle management of consumer packaging, including distribution packaging, has been applied (National Environment Agency, 2007). All stakeholders, including brand owners, manufacturers (product and packaging), fillers, importers, retailers and consumers worked together with the assistance of the government to reduce the environmental impacts of packaging. Consequently, there were 239 companies participated in the agreement, and as a result, packaging waste was reduced by 54,000 tons in 2019 (*NEA | Singapore Packaging Agreement*, n.d.). The Singapore Packaging Agreement has provided each industry with a packaging benchmarking database, which has limited the average weight for each kind of packaging in each industrial sector (Singapore National Environment Agency, 2016). In this agreement, it has also given an annual reward for companies with the highest percentage of waste reduction or high achievement. Therefore, a number of companies signing the agreement has increased each year (*NEA | Singapore Packaging Agreement*, n.d.).

Notably, this city-state country has recently adopted the Zero Waste Masterplan that aims to resilience in climate, resource and economic. According to this plan, this country aims to reach 0.25 kg/capita of waste, which was 0.36kg/capita in 2018, sent to the Semakau landfill by 2030 and reducing 30% of incineration ash and non-incinerable waste. This is a clear strategy to minimise waste generation and maximise the use of waste as a resource has been introduced (Kerdlap et al., 2019; Ministry of the Environment and Water Resources (MEWR), 2019). To reach this goal, Singapore will focus on main aspects: 1). Sustainable production that includes sustainable design, promoting resource efficiency, promoting industrial symbiosis; 2). Sustainable consumption that is related to reducing (the ongoing fight to curb food waste, tackling single-use disposables), reusing and donating, and promoting green-labelled products. In addition, Singapore has set a target for the national recycling rate to 70%, the domestic recycling rate to be 30% and the non-domestic recycling rate to be 80% as well as the amount of waste landfilled per capita being reduced from 0.36 kg in 2018 to 0.25 kg by 2030 (Ministry of the Environment and Water Resources (MEWR), 2019). According to this plan, three priority waste streams include food waste, e-waste, and packaging waste including plastics. This country set up a plan that include a mandatory packaging reporting in 2020, an EPR for e-waste by 2021, a mandatory food waste segregation for treatment from 2024 and EPR for packaging (plastics) no later than 2025.

Singapore's success in plastic waste management through introducing the Singaporean strategy, the Singapore Packaging Agreement, and the Zero Waste Masterplan, means that it has emerged as a well-recognised country in the region of Asia in the struggle to fight plastic waste. Therefore, many countries in Asia, including Vietnam could learn from Singapore’s strategies and experience.

2.5.2 Policies of SUPIs and plastic packaging in India

In the densely populated country of India, most plastic production was used for packaging and single-use plastic products (Bhattacharya et al., 2018). Plastic waste accounted for 1-4% of waste and of which came from food packaging, water bottles, household, and industrial products (Padgelwar et al., 2019). The recycling rate of plastic waste was 60% (Bhattacharya et al., 2018). There were several issues related to plastic waste in this country, including the overuse of plastic from SUPIs and packaging, the improper dumping and disposal of plastic waste (Padgelwar et al., 2019). Therefore, recently, the Indian government has announced it will prohibit six kinds of SUPIs, including plastic bags, cups, plates, small bottles, straws, and certain types of sachets (*India Tables Ban on Single-Use Plastic | Earth Day*, n.d.). However, in this large country, the management of plastic waste has been carried out flexibly in different states with some success. An example of this is how the Maharashtra government has controlled the production and the usage of plastic products since 1986 (Shahnawaz et al., 2019) by estimating the Central Pollution Control Board, New Delhi, due to the Environment Protection Act. The Act required the plastic bags used for food items should be made of virgin plastic and the plastic bags made of the recycled plastic are to be only used for items than foodstuffs. At the same time, the government also provided the Indian Standard guideline to recognise the percentage of recycled plastics and substance used on recycled plastic products (Shahnawaz et al., 2019). However, the Act has been amended many times, and in 2003, it was made compulsory for the manufacturers to register at the Pollution Control Board and pay charges to be permitted to produce the type of the plastic-based products they registered. In addition, until 2006, it was compulsory to put the codification of each type of plastic (with the number from 1 to 7 and indicating that it was the virgin or the recycled plastic on the plastic-based products) (Shahnawaz et al., 2019).

Remarkably, in 2018, the Maharashtra Non-biodegradable Garbage Act was amended (originally established in 2016). Accordingly, all kinds of carry bags were prohibited in terms of the manufacturing, transporting, distributing, marketing, storing, and importing. At the same time, cutlery made of polystyrene to be used in the food sector was also banned in Maharashtra. In 2018, a list of centres collecting PET or PETE bottles were established in Maharashtra. Then, in 2019, the India government imposed to ban a list of single-use plastic products, including plastic bags, cups, plates, small bottles, straws, and pouches (*India Tables Ban on Single-Use Plastic | Earth Day*, n.d.). In the future, plastic-based products will be all made of the recycled materials in India (*India Tables Ban on Single-Use Plastic | Earth Day*, n.d.). The achievement in controlling plastic waste, especially PPW in Maharashtra as a state in a developing country was significant; hence Vietnam should study this success and learn from it, since, Vietnam and India are in similar situations regarding the population density and economic development.

2.5.3 Policies on single-use plastic items in Indonesia

Indonesia was the fourth most populous country in the world concerning the coastal square, with 74% of the population living in the coastal area (Garcia et al., 2019), and also the second largest contributor of plastics to the marine environment, with 0.48-1.29

million t/year (Akenji et al., 2019a). The percentage of plastics in municipal solid waste was about 14% (Akenji et al., 2019a; Hidayat et al., 2019). Research indicates that mismanaged plastic waste coming from Pacific Islands countries, including Indonesia , accounted for 1.3% to 2.7% worldwide (Asari et al., 2019). Among which, cups (plastic or styrofoam) presented around over 100 tons while sup noodle containers reached 500 t/y, all of which all were landfilled or stored at home in Samoa (Asari et al., 2019).

In terms of regional plastic waste pollution, in Jakarta, approximately 25% of waste extracted from waterways was plastics and of this , approximately 16% was plastic bags, 5% was plastic packaging, 1% was plastic bottles, and 9% was other plastics were disposed of in waterways (Akenji et al., 2019a). Research carried out in Bandung, Indonesia indicates that most PPW has not been collected or disposed of properly. In Bandung, the was 25.1 g per day per capita and approximately 58 tons of it generated per day in the whole city (Chaerul et al., 2014). Among which, household and non-household discharged plastic packaging waste accounted for 70% and 64%, respectively (Chaerul et al., 2014); however, approximately 65% of plastic packaging waste went to the municipal solid waste stream and 31% of it was buried (Chaerul et al., 2014). Under acting of scavengers and junkmen, the collection rate of plastic packaging waste in Bandung reached approximately 28% (Chaerul et al., 2014). Similarly, in Medan, Indonesia, in terms of the composition of waste generated in households, plastic waste accounted for nearly 18% after organic waste (61%) (Khair et al., 2019); of which, 90% of urban domestic waste could be recycled by using the waste bank.

Regarding the plastic waste management policy, in Indonesia, managing plastic waste and municipal solid waste was a responsibility of multi ministries, including Public Work, Environment, and National Planning (Chaerul et al., 2014). In addition, each municipality implements in this their own ways without separating between regulatory and operation;

thus, it led to conflicts of interest (Chaerul et al., 2014). A list of regulations related to reducing plastic waste and SUPIs in Indonesia is presented in Table 2.8. The first achievement to note is that the policy of Circular Letter No. S.1230/PSLB3-PS on plastic bags has led to a 25-30% reduction in the use of plastic bags (Maruf, 2019). Recently, the Indonesian government has also announced it will impose duties on plastic bags at the national level (Garcia et al., 2019). Notably, Indonesia has released the National Action Plan on Marine Debris (2017-2025) generated by 13 ministries, which aims to reduce 70% of plastic ocean debris by the end of 2025 (Akenji et al., 2019a).

On the other hand, in 2016, Indonesia introduced a policy of charging \$0.02 for single-use plastic bags in 23 cities, which reduced plastic waste by 55% in the first three month trial period (Garcia et al., 2019; Maruf, 2019; Prisandani & Amanda, 2019). Furthermore, in 2018, a National Action Plan on Marine Waste Management 2018-2025 was created by the President (Regulation number 83) (Prisandani & Amanda, 2019). This plan aims to increase stakeholders' awareness and provide a strategic direction for all ministries and agencies to handle marine waste in this country.

In respect of local governance, in Bali, has enacted Governor Regulation Number 97 of 2018 on the Limitation of SUP Products (bags, polystyrene, straws) (Hidayat et al., 2019). As the regulation required, the above mentioned SUPIs must be replaced since 2018. Additionally, many campaigns have been advocated to encourage the public to eliminate SUPIs, such as plastic straws. Also, the Government encouraged mechanical recycling activities, consisting of separating, sorting, baling, washing, grinding, compounding, and palletising by adopting the Government Regulation Number 81 of 2012 on the management of Household Waste and Similar Waste Types (Hidayat et al., 2019). The city targeted to be "plastic-bag free Bali" in 2020 by introducing a strategy of Bye Bye Plastic Bags (BBPB) (Garcia et al., 2019). In 2016, in Banjarmasin, the first place of the country had banned the use of plastic bags in the retail sector, which led to a monthly reduction of 53 million of plastic bags (Garcia et al., 2019). Moreover, in Surabaya, a new policy was introduced in 2018 to encourage citizens to use buses for free and drop off their plastic bottles at terminals or directly pay the fare of the plastic bottle. The policy enabled to collect 7.5 tons of plastic bottles for recycling (Garcia et al., 2019).

In Indonesia, plastic waste rose together with population increase and the main issue of plastic waste management was the lack of an effective plastic waste treatment system (Hidayat et al., 2019). Thus, it was recommended that cooperation between Indonesian industries to collect and recycle plastics in factories was essential (Hidayat et al., 2019). Using technology to treat plastic waste was very expensive, but necessary in Indonesia. Thus, improving technology was a positive way to recycle plastic waste. Among the possible solutions for plastic waste, including reduction, landfill, incineration, recycling, and reuse, the recycling was considered to be the most feasible process to implement (Hidayat et al., 2019). Solving post-consumer plastic waste using a reverse logistic system was the best method in the context of Indonesia. To implement the reverse logistic system, cooperation among industries was imperative. In particular, how plastic waste returned to factories or manufacturers by separating it into types of post-consumer plastic waste for recycling in each industry was crucial. Therefore, industries in Indonesia were expected to work together to reach this target (Hidayat et al., 2019).

In 2008, the Indonesian Ministry of Environment introduced a "Waste Bank" which collected non-organic waste, including plastic, metal, bottles, and paper, began being sorted in households (Garcia et al., 2019), with the first waste bank being established in Bantal, Yogyakarta. This waste bank was located in the local community (Garcia et al., 2019).

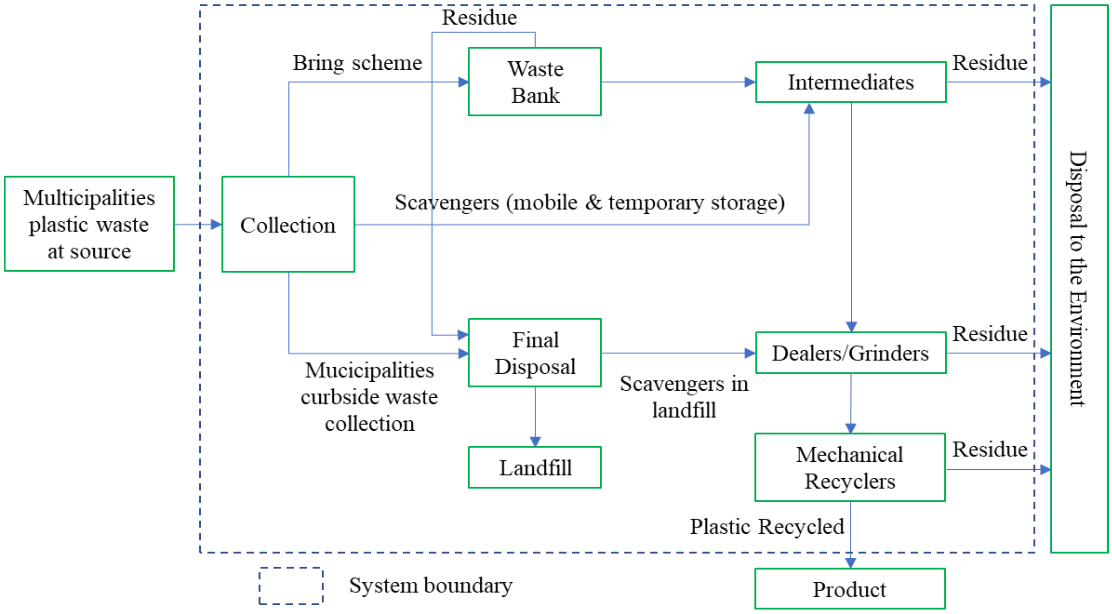

Figure 2.13. System boundary of Material Flow Analysis (MFA) in Jakarta, Indonesia, (Putri et al., 2018).

The Material Flow Analysis model (see Figure 2.13) in Jakarta showed that there were two waste collection systems, formal and informal sectors. The formal sector consisted of the municipality which was responsible for kerbside collection and the waste bank located in the local community which took responsibility to collect plastic waste from clients. The clients who were consumers signed up with the waste bank to sort their waste at home into categories established by the waste bank. The informal sector consisted of scavengers who collected plastic waste in mobile or temporary storage (Putri et al., 2018). The waste bank had a considerable impact on the increased recycling rate of plastic waste in residential areas (Putri et al., 2018). After they have collected it, the waste bank can sell their plastic waste to intermediates (96%) or recyclers (4%). The main plastic components collected in Jakarta by both informal and formal sectors were PET bottles and caps, PP cups, hard plastics (HDPE), and plastic bags, and gallon cap (LDPE) or glass; however, there was more diversity in plastic components collected by scavengers than the formal waste bank (Putri et al., 2018).

2.6 OVERVIEW OF POLICIES ON PLASTIC WASTE MANAGEMENT AND SINGLE-USE PLASTIC ITEMS IN VIETNAM

Despite the limitations in control of plastic waste, the Vietnamese government has made some efforts to restrict the current situation of plastic ocean pollution. This section will focus on policies on plastic waste and SUPIs in Vietnam.

2.6.1 Current plastic waste management in Vietnam

Vietnam was one of the main countries contributing to the plastic ocean (UNEP, 2018b). On average, in Vietnam, the amount of plastic released into the marine environment was approximately 280-730 thousand tons annually (V.-T. Nguyen & BeiPing, 2019). In HCMC, plastic pollution, including plastic packaging and SUPIs, can be seen in the rivers that go through the city. Research into the plastic floating debris found in Nhieu Loc – Thi Nghe canal, one of four main canals in HCMC, showed that plastic floating debris mass accounted for 12-43% of total debris found (Lahens et al., 2018). Of this plastic waste, 37% was plastic bags of all different colours and textures, 22% was food packaging items that were made of PS, and the remainder included plastic bottles, plastic cutlery and drinking receptacles. Notably, most plastics, consisting of bags, cups, straws, and spoons found in the canal were made of PE (79%), PP (15%), and PET (4%).

In terms of plastic production and recycling, the consumption rate of plastic increased tenfold in a period of 10 years, from 1990 to 2015. Plastic packaging made up the highest percentage (roughly 40%) of plastic production flow (Phương, 2019; Vietnam Business Council for Sustainable Development, 2019). The synthetic production industry depended significantly on scrap plastic and imported primary plastic, accounting for 80% of the demand (Vietnam Business Council for Sustainable Development, 2019). In the first six months of 2018, the percentage of plastic waste imported in Vietnam increased to 200% (IPSOS, 2019). Approximately 0.7-1.0 million tons of plastic waste were collected and then recycled to be returned in production in Vietnam (Vietnam Business Council for Sustainable Development, 2019. At the same time, about 1.3 million tons were sent to waste treatment and disposal facilities without classification and approximately 1.38 million tons of plastic waste (12.36%) was dumped in landfill (Vietnam Business Council for Sustainable Development, 2019). Thus, plastic recycling has been very limited in Vietnam. The separation rate of plastic waste at the source has been very low, mainly based on the informal sector. The informal sectors have primarily been plastic waste collections from scavengers and recycling facilities that have been not well developed. Most of the recycling facilities have been medium-sized factories focusing on craft villages with manual and rudimentary technologies. Particularly, Minh Khai craft village, in Hung Yen province, with 725 households including 6400 employees and was able to treat approximately 650 tons of plastic waste imported from oversea (Ministry of Environment and Natural Resources, 2019).

Figure 2.11 shows current plastic waste and scrap flow in the waste management system in Vietnam. First, plastic waste generated in households, markets, public areas or even on streets was collected by waste pickers or scavengers if it had economic value or could be bought by intermediates. The intermediates who bought plastic scrap or any other scraps from scavengers or waste pickers then sold it to recyclers. At the same time, the Urban Environment Company (URENCO) existed as a formal sector and took responsibility for the collection and transportation of municipal solid waste in most cities in Vietnam. The Urban Environment Company staff also collected scraps and then sold them to intermediates. Furthermore, some of the waste could be released into the environment by intermediates or individuals or households or recyclers. Notably, intermediates have worked well in buying all kinds of scraps that were valuable as raw materials for industrial sectors. However, the storage of scraps at intermediates caused environmental issues due to the lack of storage facilities and land for storing. Additionally, technologies for plastic recycling in Vietnam was outdated and limited. Most of the plastic scraps delivered to craft villages for recycling with manual and rudimentary techniques. Thus, there were a lot of serious environmental issues that needed to be concerned in craft villages in Vietnam (Phương, 2019; Vietnam Business Council for Sustainable Development, 2019). On the other hand, plastic products from the villages were of low-quality and not suitable for the plastic industry due to the contamination of plastic scraps that contained leftover or chemicals as residue. Most plastic packaging, such as cutlery, straws, cups, film made of PE, PVC, PP, PS with a low-economic value has not been collected, separated and recycled.

Moreover, there are no incineration plants for only plastic waste, such as Refuse Derived Fuel technology (Phuong et al., 2019). Particularly, research to develop a simple technology for plastic waste in the domestic market has been carried out (Phuong et al., 2019).

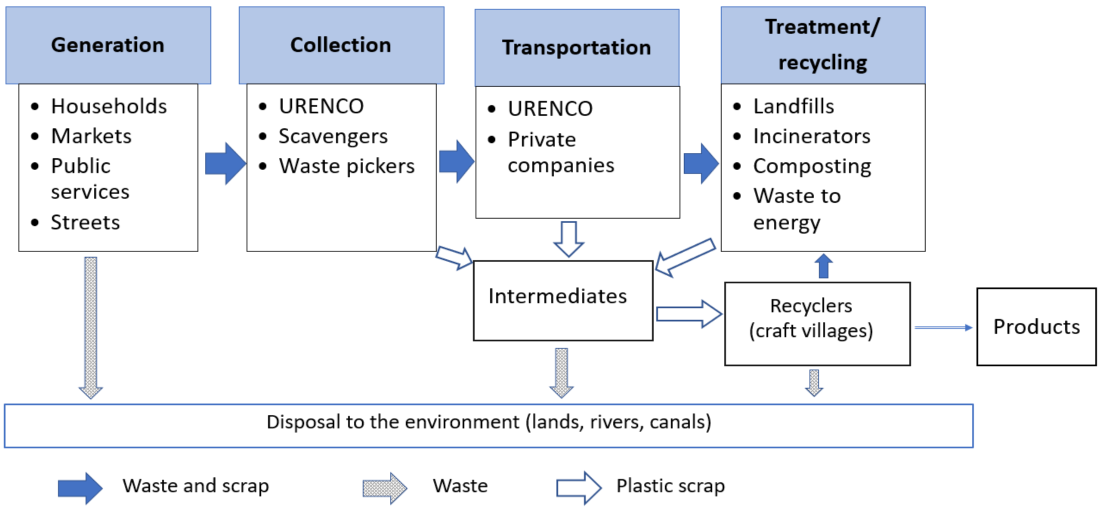

Figure 2.14 Overview of plastic flow (waste and scrap) in Vietnam, modified from (Vietnam Business Council for Sustainable Development, 2019)

In terms of enforcement framework, regulations and laws on plastic waste in Vietnam have been very limited and insufficient to manage plastic waste in an effective way (V.-T. Nguyen & BeiPing, 2019). Figure 2.15 presents the legal frameworks for plastic waste and SUPIs in Vietnam. Most of the laws or regulations focused on preventing oil pollution caused by ships, rather than for plastic waste or garbage released into the ocean (V.-T. Nguyen & BeiPing, 2019). In 2011, the Ministry of Industry and Trade introduced the Decision 582/QD-TTg on a masterplan for the plastic sector to 2020 with a vision to 2025, which allowed plastic waste to be treated as domestic materials. On the other hand, the demand for feedstock for plastic products was high and depended on the import, including the primary and scrap. In Vietnam, about 80% of raw materials for plastic production was imported (Environmental Administration, 2019). However, domestic plastic scrap coming from plastic waste recycling was minimal and limited due to the low recovering rate of plastic waste as well as the limitation in recycling facilities and outdated technologies. The Resolution 09/NQ-CP showed that the import of plastic scraps for production will be prohibited by 2024. Additionally, the Decision 491/QD-TTg on approving adjustments to the national strategy for general management of solid waste to 2025 with a vision towards 2050, which aims to replace all plastic bags with environmentally friendly plastic bags and to reduce the percentage of waste ending in landfills to 30% by 2025. Overall, to deal with plastic waste, Vietnam needs to consider enforcing the separation of waste at the source, improving waste management infrastructure, and investing in improved recycling technologies.

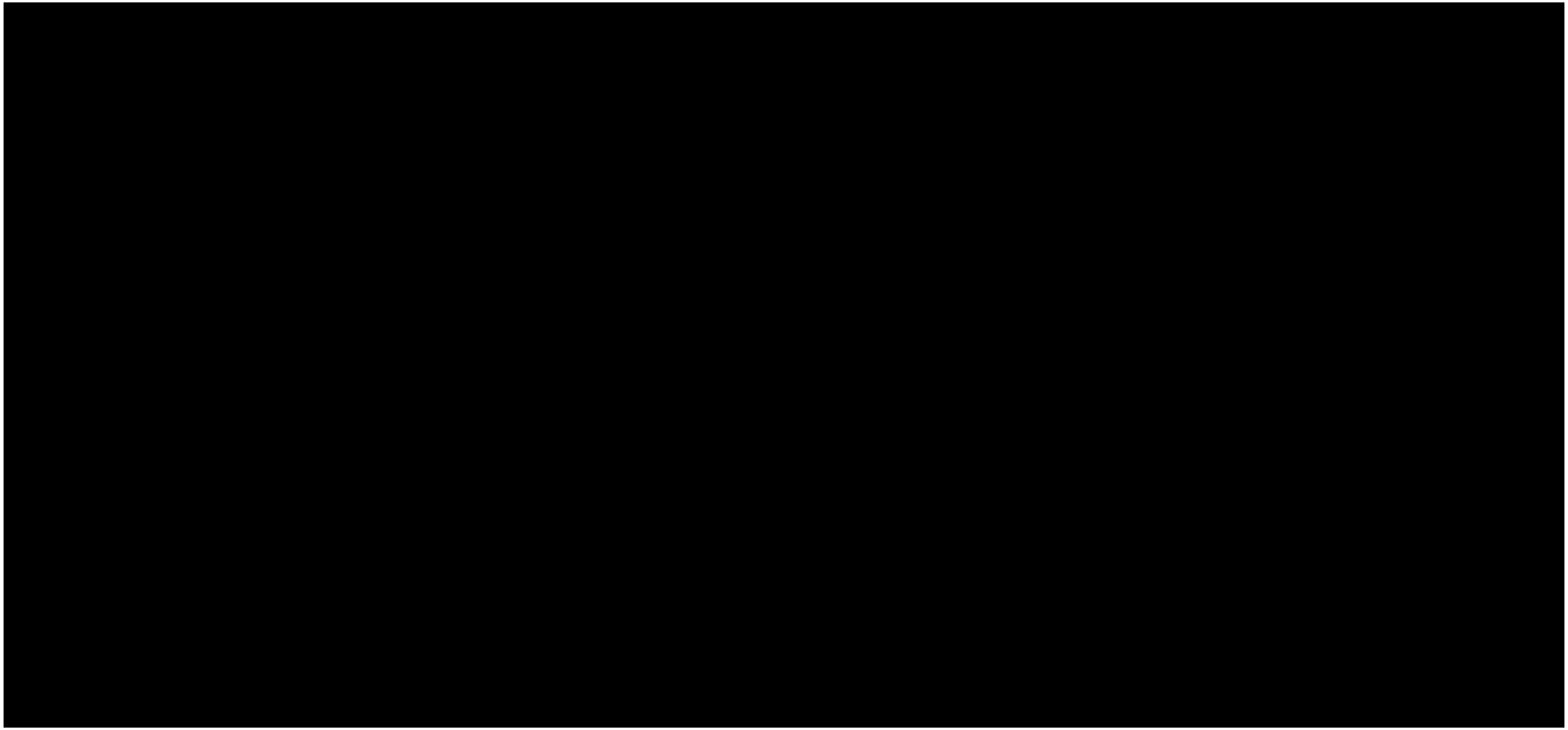

Figure 2.15 Present legal frameworks on plastic waste and SUIPs (*Italic font*) in Vietnam

Detail content of regulations and enforcement framework on SUPIs and plastic waste is presented in Table 2.9

Table 2.9 Active regulations (national and local level) and strategic activities related to reducing SUPIs and plastic waste in the enacted in Vietnam, adapted from (Vietnam Business Council for Sustainable Development, 2019)

Type of enforcement	**Tittle or Number**	**Detail content**
SUPIs		
Law 57/2010/QH12	Law on Environmental Protection Tax (article 8)	The tariff for plastic bags is 30.000-50.000VND/kg for individuals, households, and organisations who produce, import plastic bags.
Circular 34/2011/TT-BYT	Promulgating national technical regulations on containers and packaging in direct contact with foods (Article 1)	QCVN 12-1:2011/BYT - National technical regulations on safety and hygiene for synthetic resin implements, containers and packaging in direct contact with food.
Circular 07/2012/TT-BTNMT	A criterion of, a order of, procedures for recognition of environmentally friendly – nylon bags	Accordingly, an exemption of environmental protection fee is applied for environmentally friendly plastic bags.
Plastic waste management		
Decision 2992/QD-BCT	Masterplan for the plastic sector to 2020 with a vision to 2025	The plan encourages to increase the usage of waste material ratio in the sectoral masterplan. Accordingly, in the plastic sector, plastic waste is treated to be material to raise the ratio of domestic materials.
Decision 73/2014/QD-TTg	A list of waste materials to be imported to make feedstock for production	Providing a list of plastic scraps is permitted to be imported as feedstock, including waste, parings and scrap, of plastics of PVC, PE, PS, and other plastics.
Law 55/QH13	Law on environmental protection	Advice to control, collect, reuse, and recycle waste.

Type of enforcement	Tittle or Number	Detail content
Decree 38/2015/ND-CP	Management of waste and scraps	Required to classify, manage waste from generation, collection, transportation and treatment; it is compulsory for the following activities: - Waste owners shall be responsible for recycling, pre-processing, recovering, co-treatment, heat recovery or contract with a service provider for waste and waste material management" (Article 30). - Infectious waste after disinfection shall be treated like ordinary waste by suitable methods (point b, Term 5, Article 49). - Waste materials are imported for production will be stored in a covered place with fire and dust prevention measures in place. The importers shall have facilities for recycling, recovery and impurities treatment per requirement and must deposit to ensure the import materials are stored properly (Article 56). - The waste importer is required to obtain a license on environmental protection and the list is published by MONRE (https://dvctt.monre.gov.vn).
Decision 16/2015/QD-TTg	Regulations on recall and treatment of discarded products	The decision regulates responsibility of producers, consumers in discarding and managing discarded products, including inner tubes of all kinds and tires of all kinds.
Decree 155/2016/ND-CP	Penalties for administrative violations against regulations on environmental protection	
Decision 3892/QD-BCT	Approval of a master plan for industrial development in the Red River Delta by 2025 with the vision toward 2030	Detailed objectives are set for the plastic production (pipes, packages and other products) in Hai Phong, Hanoi, Hung Yen, Bac Ninh and Hai Duong and biodegradable and recyclable plastic container production is encouraged.

Type of enforcement	Tittle or Number	Detail content
Document 8170/BCT-CST	Regulates on the import and export tax exemption for recycled plastics from hazardous wastes	
Circular 34/2017/TT-BTNMT	Recall and treatment of discarded products	
Decree 68/2017/ND-CP	Management and development of industrial clusters	Providing the regulations on fields, sectors, production and business units, which are encouraged for moving into industrial clusters in Article 3. Those include production and business units polluting or having highly pollution potentials, which are located in craft villages, residential areas, cities should move into industrial clusters. There is a policy of preferences and support for investment provided to craft village clusters
Decision No. 491/QD-TTg	Integrated solid waste management strategy to 2025 and orientation to 2030	Identified the specific requirement for domestic waste at the urban area is to 100% environmentally friendly plastic bags in shopping centres, supermarket instead of normal plastic bags and 90% of domestic waste in the urban area collected and treated properly, in which direct landfill is expected to be lower than 30% of the amount of waste collected.
Directive 27/CT-TTg	A number of urgent solutions for enhancement of management of scrap import and use of imported scrap for production	The Ministry of Natural Resources and Environment is in charge of management in environmental protection for scrap import and use of scrap imported for production.

Type of enforcement	Tittle or Number	Detail content
Document 405/TB-VPCP	Announcing a number of policies related to importing plastic scraps	Ministry of Industry and Trade proactively reviews the development planning of Vietnamese plastic industry; on that basis, assume the prime responsibility and coordinate with the concerned ministries, agencies and Vietnam Plastic Association in developing a strategy for the development of the plastic industry, with priority being given to the development of domestic production and export; reviewing international treaties that Vietnam has signed and acceded to in relation to scrap recycling.
Document 5539/BTNMT-TCMT	Launching the campaign against plastic waste	Urging the community and agencies to change behaviour, the habit of using one-time plastic items, plastic bags to reduce environmental pollution and to protect the environment and public health.
Directive 08/2019/CT-BCT	Enhancement measures aims to reduce plastic waste in the industry and trade sector	The Prime Minister has required relevant agencies, units and comrades and compatriots nationwide to propose measures to solve the plastic waste problem. For ministries, branches and localities, the Prime Minister requested they continue elaborating and perfecting mechanisms and policies to solve the plastic waste problem synchronously and effectively.
Decree 40/2019/ND-CP	Amendments to decrees on guidelines for the law on environment protection	

Type of enforcement	Tittle or Number	Detail content
Decision 1746/QD-TTg	Introducing National action plan for management of marine plastic litter by 2030	Specific objectives: **By 2025:** - Reduce marine plastic litter by 50%; collect 50% of abandoned, lost or discarded fishing gear; 80% of coastal tourism areas, tourist attractions, tourist accommodations and other coastal tourism services to stop using SUPs and non-biodegradable plastic bags; ensure nationwide beach clean-up campaigns are launched at least twice a year; and 80% of marine protected areas are free of plastic. - Monitor marine plastic litter annually and assess marine plastic litter every 5 years at a number of estuaries of the 5 major drainage basins in the North, North Central Coast, central region of Central Vietnam, South Central Coast and the South, and islands with tourism potential located in the 12 insular districts. **By 2030:** - Reduce marine plastic litter by 75%; collect 100% of abandoned, lost or discarded fishing gear, and put an end to disposal of fishing gear to the sea; 100% of coastal tourism areas, tourist attractions, tourist accommodations and other seaside tourism services stop using single-use plastics and non-biodegradable plastic bags; and strive for 100% of marine protected areas free of plastic litter. - Monitor marine plastic litter annually and assess marine plastic litter every 5 years at a number of estuaries of the 11 major drainage basins and in the 12 insular districts.
Resolution 09/NQ-CP	Management the import and the use of imported scrap for production	This assigned MONRE to be in charge of state management of solid waste and requested MONRE to review, complete, supplement, and develop legal documents on environmental protection in importing scrap for production. Particularly, for plastic scrap, it is allowed to import as raw materials for the production of plastic sticks only by December 31, 2024.

2.6.2 Single-use plastics management policies in Vietnam

Generally, reducing and collecting SUPIs for recycling in Vietnam has been limited. SUPIs have not been collected due to their low economic value and their contamination. Particularly, SUPIs made of different kinds of plastics (PET, PE, PVC, PS, PP) have not been separated at the source due to the limited knowledge of consumers on the codification of plastic products and the rudimentary technologies of plastic recycling. Therefore, most plastic waste was dumped in landfills in Vietnam. Recently, with growing concern about the plastic ocean pollution, the Vietnamese government have put more efforts into controlling plastic waste as presented in Figure 2.15 According to this figure, a tax levy of $2-$3 per kg was put on producers or importers of plastic bags in 2012 by introducing the Law Environmental Protection Tax in 2010. In 2011, the Ministry of Health introduced a QCVN 12-1:2011/BYT on the National Technical Regulations for synthetic resin implements, containers, and packaging in direct contact with food, which regulated the concentration of medicals permitted in containers directly contact with food. Notably, in 2013, the Minister approved projects which aim to improve the environmental pollution control caused by the use of non-biodegradable plastic bags, with the target being to reduce plastic bags by 65% of plastic bags in 2020 with the baseline of 2010. More importantly, the Decision 1746/QD-TTg was signed on the 4^{th} of December 2019 to introduce an action plan for the management of marine plastic litter by 2030. The action plan aims to stop 80% of tourism services and tourist attractions, accommodations and coastal areas from using SUPIs and non-biodegradable bags by 2025 and to 100% by 2030 (see Figure 2.15) and detail content of regulations and enforcement framework on SUPIs and plastic waste is presented in Table 2.9.

2.7 COMPARISON OF POLICIES ON SINGLE-USE PLASTIC ITEMS IN VIETNAM AND SELECTED COUNTRIES

This section focuses on the lessons learnt from the reviewed policy measures on SUPIs in the selected countries, including the European countries, India, Singapore, and Indonesia. Then, it suggests the policy measures that are recommended for Vietnam.

2.7.1 SUPIs policies in Vietnam and in selected countries

2.7.1.1 Lessons learnt from the EU

European countries have applied the integrated policy measures to phase out different types of SUPIs. Notably, the role of strategies for plastic packaging or plastic waste is very important to lessen the leakage of plastics into the environment. Typically, they can be listed as the European Strategy for Plastic (European Commission, 2018a), the Directive 2019/904 on the reduction of the impact of certain plastic products on the environment (European Council, 2019). First, for commonly used SUPIs, such as plastic cups and plastic containers, a strategic measure to reduce the SUPI consumption has been applied for a period of 4 years, from 2022 to 2026 with an annual report by 2022. Second, SUPIs that are not very essential can be replaced, such as sticks, cutlery, plates, straws, beverage stirrers and containers, and cups, which are all made of expanded PS, has been restricted and prohibited in the market. Third, for PET bottles that are commonly used and a high potential for recycling, are required to have lids attached, which enables these cups to be collected easier and requires the rate of recycled plastic in the new products. Finally, to collect and recycle SUPIs, the role of EPR and DRS tools are vital to lessen the use of SUPIs. Furthermore, penalties have been applied in these countries. It is suggested that both developed countries and developing countries should implement EPR systems to move toward a circular economy (Liu et al., 2018). Therefore, the EPR model in developed countries like the EU should be applied in developing countries like

Vietnam. Remarkably, packaging policies, such as Packaging Covenant, which encourage plastic producers and importers' responsibility to limit their packaging materials, led to a remarkable increase of plastic packaging recycling by companies, from less than 20% in 1993 to over 50% in 2001 (Rouw & Worrell, 2011). Thus, introducing packaging material regulations is essential in the context of Vietnam to reduce plastic packaging material that will mostly be disposed of into the environment.

2.7.1.2 Lessons learnt from India

There is a need for the public and other stakeholders to adopt new policies which aim to phase out SUPIs. Stakeholders need time to prepare changes in their activities that are significantly affected by traditional plastic products. Therefore, a central agency, such as the Central Pollution Control Board in Maharashtra (Shahnawaz et al., 2019) (Chand, 2018), should be established to control activities related to plastic-based products in Vietnam. The role of the board is to monitor and provide rights, guidelines for plastic manufacturers to reach the goal of plastic recycling and a reduction in plastic disposal into the environment. In the long term, step by step phasing out unnecessary SUPIs should be implemented.

2.7.1.3 Lessons learnt from Singapore

Reviewing policies on plastic waste and plastic packaging waste implicate that there are several lessons which can be learnt from Singapore and applied in Vietnam. First, Vietnam needs to adopt regulations forcing source-separated waste in every sector, including households, public area and private sectors. Also, it is also vital to introduce a guideline for the 3Rs in each industry as Singapore has done (*NEA | Guidelines*, n.d.).

Second, Vietnam should establish a packaging agreement which is similar to the Singapore Packaging Agreement. This entails providing a packaging benchmarking database for each industry which states the limits of the weight for each kind of packaging or SUPI in each industrial sector. The limited weight would vary from the lightest to the heaviest (NEA Launches Packaging Benchmarking Database to Encourage Businesses to Reduce Waste [Press Release] | Zero Waste Singapore, n.d.). Finally, like Singapore, in most populated cities in Vietnam, there is a lack of land for landfill which means that the development of incineration technology plays a crucial role in treating waste, including plastic waste.

2.7.1.4 The similarity in policies on plastic waste management in Vietnam and Indonesia

Vietnam is one of the most populated ASEAN countries, along with Indonesia and the Philippines (*Total Population of the ASEAN Countries 2008-2018 | Statistic*, n.d.). The growing rate of fast food occurs in populated countries mainly due to it being a method for the young population to deal with the lack of time, but also because of other factors, such as hygiene, convenience, and an elaborate menu (Fast Food in the Asia-Pacific - 16 Jan 2015, n.d.). In addition, fast food products have become common in Asia- Pacific countries where pricing is the lowest in the world at less than $2 per transaction (Fast Food in Asia Pacific on the Rise Thanks to India, n.d.). The availability of chicken and burgers and their low price had led to the Asia Pacific region becoming the second or third largest market in the world (Fast Food in Asia Pacific on the Rise Thanks to India, n.d.), especially when KFC released a vegetarian menu in 2014.

Vietnam has the same issues as Indonesia does. First, the contribution from the tourism sector accounted for a significant percentage of the GDP (Garcia et al., 2019). However, the tourism industry seems to consume more takeaway products made of plastics and thus generates more plastic waste than other industries. Second, as a developing country with a limited budget for plastic waste management, public expenditure for plastic waste issues is restricted; hence, it is hard to improve the current plastic waste management.

In terms of technology, like Vietnam, the difficulty in plastic waste management in Indonesia is the contamination of plastic waste, in which plastic waste is mixed with other waste. Thus, plastic waste is not separated into each kind of plastic, such as PP, PS, PE, PET, PVC; therefore, this plastic waste is not easy to melt for recycling (Hidayat et al., 2019). One of the ways to treat plastic waste is incineration, which generates energy and reduces 90% the volume of plastic waste (Hidayat et al., 2019). However, the challenges of the incineration method are air pollution and the consequent risk to human health, which is the same in both Indonesia and Vietnam. Many companies consuming SUPIs are trying to using SUPIs which are made of PET instead of PS or PP because they are thought to produce more carbon monoxide or toxic substances than polyethylene (Hidayat et al., 2019).

Indonesia and Vietnam do not have enough land to dump plastic waste, and this method of disposal also has a high risk of landfilled plastic waste for the environment. Using technology to treat plastic waste is costly, but it is vital for both Indonesia and Vietnam. In Indonesia, the disposal of plastic packaging in households and non-households was 70% and 64%, respectively (Chaerul et al., 2014). In addition, approximately 65% of plastic packaging waste went to the MSW stream and 31% was buried (Chaerul et al., 2014). Because of the role of scavengers and junkmen, the collection rate of plastic packaging waste in Bandung reached to approximately 28% (Chaerul et al., 2014). Similarly, the collection of plastic packaging waste and economic-valued waste by scavengers and junkmen in Jakarta is also very useful in the effort to deal with plastic waste (Putri et al., 2018). However, research into plastic packaging waste composition to date has been relatively limited. Thus, academics should pay attention to research into SUPIs and PPW in Vietnam. Also, in determining the right sanctions and disincentives, both countries should consider rewards or incentives for parties affected by the laws or regulations.

In terms of the improvement of source-waste separation in both countries, the same common issue is the lack of recycling infrastructure for SUPIs and PPW, with the source-waste separation being mostly based in informal sectors, such as scavengers, junkmen, intermediates, and dealers, accounting for about 65% of total PPW generated in Bandung, Indonesia (Chaerul et al., 2014).

Several recommendations have been made for increasing the recovery rate of plastic waste in a review from Jakarta, and these could also be implemented in Vietnam given the similarities of the situation in both countries. First, source-separated waste should be enforced in households as South Korea and Japan have done (Ministry of the Environment of Japan, 2014). Both Vietnam and Indonesia have the same problem of SUPIs being mixed with other waste, including leftover food, labels, multi-layered plastic; thus, these SUPIs need to be washed and then sorted by hand in households for recycling. Second, one of the methods that can be improved and learnt from Jakarta to increase recycling activities in Vietnam is establishing the formal sector, such as a waste bank, to collect plastic waste. However, waste management infrastructure should be upgraded in the context of Vietnam. Third, scavengers, who collected 240 kg/scavenger/month and can collect soft plastic waste are proven to be more effective than the waste bank, which raised 260 kg/waste bank/month (Putri et al., 2018). The waste bank includes 10-80 clients (Putri et al., 2018). Therefore, it is vital to recognise scavengers in the formal sector in the waste collection system due to their effectiveness. In Vietnam, scavengers also act as the informal sector (Phu et al., 2018). In particular, scavengers should be empowered to become specific recycling waste collectors in either mobile ways or landfills. Finally, SUPIs, including straws, cutlery, food containers, cups, lids, and plastic packaging, have low economic value; hence, the government should support plastic recyclers if they invest in recycling the low-value SUPIs.

Comparison policies of plastic waste in both countries showed that improving plastic waste management in both countries requires the participation of multi-stakeholders, including individuals, institutions, and corporations. In both countries, it is suggested that a diverse range of integrated policies on plastic waste and plastic packaging waste be adopted to deal with the plastic waste generation. It is vital to raise public awareness of their roles in the reduction of SUPIs. In addition, applying the Act of Plastic Packaging is also crucial to deal with the current generation of plastic waste in both countries

2.7.2 **The gap in SUPIs policies in Vietnam and recommendations from the literature review**

In summary, from reviewing policies on SUPIs and plastic waste management in developing countries and developed countries, the following main issues should be prioritised for application in Vietnam.

Suggestions for a strategic framework

It is essential to apply a variety of measures to minimise SUPIs and plastic waste being released into the environment.

- Diversity in measures for each type of SUPI (lessons from Europe).
- Diversity in legal measures: regulatory and other economic tools (tax, agreement voluntary, pricing mechanism).
- Diversity in policy measures for multi-stakeholders, including the public, institutions, co-operation, customers, producers, non-government organisations.
- Diversity in policy measures for regions that are different in economic characteristics and geography: this should empower local governments to develop

their policy frameworks to improve the collection and recycling facilities at the regional level as Indonesia and India have done.

Enforcement regulations

- Sorting waste at the source needs to be compulsory by regulations in all urban areas in Vietnam as this increases the recovery rate of plastic waste and encourages plastic recycling activities in the whole of the country. Singapore is a good example (Seik, 1997), and research into the waste recycling system in Hoi An city, Vietnam showed that the potential of recyclable waste (75%) was very high (Phu et al., 2018). Thus, policies and regulations on plastic waste should be introduced in Vietnam (V.-T. Nguyen & BeiPing, 2019).
- It is crucial to introduce a standard or benchmark on the weight of plastic packaging or SUPIs, which would control the amount of plastic used for plastic packaging and SUPIs. Therefore, the amount of plastic waste generated by the use of these items would also decrease. The benchmark policy has been applied in some developed countries, such as South Korean, Japan (EEA, 2015; European Parliament and Council, 2018; European Parliament and Council of the European Union, 2017; Study, 2007), and Singapore, as well as the Netherlands (Rouw & Worrell, 2011).
- It is vital to introduce national regulations for the packaging industry. Particularly, customers need to know about the resin identified codification for plastic products, which assists them in separating plastic waste at home. Thus, the resin identification codes for plastic products should be made compulsory, as Maharashtra has been doing since 2006 (Shahnawaz et al., 2019). It is important to have a mark describing whether the product is made of the virgin or recycled plastic.

- It is essential to introduce EPR schemes for plastic products through regulations, sanctions and incentives
- Non-essential SUPIs in each industry should be identified, and these subsequently phased out.

Governments

- First, in Vietnam, there has been no data on waste composition nationwide and local levels as well. Thus, the government needs to analyse the current use, disposal, and recycling rate of plastic waste and SUPIs at the level of different industries or households in Vietnam. Using the current data of waste composition, the government should give priority orders for solutions to collect, recycle or phase out plastics or SUPIs and focus on the industry that is causing the most pollution.
- Empowering and encouraging local authorities to manage their plastic waste and SUPIs is essential, especially coastal areas or coastal tourism attractions, like Indonesia has (Garcia et al., 2019; Maruf, 2019).
- It is important to establish recycling industrial zones which enable recycling activities to be undertaken in effective ways. In particular, plastic waste that has low-economic value, such as PP, PS, PVC, PE is to be recycled. In fact, four types of plastics are commonly recycled, which include HDPE, LDPE, PP, PS and PVC (Lam et al., 2018). In particular, Hoi An city is a model example that shows a lack of recycling facilities leading to a low recycling rate (24%) for all materials (papers, plastic, and metals) (Phu et al., 2018). Therefore, in the short term, the priority should be to collect the afore mentioned types of plastics for recycling activities in Vietnam.

- Providing incentives or benefits for plastic manufacturers existing in craft villages plays a vital role, as this allows them to improve technologies and move into the recycling zones.
- Encouraging the establishment of a network of plastic recycling manufacturers that allows companies or supply chains using SUPIs to connect with them for plastic recycling activities is beneficial.

Much other research also suggested solutions to plastic waste management in Vietnam. These solutions that have been recommended include improving the knowledge and the habit of the community in disposing of SUPIs in the proper manner, reducing the use of bags, cups, and straws made of plastic, and requiring the separation of waste at the source (Danh & Hoi, 2019). In summary, the policy recommendations from the review process is presented in Figure 2.16.

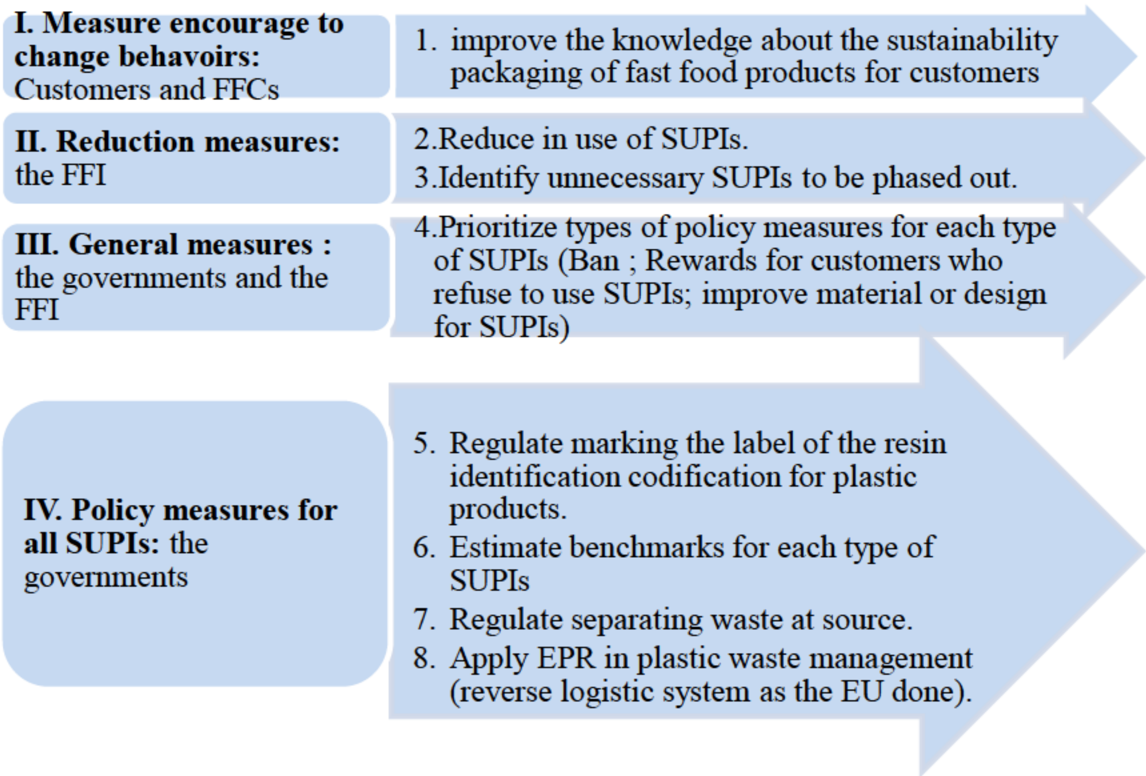

Figure 2.16 The policy measures recommended for Vietnam

Chapter 3: The current use and disposal of SUPIs in the fast food industry in Vietnam

This chapter reported the components and the number, and the weight of SUPIs consumed and disposed of per day in HCMC, Vietnam. In this chapter, it attempted to determine the waste composition generated and the weight of SUPIs consumed per day by six FFCs, including Lotteria, KFC, Jollibee's, Popeyes, Texas Chicken, and McDonald's in HCMC. 126 structured questionnaires were fulfilled by restaurant managers of the six selected FFCs in HCMC. This chapter was formatted differently from other chapters of the thesis due to the journal's requirement.

Chapter 3 is included as it appears in **Nature Environment and Pollution Technology (2021)**

Statement of Contribution to Co-authored Published Paper

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My contribution to the published paper involved:

- Designing and conducting the questionnaire
- Data acquisition and analysis
- [redacted]

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THE CURRENT USE AND MANAGEMENT OF SINGLE-USE ITEMS IN THE FAST FOOD INDUSTRY IN HO CHI MINH CITY, VIETNAM

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3.1 ABSTRACT

The study aims to determine the composition and the weight of individual single-use items (SUIs) generated in the selected fast food restaurants (FFRs) in Ho Chi Minh City (HCMC), Vietnam. A semi-structured questionnaire was used to collect data of SUIs consumed per day from 126 FFRs covering across six popular FFCs. At the same time, waste from 30 FFRs was collected, and its composition and weight were determined. Consequently, the amount and composition of the waste varied among the studied FFCs and is dependent on the food menu, the number of franchises for each FFC, customer number, size and the type of SUIs used at these restaurants. Total waste collected across the six FFCs was 6 t/d and was equivalent to 1560 t/y in HCMC. Of which, single-use plastic items (SUPIs) waste and single-use paper items (SUPaIs) waste accounted for 39% and 28%, respectively. The total weight of unnecessary SUPIs (condiment containers, straws, and forks) generated was about 44 t/yr. The results suggest that the necessity of standardizing the type and size of the SUIs used at the FFRs, phasing out the use of unnecessary SUPIs, improving the local waste management practices through material recovery and recycling.

Keywords: fast food industry; single-use items; single-use plastic items; single-use paper items; waste management, Ho Chi Minh City

3.2 INTRODUCTION

The FFI has rapidly developed for decades due to economic development and an increase in the “on the go” consumption culture. The global fast food market is growing at a compound annual growth rate of 4.2% and is estimated to be worth more than $690 billion in 2022 (Zion Market, 2017). Single-use plastic items (SUPIs) are commonly used in fast food restaurants (FFRs), small packaging industries and groceries for the takeaway culture, which treats plastics as waste rather than a valuable resource. Thus, the FFI generates a considerable amount of packaging waste or single-use items (SUIs) that include cups, containers, cutlery, straws, lids, bags. Most packaging waste comes from dining areas (39%), followed by kitchen areas (36%) and outside restaurants (25%) (Aarnio & Hämäläinen 2008). Plastic packaging accounted for 47% of the globally generated plastic waste, with more than 50% originating from Asia (UNEP 2018b). It is estimated that food delivery packaging waste account for 1% of the annual municipal solid waste generated in China (Song et al. 2018). Most packaging waste in the FFI is landfilled, although its theoretical recovery potential was 93%, only 29% of the packaging waste is recovered (Aarnio & Hämäläinen 2008). The disposal of the packaging waste, especially plastic waste, is considered as wasting resources, polluting the environment and affecting marine life due to its persistence in the environment (Leal Filho et al. 2019, Moharir & Kumar, 2019). Therefore, addressing SUPIs and plastic packaging in the FFI should be considered as one of the priorities to deal with ocean pollution.

The consumption of SUIs, including single-use plastic items (SUPIs) and single-use paper items (SUPaIs), has been increasing due to the development of the FFI in urban (Gautam & Caetano 2017). With the introduction of online food ordering and home delivery, especially through the use of mobile devices, a sharp increase in SUIs consumption in FFI has been reported (Gautam & Caetano 2017). It is estimated that more than 69% of customers have ordered food by using mobile devices (Gupta 2019). Notably, plastic packaging waste accounts for one-third of total plastic production, much of which is used for the production of SUPIs (UNEP 2016). Globally, 360 million tons of plastic were produced in 2018 with 51% of total plastic production originating from Asia (Plastics 2019) and nearly 40% of plastic was discarded after a single use (Ocean

Conservancy 2019). It has been estimated that 12,000 Mt of plastic waste will be disposed to landfills or in the natural environment by 2050 (Geyer et al. 2017). More importantly, 146 Mt of primary non-fibre plastics was used in the packaging industry, which is mainly composed of polypropylene (PP), polystyrene (PE), and polyethylene terephthalate (PET), that contributed significantly to plastic packaging waste (Geyer et al. 2017). In particular, in the FFI, it is estimated that plastic packaging waste accounted for 11% of the waste generated in McDonald’s restaurants in Finland (Aarnio & Hämäläinen 2008). Additionally, plastic containers made of PP and polystyrene (PS) accounted for approximately 75% of the total packing waste in high-populated megacities in China (Song et al. 2018), one of the major countries contributing to global marine plastic pollution (Ocean Conservancy 2019).

With a growing concern of ocean pollution caused by SUPIs, many countries have introduced policies to phase out SUPIs (Ocean Conservancy 2019). As on to date, 27 countries have introduced a ban on the manufacture, distribution, use, sale, and/or import of SUPIs (UNEP 2018a). However, only 22 countries have enacted to ban specific products, such as plastic plates, cups, and utensils while, 16 countries have prohibited materials of polymers, most commonly polystyrene and expanded polystyrene (UNEP 2018a). In ASEAN countries, 18 cities in Indonesia have planned to ban bags, straws and foam containers for food by 2025 (Akenji et al. 2019). Similarly, Malaysia will also ban drinking straws by 2030, whilst Thailand is planning to phase out SUPIs in 2022 (Akenji et al.,2019).

Vietnam is one of the five major countries that is importing plastic waste through transboundary agreement (UNEP 2018a). With the increased awareness about the ocean plastic pollution, Vietnam has enacted limited policies on SUPIs, except a levy on plastic bags (UNEP 2018b). Vietnam is ranked as the eighth-most valuable market for global food chains (*Vietnam: Vietnam Ranks Eighth for Global Franchise Expansion - ProQuest*, n.d.). In particular, the food and beverage sector accounts for the major share of consumers' monthly expenditure, which grew by 18% in 2018 (*Vietnam: Vietnam's Food Processing, Packaging Sector Thriving - ProQuest*, n.d.). In Vietnam, Kentucky Fried Chicken (KFC), Lotteria, Jollibee, Pizza Hut and The Pizza Company recorded revenues of VND5 trillion ($213.5 million) in 2018, an increase by 13% from 2017 (*Vietnam: Fast Food Chains in the Slow Lane amid Focus on Health - ProQuest*, n.d.). Interestingly, the waste generated by the FFI in Vietnam is considered as commercial waste and is collected and landfilled along with the waste generated from hotels and restaurants (Verma et al. 2016). Ho Chi Min City (HCMC) is the largest city of Vietnam. In 2018, the amount of municipal solid waste generated in HCMC was about 8,900 t/yr, among of which, food waste accounted for 60%, followed by plastic waste (14%). A survey of 752,000 Vietnamese people, with 50% of respondents in HCMC, indicated that they would prefer either to eat out in quick services (36%) or to choose a restaurant (50%) because of its convenience (DecisionLab 2016). Data collected from websites of the above mentioned six popular FFCs indicated that there are approximately 520 FFCs in Vietnam. Of which, Lotteria owns 210 franchise restaurants, followed by 140 KFC restaurants, 100 Jollibee restaurants, 26 Popeyes Stores, 20 Texas Chicken, and 23 McDonald's restaurants across the whole country. Nevertheless, research in solid waste management of the FFI is still limited (Aarnio & Hämäläinen 2008), especially from the FFI in Vietnam. To our knowledge, the composition and management of SUIs in the FFI in HCMC has not been investigated. The study aims to determine the weight and the composition of SUIs consumed and disposed of per day as well as to examine the waste generation and management as well as in FFCs in HCMC.

3.3 METHODOLOGY

3.3.1 Research design

The study aims to determine the type, composition and the total weight of individual SUIs consumed and disposed of per day as well as examine waste generation and management in the selected FFCs in HCMC. Accordingly, this research was carried out by collecting both qualitative and quantitative data (see Fig. 1).

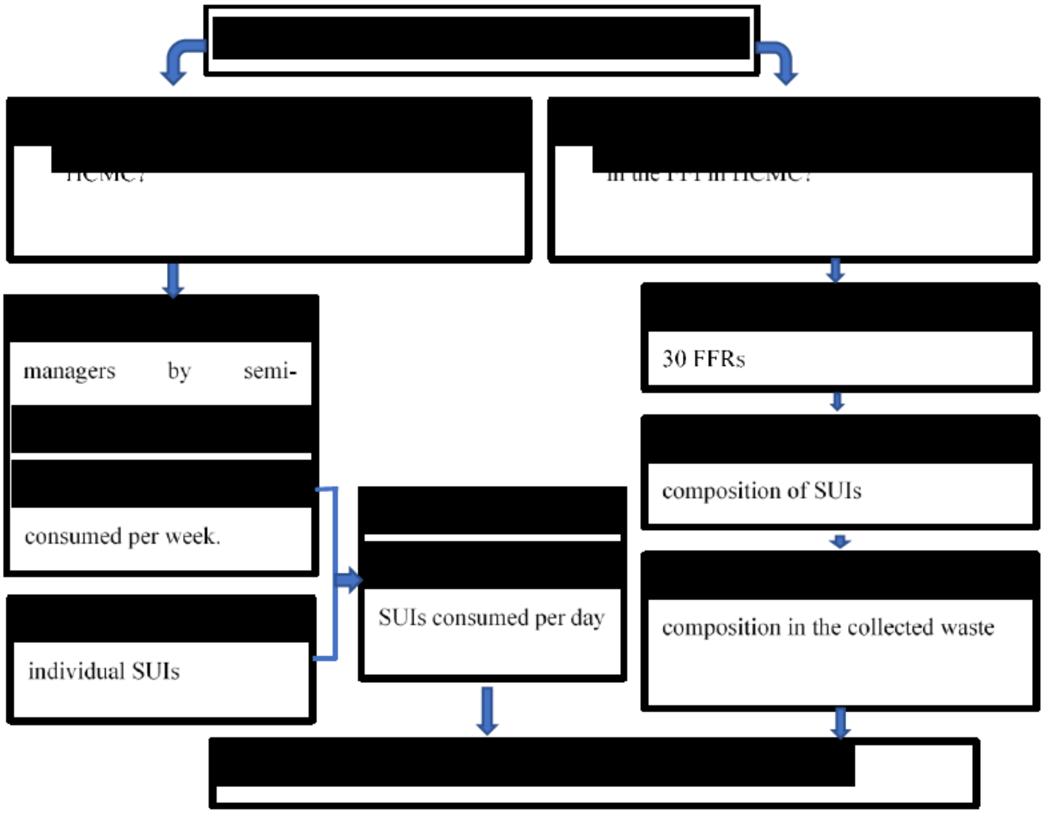

Fig. 1: The process of determining the weight and the composition of SUIs in FFRs in HCMC

The qualitative data were collected by using a semi-structured questionnaire to quantify the daily and annual waste generation and management practices at the selected FFRs in HCMC. The qualitative research collected data of SUIs from 126 respondents of 183 restaurants belonging to six popular FFCs (Lotteria, KFC, Jollibee's, Popeyes Stores, Texas Chicken, and McDonald's) in HCMC. The data was then calculated for 183 FFRs of six FFCs in total in HCMC at the period of the survey in 2017 see Table 3.1.

Table 3.1: The total number of FFRs used for survey and waste collection through dedicated waste collection bins in HCMC in 2017

Fast food company	Total restaurants		Number of FFRs surveyed (n_1)	Number of FFRs agreed to collect their waste bins (n_2)
	r[1]	%		
Lotteria	90	49.18	62	11
KFC	49	26.78	34	6
Jollibee's	14	7.65	10	4
Popeyes Stores	11	6.01	8	3
Texas Chicken	10	5.46	7	3
McDonald's	9	4.92	5	3
Total	**183**	**100**	**126**	**30**

The survey included four sections with 40 questions (from Q. 1 to Q. 40), and qualitative data was collected. The semi-structured questionnaire focused on the following main sections. Section 1: General information about fast food restaurant profile, seven questions (from Q. 1 to Q. 7), focused on the restaurant's location, number of customers visiting restaurants every day. Section 2: SUIs use and management with 18

[1] Source: Websites of fast food companies in Vietnam in 2017

questions (from Q. 8 to Q. 25). These questions were about the composition, and the number of SUIs consumed per day. The data collected from the survey is also used in quantitative research. Section 3: Waste generation and management with 13 questions (from Q. 26 to Q. 38). These questions concentrated on current waste management in the restaurant. Section 4: Manager's experience in restaurant management with two questions (from Q. 39 to Q. 40). Most of the questions were multiple-choice questions. In this questionnaire, section 2 is used for quantitative research. Section 2 of the questionnaire focused mainly on opening questions to ask restaurant managers about the number of SUIs consumed per week. The respondents are restaurant managers who are responsible for waste management and general supervision. From websites of FFCs, the information about restaurants' address was used for the survey process.

Primary data was collected from 30 waste bins randomly selected across the 30 restaurants (see Table 3-1). The collected waste was then separated and weighed into the following components: (1) SUPIs (condiment containers and lids; cutlery; bottles; cups; straws; condiment bags; other plastics); (2) food waste; (3) SUPaIs (cups, bags, other papers); (4) other waste. The weight of the individual components was also measured, and their percentage in the total sample was determined.

3.3.2 Fast food industry survey

3.3.2.1 Fast food restaurant profile

Six popular FFCs in HCMC were selected for the study as presented in Table 3-1. In 2017, there were 183 FFRs for the six selected restaurants in HCMC. Data collected from websites of FFCs in Vietnam at the period of the survey shows that the biggest chain of FFC in HCMC is Lotteria with 90 restaurants, followed by KFC, Jollibee, and Popeyes Stores with 49, 14, and 11 restaurants, respectively. Later, two more FFCs came into existence Texas Chicken and McDonald's with 10 and 9 restaurants, respectively. One hundred sixty-three restaurants belonging to the six selected FFCs were surveyed. Of which, 37 FFRs declined to respond. Thus, 126 FFRs participated in the survey and were randomized as per Solvin's formula (Perdana 2018). For each FFC, 50% of the sample size was surveyed in suburban districts, and the remaining rest were surveyed in central districts of HCMC.

3.3.2.2 Profile of the respondents

Of the total 163 FFRs, managers from only 126 FFR agreed to participate in the survey. Some managers did not agree to participate or were too busy at the time of the survey. Sometimes, only one of the two shift managers agreed to participate in the survey. Most of the managers who participated in the survey had worked previously as a crew at the same restaurant before becoming a manager.

3.3.2.3 Sampling

Managers' participation in the research was voluntary and they signed a consent form with confidentiality of responses. The survey was carried out for four months (January 2017 through April 2017). The population size (N) is the total number of FFRs belonging to the selected six FFCs in HCMC (N =183 retrieved from websites of FFCs) at the period of the survey (2017). With confidence level e = 0.05%, using Solvin's formula (Perdana,2018), the total number of restaurants participated in the survey (n= 126) was estimated as shown in the equation [1]:

$$n = \sum_1^6 n_1 = \frac{N}{1+N(e)^2} = \frac{183}{1+183*(0.05)^2} = 126 \qquad \text{Eq. [1]}$$

The number of FFR surveyed for each FFC (n1) was calculated based on the percentage of the number of restaurants that each FFC owned in HCMC, which was multiplied by the sample size (n = 126). Value n1 of one FFC was calculated by using the equation [2]:

$$n_1 = r/N*100\%*n \qquad \text{Eq. [2]}$$

3.3.3 Collection and compositional analysis of fast food restaurant waste

Grab samples of waste were collected from 30 FFRs belonging to the six selected FFCs (value n_2, column 5, Table 3-1). The collected waste was separated into five main compositions: (1) SUPIs (cutlery, cups or containers, condiment bags, condiment containers and lids, straw, other plastic); (2) food waste; (3) SUPaIs (cups, bags, other paper); and (4) other waste. The separated components were then weighed by using a weighing balance (Kingship, Model: KD-TBED). In each waste bin, a large plastic bag placed to collect the waste. Upon filling up, the bag was brought and placed in the dedicated area of restaurant yard. Thus, the bags in the study were collected from dedicated areas.

3.3.4 Calculations

3.3.4.1 The number and the weight of SUIs consumed per day

The total weight of individual SUI is denoted as w_1 (gram). Data on the number of SUIs consumed per week (Monday through Friday) is denoted as m (items/week) and this data was provided by the restaurant managers. The total number of SUI consumed per day by a FFR is denoted by m_1 (items).

$$m_1 = \sum_1^{n_1} m \qquad \text{Eq. [3]}$$

The total average weight of SUI consumed per day by all surveyed restaurants is denoted as q_1 (kg/day) in the equitation [4].

$$q_1 = m_1 * w_1 \qquad \text{Eq. [4]}$$

The average number of SUI consumed per day by FFR belonging to any FFC is denoted by m_2 (items/day).

$$m_2 = m_1/n_1 = \left(\sum_1^{n_1} m\right)/n1 \qquad \text{Eq. [5]}$$

The total weight of SUI consumed per day by FFC is denoted by q_2 (kg/day). The value r – the number of FFRs of one FFC in HCMC at the period of the survey, the value r is presented in Table 1.

$q_2 = m_2 * r * w_1$ Eq. [6]

The total weight of SUI consumed per day by six selected FFCs is denoted by q_3 (kg/week). The total number of SUIs consumed per day by FFC is m_3 (items/day).

$m_3 = m_2 * r$ Eq. [7]

$q_3 = \sum_1^6 q_2$ Eq. [8]

The study also compares the q_2 value among the studied FFCs. The difference in q_2 value will provide the total weight of each SUIs consumed per day at each FFC. This q_2 value is variable and is dependent on the number of FFRs established in HCMC. Similarly, q_3 value indicates the difference in the total weight of each type of SUIs consumed per day by six FFCs in HCMC. The q_3 and m_3 values vary depending on the weight, and the number of individual SUIs consumed per day, which is presented in section 3.3.

3.3.4.2 Amount of SUIs collected from the waste bins and estimating the total amount of waste generated by six fast food companies

The total amount and the composition of waste generated per day by FFC were calculated by weighing each separated SUI collected from the waste bin and expressed as a_1 (kg/day/bin). The number of waste bins generated per day at FFR is denoted by u (bins/day/restaurant). The average weight of each SUI generated per bin at any FFR is denoted by a_2 (kg/day/bin/restaurant) in the equation [9].

$a_2 = \frac{\sum_1^u a_1}{u}$ Eq. [9]

The average number of waste bins generated per day by FFR is u_1 (bins/restaurant) whilst, n_2 is the number of restaurants whose waste was collected (column 5, Table 1).

$$u_1 = \frac{\sum_1^{n_2} u}{n_2} \qquad \text{Eq. [10]}$$

The estimated total weight of each SUI generated per day by FFC is denoted as a_3 (kg/day) and the number of FFRs for each FFC in HCMC is denoted at k (restaurants/company). From the above three values a_2, u_1 and k, the weight of SUIs generated per day by each FFC (a_3) was calculated by using the equation [11] shown below:

$$a_3 = a_2 * u_1 * k \qquad \text{Eq. [11]}$$

The weight of SUIs generated per day by each FFC (a_3) is presented in section 3.1.1 and is compared with the q_3 value in section 3.2.

3.4 RESULTS AND DISCUSSION

3.4.1 Waste management in FFRs

Waste management at each FFR is started by collecting waste in the dining area and the kitchen area of the FFR. Therefore, each FFR has two types of waste bins, one in the dining area and the other in the kitchen area. A black plastic bag of 200 L capacity is generally placed in the waste bins. When the bag is full, it will be transferred to a dedicated area of the restaurant. Thereafter, the restaurant crew will collect these bins and move them outside of the restaurant to be picked up by the waste collection truck and transported to landfills. The District Public Services Company Limited (DPSC) or HCMC Urban Environment Company Limited (CITENCO) of each district is responsible for transporting them to landfills. During the time before these bins are collected by DPSC or CITENCO, there are sometimes waste pickers coming to look for sellable SUPIs, such as plastic bottles, in these bins to pick up. However, all cutlery, straws and cups with lids as well as bags made of plastic are not picked up by these informal pickers due to the low value of these SUPIs.

With respect to SUI management, each FFR places an order with the headquarter for the delivery of a certain number of SUIs. These SUIs are delivered directly to the concerned FFRs at a regular basis. SUIs used at each studied FFR were qualified and met the standard of QCVN 12-4:2015/BYT on National technical regulation on the safety and hygiene glass, ceramic, porcelain and enamelled implements, containers, and packaging in direct contact with food. In turn, each FFCs orders their supply chain to manufacture SUIs meeting their requirements. Regarding to the use of SUPIs at the FFRs, there were no policies to limit the use of SUIs per customers. These findings suggest that restaurant managers can improve the use of SUPIs by encouraging their staffs to ask customers either they want to use SUPIs or limit the number of SUPIs delivered to their customers based on the order, which leads to reduce the number of SUPIs released into the environment.

3.4.2 Waste generation and waste composition

3.4.2.1 Waste generation

The estimated daily waste (Monday through Friday) generated at the studied FFCs is presented in Fig. 2B and Fig.3. Results showed that approximately 6 t/d of waste was generated at the studied FFCs and is dependent on the location of the FFR and the number of customers visited. Of the total waste, SUPIs accounted for 39.4%, followed by food waste (32.7%) and SUPaIs waste (27.5%) (see Fig. 2B).

The survey results also indicated that the studied FFCs had only one day off due to the Tet holiday in HCMC. Thus, the total waste generated for one year (260 days) was estimated to be 1,560 t/yr, excluding the weekends. Among of which, plastic waste originating from SUPIs (SUPIs waste) would account for 590 t/yr. These findings were in accord to a previous research reporting that the percentage of food waste and inorganic waste accounted for 30% and 70%, respectively, of the waste generated in KFC outlets in Semarang, Indonesia in 2015 (Alfagi et al. 2015). These findings were also in line with a previous research in Italy, which reported that food waste accounted for approximately 28% reported in waste of Fano seafood restaurants in 2019 (Tatàno et al. 2017).

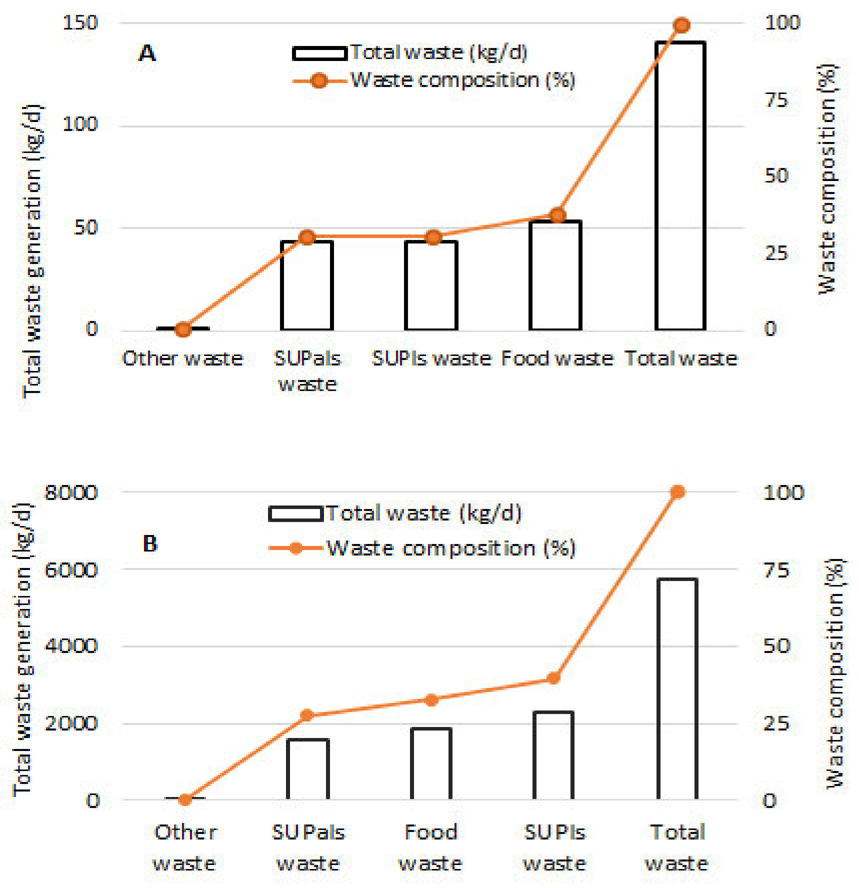

Fig. 2: Total waste amount (kg/d) and its composition (%) from the waste (A) collected from 30 waste bins across the selected six FFCs (B) estimated for 183 FFRs in HCMC.

Among the six FFCs, Lotteria produced more than 2 t/d, followed by KFC with 1.4 t/d (Fig.3). The highest daily waste generation noticed for Lotteria than other FFCs in the study was due to the fact that Lotteria had the highest number of restaurants (90) operated in HCMC. McDonald's with the lowest number of restaurants (9), produced 1 t/d of waste more than the other three FFCs (Fig.3).

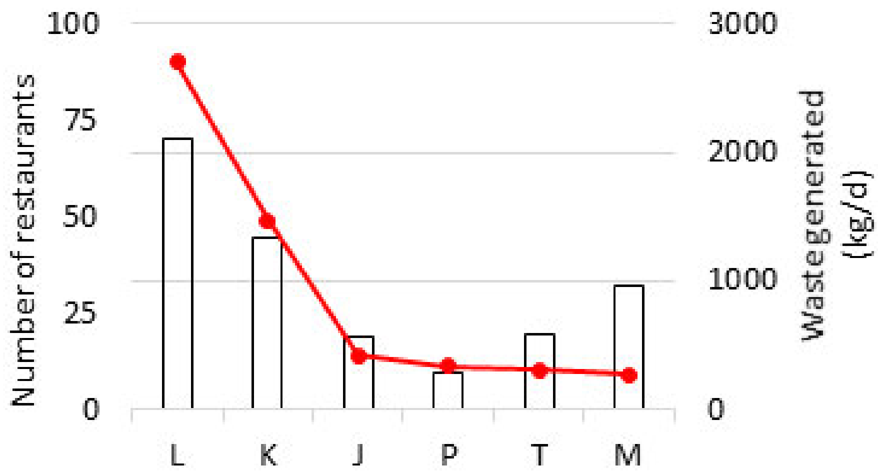

Fig. 3: Total number of FFRs and the amount of waste generated across the studied six FFCs in HCMC. Note: L: Lotteria; K: KFC; J: Jollibee's; P: Popeye Stores; T: Texas Chicken and M: McDonald's.

Notably, the survey indicated that on an average, more than 500 customers were registered at McDonald's every day, the highest average number of customers visited in comparison with other offers. Evidence shows that food menu, material consumption and waste management policies of FFC play a critical role in the amount of waste generated. The waste management policies of FFCs also influence the composition and the recovery of SUPIs (Hilario 2014). In particular, McDonald's generates large amount of paper waste and is planning to use packaging material that is 100% derived from renewable resources, recycled or certified by 2025 (McDonald's, 2019). Accordingly, McDonald's policy currently indicates that 50% of the company's guest packaging originates from renewable or certified sources. These policies affects considerablly the composition of waste the company-owned restaurants generates.

3.4.2.2 Organic waste and non-organic waste

The composition of waste generated in FFRs and the consumption of SUIs are presented in Fig 5. Overall, a significant variation in the composition of waste generated across the studied FFCs, especially with SUIs, was noticed for both 30 waste bin data and the calculated waste data for the 183 restaurants. Of the total waste, organic waste, i.e., food waste generated by the customers (post-consumption), accounted for 37.8% of the total waste in the 30 waste bins (Fig. 4A). This finding is in line with the previous research, the organic waste accounted for 30% of waste reported in KFC outlets in Semarang, Indonesia (Alfagi et al. 2015).

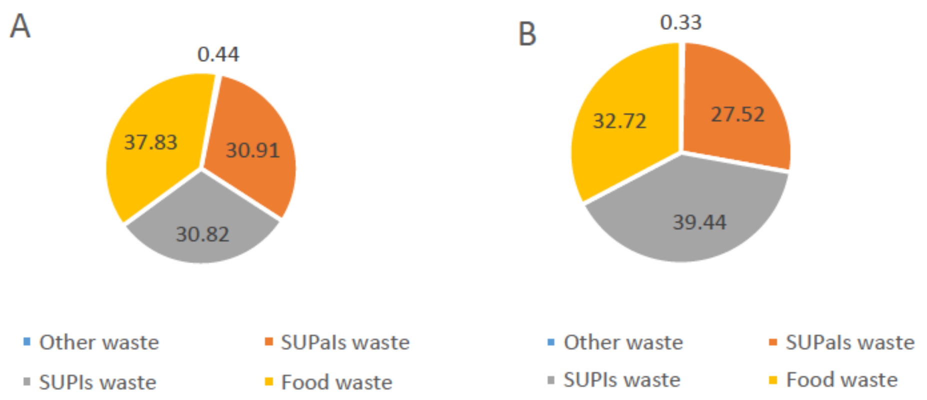

Fig. 4: The percentage of waste composition and SUIs disposed at the studied restaurants in HCMC: (A) Data of waste composition collected from 30 waste bins, (B) data of waste composition estimated for 183 FFRs.

The corresponding value for the 183 restaurant waste data was 33% (Fig. 4B). The total SUIs waste, i.e. SUPIs and SUPals together accounted for 61.7% of the total waste in 30 waste bins (Fig. 4A) and 67% of total waste calculated for 183 FFR (Fig. 4B). This difference in the composition of food waste and SUIs is obviously due to the difference in the number of restaurants, food menu, packaging material consumed and policies adopted by each FFC on the use of SUIs. For instance, FFCs Lotteria and KFC consumed a large amount of diversified SUPIs in comparison with the other FFCs. Further, the number of restaurants for both Lotteria (90) and KFC (49) is higher than the other four FFCs in HCMC, thereby resulting in generating vast amounts of SUPIs wastes. Nevertheless, the proportion of SUIs waste (67%) noticed in the present study was 1.5 lower than the value of 93% reported for packaging waste at McDonald in Finland in 2006 (Aarnio & Hämäläinen 2008) due to the improvement in material consumption and waste management policies of these FFCs over last ten years. In particular, McDonald's has gained 50% of the company's guest packaging that originates from renewable or certified sources (McDonald's, 2019). This company has eliminated packaging through innovating material and design (McDonald's, 2019). Similarly, KFC has applied and performed corporate social responsibility (CSR) successfully since 2012, which considered the environment as one of four factors in their CSR reports (Bediako 2018). On the other hand, the menu of both two companies - owned restaurants in HCMC focus on Vietnamese traditional dishes (more rice) that are significantly different from the normal fast food. All these solutions of both FFCs led to reduce in the amount of packaging waste generated in comparison with the research in Finland in 2006. However, this result is also in accord to 70% of inorganic waste reported at KFC outlets in Semarang, Indonesia in 2015 (Alfagi et al. 2015). It can be explained that the same component of waste in both regions, which consist of plastic and beverages packaging and drinks leftover (Alfagi et al. 2015). In addition, in both countries, it has not an obligatory for FFRs to separate the waste into different components for recycling. This leads to the similarity in the component of the inorganic waste of KFC outlets in Semarang and HCMC.

Within SUIs, SUPIs and SUPals accounted for 30.8% and 30.9% respectively for the total SUIs generated in 30 waste bin data (Fig. 4A). The corresponding values for 183 FFR were 39.4% and 27.5%, respectively. Interestingly, SUPIs waste noticed in the present study was 2.3-3.5 times higher than the value reported in the literature. In particular, plastic waste accounted for 11% of total waste generated at McDonald's restaurants in Finland in 2006 (Aarnio & Hämäläinen 2008), which was 2.8 to 3.5 times lower than these study findings. This consequence can be explained as the consequence of the difference in McDonald's policies in several developed countries and Vietnam. In particular, although McDonald's has set its policy on the type of packaging materials to be used for its operations since the 2000s and these policies leads to that the packaging material has currently accounted for 22% of the global plastic packaging for function and safety of food worldwide (McDonald's, 2019). However, observing from the survey process in HCMC indicated that the McDonald's – owned restaurants still use a variety of SUPIs, such as spoons, forks, knives, straws, condiment containers, and cups as presented in

Table 3.2. Thus, the percentage of plastic packaging waste at McDonald's in Finland in 2006 was lower than these findings. Similarly, SUPIs accounted for only 17% of the waste generated in seafood restaurants in Fano, Italy (Tatàno et al. 2017), which was from 1.8 to 2.3 times lower than the percentage of SUPIs in the waste generated by these studied FFRs. It can be explained that restaurants in Fano, Italy served seafood that is preferred to be eaten in dining area instead of taking them away as fast food. Additionally, both countries, Finland and Italy are two of the European countries where is the first voluntary region issued policies on the limitation in use of SUPIs (UNEP, 2018a). In contrast, the large percentage of SUPIs (30,8% of the waste in 30 bins and 39.4% of the waste calculated for 183 restaurants) in the waste generated the studied FFRs was 2.8 times higher than the value of 14% of plastic waste reported in the municipal solid waste in HCMC. The difference can be explained by the significant contribution of domestic waste (60-70%) to the municipal solid waste generated in HCMC (Thang et al. 2018).

3.3 Composition of SUPIs and SUPals

Data on the number and weight of SUIs consumed per day collected from the FFRs is presented in Table 3.2 and Fig. 5.

Table 3.2: The type and the weight of individual SUPIs used by six FFCs (gram)

Type of SUPIs	Lotteria	KFC	Jollibee's	Popeyes Stores	Texas Chicken	McDonald's
Plastic spoon 1	-	1.38	-	-	-	2.67
Plastic spoon 2	3.80	2.88	3.37	3.50	2.84	3.65
Plastic fork	2.83	3.08	3.02	2.85	2.99	3.57
Plastic knife	-	-	-	-	2.8	3.81
Plastic straw	0.64	0.47	0.44	0.52	0.56	0.52
Plastic condiment container	0.58	0.86	0.47	0.81	1.02	0.58
Small plastic lid	1.55	1.39	1.68	1.98	-	1.80
Big plastic lid	2.7	4.62	-	-	2.30	-
Plastic cup	14.4	13.6	-	-	13.21	20.39
Plastic ice cream cup	5.47	9.01	-	-	-	-
Plastic container	37.85	5.61	-	-	-	-
Plastic bag	4.22	6.07	6.36	-	-	3.13
Styrofoam container	-	-	4.03	-	-	-
Big paper cup	12.06	10.66	9.26	9.02	10.71	9.03
Small paper cup	7.08	9.00	7.16			
Paper ice cream cup	6.68	-	7.93	-	-	9.78
Paper tea cup 1	-	-	10.14	-	-	-
Paper tea cup 2	-	-	13.98	-	-	-
Medium paper bag	8.00	6.96	5.68	6.21	5.84	5.92
Large paper bag			6.19			9.18
Small paper bag	3.05	7.05	5.77	4.42	1.2	9.41
Wrapping paper	2.85	1.64	3.24	2.85	2.68	2.24
Paper container 1	-	8.32	-	-	-	7.57
Paper container 2	-	17.48	-	-	5.87	11.2
Paper container 3	-	27.09	25.29	28.40	34.98	13.09

Note: (-) Not used.

In particular, the estimated amount of SUIs consumed per day across the 183 FFR was 2.49 t (Fig. 5A and Fig. 5C). Of which, the amount of SUPaIs (57% - 1.41 t – Fig. 5C) was 1.3 times higher than the SUPIs (43% - 1.08 t – Fig. 5A). In contrast, the amount of SUIs waste generated was 3.87 t (Fig. 2B) with SUPIs share (2.27 t) was 1.42 times more than that of SUPaIs waste (1.6 t). The reason for this difference is that many customers brought takeaway drinks or food from other food services when they visited to the studied FFRs. This increased the number of SUPIs disposed of in the studied FFRs.

Fig. 5B shows that the number, type and the weight of individual SUPIs consumed varied across the six FFCs in HCMC. Plastic cups accounted for the highest weight (400 kg), followed by plastic lids (193 kg). This result is in accord with the previous results indicated that 75% of food delivery packaging waste in Chinese megacities was plastic containers (Song et al. 2018) and 32 million of SUPIs annually consumed were plastic bottles, cups, bags and disposal plastics by food delivery (Jang et al. 2020).

In addition, the considerable number of SUPIs, including condiment containers, straws, and forks, appears to around 168 kg per day and was estimated to be about 43.7 t/yr (260 weekdays/yr). Most of these SUPIs have been identified as unnecessary SUPIs and have been enacted to be banned in many countries (UNEP 2018a).

In terms of the number of SUIs, the total number of individual SUPIs and SUPals consumed across the studied FFCs is presented in Fig. 5A and Fig. 5C. Results showed that the total number of SUPIs consumed across the studied FFCs were 415633 items and was 2.5 times higher than that of SUPaIs (166357 items). However, the total weight of SUPIs consumed was 1.3 times lower than that of SUPaIs. This variation in the weight distribution between SUPI and SUPals was obviously due to the difference in the weight of individual SUIs.

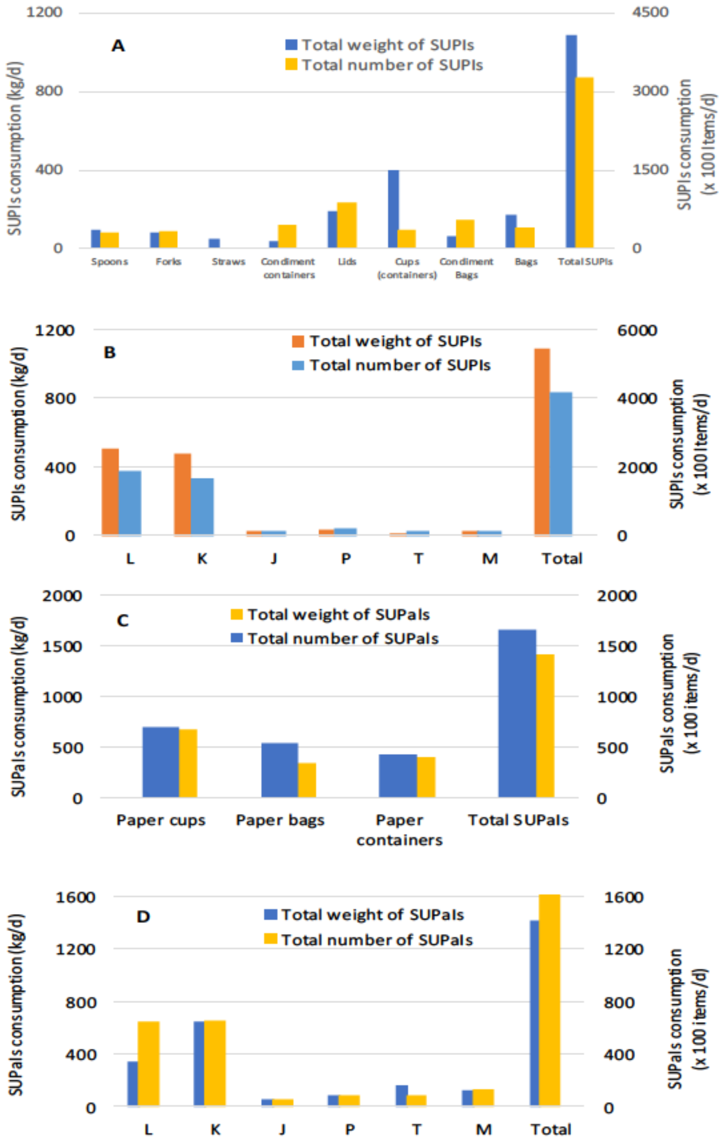

Fig. 5: The total weight and the number of SUIs consumed per day by six FFCs: (A) by each type of SUPIs, (B) by SUPIs across FFCs, (C) by each type of SUPaIs, and (D) by SUPaIs across FFCs. Note: L: Lotteria; K: KFC; J: Jollibee's; P: Popeye Stores; T: Texas Chicken and M: McDonald's.

Regarding to the weight of SUIs, the total weight of SUPaIs consumed per day was approximately 1.41 tons and 1.3 times higher than the weight of SUPIs (1.08 t). Results showed that the number, type and the weight of individual SUPIs consumed varied across the six FFCs in HCMC (Fig. 5B) and depended on the number of the company-owned restaurants. The relatively high amount of SUPIs consumed by Lotteria (508 kg) and KFC

(474 kg) was due to the fact that these two FFCs had the highest number of franchises in HCMC, 90 and 49 respectively. Accordingly, the weight of paper cups consumed 670 kg per day and was the highest among the SUPals. This amount of consumption of SUPals in HCMC was half the consumption rate by under 65 Portuguese population (Gautam & Caetano 2017). Among SUPaIs, a paper bag was the least consumed item (338 kg) (see Fig 6C). Among the FFCs, highest SUPals consumption (646 kg/d) was noticed for KFC followed by Lotteria, Texas Chicken and McDonald’s (Fig. 5D). Conversely, Jollibee’s and Popeyes Stores had the lowest consumption rate of SUPaIs.

In respect of the material for SUPIs, the SUPIs used in the studied restaurants were made of polypropylene (PP- the resin identification codification - 6), such as forks, spoons, and knives or condiment containers or Polystyrene (PS – the resin identification codification - 5). Among these SUPIs, only PP and PS have a high potential for recycling (Van der Harst & Potting 2014). SUPIs made of PS are expected to have less environmental impacts than those made of PP. Previous studies indicated that the effects of these SUPIs on the environment would be reduced by 20% through effective recycling (Gallego-Schmid et al. 2019). Therefore, PS instead of PP should be used for the manufacturing of SUPIs. Furthermore, Lotteria, Jollibee’s and KFC in HCMC used plastic utensils without resin identification codifications. The resin identification codifications enable consumers to identify the post-consumer plastic products that can be recycled in their communities or not (UNEP 2018a). Therefore, it is essential to regulate all plastic manufacturers to mark the resin identification codifications on their plastic products.

Regarding to the diversity of SUIs, Table 2 presents the type and the weight of individual SUIs across six FFCs. Among FFCs, Lotteria, KFC, Jollibee’s and Popeyes Stores did not provide plastic knives to their customers. As a standout, Jollibee’s provided styrofoam container as packaging material for a particular rice dish. The lighter weights of SUPIs used in these restaurants were the plastic straw and condiment container and their weight ranged from 0.44 g (company Jollibee's's straw) to 0.86 g (KFC's condiment container). Interestingly, Jollibee consumed the lowest amount of these two items. In contrast, the plastic cup from McDonald's (20.39 g) and a single plastic container of Lotteria (37.85 g) were the heaviest SUPIs used in these FFCs. However, the weight of other individual SUPIs ranged between 2 and 6 g across the six studied FFCs. Interestingly, Lotteria and KFC were the only FFCs with more diversified usage of SUPIs. From Table 2, it can be seen that the typical types of SUPIs, such as spoon, fork, straw, and condiment container have the same function for all fas food restaurants. If we regulate that the same amount of plastic for one individual spoon, one individual fork, one individual straw, and condiment container is 2.84 gram (Texas Chicken), 2.83 gram (Lotteria), 0.44 gram (Jollibee's), and 0.47 gram (Jollibee's), respectively (see Table 2), therefore, the amount of plastic that would be preventable to be released into the environment by six FFCs in HCMC will be 42.3 kg/day, equal to 11 tons/year. These results suggest that the standardization of the size and the weight of each SUPI leads to prevent a considerable amount of plastic waste coming from SUPIs releasing into the environment.

The evidence from this study shows that there are several recommendations to improve the use and management of SUIs at the FFR, which aims to reduce the amount of plastic waste released into the ocean. Firstly, the role of restaurant managers in encouraging their staffs to provide the accurate number of required SUPIs to their customers. Secondly, the government should regulate separating waste at source to collect and recycle plastic waste and other waste. Thirdly, the FFCs need to identify unnecessary SUPIs to be phased out in short time, which have done in several developed countries (Accorsi et al. 2014). In addition, the Vietnamese government should issue the Packaging and Plastic Act as the intervention policy to standardize the size and the weight of each type of SUPIs, which would prevent a considerable amount of plastic waste of SUPIs released into the environment. Finally, it is necessary to use reusable items in dining areas of FFRs, which leads to a significant reduction of plastic cups, and cutlery used once. The further research should focus on the role of managers in sustainable alternatives to SUPIs.

3.5 CONCLUSION

The study showed that amount and type of SUIs consumed and disposed of varied among the studied FFCs and is dependent on the local waste management technologies and the national policies in HCMC. Results showed that 6 t/d or 1560 t/yr of total waste was generated by the selected six FFCs in HCMC. Of the total waste generated, SUPIs and SUPaIs accounted for 39% and 28%, respectively. Among the six FFCs, Lotteria consumed and generated the highest amount of waste while Popeyes Stores generated the least amount of waste. The total weight of unnecessary SUPIs (condiment containers, straws, and forks) was about 44 t/yr. For sustainable waste management and to reduce the amount of plastic waste generated by the FFI, policies on separating waste at source, standardization in the size, the weight and material used for SUPI are highly recommended. Further, vital roles of FFCs in improvement of SUPI management are to identify unnecessary SUPIs to be phased out at all FFCs in the near future and improve the local waste management practices through material recovery and recycling.

3.6 ACKNOWLEDGEMENT

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3.7 CONFLICT OF INTEREST

The authors declare no conflict of interest

Chapter 4: KAP of Customers and Restaurant Managers Regarding the Use and Disposal of SUPIs in the FFI in Vietnam

4.1 ABSTRACT

The plastic waste generated in the FFI in Vietnam comes from the use and disposal of SUPIs in FFRs and the behaviour of waste producers is affected by their knowledge and attitude. This chapter aims to examine the knowledge, attitude, and practice (KAP) of customers and restaurant managers on the use and the disposal of SUIs (SUPIs and SUPaIs) at FFRs and at their home (only customers). The research findings indicated that both customers and restaurant managers have limited knowledge of the environmental impacts of SUIs and single-use environmentally friendly items (SUEFIs). Approximately over half of the customer respondents (60%) used SUPIs when eating at the FFRs and 82% of them did not use them at home but threw them in bins. Furthermore, there was a relationship among the education variable and the use of SUPIs ($p = 0.037$) and the disposal of SUPIs ($p = 0.02$) at home. Most of the restaurant manager respondents (70%) agreed with the use and disposal of SUPIs at their FFRs and 60% and 32% of them believed that SUIs should be landfilled and the use of SUPIs would be declined, respectively. These results implicate that the vital role of FFCs plays in the improvement of plastic waste generation.

reusable items is more detrimental than the use of SUPIs regarding climate change impacts (Blanca-Alcubilla et al., 2020; Chitaka et al., 2020; Gallego-Schmid et al., 2019), these policy recommendations should be considered for implementation. Also, considering other environmental impacts, both of the policy recommendations would save many other resources, such as water and energy during the process of plastic production at stages of petrol extraction. Hence, further research should focus on a schedule to phase out these unnecessary SUPIs and focus on the technical factors which would enable these policy recommendations to be adopted.

Chapter 7: Conclusions

7.1 INTRODUCTION

Plastic waste is a significant environmental concern in Vietnam. Being a top five countries in the mismanagement of plastic waste (UNCRD, 2019), the Vietnamese government has been seeking and adopting suitable measures to deal with this issue. This thesis investigated the current use and disposal of SUPIs and waste management in the FFI in HCMC and Vietnam. Then, the thesis also recommended the policy measures based on the actual investigations and analysis of the potential consequence of the implementation of these policy recommendations. The results provide policymakers and researchers as other organisations with solutions to cope with the current pollution of plastic waste coming from the use and disposal of SUPIs in Vietnam. This chapter offers the overall conclusions, the achievement of the mentioned research objectives, highlights contributions of this research, and limitations, as well as directions for future research.

7.2 REVIEW OF RESEARCH OBJECTIVES

The research aims to improve plastic waste management and the use and disposal of SUPIs in the FFI in Vietnam. Therefore, the research recommends a guideline for main stakeholders who are involved in the use and the disposal of SUPIs.

Objectives:

1. To review policies of single-use plastics in selected countries.

2. To determine the components and weight of SUIs consumed and disposed of in FFI in Vietnam (a case study in HCMC).
3. To investigate the KAP of customer, fast food restaurant representatives who play main roles in management of SUPIs in FFI in HCMC.
4. To examine key stakeholders' choices on the recommended policy measures for improving plastic waste management in the FFI in Vietnam.
5. To analysis the potential implementation outcomes of several recommended policy measures for the FFI in Vietnam.

Overview of the research objectives is presented in Figure 7.1. These objectives have close relationships together to achieve the research aim. To carry out these objectives, the research used a variety of methods including literature review (objective one), surveys with structured questionnaires (objective two and three), interviews (semi-structured interview), measuring the waste weight (objective two), and calculating the waste weight based on the measured amount of SUPIs (objective five).

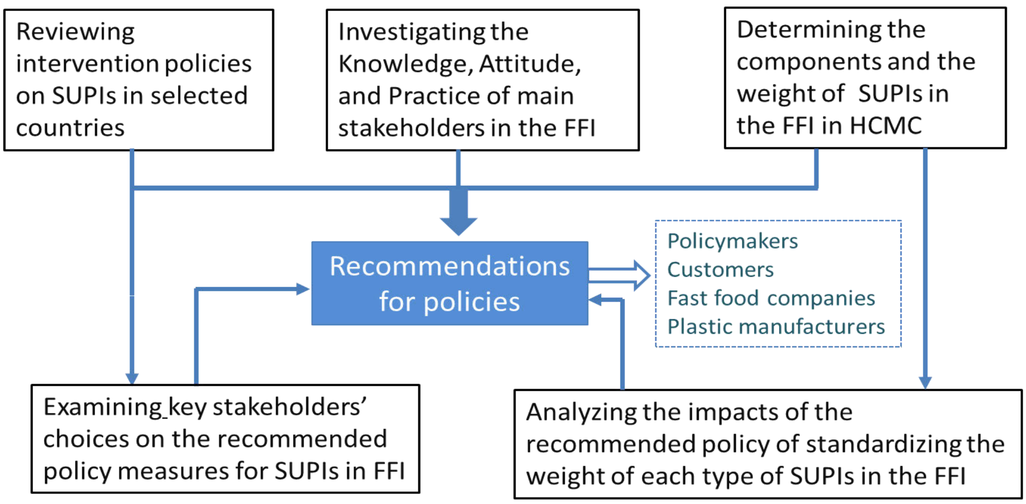

Figure 7.1 Overview objectives of the research.

By applying these methods, these results point out the importance of the research and its contributions to the FFI in Vietnam, which is described generally in Table 7.1.

Table 7.1 Overview of the Thesis Findings and Contributions.

	CHAPTER 2	CHAPTER 3	CHAPTER 4	CHAPTER 5	CHAPTER 6
Chapter Title	Literature review	The current use and disposal of SUPIs in FFI in HCMC, Vietnam	The KAP of customers and restaurant managers on the use and the disposal of SUPIs in the FFI in HCMC, Vietnam	The key stakeholders' choices on the policy recommendations for SUPIs in the FFI, Vietnam	The potential impacts of the policy recommendations in the FFI in Vietnam
Research Objectives	To review policies of SUPIs in selected countries and lessons learnt for Vietnam.	To determine the components and weight of SUPIs consumed and disposed of in the FFI.	To investigate the KAP of key stakeholders about the use and disposal of SUPIs in FFI, HCMC.	To examine the key stakeholders' choices on the policy recommendations in FFI.	To analyse the potential implementation outcomes of the policy recommendations.
Data Sources	Journal articles; Books and book chapters; Policy documents; Archival records;	Structured questionnaire; Policy documents; Journal articles;	Structured questionnaires; Journal articles; the policy measures recommended in chapter 2 and 3	Semi-structured interviews; Journal articles; The recommended policy measures in chapter 4.	The policy recommendations offered in chapter 2, 3, 4, and 5; Data in chapter 3.

Findings and Contributions	Review of the FFI: its history, packaging material, waste management. The recommended policy measures for Vietnam to deal with SUPIs	Plastic waste (2.27 t/d) from SUPIs, paper waste (1.6 t/d), food waste (2.1 t/d) are the main components of waste in the FFI, The most weight of plastic cups (400 k/d) and Lotteria has the largest amount of waste (2 t/d).	The limitation in the knowledge of both kinds of respondents about the environmental impacts of the use of SUPIs, The improper disposal of SUPIs of both customers, restaurant managers,	The necessity of implementation of measures encourage change behaviours, reduction measures of SUPIs and introducing the Act of packaging and plastic.	Stopping using condiment containers, straws, and cups would prevent 140 t/y and 360 t/y of plastic in HCMC and Vietnam, respectively, Standardising the weight of each type of SUPIs would limit 55 t/y and 140 t/y of plastic in HCMC and Vietnam, respectively.
Implications	Identification of the research gaps, Contribution to existing knowledge on plastic packaging waste management in the FFI	The FFI in Vietnam consumed an enormous number of SUPIs and generated much plastic waste. The demand for introducing policies to phase out or lessen the use of SUPIs.	The necessity or consideration of raising awareness of customers, restaurant managers on the impacts of the use and disposal of SUPIs;	Consideration of the implementation capacity of the recommended policy measures including eliminating the identified unnecessary SUPIs and standardising the size or weight of SUPIs.	Consideration of integrated implementation of the policy recommendations in the short term and long term, especially two analysed policy measures.

7.3 RESEARCH FINDINGS

The research achieved the important findings contributing significantly to improve plastic waste management in the FFI in Vietnam. Chapter 1 provided a general introduction including the research background, research objective, significance of the research, scope and limitations of the research. Based on the review literature, the policy measures to improve management of SUPIs were recommended for the FFI in Vietnam in plastic waste management, which is used as baseline for the next Chapters. These results were presented in Chapter 2 including the following contents: 1) the development of the FFI, 2) the type and composition of packaging materials, 3) waste generation and management of packaging materials, 4) the environmental impacts of plastic packaging waste, 5) factors influencing on the waste generation in the FFI, 6) overview of policy measures on SUPs, 7) policies on SUPs in the European countries, 8) Overview of policies on SUPIs in Asian countries, 9) overview of policies on plastic waste management and SUPIs in Vietnam, 10) comparison of policies on SUPIs in Vietnam and selected countries. The aim of this chapter is to suggest the policy measures recommended for Vietnam. Therefore, ultimately this chapter showed the research gap on plastic waste management in Vietnam and selected countries and recommended the policy measures for Vietnam.

The composition and the number of SUPIs consumed and disposed of in HCMC and Vietnam were indicated in Chapter 3. These findings showed that amount and type of SUIs consumed and disposed of varied among the studied FFCs and was dependent on the number of the company-own restaurants and plastic waste management policies in HCMC. Results indicated that six FFCs in HCMC created 6 t/d or 1560 t/y of total waste;

of which, SUPIs and SUPaIs accounted for 39% and 28%, respectively. Among the selected six FFCs, the highest amount of waste was generated by Lotteria; in contrast, Popeyes Stores generated the least amount of waste. The policy recommendations continued to be revised after Chapter 3. Accordingly, instead of estimating benchmarks for each type of SUPIs, the findings in this Chapter suggested to standardise the weight of each type of SUPIs in the FFI.

The findings of investigating the KAP of customers and restaurant managers about the environmental impacts of the use and disposal of SUPIs were revealed in Chapter 4. This chapter's aim is to examine perspective of customers and restaurant managers on the environmental impacts of SUPIs in the FFI in HCMC, Vietnam. The research findings showed that the knowledge of both customers and managers in the FFI about the environmental impacts of SUIPs was insufficient. Approximately over a half of the customer respondents (60%) used SUPIs when eating at the FFRs and 82% of them did not use these items, instead of, threw them in bins when having them at home. Most of the restaurant manager respondents (70%) agreed with the use and disposal of SUPIs at their FFRs and 60% and 32% of them believed that SUIs should be landfilled and the use of SUPIs would be declined, respectively. Notably, the occupation and level of education of customers affects their behaviour of buying FF online, using SUPIs (cutlery), and disposing of these. Ultimately, the recommended policy measures were revised, instead of improving the customers' knowledge about the sustainability packaging, it should be about the environmental impacts of the use and disposal of SUPIs in the FFI in Vietnam.

The policy recommendations suggested in previous chapters were used to interview with the thirty-four key stakeholders' choices on policy measures recommended for SUPIs in the FFI in Vietnam, which are showed in Chapter 5. These recommended policy measures include (1) Measures encourage to change behaviour (for customers and fast food restaurant (FFR) staffs); (2) Reduction measures for SUPIs; (3) Measures for each type of SUPIs; and (4) Measures for all SUPIs in the FFI, all of which were suggested from the research results in Chapter 2, 3, and 4. By using social media and face-to-face interviews, the study findings indicate the customer interviewees preferred the policy measures related to improving materials (70%) and design (40%) for SUPIs and the identified avoidable SUPIs were plastic bags (68% of respondents agreed), plastic condiment containers (50%), and plastic straws (less 45%). Most of the stakeholder groups (70% of customer respondents, 100% of restaurant manager respondents and policymaker respondents, as well as plastic manufacturer respondents) who participated in the interviews agreed that a ban on SUPIs should not be applied in the context of Vietnam due to the difficulty of enforcement and the expected non-compliance with the regulations by the majority of the community. All interviewees agreed that it was vital to improve the knowledge of customers and restaurant crews on the use and the disposal of SUPIs in the FF. In contrast, most stakeholders, especially policymakers, believed that the separation of waste at the source should be obligatory since it is an effective way to collect and recycle plastic waste from SUPIs; however, restaurant manager respondents thought that it was a challenge for them due to the extra time needed for their staff to complete this task. The policymakers and experts who participated in the interviews tended to agree with the most policy recommendations, while the other stakeholders placed more importance on the customers' demands. Finally, this chapter finalised six recommended policy measures to improve plastic waste management in the FFI in Vietnam.

Ultimately, based the statistical data collected in Chapter 3, the potential implementation outcomes of two recommended policy measures including eliminating the identified unnecessary SUPIs and standardising the weight of each SUPI type in the FFI in both HCMC and the whole country of Vietnam were analysed in Chapter 6. The results revealed that it would prevent 140 tons and 360 tons of plastic released into the environment in HCMC and Vietnam, respectively if the government had adopted the former policy recommendation. Also, applying the recommended policy of standardizing the weight of each SUPI type in the FFI would eliminate around 55 tons of plastic waste in HCMC and 140 tons country-wide.

7.4 THE POLICY RECOMMENDATIONS

This research suggested the six recommended policy measures: 1) Improving the knowledge of customers, restaurant staffs and managers about the environmental impacts of the use and disposal of SUPIs, 2) Reducing in the use of SUPIs, 3) Identifying unnecessary SUPIs to be phased out, 4) Regulating separating waste at the source, 5) Introducing the Act of Packaging and Plastics, 6) Supporting plastic recycling activities. Each policy recommendation is targeted at different stakeholder group. In particular, the recommendation one is for customers and restaurant crews in the FFI. The recommendations two and three are for the industry and the government at both of the local and the national levels.

7.4.1 Measures encourage to change behaviours

This study indicated that the knowledge of customers and restaurant managers about the environmental impacts of SUPIs (Chapter 4) has been limited. Hence, these measures are targeted at customers and restaurant managers, who are involved in the use and disposal of SUPIs in the FFI in Vietnam. In particular, it is crucial to raise awareness for customers and restaurant staff who work in the FFI about the social, environmental and economic impacts of mismanagement of SUPs (UNEP, 2018b). In addition, educating customers about the environmental benefits of recycled plastics likely stimulates demand for recycled plastic containing products (Akenji et al., 2019b). In fact, behavioural change of customers toward sustainable consumption pattern is still a challenge. To change habitual consumption pattern based on plastic, information campaign with specific topic should be encouraged to raise the public awareness due to its proven effect (Heidbreder et al., 2020).

7.4.2 Reduction measures in the use of SUPIs

The purpose of these measures is to reduce the use of SUPIs in the FFI. Hence, these policy recommendations focus on the FFI that consumes SUPIs. First, it is crucial for FFCs to identify unnecessary SUPIs in their fast food chains. Second, these FFCs need to make a schedule to discontinue these items. In this chapter, both customers and restaurant managers have identified four kinds of SUPIs as the first choice in the descending percentile order to be phased out. These identified avoidable items comprised plastic bags, plastic condiment containers, plastic cups, and plastic straws as Chapter 5. For instance, the first step of a ten-step roadmap that guides policymakers to deal with SUPs was to identify alternatives and design their business models, which reduce SUPs in ASEAN countries (Akenji et al., 2019b). In fact, several companies, including McDonald’s in Australia, have applied policies stopping the use of plastic straws (*McDonald’s plastic straws to be phased out across Australia by 2020 - ABC News*, n.d.; Gibbens, 2019). Therefore, these results reflect the potential effects of implementation of this policy recommendation.

7.4.3 General measures to control plastic waste generation

These policy recommendations to control plastic waste generation include the following measures: 4) regulating separating waste at the source, 5) introducing the Act of Packaging and Plastic, 6) supporting plastic recycling activities. These measures are targeted at policymakers who play a significant role to develop and adopt the policies. Generally, plastic pollution is a global issue, not only Vietnam. Therefore, in Vietnam, it is crucial to consider the implementation of the recommended policy measures to achieve a significant reduction in plastic waste. However, in Vietnam, among challenging environmental issues, each policy measure should have a schedule to step by step reduce the plastic consumption and the plastic waste generation. Furthermore, to mitigate the use of plastics, it requires an effective collaboration from all stakeholders, including policymakers, the FFI, consumers, and scientists, as well as plastic producers.

7.5 RESEARCH CONTRIBUTIONS AND IMPLICATIONS

These findings contribute to existing knowledge on plastic waste generation and management in the FFI overall and Vietnam. This section points out this research's contributions to the FFI and academic world generally.

7.5.1 Contributions to Academic Knowledge

This findings from this research make several significant contributions to the current literature. Notably, the study benefits other researchers in reviewing waste generation and management in the FFI and policies related to the use, disposal, and management of SUPIs generally. First, the research into SUIs, their material, and the waste generation and management in the FFI have been limited in the academic field due to difficulties in the data collection and its transparency (Aarnio & Hämäläinen, 2008; Shokri et al., 2014; Singh et al., 2014; Tatàno et al., 2017). The research into the solid waste generation in the FFI has been limited due to difficulties in the data collection and its transparency (Shokri et al., 2014)

Thus, this research provides extra data on plastic waste generation and management, as well as factors influencing on the generation of plastic waste in the FFI in developing countries like Vietnam. Additionally, the study findings provide detail policies on SUPs over the world, which have enacted or planned to regulate in both developing countries and developed countries over the world (Akenji et al., 2019b; UNCRD, 2019; UNEP, 2018a). hence The review of these policies has still been limited in the academic world and need to be updated monthly due to the worsening trend of plastic ocean pollution (Williams & Rangel-Buitrago, 2019a). This research also impressed the comparison of policies of SUPIs in developed countries and developing countries and highlighted lessons learnt from other countries for Vietnam in the management of plastic waste and SUPs. These findings provide other researchers with the policies on SUPs in countries like Vietnam, Indonesia, India, the EU countries and Australia, as well as Singapore.

Second, as my knowledge, the research into the use and disposal of SUPIs in the FFI in Vietnam has not been mentioned. In the context of the habitual consumption pattern most based on the plastic and plastic packaging in Vietnam, the review of policies on plastic waste and SUPs has been still limited. Hence, this research updated and indicated the current policies on plastic waste and SUPIs, which has been recently adopted to cope with the current disposal, management of plastic waste and the current use and disposal of SUPIs in the FFI in Vietnam. Consequently, other researchers in Vietnam also get benefits from this research when they find the research gap and the needs to carry out further research into SUPs generally and in FFI, specifically in Vietnam.

Third, by investigating the knowledge, attitude, and practice (KAP) of customers and restaurant managers, this research highlighted the gap about KAP of the respondents, which needs to be improved. Therefore, further research could concentrate on methods to raise awareness of these respondents to improve the use and disposal of SUPIs in the FFI. In addition, the results of interviews with key stakeholders involved in the FFI suggest the significant knowledge of multiple stakeholder's perspectives on plastic waste management in Vietnam.

7.5.2 Contributions for the Public, the Industry and Policy

For policymaker, by conducting a deep investigation in FFRs in HCMC, this research showed the current number and weight of SUPIs consumed and disposed of daily; therefore, the policymakers, other researchers, and the public can find the overuse of SUPIs in the FFI. Additionally, analysing the potential implementation outcomes of two recommended policy measures, including ceasing the use of unnecessary SUPIs and standardising the weight of SUPIs, reveals the high possibility and implementation of these policies. All these mentioned findings force policymakers to turn these policies into reality, which would improve the plastic waste management in Vietnam. Furthermore, the investigation in the KAP of customers show that their knowledge on the environmental impacts of SUPIs is insufficient; hence, the policymakers and the FFI would consider working together to improve the current situation because of the significant role of customers what plays in the plastic waste management.

For the FFI, lessening plastic waste coming from the use of SUPIs needs to be impressed by the voluntary contribution of the industry (Forrest et al., 2019). This research reviewed policies on SUPIs and plastic waste offered by many packaging companies that stopped consuming SUPIs, such as eliminating plastic straws in Starbucks' and McDonald's restaurants are typical examples (*McDonald's Plastic Straws* *to Be Phased out across Australia by 2020 - ABC News*, n.d.; Sarah Gibbens, 2019). Other companies, therefore, would find opportunities to drive their packaging toward the sustainability packaging. Additionally, this study investigated into the use and disposal of SUPIs in six selected FFCs in HCMC; as a result, it indicated that these companies consumed a large number of SUPIs, which became plastic waste after once used and ultimately, they ended up in landfills. Consequently, the FFI could find the same opportunity to drive their companies toward the sustainability packaging. On the other hand, by investigating the KAP of restaurant managers in six FFCs, this research provided the gap in the KAP of managers who are responsible for management of plastic waste in their restaurants, the gap encourages these FFCs to improve their policies toward adopting to the circular economy.

By interviewing with plastic manufacturers, this research showed the current use of plastic products and plastic recycling activities, as well as plastic recycling technologies in Vietnam, which is outdated and need to be improved. Although it is the same status of recycling technologies in many developing countries like Vietnam, the government can consider supporting more technologies and funds for these activities. The evidence from this study implicates that the integrated implementation of the recommended policy measures is crucial to improve the current management of plastic waste and SUPIs in Vietnam. Accordingly, the Vietnamese government should not only consider to implement the policy measures encourage to change behaviour but also pay attention to the reduction measures and the general measures to control plastic waste in the FFI to confront with the serious situation of plastic ocean pollution caused by mismanagement of plastic waste.

7.6 RESEARCH LIMITATIONS

Although this research provided a significant contribution to plastic waste management in the FFI in Vietnam, several limitations need to be considered. First, a limited number of waste bins were collected in FFRs to measure the composition and the weight of SUPIs in selected FFCs in HCMC, which may not represent the FFI in Vietnam. Therefore, larger sample sizes in six selected FFCs in HCMC would provide more validity to the research results. Second, the low response rate of restaurant managers when carrying out surveys about KAP of restaurant managers on the use and disposal of SUPIs in the FFI and interviews about their choices on the policy recommendations. A possible explanation is that these managers are always busy in their position; thus, they have not enough time to participate in the research. Third, the calculation of the number and the weight of SUPIs in Chapter 3 and Chapter 6 is for weekdays, excluding the weekend. Hence, if the calculation included the use of SUPIs in the weekend, the weight of SUPIs consumed and disposed of would be much higher. In addition, the consumption of SUPIs in HCMC and other provinces in Vietnam is quite relatively different; the exact number of SUPIs estimated for six FFCs consumed in Vietnam is limited.

7.7 DIRECTIONS FOR FUTURE RESEARCH

As most research, this research has provided other researchers with future research opportunities. The results indicate the importance of policy measures issued by governments and the FFI as well as roles of waste producers in use and the disposal of SUPIs and plastic packaging. While research into plastic waste packaging or SUPIs in the FFI has been still limited (Aarnio & Hämäläinen, 2008; Gallego-Schmid et al., 2019; Jr et al., 2018; Song et al., 2018b), this research provides a clear vision into the current policies of governments in control and management of plastic waste and SUPIs over the world. It also underscores the current policies on plastic waste management, as well as the current use and disposal of SUPI in the FFI in Vietnam.

In addition, this research suggested the policy recommendations from the deep investigations into the FFI. Therefore, future research can benefit from the inclusion of a more range of these recommended policy measures for other developing countries like Vietnam. Furthermore, by investigating the knowledge, attitude, and practice (KAP) of customers and restaurant managers, this research highlighted the gap about KAP of the respondents, which needs to be improved. Therefore, further study could concentrate on methods to raise awareness of these respondents, which affects the use and disposal of SUPIs significantly in the FFI. Ultimately, in terms of plastic recycling activities in Vietnam, considerably more work will need to be done to encourage to intent what technologies should be adopted to improve plastic recycling activities in Vietnam.

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Appendices

Appendix A : Summary the European Strategy for Plastic (European Commission, 2018a, 2019)

Measure group	Measures	Actions
Improving the economics and quality of plastics recycling	Preparatory work for a future revision of the Packaging & Packaging Waste Directive: initiate work on new harmonised rules to ensure that by 2030 all plastic packaging placed on the EU market can be reused or recycled in a cost-effective manner.	Develop product policies, standards and a holistic assessment methodology to assess and support the design of circular products, services and business models.
		Develop regulatory and financial incentives to stimulate demand for recycled content.
	Improve the traceability of chemicals and address the issue of legacy substances in recycled streams.	Enforce, harmonise and adapt existing EU chemical regulations, including REACH, the Toy Safety Directive and the regulation on food-contact materials.
		Facilitate gathering and sharing of information and data on collection, sorting and recycling performance and best practices, to enable cross-value-chain collaboration and compatibility.

Measure group	Measures	Actions
		Set up guidelines on how to improve performance of recycled plastics over time, including treatment and decontamination of legacy materials and hazardous substances.
	New eco-design requirements to support the recyclability of plastics Improving	Develop and implement regulatory incentives such as extended producer responsibility systems and shared responsibilities across the value chain to steer (plastic) product design towards reuse and cost-effective recycling.
		Develop regulatory measures and incentives such as EPR systems, eco-design and minimum product requirements to steer product design towards elimination, use of renewable or recycled feedstock, reuse and cost-effective recycling (Packaging and Packaging Waste, Eco-design, and Waste Framework Directive).
		Develop regulatory measures, such as a stewardship framework or EPR with modulated fees, integrating new digital technologies, to cover costs of waste collection

Measure group	Measures	Actions
		and processing, to incentivise product design towards circular pathways, and to fund innovation in this field.
		Develop regulatory and financial incentives to drive product design towards products that can be effectively reused or recycled where they are put on the market (e.g. in PPWD, Eco-design Directive and WFD).
	Launching an EU-wide pledging campaign targeting industry and public authorities	Collaborate towards a common vision across the plastic value chains to trigger actions on regional, national, European and global level.
	Assessment of regulatory or economic incentives in revision of Packaging waste; evaluation/review of the Construction Products Regulation; and evaluation/ review of End-of-life Vehicles Directive	Develop and implement regulatory incentives such as extended producer responsibility systems and shared responsibilities across the value chain to steer (plastic) product design towards reuse and cost-effective recycling.
		Develop regulatory measures and incentives such as EPR systems, eco-design and minimum product requirements to steer product design towards elimination, use of

Measure group	Measures	Actions
		renewable or recycled feedstock, reuse and cost-effective recycling (Packaging and Packaging Waste, Eco-design, and Waste Framework Directive).
		Develop regulatory measures, such as a stewardship framework or EPR with modulated fees, integrating new digital technologies, to cover costs of waste collection and processing, to incentivise product design towards circular pathways, and to fund innovation in this field.
		Develop regulatory and financial incentives to drive product design towards products that can be effectively reused or recycled where put on the market (e.g. in PPWD, Eco-design Directive and WFD).
	Food-contact materials: swift finalisation of pending authorisation procedures for plastics recycling processes better characterisation of	Set up guidelines on how to improve performance of recycled plastics over time, including treatment and decontamination of legacy materials and hazardous substances.

Measure group	Measures	Actions
	contaminants and introduction of monitoring system	
	Development of standards for sorted plastics waste and recycled plastics	Develop regulatory and financial incentives to stimulate demand for recycled content.
	Ecolabel and GPP: further incentivise the use of recycled plastics, including by developing adequate verification means	Develop regulatory and financial incentives to stimulate demand for recycled content.
		Provide regulatory and fiscal incentives to stimulate demand for recycled plastics, including public procurement and accounting for the costs of negative externalities linked to different primary feedstocks.
		Develop and implement harmonised standards for quality of mechanically and chemically recycled plastics and for verification of recycled content, taking into account safety and application areas.
	New guidelines on separate collection and sorting of waste	Enforce waste legislation and develop regulatory framework to harmonise collection systems, allowing a certain degree of local adaptation to socioeconomic conditions.

Measure group	Measures	Actions
	Ensure better implementation of existing obligations on separate collection, including through ongoing review of waste legislation	Enforce waste legislation and develop regulatory framework to harmonise collection systems, allowing a certain degree of local adaptation to socioeconomic conditions
Curbing plastic waste and littering	Legislative proposal on port reception facilities	
	Development of measures to reduce loss of fishing gear: legislative instrument on single use plastics and fishing gear	Develop product policies, standards and a holistic assessment methodology to assess and support the design of circular products, services and business models.
	Development of measures to limit plastic loss from aquaculture (e.g. BREF document)	
	Improved monitoring and mapping of marine litter	Harmonise definitions, frameworks for systematic data gathering, and analyses of plastic flows and pollution at European and global level.

Measure group	Measures	Actions
		Develop open collaboration platforms to enable more comprehensive analyses and frequent benchmarking on plastic flows and impacts, to provide information on and for investments, and to create political and public will.
	Support MS with the implementation of their POM's under the MSFD and links with waste/litter management plans under the WFD	
	Develop harmonised rules on defining and labelling compostable and biodegradable plastics	Develop a legal framework on communication about composability and biodegradability and provide clear information and business guidance on the different after-use pathways, and their complementarity.
	Lifecycle assessment to identify conditions where use of compostable and biodegradable	Develop and implement more holistic methodologies to assess the economic, environmental and social impacts of different after-use pathways for used plastics to inform design and decision-making.

Measure group	Measures	Actions
	plastics is beneficial, and criteria for such application	Develop a methodology to compare environmental, social and economic impact of different after-use pathways enabled through material selection for a range of common products and take regulatory measures accordingly.
		Harmonise policymakers' efforts across Europe to provide a clear direction for R&I and implementation of compostable or biodegradable materials and their after-use pathways.
	Restrict use of oxo-plastics via REACH	
	Restrict intentional addition of microplastics to products via REACH	
	Policy options to reduce release of microplastics from tyres, textile, paint	
	Measures to reduce plastic pellet spillage	

Measure group	Measures	Actions
	Evaluation of the UWWTD, assess effectiveness on microplastics capture and removal	
Driving investment and innovation towards circular solutions	Guidance on eco- modulation of EPR fees	Develop and implement regulatory incentives such as extended producer responsibility systems and shared responsibilities across the value chain to steer (plastic) product design towards reuse and cost-effective recycling.
		Develop regulatory measures and incentives such as EPR systems, eco-design and minimum product requirements to steer product design towards elimination, use of renewable or recycled feedstock, reuse and cost-effective recycling (Packaging and Packaging Waste, Eco-design, and Waste Framework Directive).
		Develop regulatory measures, such as a stewardship framework or EPR with modulated fees, integrating new digital technologies, to cover costs of waste collection

Measure group	Measures	Actions
		and processing, to incentivise product design towards circular pathways, and to fund innovation in this field.
		Develop regulatory and financial incentives to drive product design towards products that can be effectively reused or recycled where they are put on the market (e.g. in PPWD, Eco-design
	Recommendations by the 'Circular Economy Finance Support Platform'	Provide and enable funding and financial incentives for infrastructure and (long-term) R&I that maximises plastics value retention.
	Feasibility of a private- led investment fund for innovation	Provide and enable funding and financial incentives for infrastructure and (long-term) R&I that maximises plastics value retention.
		Provide funding for research and financial incentives for systemic innovation across the plastics value chain.

Measure group	Measures	Actions
	Direct financial support through European Fund for Strategic Investments (EFSI) and other EU funding instruments	Provide and enable funding and financial incentives for infrastructure and (long-term) R&I that maximises plastics value retention.
		Provide regulatory, legal and financial incentives to support (long-term) R&I in and scale-up of innovative bio-based materials and chemicals towards a self-sustaining critical mass, guided by systems thinking.
		Set up, connect and participate as an active stakeholder or shareholder in investment instruments to enable investors and lenders to provide funds for circular economy business models
	Life cycle impacts of alternative feedstock for plastic production	Provide regulatory, legal and financial incentives to support (long-term) R&I in and scale-up of innovative bio-based materials and chemicals towards a self-sustaining critical mass, guided by systems thinking

Measure group	Measures	Actions
	Development of a Strategic Research and Innovation Agenda on plastics to guide future funding decisions	This report forms a major input into the Development of the Strategic Research and Innovation Agenda
Harnessing global action	Project to reduce plastic waste and marine litter in East and Southeast Asia	
	Examining options for specific action to reduce plastic pollution in the Mediterranean (Barcelona Convention)	
	Cooperation on plastic waste prevention in major world river basins	

Measure group	Measures	Actions
	Renewed engagement on plastics/marine litter in fora such as the UN, G20, MARPOL, regional sea conventions	
	Support action under the Basel Convention, particularly for the implementation of the toolkit for environmentally sound waste management	
	Promote a circular plastics economy in non-EU countries through policy dialogues on trade, industry and environment, as well as economic diplomacy	Collaborate towards a common vision across the plastics value chains to trigger actions at regional, national, European and global level
	Use bilateral, regional and thematic funding in EU development, neighbourhood and enlargement policies	

Measure group	Measures	Actions
	Support the development of international industry standards for sorted plastic waste and recycled plastics	Set up a cross-value-chain platform with participation incentives to gather and share information and data on material composition of primary and secondary plastics, to support industrial symbiosis and to determine the (future) role of mechanical recycling
	Ensure that exported plastic waste is dealt with appropriately, in line with the EU waste shipment regulation	
	Support the development of a certification scheme for recycling plants in EU and third countries	

Appendix B : The questionnaire on the use and disposal of SUPIs in the FFI in HCMC

We are researchers who are carrying out a survey on the use and disposal of single-use items, as well as the waste management in the fast food industry in HCMC, Vietnam. We would like to invite you as restaurant managers to participate in this research. Your participation is voluntary and you have a right to withdraw the research any time. We greatly appreciate your kind contribution to our research and a result of this research aims to manage and use more efficiently natural resource.

CONFIDENTIALITY

The information you provide in this questionnaire will be treated confidentially. That is your personal detail will not be given to your employer or anyone and no one will be identified in the report.

I. INFORMATION OF TYPES OF FAST FOOD SERVICES

Q1. Your company belongs to one of the following brands:

☐ 1. KFC ☐ 2. McDonald's ☐ 3.Texas Chicken ☐ 4. Lotteria

☐ 5. Popeyes ☐ 6. Jollibee's ☐ 7. Papa's Chicken

Q2. Your company is located at the following districts in Ho Chi Minh city:

☐ 1. District 1 ☐ 2. District 2 ☐ 3. District 3 ☐ 4. District 4

☐ 5. District 5 ☐ 6. District 6 ☐ 7. District 7 ☐ 8. District 8

☐ 9. District 9 ☐ 10. District 10 ☐ 11. District 11 ☐ 12. District 12

☐ 13. Thủ Đức ☐ 14. Gò Vấp ☐ 15.Tân Bình ☐ 16. Tân Phú

☐ 17. Bình Thạnh ☐ 18. Bình Tân ☐ 19.Phú Nhuận ☐ 20. Củ Chi

☐ 21. Hóc Môn ☐ 22. Bình Chánh ☐ 23.Nhà Bè ☐ 24. Cần Giờ

Q3. Types of fast food products that your outlet serves:

☐ 1. beverages ☐ 2. fast food and others ☐ 3. fast food & beverage

☐ 4. pizza & beverage ☐ 5. others…………………………………………………………..………

Q4. The average number of customers visited are served daily:...

Q5. The average number of meals are served daily:…………………………………………………….

Q6. The number of taking away meals in comparison with sited meals:

☐ 1. less ☐ 2. equal ☐ 3. more

Q7. The kind of customer frequently go to the outlet:

☐ 1. pupils, students ☐ 2. officials ☐ 3. children ☐ 4. Laborers

II. FOOD PACKAGING AND SINGLE USE ITEMS USED IN THE OUTLET

Q8. In a diet, excepting food, will including (multiple choice):

☐ 1. fork ☐ 2. spoon ☐ 3. small bowl

☐ 4. condiment container ☐ 5. stick ☐ 6. others:………………….

Q9. Which of the following single use items that your outlet use is made of plastic:

☐ 1. fork ☐ 2. spoon ☐ 3. bowl ☐ 4. straw

☐ 5. condiment container ☐ 6. bag ☐ 7. food container ☐ 8. cup

☐ 9. lid ☐ 10. condiment bag ☐ 11. other: ……………………….

Q10. In brief, why the outlet selects the plastic single use items to use: ....

....

Q11. Which of the following single use items that your outlet uses is made of wood/paper:

☐ 1. fork ☐ 2. spoon ☐ 3. bowl ☐ 4. straw

☐ 5. condiment container ☐ 6. bag ☐ 7. food container ☐ 8. cup

☐ 9. lid ☐ 10. condiment bag ☐ 11. other: ……………………………….

Q12. In brief, why the outlet selects the wood single use items to use: ....

....

Q13. The bag is made of:

☐ 1.paper bag ☐ 2. plastic bag ☐ 3. plastic box

☐ 4. foam box ☐ 5. others: ………………………..……………………………………..…

***Q14**. For taking away customers, the food is contained in:*

☐ 1.paper bag ☐ 2. plastic bag ☐ 3. plastic box

☐ 4. foam box ☐ 5. others:……………………….……………………………………..…

***Q15**. For taken away meals, the food is contained in:*

☐ 1.paper bag ☐ 2. plastic bag ☐ 3. plastic box

☐ 4. foam box ☐ 5. others:……………………………………….…………………..…

Q16. The number of food containers is imported per month/week/day:...

Q17. The number of spoons is imported per month/week/day: ....

Q18. The number of bowls is imported per month/week/day: ....

Q19. The number of forks is imported per month/week/day: ....

Q20. The number of cups is imported per month/week/day: ....

Q21. The number of straws is imported per month/week/day: ....

Q22. The number of condiment containers is imported per month/week/day: ....

Q23. The number of bags is imported per month/week/day: ....

Q24. The number of lids is imported per month/week/day:...

III. WASTE GENERATION AMD MANAGEMENT IN FAST FOOD RESTAURANTS

Q25. Most components of solid waste in your outlet are:

☐ 1. packaging ☐ 2. disposal tableware

☐ 3. disposal food ☐ 5. others: ………………………..…………………..…

Q26. Currently, storage of solid waste in your outlet are:

☐ 1. separately food waste and the rest in 2 bins ☐ 2. both kinds of waste in a bin

☐ 3. other case: ……………………………………………………………………………………….

Q27. Disposal tableware made of plastic are:

☐ 1. stored and then sold for collectors ☐ 2. disposed in bins

☐ 3. other: ……………………………………………………………………………………………….

Q28. A person who is responsible for collecting solid waste in the outlet is:

☐ 1. staff in the outlet ☐ 2. customer ☐ 3. both

Q29. A company who is major responsible for collecting the solid waste of the outlet is:

☐ 1. the CITENCO ☐ 2. many companies depend on each solid waste

☐ 3. other:………………………………………………………………………………………………..

Q30. A frequency of solid waste collection is:

☐ 1. once/day ☐ 2. 2 times/day ☐ 3.3 times/day ☐ 4. other: ……………………..

Q31. How is solid waste collected?

☐ 1. collecting as storage of the outlet ☐ 2. all solid waste collected together in a bin
☐ 3. other: ……………………………………………………………………………..

Q32. In your opinion, in term of solid waste management by the government, does the discharge of solid waste generated by your outlet impact on the environment?

☐ 1. Yes, reason: ....

☐ 2. No, reason: ....

☐ 3. other idea: ………………………………………………………………………………………..

Q33. To reduce plastic SUPIs in your outlet, in your opinion, which items should be reduced and why: ....

....

……………………………………………………………………………………………………….

Q34. In your opinion, does your outlet manage well the solid waste?

☐ 1. Yes, reason: ....

☐ 2. No, reason: ....

☐ 3. other idea: ………………………………………………………………………………………..

Q35. To manage and control the solid waste better, what does your outlet focus on?...........................

……..…

……
…..

IV. PERSONAL EXPERIENCE OF RESTAURANT MANAGER

Q36. In term of managers, please time you work for the outlet:

☐ 1. under 2 months ☐ 2. 3 months to 1 year ☐ 3. over 1 year

Q37. Your experience in fast food industry:

☐ 1. under 1 year ☐ 2. 1-under 3 years ☐ 3. 3-5 years ☐ 3. over 5 years

Appendix C : Questionnaire on the Knowledge, Attitude, and Practice of customers on SUIs in the FFI

The questionnaire is designed to survey on their Knowledge, Attitude, and Practice of customers about the use of disposal of SUIs. It asks also questions about their adverse impacts on the environment after being disposed of. Your participation in this research is very essential and important for us to complete our research. The questionnaire does not aim to be used commercial or trade purposes, all personal information from respondents will be confidential and respondents have the right to withdraw from participating in this research.

A. PERSONAL INFORMATION

a) Gender: ☐ 1. Male ☐ 2. Female
b) Age:
c) Occupation:
d) Level of education: ☐ 1. Under diploma ☐ 2. Diploma holder ☐ 3. Higher educate

Definition of single-use items (SUIs) that are items only used once and then disposed of. SUIs include plastic cutlery, plastic straws, plastic food containers, boxes, wrapping, bags. SUIs can be made of plastic (SUPIs) or paper (paper laminated with plastic layer - SUPaIs).

B. KNOWLEDGE

1. In your opinion, what are the impacts of SUPaIs waste on the environment?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

2. In your opinion, what are the impacts of SUPIs waste on the environment? (multiple choice question)

…………………………………………………………………………………………………

…………………………………………………………………………………………………

……………………………………………………………………………………………….

3. What information do you known about the impacts of SUIs?

☐ 1. I have zero knowledge ☐ 2. From colleagues, companies ☐ 3. The internet

☐ 4. Television ☐ 5. From closed people, such as friends ☐ 6. Others:

C. ATTITUDE

4. What influences your decision when choosing a fast food restaurant?

☐ 1. Price ☐ 2. Location ☐ 3. SUIs ☐ 4. Menu ☐ 5. Promotion

☐ 6. The quality of service: ....

5. Are you satisfied (agree) with SUIs provided by FFR?

☐ 1. Disagree ☐ 2. Agree ☐ 3. Neutral

D. PRACTICE

How often do you have fast food?

	Once month	Once week	2-4 times/week	Every day	Rarely
6. Eating in a fast food restaurant	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
7. Takeaway or online order	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

8. At fast food restaurants, when provided with SUIs, how do you use them for your meals?

☐ 1. I eat my meals with my hands ☐ 2. I use SUPIs (cutlery) provided by FFRs

☐ 3. I use my own SUPIs ☐ 4. I only use SUPIs if it is really necessary

9. For takeaway meals at home, when provided with SUPIs, how do you use SUPIs?

☐ 1. I eat my meals with my hands ☐ 2. I use cutlery provided by the fast food restaurants

☐ 3. I use family-owned items

10. For takeaway meals at home, when receiving SUPIs (cutlery) provided by FFRs, how do you treat SUIs?

☐ 1. I do not use and throw them in bins ☐ 2. I keep them, as they may have another use

☐ 3. I reuse them several times before disposing of

11. For takeaway meals at home, after using SUPIs (cutlery), how do you dispose of SUPIs?

☐ 1. I separate them and sell them to waste pickers ☐ 2. I wash and reuse them several times before discarding

☐ 3. I throw them in bins after using

E. SOLUTIONS

12. Are you familiar about single-us environmentally friendly items (SUEFLs)?

☐ 1. No ☐ 2. Yes

13. What is SUEFIs?

………..

………...

………...

14. Do you agree with SUPIs being replaced by SUEFIs with an increase of fast food price?

☐ 1. Disagree ☐ 2. Agree ☐ 3. Neutral

15. If FFCs alter SUPIs by SUEFIs, so the price for this service increases, what is your willingness to pay for this change?

☐ 1. The price increases from 1-5% ☐ 2. The price increases from 6-10% ☐ 3. Fully disagree

F. INFORMATION OF THE FAST FOOD COMPANY

○ 1. KFC ○ 2. McDonald’s ○ 3. Texas Chicken

○ 4. Lotteria ○ 5 Popeyes ○ 6. Jolibee

Address:…………………………………………………………

Code:…………………………………………………

Thank you very much for your kind participation!

Appendix D : Questionnaire on Knowledge, Attitude and Practice of Restaurant Managers on Single-use Items in the FFI

The questionnaire is designed to survey restaurant managers about their Knowledge, Attitude, and Practice of customers about the use of disposal of SUIs. It asks also questions about their adverse impacts on the environment after being disposed of. Your participation in this research is very essential and important for us to complete our research. The questionnaire does not aim to be used commercial or trade purposes, all personal information from respondents will be confidential and respondents have the right to withdraw from participating in this research. Thank you very much for your kind participation.

Note: Symbols for type of questions ○ **Single choice;** ☐ **Multiple choices**

The definition of single-use items (SUIs) that are only used once and are then disposed of. SUIs include plastic cutlery, plastic straws, plastic food containers, boxes, wrapping, bags. SUIs can be made of plastic (SUPIs) or paper (paper laminated with plastic layer - SUPaIs).

A. PERSONAL INFORMATION

[a] Position:…………………………………… Gender: ○ Male ○ Female

[b] Education: ○ 1. Graduated university ○ 2. Graduated colleges

○ 3. Vocational education ○ 4. High school ○ 5. Others:……………………

[c] Working experience: ○ <1 year ○ From 1-5 years

○ 6- 10 years ○ >10 years

[d] Your role in your company?

	1. Completely no	2. No	3. Neutral	4. Yes	5. Significantly
i. Have a right to participate in all meetings organized by the company in HCMC					
ii. The level of your contribution to the company?					
iii. The implementation of your contributions to the company?					

B. **KNOWLEDGE**

16. In your opinion, what does the use of SUPaIs impact the environment?

……

……

……..

17. In your opinion, what does the use of SUPIs impact on the environment?

……

……

……………………………………………………..…………………………………………………

………………………………

18. What information do you known about the adverse impacts of SUIs?

☐ 1. I have zero knowledge ☐ 2. From colleagues, companies ☐ 3. The internet

☐ 4. Television ☐ 5. From close people, such as friends ☐ 6. Others:

C. ATTITUDE

	1. Completely disagree	2. Disagree	3. Neutral	4. Agree	5. Completely agree
19. SUIs should be used with fast foods?					
20. SUPIs should be landfilled after being used once?					
21. SUPIs should be recyclable?					
22. Are you satisfied with all SUIs provided by FFRs					

D. PRACTICE

23. At your restaurant, what are SUIs treated?

	1. SUPaIs	2. SUPIs	3. Others
a) Separated and reused			
b) Separated and thrown away			
c) No separation and thrown away			
d) Others:………………….			

24. Do you agree with the above treatment? (circle your choice)

1. Fully disagree	2. Disagree	3. Neutral	4. Agree	5. Fully agree

E. CHOICE OF SOLUTIONS FOR SUPIs

Single-use environmentally friendly items - SUEFIs are degradable items

25. Are you willing to recommend that your company to replace SUPIs by SUEFIs?

○1. Yes ○ 2. No ○ 3.Others…………………

26. If SUEFIs are preferred by your customers, will you use them in your restaurants, even their prices are higher than SUPIs's prices?

○ 1. Yes ○ 2. No ○ 3. The company decides it ○ 4. Others:………………...

27. 14) If SUEFIs' prices are higher than SUPIs' prices, how willing are you to use them in your restaurant?

○ 1. Increase by 1 - 5% ○ 2. Increase by 6 - 10% ○ 3. Increase 10 - 20%

○ 4. Increase over 20% ○ 6. The same price ○ 5. The company decides it

28. Please mark as (✓) in the solution you think that it should be applied for each type of SUIs:

	1. SUPaIs	2. SUPIs	3. No need any measures
a) Reduce using			
b) Stop using			

29. ***If implementing a solution to improve environmental issues caused by SUPIs, what is your expectation for this solution?***

☐ 1. It has been proven successfully in other establishments

☐ 2. It has been analysed cost-benefit and will bring profits for your restaurants

☐ 3. It has been recommended by academic experts

☐ 4. It has been approved by the company

☐ 5. No need any solutions because of the good current status of SUIs.

☐ 6. Others:……………………………………………………………………………………….…

F. INFORMATION OF FAST FOOD RESTAURANT

○ 1. KFC ○ 2. McDonald's ○ 3. Texas Chicken

○ 4. Lotteria ○ 5 Popeyes ○ 6. Jollibee's

Address:……………………………………………………

Code:……………………………………….

Thank you very much for your kind participation!

Appendix E: Information Sheet

The ethics reference number is 2019/077

TITLE OF PROJECT

Single-Use Plastic Waste Management and Policy in The Fast Food Industry in Vietnam

INFORMATION SHEET

Who is conducting the research	Chief Investigator: Prasad Kaparaju School of Engineering and Built Environment Contact phone: 0437 092 944 Contact email: p.kaparaju@griffith.edu.au Student Researcher: Thi-Kim-Chi Do School of the Engineering and Built Environment

Contact Phone: 0421445333

Contact Email: thikimchi.do@griffithuni.edu.au

Why is the research being conducted?

The interview is designed to collect opinion and ideas from all stakeholders related to disposal of single-use plastic items (SUPIs) in the fast food industry in Vietnam (Ho Chi Minh City) and their options to pursuit a policy of improve recovery potential of SUPIs in the fast food industry. The research results will be reported in an academic thesis and may also be disseminated via journal articles and conference presentations.

What you will be asked to do

All stakeholders, including consumers, policymakers, fast food company's representatives, waste collection management company, and plastic manufacturer' s representatives are encouraged to participate in the survey as interviewees by answering the unstructured questions. The main questions are related to the following issues:

- All stakeholder's knowledge on single-use plastics and their adverse impacts on the environment.
- All stakeholders' options to phase out single-use plastics.

- All stakeholders' attitude to policies to phase out SUPIs

The basis by which participants will be selected or screened (Please see file list of interviewees)

- Customers: investigators will go directly to the fast food outlets and look for customers who are available to participate in the research project.
- Fast food company representatives: investigators (research team) will connect to restaurant managers who participated in the previous research at fast-food restaurants in HCMC to ask for help.
- Waste collection management company: Research team will access to them via direct contact to them by introducing by policymakers because they are managed by the Ho Chi Minh City government. The research team has already got contacts of them and their agreement to participate in this project.
- Plastic manufacturers: Research team has got contacts of them via previous research and three of them agreed to participate in this project. Other companies can be accessed by their websites.
- Policymakers: introduced by supervisor teams, research team has contacted to the policymakers and they agreed to participate in these interviews.

The expected benefits of the research

This research aims to give a guideline for every stakeholder who is involved in the fast food industry to improve recovery potential of single-use items, especially single-use plastic items, and all stakeholders' participation help the conducted guideline implement and reduce plastic waste as well as improve resource efficiency.

Risks to you

By responding to the questions in the questionnaire, you have no trouble or risks. It means that participating in this project will not have any effect on your health, your income or your likelihood. The research team is fully responsible for what they will do such as cleaning the area surrounding bins where the research team collect the waste by customers and by your kitchen.

Your confidentiality

The data is collected and stored in the computers as excel files or SPSS to enable analysis and presentation in dissertation and publications. Interviews will be noted by writing down a sheet and will not be recorded if interviewees do not agree.

However, the information of fast food companies will not be provided to readers by coding the restaurants and companies to guarantee full participation of fast food managers. The detail information of fast food managers, including their comments, identifiable information such as occupation, workplace, job title, and other personal detail will not be identified in the research project. However, the research team can store identifiable information for further research or the lack of data which needs to be fulfilled. All research data will be retained in a password protected electronic file at Griffith University for a period of five years before being destroyed.

This research is designed to guarantee that all personal information to identify participants will not be presented in any reports or data. On the other hand, your company name will not be identifiable by all publications of the research team. Therefore, you have also rights to quit any questions at any time.

Your participation

Your participation in this research is highly appreciated, but voluntary. Therefore, you have also rights to withdraw from this project at any time.

A plain language summary of research results will be sent to you via your email if you are concern.

Questions / further information

If you require additional information or have any questions, please contact me as a member of the research team as the following information:

Name: Chi Do

Email: **thikimchi.do@griffithuni.edu.au**

The ethical conduct of this research

This research has been approved by Griffith University which conducts research in accordance with the *National Statement on Ethical Conduct in Human Research*. If you have any concerns or complaints about the ethical conduct of the research project, you should contact the Manager, Research Ethics on 3735 4375 or **research-ethics@griffith.edu.au**. The GU ethics reference number for this project is 2019/077.

Privacy Statement – non disclosure

The conduct of this research involves the collection, access and/or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your anonymity will at all times be safeguarded. For further information consult the University's Privacy Plan at http://www.griffith.edu.au/about-griffith/plans-publications/griffith-university-privacy-plan or telephone (07) 3735 4375."

Appendix F: Consent Form

Griffith UNIVERSITY
Queensland, Australia

The ethics reference number is 2019/077

Research Team	Name(s) Prasad Kaparaju and Thi-Kim-Chi Do
	School(s): School of Engineering and Built Environment
	Contact Phone: 0421445333
	Contact Email: thikimchi.do@griffithuni.edu.au

I have had explained to me the purpose to which the information I have provided will be put, and I consent to its use. I understand that Freedom of Information legislation may result in persons seeking to gain access to part or all of the thesis in which it is included.

By signing below, I confirm that I have read and understood the information package and in particular:

- I understand that my involvement in this research will include.
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that my interview is not recorded if I do not agree.

- I understand that there will be no direct benefit to me from my participation in this research (this may need to be modified for some projects);

- I understand that my participation in this research is voluntary

- I understand that if I have any additional questions, I can contact the research team;

- I understand that I am free to withdraw at any time, without explanation or penalty;

OR

- I understand that my name and other personal information that could identify me will be removed or de-identified in publications or presentations resulting from this research;

- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 4375 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and The GU ethics reference number for this project is 2019/077.

- I agree to participate in the project.

Appendix G : A list of the interviewees

Customers

	Number of Code	Gender	Location/Institution	Total time (in minutes)	Date of interview	Date of conducting transcription	Number interviews
1	M-C1	M	McDonalds' Hoang Dieu street, district 4, HCMC, Vietnam	28:20:00	06.01.2020	30:06:2020	I
2	M-C3	M	#	19:43	06.01.2020	30.06.2020	I
3	M-C2	M	#	14:24	06.01.2020	30.06.2020	I
4	M-C4	M	#	12.05	06.01.2020	30.06.2020	I
5	T-C1	F	Texas Chicken Nguyen Thai Hoc street, district 1, HCMC, Vietnam.	8:07	03.01.2020	01.07.2020	I
6	T-C2	M	#	11:07	03.01.2020	30.06.2020	I
7	T-C3	M	#	7:55	03.01.2020	01.07.2020	I
8	T-C4	M	#	7:50	03.01.2020	01.07.2020	I

9	L-C1	M	Lotteria Nguyen Thai Hoc street, district 1, HCMC, Vietnam.	19:36	03.01.2020	30.06.2020	I
10	L-C2	M	#	4:31	03.01.2020	01.07.2020	I
11	L-C3	F	#	7:50	08.01.2020	05.07.2020	I
12	L-C4	M	#	8:50	08.01.2021	05.07.2021	I
13	L-C5	F	#	9:17	08.01.2022	05.07.2022	I
14	J-C1	M	Jollibee Nguyen Thi Minh Khai street, district 1, HCMC, Vietnam.	13:13	08.01.2020	05.07.2020	I
15	J-C2	F	#	10:05	08.01.2020	05.07.2021	I
16	J-C3	M	#	11:30	08.01.2021	05.07.2022	I
17	J-C4	F	#	9:06	08.01.2022	05.07.2023	I
18	J-C5	M	#	11:09	08.01.2023	05.07.2024	I
19	J-C6	M	#	12:45	08.01.2020	05.07.2025	I
20	K-C1	M	KFC Nguyen Thai Hoc street, district 1, HCMC, Vietnam.	10:32	05.01.2020	05.07.2026	I
21	K-C2	M	#	13:05	05.01.2021	05.07.2027	I

22	K-C3	M	#	12:49	05.01.2022	05.07.2028	I
23	K-C4	M	#	11:13	05.01.2023	05.07.2029	I
24	K-C5	M	#	15:24	05.01.2023	05.07.2029	I

Other stakeholders

	Number of Code	Name	Gender	Position	Institution/Location	Total time (h:mm:ss)	Date of interview	Number interviews
Local policymakers (LP)								
1	LP-1	Do Thi Diem Thuy	F	Head Division of Waste Management	Department of Natural Resource and Environment in HCMC, Vietnam	1:59:00	06.01.2020	I
2	LP-2	Nguyen Thanh Thuy	F	Head Division of Waste Management	Department of Natural Resource and Environment in Hanoi, Vietnam	1:05:12	25:12:2019	I
3	LP-3	Huynh Dang Thi	M	Head Division of	HCMC Management Board for Solid Waste Treatment Complexes	0:20:12	16.01.2020	I

				Environment Technology				
National Policymakers (NP)								
4	NP-1	Nguyen Trung Thang	M	Deputy Director General	Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE)	0:24:13	25.12.2019	I
5	NP-2	Nguyen Dang Thi	M	Dead Division of Plastic Waste	Ministry of Natural Resource and Environment	0:29:24	25.12.2019	I
6	NP-3	Tran Duc Vuong	M	Chairman	Plastic Recycling Association in Vietnam	0:58:00	25.12.2019	I
Expert (EX)								
7	EX-1	Pham Manh Hoai	M	Expert	WWF	0:40:35	07.01.2020	I

8	EX-2	Tang Thi Hong Loan	F	Director	EPRO Environment Consultant Limited Company	0:35:12	07.01.2020	I
Plastic manufacturer (PM)								
9	PM-1	Pham Van Son	M	Director	Viet Thanh Plastic and packaging company. The address: No. 29 TTN8 St, Tan Thoi Nhat ward, district 12, HCMC, Vietnam	6:00	13.01.2020	
Restaurant Managers (RM)								
10	RM-1	Nguyen Tu Minh Trung	M	Staff	Popeyes District 12, HCMC, Vietnam	20:21	06.01.2020	I

Appendix H : The data of the number and weight of SUIs consumed per day by survey with structured questionnaire in the six studied FFCs in HCMC.

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
1	Plastic Spoons	**L**	**90**	67	40	3.80	154.85	0.59	6193.80	23.54	154.85	52.96
		K	**49**	28	11	2.88	208.45	0.60	2293.00	6.60	208.45	29.42
		J	**14**	11	8	3.37	120.50	0.41	964.00	3.25	120.50	5.69
		P	**11**	9	5	3.50	203.00	0.71	1015.00	3.55	203.00	7.82
		T	**10**	6	2	2.84	72.50	0.21	145.00	0.41	72.50	2.06

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
		M	**9**	5	2	3.16	110.00	0.35	220.00	0.70	110.00	3.13
	Total						**869.30**	**2.86**	**10830.80**	**38.05**	**869.30**	**101.06**

2	Plastic Forks	**L**	90	67	16	2.83	213.31	0.60	3413.00	9.66	213.31	54.33
		K	49	28	5	3.08	175.00	0.54	875.00	2.70	175.00	26.41
		J	14	11	4	3.02	157.40	0.48	630.00	1.90	157.50	6.66
		P	11	9	1	2.85	125.00	0.36	125.00	0.36	125.00	3.92

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
		T	10	6	2	2.99	212.50	0.64	425.00	1.27	212.50	6.35
		M	9	5	0	3.57	0.00	0.00	0.00	0.00	0.00	0.00
	Total						**883.21**	**2.61**	**5468.00**	**15.88**	**883.31**	**97.67**
3	Plastic Straws	**L**	90	67	55	0.64	496.01	0.32	23014.80	14.73	418.45	24.10
		K	49	28	25	0.47	909.10	0.43	19238.40	9.04	769.54	17.72
		J	14	11	9	0.44	258.29	0.11	2324.60	1.02	258.29	1.59
		P	11	9	6	0.52	380.50	0.20	2058.00	1.07	343.00	1.96

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
		T	10	6	6	0.56	296.00	0.17	980.00	0.55	163.33	0.91
		M	9	5	3	0.52	416.67	0.22	1250.00	0.65	416.67	1.95
	Total						**2756.56**	**1.44**	**48865.80**	**27.06**	**2369.28**	**48.24**

4	Plastic Condimen	**L**	90	67	14	0.58	148.50	0.09	2079.00	1.21	148.50	7.75
		K	49	28	17	0.86	486.59	0.42	8272.00	7.11	486.59	20.50
		J	14	11	3	0.47	51.33	0.02	154.00	0.07	51.33	0.34

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
	t containers	**P**	11	9	5	0.81	525.00	0.43	2625.00	2.13	525.00	4.68
		T	10	6	2	1.02	92.50	0.09	185.00	0.19	92.50	0.94
		M	9	5	2	0.58	192.50	0.11	385.00	0.22	192.50	1.00
	Total						**1496.42**	**1.16**	**13700.00**	**10.93**	**1496.42**	**35.22**
5	Plastic Lids	**L**	90	67	55	1.47	496.01	0.73	23014.80	33.83	418.45	55.36
		K	49	28	25	3.01	909.10	2.73	19238.40	57.81	769.54	113.31
		J	14	11	9	1.68	258.29	0.43	2324.60	3.91	258.29	6.07

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
		P	11	9	6	1.98	380.50	0.75	2058.00	4.07	343.00	7.47
		T	10	6	6	2.30	296.00	0.68	980.00	2.25	163.33	3.76
		M	9	5	3	1.80	416.67	0.75	1250.00	2.25	416.67	6.75
	Total						**2756.56**	**6.08**	**48865.80**	**104.13**	**2369.28**	**192.72**
6	Plastic Cups	**L**	90	67	35	11.40	213.29	2.43	7465.00	85.10	213.29	218.83
		K	49	28	10	13.60	232.60	3.16	2326.00	31.63	232.60	155.00

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
		J	14	11	9	0.00	88.84	0.00	799.60	0.00	88.84	0.00
		P	11	9	3	9.86	75.00	0.74	225.00	2.22	75.00	8.13
		T	10	6	1	13.21	125.00	1.65	125.00	1.65	125.00	16.51
		M	9	5	1	20.39	130.00	2.65	130.00	2.65	130.00	23.86
	Total						**864.73**	**10.64**	**11070.60**	**123.26**	**864.73**	**422.34**
7		**L**	90	67	47	1.11	328.18	0.36	15424.40	17.12	328.18	32.79
		K	49	28	12	1.15	437.50	0.50	5250.00	6.04	437.50	24.65

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
	Plastic condiment bags	**J**	14	11	2	0.92	77.00	0.07	154.00	0.14	77.00	0.99
		P	11	9	2	0.89	82.50	0.07	165.00	0.15	82.50	0.80
		T	10	6	2	1.60	92.50	0.15	185.00	0.30	92.50	1.48
		M	9	5	1	1.10	140.00	0.15	140.00	0.15	140.00	1.39
	Total						**1157.68**	**1.31**	**21318.40**	**23.90**	**1157.68**	**62.10**
8		**L**	90	67	25	4.22	186.75	0.79	4668.80	19.70	186.75	70.93

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
	Plastic Bags	K	49	28	4	6.07	333.40	2.02	1333.60	8.09	333.40	99.16
		J	14	11	4	6.36	36.25	0.23	145.00	0.92	36.25	3.23
		P	11	9	2	0.00	202.50	0.00	405.00	0.00	202.50	0.00
		T	10	6	2	0.00	362.50	0.00	725.00	0.00	362.50	0.00
		M	9	5	0	3.13	186.75	0.58	140.00	0.44	0.00	0.00
	Total							**0.00**		**0.00**	**1121.40**	**173.32**
1		L	90	67	55	9.57	282.72	2.71	15549.80	148.81	282.72	243.51

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
	Paper Cup	**K**	49	28	25	9.83	676.50	6.65	16912.40	166.25	676.50	325.85
		J	14	11	9	8.21	169.44	1.39	1525.00	12.52	169.44	19.48
		P	11	9	6	9.02	305.40	2.75	1833.00	16.53	305.50	30.31
		T	10	6	5	10.71	171.00	1.83	855.00	9.16	171.00	18.31
		M	9	5	3	9.03	416.67	3.76	1250.00	11.29	416.67	33.86
	Total						**2021.73**	**19.10**	**37925.20**	**364.56**	**2021.83**	**671.32**

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
2	Paper Bag	**L**	90	67	41	5.53	192.65	1.06	7898.60	43.64	192.65	95.79
		K	49	28	17	7.01	492.94	3.45	8380.00	58.70	492.94	169.20
		J	14	11	9	5.88	194.56	1.14	1751.00	10.30	194.56	16.02
		P	11	9	6	5.32	347.17	1.85	2083.00	11.07	347.17	20.30
		T	10	6	4	3.52	306.25	1.08	1225.00	4.31	306.25	10.78
		M	9	5	3	8.17	350.00	2.86	1050.00	8.58	350.00	25.74

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
	Total						**1883.56**	**11.44**	**22387.60**	**136.60**	**1883.56**	**337.82**
4	Paper Container	**L**	90	67	12		238.75	0.00	2865.00	0.00	238.75	0.00
		K	49	28	2	17.63	175.00	3.09	350.00	6.17	175.00	151.18
		J	14	11	1	25.29	60.00	1.52	60.00	1.52	60.00	21.24
		P	11	9	2	28.40	112.50	3.20	225.00	6.39	112.50	35.15
		T	10	6	3	34.98	388.33	13.58	1165.00	40.75	388.33	135.84

	Type of SUPI	FFC	Number of restaurants in HCMC (r)	Number of surveyed restaurant (n1)	Valid N	The net weight of one type of SUI - w1 (g)	The average number of one type of SUI consumed daily by one surveyed restaurant - m (item)	The total weight of one type of SUI consumed per day by one restaurant - q (kg/day)	The total number of one type of SUI consumed daily by all surveyed restaurants of one FFC- m1 (item/day)	The total weight of one type of SUI consumed per day by all surveyed restaurants of one FFC - q1 (kg/day)	The average number of one type of SUI consumed per day by one restaurant of one company - m2 (item/day)	The total weight of one type of SUI consumed per day by one company - q2 (kg/day)
		M	9	5	1	9.52	700.00	6.66	700.00	6.66	700.00	59.96
	Total						**1674.58**	**28.04**	**5365.00**	**61.49**	**1674.58**	**403.36**

Notice: This data was used to calculation in Chapter 3 and Chapter 6. Note: L: Lotteria, K: KFC, J: Jollibee's, P: Popeyes, T: Texas Chicken, M: McDonald's.