



Perception and Behavioral Changes of Thai Youths Towards the Plastic Bag Charging Program

Sujitra Vassanadumrongdee^{1,*}, Dawisa Hoontrakool¹, Danny Marks²

¹ Environmental Research Institute, Chulalongkorn University, Phayathai Rd.,
Wangmai, Pathumwan, Bangkok, 10330 Thailand

² Department of Asian and International Studies, City University of Hong Kong

* Corresponding author: Email: Sujitra20@gmail.com

Article History

Submitted: 6 February 2020/ Revision received: 22 March 2020/ Accepted: 25 March 2020/ Published online: 15 May 2020

Abstract

Thailand has one of the highest usage of plastic bags globally, with over 45,000 million plastic carrier bags used annually. Because of its high plastic consumption and mismanagement of plastic waste, Thailand was ranked sixth globally in terms of its contribution to marine plastic pollution in 2015. While many countries have introduced plastic bag charges or taxes to reduce consumption, the Thai government is reluctant to do likewise due to political concerns about whether the public will accept this. This study presents findings on perception and acceptance level of university students towards plastic bag charging program in their campuses. We investigated the factors influencing intention and behavior and changes in students' attitude from 2017–2019. Results show that students' reusable/cloth bags use behavior and charge acceptance have increased over time. Testing is based on the Theory of Planned Behavior. We find that the factor which most influences consumers' intention is perceived behavior control, which itself is determined by waste impact knowledge level and the perceived convenience of carrying reusable bag. In addition, the finding show that charging schemes are effective in breaking the habit of using plastic which will lead to a sustained change in behavior. Hence, policymakers should move implement plastic bag charging regulations in Thailand.

Keywords: Plastic bag charging; Thailand; University; Reusable bag use behavior; Habit change; Marine plastic pollution

Introduction

Plastic carrier bags, or plastic bags, are popular means of carrying goods as they are thin, lightweight, and inexpensive. Due to their

low price, retail shops and supermarkets in many countries offer free plastic bags to customers as part of their service, causing excessive use around the world. The world

roughly uses between 500 billion and 1.5 trillion plastic bags every year [1].

Thailand is seen as one of the countries where its residents intensively use plastic bags in their daily life, with an estimated 3–8 bags used per person in Bangkok per day and over 45,000 million bags per year [2]. It is unsurprising therefore that Thailand is among ten countries responsible for more than half of the world's estimated 8 million tons of plastic waste dumped into the oceans every year [3–4].

Most plastic bags produced in Thailand are thin, leading to a short life-span. Having low-recycling value and only a single-use function, plastic bags have caused pollution, flooding in the cities and killed marine animals, thereby increasing the risk of microplastic contamination. Thais' awareness of plastic pollution sharply increased in 2018 when the media reported about a short-finned pilot whale found beached and dead in Songkhla Province with approximately 8 kg of plastic bags in stomach and intestines [5].

Past efforts in Thailand mainly relied on promotional campaigns. For example, many shopping malls and supermarkets offer bonus reward points to customers for not accepting plastic bags. However, the response from customers has been minimal since most people are already addicted to the convenience of using plastic bags [6]. International experience showed that proactive policy instruments, such as bans or charges, are more effective than voluntary campaigns. Although not all measures are successful, if carefully designed and enforced, charging for plastic bags has proven to be effective in many countries. Introduced in 2002, the Republic of Ireland plastic bag tax reduced plastic bag use by more than 90% [7].

Having seen the success of regulations in other countries, academia and civil society in Thailand have called for the Thai government to adopt a regulation which charges customers to

obtain bags in order to curb plastic bag consumption. However, the Thai government has been reluctant to introduce such regulations due to political concerns over the public's limited level of acceptance [8]. Although there is no national regulation on plastic bag ban, it has been implemented in some universities. This study focused on Chulalongkorn University's plastic bag charging scheme which has been implemented for three years (2016–2019).

In October 2016, Chulalongkorn University launched 'Chula Zero Waste' initiative, a five-year action plan on solid waste and hazardous waste management. Under this action plan, a plastic bag reduction project has been implemented, firstly by a three-month campaign of plastic bag reduction, then the project introduced a plastic bag charging program since February 2017. With the exception of hot food, customers will not receive free plastic bags. Instead, they must pay 2 THB (0.06 USD) per bag if they want one. This program has led to a 90% reduction of plastic bag consumption, almost 4 million bags saved in 3 years [8–9].

This article presents the findings on perception and acceptance level of university students towards plastic bag charging program and investigates the factors influencing intention and behavior of the students in terms of using reusable bags as an alternative to plastic carrier bag. Thai youths are active social agents which have the capacity to make significant impacts to the society [10]. This research conducted on the real practice case study which provides information for policy makers to learn what levels Thai youths are ready for plastic bag charging program at the national level.

The article's key research questions are as follows: 1) Did the plastic bag charging increase the intention and behavior of university students to use reusable bags? 2) To what extent do university students perceive and accept the plastic bag charging as a way to reduce plastic

waste? 3) Do university students have a more positive attitude towards plastic bag charging after intensive media campaigns on plastic pollution conducted in 2018?

Factors explaining the effectiveness of plastic bag charging and plastic bag consumption behavior

While one of the most common way to interpret the effectiveness of a charge on carrier bags is to explain it as a market-based instrument that internalizes the costs of pollution, it can be interpreted as a tool to instigate changes in consumers' decision-making processes as explained by concepts from psychological research [11]. It is therefore important to see whether charging for bags can raise awareness and lead to the sustained change of consumer behavior, namely, the habit of bringing own bags. Charges on single-use plastics can have a significant impact on plastic reduction as it disrupts consumers' automated choices of accepting plastic bags and making them think more conscious [11–13]. Therefore, we decided to test this hypothesis.

H1: Plastic bag charging can positively change reusable/cloth bag use behavior over time.

1) Theoretical foundation

The Theory of Planned Behavior (TPB), the Norm-Activation-Theory, and the Value-Belief-Norm-Theory have been applied to pro-environmental behavior studies. However, TPB seems to be the most influential theory in explaining waste prevention behavior [14]. According to TPB [15], attitude, subjective norm or social norm (SN) and perceived behavior control (PBC) are the determinants of intention which is the closest antecedent of behavior [16].

Attitudes refers to the level of positive or negative evaluation of performing behavior [15]. In environmental behavior studies, environmental concern is widely used as a predictor of the pro-

environmental behavior and was found to significantly affect the attitude towards plastic bags use [17–18].

However, Ajzen and Fishbein [19] argued that specific attitude on the issue is a better predictor of the intention of the specific behavior than general attitudes such as a pro-environmental orientation. Therefore, environmental concerns or values related to waste, plastic bag and reusable/cloth bag are used as the determinants of attitude in this study.

SN refers to individuals' perception of whether significant others approve their behavior. Guilt, as well as fear of being criticized, have an impact on people plastic avoidance decision [20–21]. SN can also affect people's decisions in the form of symbolic action or cultural identity [21]. Several studies found that SN influences people's intention to use reusable or cloth bags [22–24].

PBC refers to individuals' perception of the ease of performing a particular behavior which makes TPB different from Ajzen and Fishbein (1980)'s Theory of Reasoned Action [25]. PBC has a meaning in term of motivation of the intention. People who believe that they do not have a resource or ability to act tend to not undertake that behavior, even though they have a positive attitude regarding it [15]. Moreover, PBC can directly relate to behavior especially in the case that perceived behavior is the same as the truth in the system or facilities provided [26]. Many researchers have found the positive effect of PBC in terms of intention to purchase green products [27–29]. Convenience can represent another aspect of PBC since being convenient to do something means that it is easier to pursue or perform the new behavior. By focusing on the plastic use behavior side, convenience such as the availability and low prices were reported as a significant determinant of behavior [30–32].

Although many studies have confirmed the effect of all three TPB components, Chang and

Chou [33] found that only attitude and PBC positively affected one's intention to use reusable bag but did not find an effect of SN. Lam and Chen [34] found only a small impact of attitude, concern, and personal responsibility on bringing reusable bags while found a major effect from PBC. Therefore, these hypotheses were set to be tested.

H2: Environmental attitude (ATT) positively influences reusable/cloth bag use intention.

H3: SN positively influences reusable/cloth bag use intention (INTENTION).

H4: PBC positively influences reusable/cloth bag use intention.

H5: Reusable/cloth bag use intention positively influences consumer behavior.

2) Extended theory factors

2.1) Habit

Habit refers to learned actions that are produced automatically in response to contextual cues that have been associated with their performance [35]. It is the non-intentional route to behavior and can be observed as differences between actual and intended behavior [36].

Plastic bag consumption was found related to habit in immigrants in Canada [37], residents in China [38] and in Malaysia [39]. Similarly, Musa et al. [23], and Bartolotta and Hardy [40] found that the campaign participants failed to reduce their plastic use even they were willing to do so because they were not able to adopt new habits.

Although habit of plastic bag use has been developed, habits can change. Romero et al. [37] found that habits can change as a result of changes in norms and/or external conditions even there is no change in attitude. The plastic bag charge can be seen as the operant conditioning influencing behavior change [41]; in other words, it can be seen as habit discontinuity [42]. Then it is viewed as a context change. Therefore, according to economic theory [43], people will seek to avoid the charge

which leads to change in their behaviors and become a habit in the long term [11, 42, 44]. The carrier bag charge evidently showed an effective effect on change to habits in Ireland [45], in Wales after the charge was introduced for six months [11] and in Argentina after two months [18]. However, plastic bag use in South Africa only reduced at the beginning stage [46]. In addition, research specific on habit development reveals that new behavior becomes habitual, on average, 66 days after it is first introduced [47]. Thongplew and Kotlakome [48] found that in Thailand, changes in routine practice occurred due to pricing intervention. Therefore, these hypotheses are set to be tested.

H6: Consumers perceived habit (HAB) of plastic bag use negatively associates with behavior.

H7: The plastic bag charging policy adversely affects the habit of using plastic bag in the long-term.

2.2) Attitude towards plastic bag charging

Contextual factors are another factor that reportedly affect consumers' intention and thus lead to behavior change [49]. Lam and Chen [34] found that goods situational variables such as capability to be able to be carried with bare hands and embarrassment when carrying play a major role in predicting the actual purchase behavior in Taiwan. Nudging policy motivates consumers' decision through reminding consumer choice [50]. However, the effect was found to be limited to only households with high socio-economic status [1]. Voice prompt intervention was found to decrease plastic bag use in Japanese supermarkets [36]. Government facilities and interventions such as recycling facilities, public transportation services, and pricing regimes have found to be useful determinants of pro-environmental behavior engagement [51–53]. In addition, Synthia and Kabir [54] reported that the shift of responsibility of the cost to government is

another reason consumers' behavior does not directly correlate to attitude. In this research, consumer perception or attitude of the plastic bag charging was both an intra-psychic, individual internal psychological, and an environmental variable in the TPB model—in other words, a psychological effect due to contextual change from the charge. Therefore, this hypothesis was set to be tested.

H8: Attitude toward plastic bag fee collection (BAGFEE) positively influences INTENTION.

Environmental knowledge has also been found to be an important determinant of attitude, SN, and PBC for environmentally friendly products, thereby having an indirect effect on consumer intention and behavior [29]. Jakovcevic et al. [18] suggests that information alone can have an effect on plastic bag use behavior and the campaigns can be effective information provider. Thereby, several campaigns found a positive effect on plastic bag reduction and environmental awareness [55–56]. Nevertheless, the effectiveness of a campaign also depends on the clarity of guidelines, policies and implementation the government provides [45].

In this research, the environmental knowledge was separated into two variables by their sources: 1) plastic waste knowledge and news including general knowledge and the harm of plastic to animals; 2) perceived knowledge through various public relations (PR) campaign modes including billboards, social network, and posters; and 3) overall direct effect of the campaign including the rising of waste reduction awareness and the receiving of waste impact information was examined. Therefore, we tested the following hypotheses too:

H9: Waste impact knowledge (KNOW) positively influences ATT, SN, PBC and BAGFEE.

H10: PR positively influences ATT, SN, PBC and BAGFEE.

H11: Campaign effect positively influences ATT, SN, PBC and BAGFEE.

H12: Campaign effect positively influences INTENTION.

H13: Campaign effect positively influences consumer behavior.

2.4) Demographic factors: gender, age, income level

The literature has found that gender has a significant impact on plastic bag use behavior. Several studies found that females are more likely to accept and apply reusable bag use than males are [57–60]. Hohmann et al. [35] found that females have a greater intention to reduce plastic bag use than male. However, Ari and Yilmaz [24] and Thomas et al. [44] did not find a significant effect of gender on environmental awareness, cloth bag use intention and reducing plastic bag behavior. Similarly, an increase in age has found to positive correlate with plastic bag reduction behavior [24, 35, 61].

Two studies found that low-income consumers have made greater efforts to reduce plastic bag use than high-income group [24, 46] have done. However, Hohmann et al. [35] did not find a significant impact of income level on plastic bag reduction in the case of Thailand.

In this research, gender, faculty discipline, year representing age, and monthly household income levels were tested using a multiple regression model with intention as the dependent variable, separately from the structural equation model analysis.

Methods

1) Data collection

This research is an extended study of Tanyaphicha [62] which investigated the impact of Chula Zero Waste scheme on reusable bag use behavior during the first year of the program's implementation. The program began in October 2017. This research was conducted in early 2019 to investigate the

intention and behavioral change and the effectiveness of the charge in a longer period. Therefore, the survey questionnaire was adapted from Tanyaphicha [62]. Behavior, habit and policy opinions were compared with the finding from Tanyaphicha [62] to observe any attitudinal change over time, especially after intensive media coverage on marine plastic pollution from 2018 onward. The self-administered questionnaire survey was conducted from January to February 2019 in classes of students from various faculties and class year. 406 responses were collected, using Yamane's formula for the sample size with a 95% confidence coefficient. Concurrently, invalid questionnaires were eliminated. Therefore, 403 responses were used in the analysis model.

2) Analytical framework

First, to test hypotheses 2–6, 8–13, the conceptual structural equations of our model, as Figure 1 illustrates, was tested to confirm TPB and to evaluate the impact of extended factors: habit, BAGFEE, general knowledge, campaign effect, campaign PR, using SPSS AMOS 22.0 software. Secondly, the demographic dummy variables including gender, year, discipline, and income level were tested by using a multiple regression model with intention as the dependent variable. Last, to test H1, H7, and the

change in charging acceptance, the finding of behavior, habit and charging acceptance were compared with the finding from Tanyaphicha [62] using t-test analysis to investigate the change over time.

Results

1) Descriptive statistics

From Table 1, the majority of the respondents were female, comprising 65.53%. The faculty discipline of the respondents consisted of 62.07% from a social science discipline and 37.68% from a natural science and technology discipline. The majority of respondents were first- students (57.39%), following by year 2 students (23.4%). More than half of the respondents (51.77%, 210 people) reported that their household monthly income were higher than 70,000 THB (2,231 USD) which is higher than Bangkok average monthly household income, which was, in 2017, approximately 45,600 THB (1,453 USD) [63]. The majority of respondents (64.53%, 262 people) reported that their monthly expenditure to be between 5,000 (159 USD) -15,000 THB (478 USD). Although they had a high level of household income, the students had limitations on their spending, only 7.63% of respondents were found with a high expenditure level.

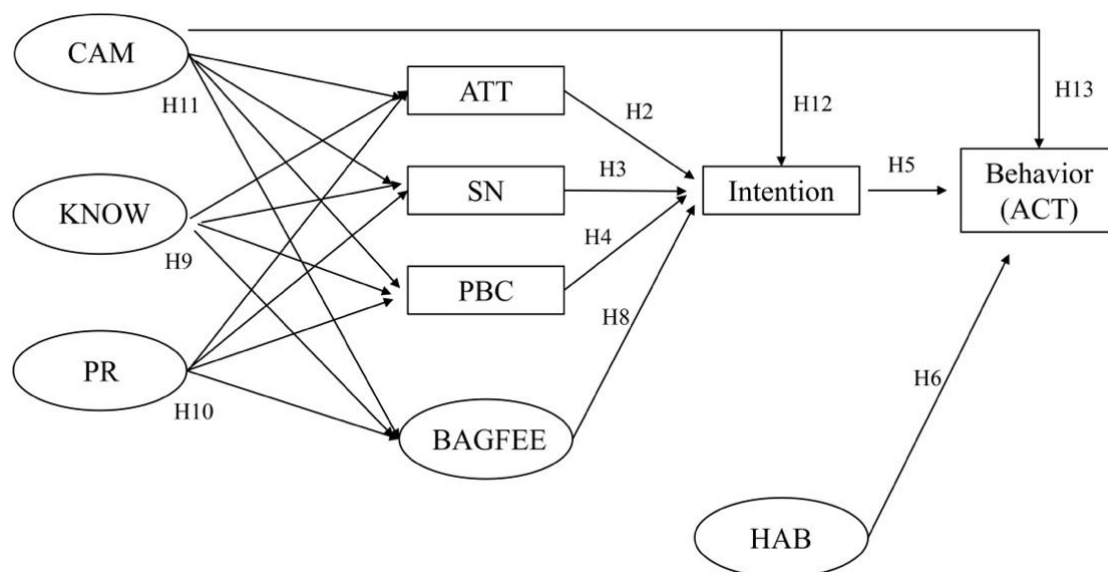


Figure 1 Conceptual model.

Table 1 Demographic information on university students who participated in the surveys (N = 406)

Demographic category	Survey (%)
Gender	
- Male	140 (34.48)
- Female	266 (65.52)
Discipline	
- Science & technology	153 (37.68)
- Social science	252 (62.07)
- No answer	1 (0.25)
Year	
- Year 1	233 (57.39)
- Year 2	95 (23.40)
- Year 3	27 (6.65)
- Year 4	48 (11.82)
- Year 5	5 (1.23)
- No answer	1 (0.25)
Monthly student expenditure	
- Less than 5,000 THB	111 (27.34)
- 5,000–15,000 THB	262 (64.53)
- More than 15,000 THB	31 (7.63)
- No answer	2 (0.49)
Monthly household income	
- Less than 30,000 THB	32 (7.88)
- 30,000–70,000 THB	152 (37.44)
- More than 70,000 THB	210 (51.77)
- No answer	12 (2.96)

2) Consumer perception and reason behind reusable/cloth bags use behavior

The survey results show that 14.78% of the respondents frequently prepare reusable/cloth bags when they go to the university cooperatives and 7-Eleven shops in the university, and 14.54% of the respondents often prepare reusable/cloth bags. 53.45% of the respondents have prepared reusable/cloth bags to use when they went to the convenient stores outside the university during the past 1 month. Furthermore, 29.46% of the respondents strongly agreed that they intend to use reusable/cloth bags more often both inside and outside the university, while 44.06% of the respondents also agreed.

The main reason for reusable/cloth bags use by respondents was, was shown in Figure 2, “to reduce the amount of waste from plastic bags” (45.43%) following by “recognizing the impact of plastic bag use” (28.57%). The concern about waste seems to be the main factor influencing reusable/cloth bags use behavior. The questionnaires further asked what factors will make the respondents bring their own reusable/cloth bags. Figure 3 shows that “stores do not give away plastic bags” (22.02%) was the main reason following by “reusable/cloth bags are easy to carry, foldable and easy to clean” (19.86%) and “stores offer discounts or points” (18.27%).

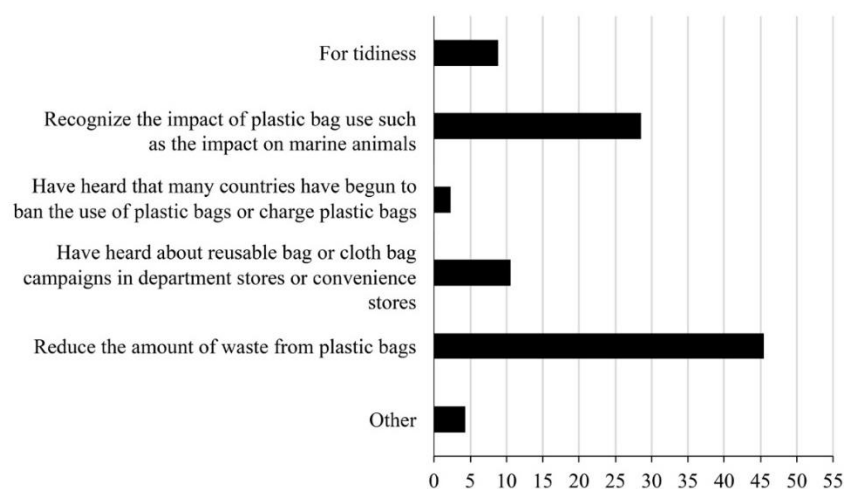


Figure 2 Main reasons to use reusable or cloth bags (%).

Note: Other reasons included bringing a reusable/cloth bag to carry their stuffs or as a routine, having too many plastic bags already, cloth bag is pretty and light, and cloth bag is convenient and strong.

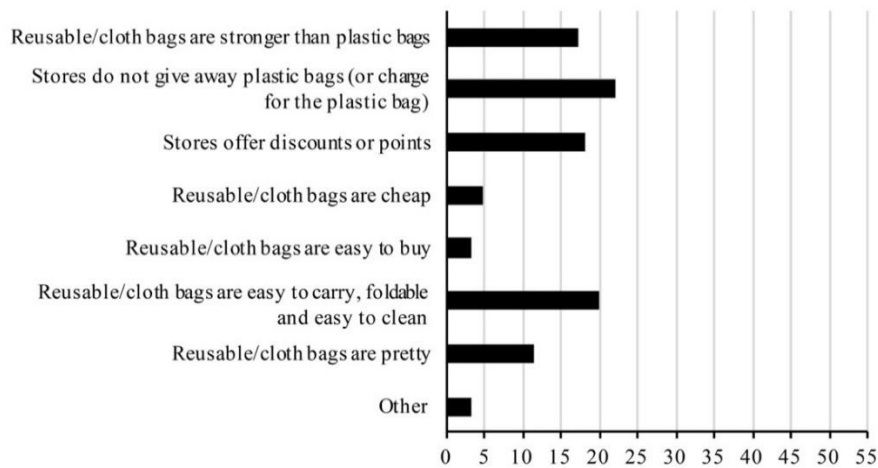


Figure 3 Factors that will induce respondents to bring their own reusable or cloth bags (%).

Note: Other reasons included to reduce waste and awareness of the harms to environment and climate change, following the trend and campaigns, receiving a lot of cloth bags before, and multiple answers.

3) Confirmatory factor analysis, validity and reliability

There are six constructed variables using in the analysis model, therefore confirmatory factor analysis was performed to test for the reliability of each construct. The factor loadings from the standardized regression weight for each observed variable were in the range of 0.5 - 0.85 except for the statement “receiving a free plastic bag when purchasing goods is the right of consumers” of the ATT construct which has factor loading lower than 0.000. Hence, this variable was excluded from the construct. Cronbach's alpha coefficients were examined for the consistency and reliability of each construct. It was suggested to be greater than 0.7 [64]. Factor loadings and Cronbach's alpha test were shown in Table 2.

For the model fit, Chi-square is suggested to be not significant (p -value > 0.05) and root mean square error of approximation (RMSEA) is suggested to be less than 0.08 for the model absolute fit, comparative fit index (CFI) is suggested to be greater than 0.90 for the incremental fit and Chi-square/degree of freedom (df) is suggested to be less than 3.0 for the parsimonious fit [65]. The model presented

an appropriate fit of Chi-square's p -value = 0.131, RMSEA = 0.035, CFI = 0.994, and Chi-square/df = 1.502.

4) Structural analysis

The results of the structural equation model are shown in Table 3. TPB framework is shown to adequately predict intention and behavior because SN and PBC had a positive effect on intention ($\beta = 0.130$, $p = 0.003$ and $\beta = 0.418$, $p < 0.001$ respectively) along with a positive effect of intention on behavior ($\beta = 0.187$, $p = 0.001$). However, the results do not show a significant relationship between ATT and intention. In addition, a positive direct effect of PBC on behavior ($\beta = 0.156$, $p = 0.006$) was found from the analysis.

As hypothesized, the results show that the attitude toward BAGFEE had a positive effect on intention ($\beta = 0.029$, $p < 0.001$) in other words, there was the effect of inclusion of perceived contextual change on intention, although the effect was not high. The habit of plastic bag use had a significant negative effect on reusable/cloth bag use behavior ($\beta = -0.137$, $p = 0.004$). The level of perceived plastic waste knowledge and news (KNOW), PR and CAM positively

affected BAGFEE ($\beta = 0.097$, $p = 0.046$, $\beta = 0.127$, $p = 0.042$ and $\beta = 0.177$, $p = 0.005$ respectively). Moreover, CAM also had a direct positive effect on intention and behavior ($\beta = 0.091$, $p = 0.030$ and $\beta = 0.129$, $p = 0.007$ respectively). The structural model results are summarized in Figure 4.

KNOW also had a positive effect on PBC ($\beta = 0.108$, $p = 0.031$) but the effect on ATT and SN were not supported. PR had a positive effect on SN ($\beta = 0.169$, $p = 0.004$) while CAM had a positive effect on ATT and SN ($\beta = 0.157$, $p =$

Table 2 Validity and reliability of the constructed variables

Construct	Statement	Cronbach's alpha	Loading	%Variance extracted
Environmental attitude (ATT)	- If we all consume, regardless of the increasing waste, the ecosystem will deteriorate and affect all of us.	0.517 (0.772)*	0.723	51.724 (68.246)*
	- Plastic bag usage is one of the causes of global warming.		0.717	
	- Receiving a free plastic bag when purchasing goods is the right of consumers. (reverse)		0.000	
	- If all of us use reusable/cloth bags instead of plastic bags, the country waste problem will be solved.		0.628	
Social norm (SN)	- You think your friends will admire you if you use reusable/cloth bags.	0.726	0.786	78.572
	- If your friends use reusable/cloth bags, you will use them as well.		0.786	
Perceived behavior control (PBC)	- The use of reusable/cloth bags is a waste of time/useless. (reverse)	0.581	0.615	55.236
	- Reusable/cloth bags are difficult to be folded and inconvenient to be carried around. (reverse)		0.542	
	- You believe that you can use reusable/cloth bags instead of plastic bags.		0.500	
Attitude toward plastic bag charging (BAGFEE)	- Charging for plastic bag is a way that can reduce a lot of plastic bag waste.	0.734	0.618	65.372
	- The university cooperative and 7-Eleven shops in the university do not give away plastic bags (charge 2 THB) causing you to use more reusable/cloth bags.		0.667	
	- The university should continue charging 2 THB for plastic bag.		0.676	
Public relation (PR)	- How much campaign cut-outs around the university remind you to reduce plastic bag use?	0.773	0.745	68.915

Table 2 Validity and reliability of the constructed variables (*continued*)

Construct	Statement	Cronbach's alpha	Loading	% Variance extracted
Public relation (PR) (<i>continued</i>)	- How much online social media e.g. Chula Zero Waste Facebook remind you to reduce plastic bag use?		0.599	
	- How much campaign posters of the initiative at the university cooperative and 7-Eleven shops remind you to reduce plastic bag use?		0.723	
Campaign effect (CAM)	- Have the Chula Zero Waste's awareness campaigns helped you to pay more attention to waste reduction and separation?	0.768	0.812	81.226
	- How much information about the impact of waste, especially plastic waste, to the environment have you received from the Chula Zero Waste Initiative (e.g. around hundred thousand of sea animals died because of plastic waste)?		0.812	

Notes: Using principle component analysis exacted method with oblique rotation, n = 403

* = Excluded "Receiving a free plastic bag when purchasing goods is the right of consumers" observed variable

Table 3 Conceptual model results

Hypothesis	Standardized path coefficient (β)	t-value	Result
H2: ATT > INTENTION	0.044	0.957	Not supported
H3: SN > INTENTION	0.130	3.003**	Supported
H4: PBC > INTENTION	0.418	9.625***	Supported
H5: INTENTION > ACT	0.187	3.287**	Supported
H6: HAB > ACT	-0.137	-2.910**	Supported
H8: BAGFEE > INTENTION	0.029	4.527***	Supported
H9.1: KNOW > ATT	0.051	1.027	Not supported
H9.2: KNOW > SN	-0.016	-0.344	Not supported
H9.3: KNOW > PBC	0.108	2.159*	Supported
H9.4: KNOW > BAGFEE	0.097	1.993*	Supported
H10.1: PR > ATT	0.066	1.038	Not supported
H10.2: PR > SN	0.169	2.844**	Supported
H10.3: PR > PBC	0.077	1.211	Not supported
H10.4: PR > BAGFEE	0.127	2.038*	Supported
H11.1: CAM > ATT	0.157	2.431**	Supported
H11.2: CAM > SN	0.292	4.855***	Supported
H11.3: CAM > PBC	0.094	1.446	Not supported
H11.4: CAM > BAGFEE	0.177	2.797**	Supported
H12: CAM > INTENTION	0.091	2.177*	Supported
H13: CAM > ACT	0.129	2.697**	Supported
PBC > ACT	0.156	2.760**	Supported

Notes: n = 403, * = p < 0.05, ** = p < 0.01, *** = p < 0.001

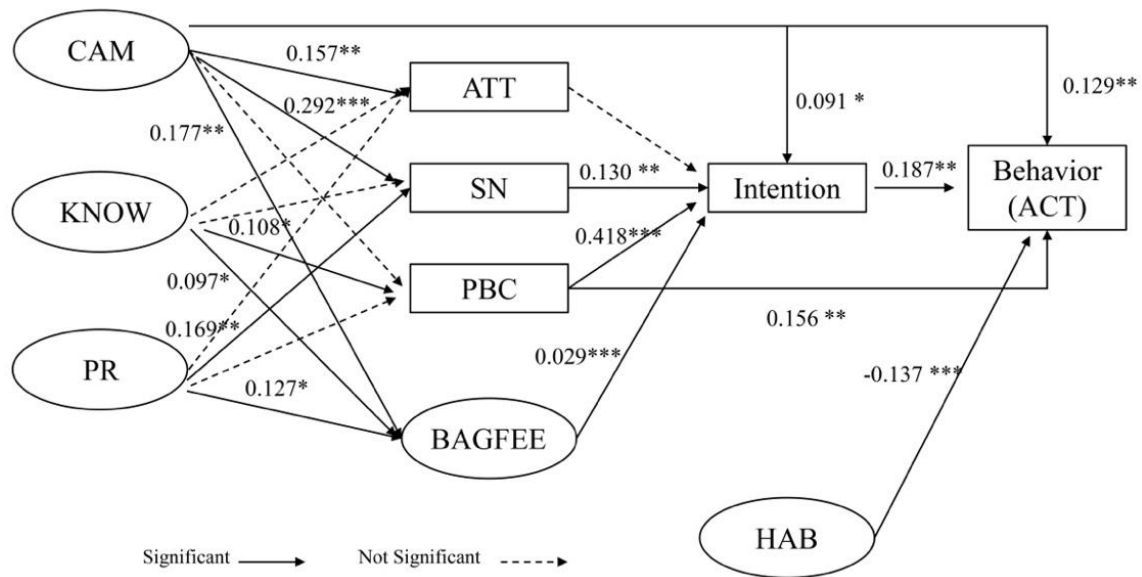


Figure 4 Conceptual model with results.

Notes: * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$

5) Demographic variable test

In addition to the conceptual model, gender, year of study which represents age, discipline, and income level dummy variables were tested using multiple regression model with intention as the dependent variable. The effects of these factors on intention were tested by including ATT, SN, PBC, BAGFEE, and CAM which are variables that were hypothesized to have effects on intention to improve the accuracy of the model. The results show that only gender had a significant effect on intention: female respondents were more likely to change their intention than males were. This finding is consistent with Hasan et al. [66]. The results are shown in Table 4.

6) Habit, behavior and policy acceptance change over time

The results from Table 5 show that from 2017–2019 the perceived habit of plastic bag use has significantly been reduced, suggesting the significant positive effect of the plastic bag charge scheme. Reusable/cloth bag use behavior has increased over time, confirming the overall impact of the charging scheme and the campaign effect. Moreover, respondents that agree with

the charging scheme have significantly increased, confirmed by the increase of the agreement on these 2 statements: 1) “The university should continue charging 2 THB for plastic bag;” and 2) “The university should continue charging 2 THB for each plastic bag”. Thomas et al. [44] found that an increase in support for bag charging policies can lead to an increase in support of other related policies such as a charge for plastic bottle and excessive packaging and other waste-reduction policies.

Discussion

1) TPB findings

The results of the conceptual model confirm that TPB is an appropriate framework to predict the intention and behavior of reusable/cloth bag usage. However, in contrast with previous studies, ATT did not show a significant association with reusable/cloth bag use intention. Although the survey results reveal that the main reason why the respondents continue to use reusable/cloth bag is environmental concern, the results from the conceptual model can imply that environmental concern does not directly influence the reusable/cloth bag intention, but may affect the intention through other factors instead. PBC was found to

have the highest effect on intention. This is consistent with not only our survey results which also found the perceived inconvenience as the main reason for not using reusable/cloth bags, but also with the literature, such as Ertz et al. [16], Chang and Chou [33], Ohtomo and

Ohnuma [36], and Hasan et al. [66]. In addition, there was a direct effect of PBC on behavior consistent with Kaiser and Gutscher [26]. Therefore, plastic waste knowledge which has a significant effect on PBC is highly recommended to be a focal point and target of investment.

Table 4 Multiple regression results

Variable	Coefficient	t-value
Constant	3.894	49.150***
Female	0.188	2.556*
Year 2	0.034	0.485
Year 3	-0.006	-0.045
Year 4 and above	-0.028	-0.263
Science & Technology	-0.034	-0.471
Household income Less than 30,000 THB	-0.066	-0.531
Household income 30,000–70,000 THB	-0.048	-0.661
ATT	0.035	0.804
SN	0.096	2.496*
PBC	0.344	8.891***
BAGFEE	0.185	4.539***
CAM	0.093	2.515*

Notes: n = 403, * = p < 0.05, ** = p < 0.01, *** = p < 0.001, R² = 0.440

Table 5 T-test analysis of plastic bag use habit and reusable/cloth bag use and policy acceptance in 2017 and 2019

Statement (Variable)	Mean (SD)		t-test
	2017	2019	
Previously, we received free plastic bags from the stores, therefore, we are not get used to carrying our own reusable/cloth bags. (HAB)	4.03 (0.88)	3.76 (1.02)	4.112***
During the past 1 month, have you prepared any reusable/cloth bags (instead of buying a 2-THB bag) when you went to the cooperative shops and 7-Eleven shops in the university? (ACT)	0.13 (0.33)	0.29 (0.45)	-5.406***
The university should continue charging 2 THB for plastic bag. (Policy 1)	3.78 (1.08)	4.14 (0.84)	-5.330***
	63.7% agree	79.5% agree	
The Thai government should act toward the ban of free distributed plastic bags in convenient stores, department stores and supermarkets (by charging for the bags) as other countries do. (Policy 2)	3.74 (1.06)	4.19 (0.88)	-6.621***
	62.5% agree	78.7% agree	

Note: n = 403, *** = p < 0.001

Further, the conceptual findings supported the influence of attitude toward plastic bag charging on reusable/cloth bag use intention. This is consistent with the survey finding which found “stores do not give away plastic bags” as the main reason for the respondents to bring their own reusable/cloth bags. The charging scheme adds pollution costs to the price of plastic bags, thereby making students realize the internal costs of plastic and raising the students’ awareness of pollution (BAGFEE). In order to increase the acceptance of plastic bag charging, the efficiency and transparency of the implementation are factors that should be considered [39, 53].

2) Knowledge and awareness

Besides the trial of plastic bag charging and ban in several major universities in Thailand, plastic reduction campaigns have been intensively conducted by public and private sectors in 2018. Additionally, the Pollution Control Department (PCD) drafted a 13-year Roadmap on Plastic Waste Management (2018–2030) which set the target of banning seven types of single-use plastics in 2022. The roadmap, however, has no detailed measures on developing specific laws and regulations [2]. Further, the government has created a joint agreement with 46 convenience and department stores to stop giving away free plastic bags from January 2020 onward [67]. According to the results in Table 5, the acceptance of the plastic bag charging has increased. The research team therefore expects that the rising awareness of plastic pollution and impact would increase the positive perception of the public towards plastic bag charging regulations at the national level – as shown by university students in this study.

The results from the conceptual model show that plastic waste knowledge and news have effects on intention through the influencing on PBC and attitude toward plastic bag charging, while PR has effects on intention through the

influencing on SN and BAGFEE. The effect of PR on SN is likely to come from the PR within social media. Further, the test of the overall direct effect of the campaigns shows the influence on ATT, SN, BAGFEE and also shows direct influence on intention and behavior. Although KNOW, PR and CAM have influenced on various TPB components, all of them raised the acceptance of the plastic bag charging scheme consistent with the findings of Kamaruddin and Yusuf [55]. Thus, these findings indicate that plastic waste knowledge provision, PR and awareness campaign tend to be effective methods to increase reusable/cloth bag use. Moreover, the result confirms the increase in reusable/cloth use behavior between 2017 and 2019, which suggests that these factors would create a positive effect on behavior over time.

Theoretical and policy implications

The results indicated that while the TPB has been adequately confirmed, PBC has the highest effect on intention, followed by SN. The attitude change resulting from the charging scheme also revealed an effect on intention. Knowledge about the negative impacts of plastic waste, which have effects on PBC and intention, are therefore recommended to be provided through public education. Moreover, the PBC can be increased through making reusable bag to be used on a daily basis. Consequently, the factors affecting the convenience of using reusable bag, such as the design of reusable bag should be improved.

The overall campaign, including the PR provision, was found to affect attitude, SN, and perceived attitude on plastic bag charging and also had a direct effect upon reusable bag use intention and behavior. Female respondents seemed to be more likely to use reusable/cloth bags than male respondents were. Thus, a design that is portable and convenient for male consumers should be promoted. We recommend conducting further research focusing on the factors affecting

male consumers' behavior. Policy acceptance has significantly increased in 2019 which we deem to be primarily due to the intensive media campaign on plastic pollution in 2018.

Regarding policy implications, the regulatory approaches in reducing plastic bags mainly practiced are the banning of them and adoption of pricing mechanisms. Although banning should theoretically be able to reduce plastic bags by 100%, in practice, there are many challenges its implementation faces, including low level of law enforcement and shortage of alternatives [68–70], which in turn lead to civil disobedience [71].

Verplanken et al. [42] and Poortinga et al. [11] suggested that besides the change in attitude and intention, the plastic bag charge can significantly change consumer behavior by breaking the consumer old habits. This suggestion is confirmed by our results, which illustrate that a change in perceived habit from 2017 to 2019 lead to an increase in reusable/cloth bag use behavior in the long term. While Hohmann et al. [35] argued that plastic bag charging would create the desire impact only in short term because the cost of plastic bags is usually small compared to other purchased items, Satararuji et al. [72] suggested that the charge should be 1.5 to 2 THB in order to achieve an effective result.

Consistent with Satararuji et al. [72] that found approximately 57% of their respondents agreed with implementing plastic bag charging scheme in Thailand, our survey shows that 79.5% of youths agreed that Thai government should act to the ban of free distributed plastic bags in convenient stores, department stores and supermarket. 78.7% of respondents also agreed that the university should continue charging 2 THB for plastic bags. The results reveal an increase in charging scheme acceptance over time which may be due to an increase in environmental knowledge and awareness because knowledge can affect attitudes toward charging schemes.

As mentioned in the discussion section, the increases in plastic waste related knowledge and the awareness campaign tends to increase policy acceptance and change consumers' intention towards reusable/cloth bag use. Although regulatory approaches seem to be able to create a higher reduction of plastic waste the voluntary approaches do [73], public education is suggested to be conducted simultaneously along with charging schemes. Sweden and Finland have used public information schemes as part of the implementation of the EU plastic bag directive 2015/720 [71]. The results also show the effect of plastic bag charging schemes on consumer intention and a halt in plastic bag use habit. Thus we suggested that charging schemes should be implemented in Thailand and elsewhere.

Conclusions

This study investigated the factors influencing intention and behavior of Thai consumers in using reusable/cloth bags in a university context where there are plastic bag charging schemes. This study extended the TPB theory, exploring the impact of the awareness campaign, knowledge level, the psychological effect of the charging scheme, and changes in attitudes over time.

In conclusion, charging schemes influence university students to use more reusable bags through attitude and contextual changes and breaking habits over time. The charge should be high enough to change consumers' behavior in order to break their old habit of using plastic bag. In addition, awareness campaigns and plastic bag charging are recommended to be introduced simultaneously. Although this study has some limitations in generalizing the results to wider population in Thailand, our findings showed positive support from youths to implement a national law which charges for plastic bag in Thailand.

Acknowledgements

This Research is funded by Chulalongkorn University CU-GR(S)_61_45_54_01. We highly appreciated comments from anonymous reviewers.

References

- [1] Rivers, N., Shenstone-Harris, S., Young, N. Using nudges to reduce waste? The case of Toronto's plastic bag levy. *Journal of Environmental Management*, 2017, 188, 153–162.
- [2] Pollution Control Department (PCD). (draft) Roadmap on plastic waste management (2018-2030), 2018. (in Thai)
- [3] Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R., Law, K.L. Plastic waste inputs from land into the ocean. *Science*, 2015, 347(6223), 768–771.
- [4] Ocean Conservancy and McKinsey Center for Business and the Environment. *Stemming the tide: Land-based strategies for a plastic-free ocean*, 2015.
- [5] Marks, D., Miller, M.A., Vassanadumrongdee, S., The geopolitical economy of Thailand's marine plastic pollution crisis. *Asia Pacific Viewpoint*, 2020.
- [6] Rujivanarom, P. ASEAN battles marine debris. *The Nation*, 2019. [Online] Available from: <https://www.nationmultimedia.com/detail/national/30365186> [Accessed 1 May 2019].
- [7] Convery, F., McDonnell, S., Ferreira, S. The most popular tax in Europe? Lessons from the Irish plastic bags levy. *Environmental and Resource Economics*, 2007, 38(1), 1–11.
- [8] Mark, D. What Thailand needs to do to kick its plastic addiction. *Bangkok Post*, 2018. [Online] Available from: <https://www.bangkokpost.com/opinion/opinion/1587290/what-thailand-needs-to-do-to-kick-its-plastic-addiction> [Accessed 19 June 2019].
- [9] Environmental Research Institute (2019). *Chula Zero Waste Initiative: Third-year progress report* (in Thai).
- [10] Wyness, L. "Talking of citizenship ..." Exploring the contribution an inter-generational, participatory learning project can make to the promotion of active citizenship in sustainable communities. *Local Environment*, 2015, 20(3), 277–297.
- [11] Poortinga, W., Whitmarsh, L., Suffolk, C. The introduction of a single-use carrier bag charge in Wales: Attitude change and behavioural spillover effects. *Journal of Environmental Psychology*, 2013, 36, 240–247.
- [12] Romer, J.R., Tamminen, L.M. Plastic bag reduction ordinances: New York City's proposed charge on all carryout bags as a model for U.S. cities. *Tulane Environmental Law Journal*, 2014, 27(237), 237–275.
- [13] Schnurr, R.E.J., Alboiu, V., Chaudhary, M., Corbett, R.A., Quanz, M.E., Sankar, K., ..., Walke, T.R. Reducing marine pollution from single-use plastics (SUPs): A review 2018. *Marine Pollution Bulletin*, 2018, 137, 157–171.
- [14] Pakpour, A.H., Zeidi, I.M., Emamjomeh, M.M., Asefzadeh, S., Pearson, H. Household waste behaviours among a community sample in Iran: An application of the theory of planned behaviour. *Waste Management*, 2014, 34(6), 980–986.
- [15] Ajzen, I. The theory of planned behavior. *Organizational behavior and human. Decision Processes*, 1991, 50(2), 179–211.
- [16] Ertz, M., Huang, R., Jo, M.S., Karakas, F., Sarigöllü, E. From single-use to multi-use: Study of consumers' behavior toward consumption of reusable containers. *Journal of Environmental Management*, 2017, 193, 334–344.

- [17] Sun, Y., Wang, S., Li, J., Zhao, D., Fan, J. Understanding consumers' intention to use plastic bags: Using an extended theory of planned behaviour model. *Natural Hazards*, 2017, 89(3), 1327–1342.
- [18] Jakovcevic, A., Steg, L., Mazzeo, N., Caballero, R., Franco, P., Putrino, N., Favara, J. Charges for plastic bags: Motivational and behavioral effects. *Journal of Environmental Psychology*, 2014, 40, 372–380.
- [19] Ajzen, I., Fishbein, M. Attitude-behavior relations: a theoretical analysis and review of empirical research. *Psychological Bulletin*, 1977, 84(5), 888–1918.
- [20] Muralidharan, S., Sheehan, K., “Tax” and “Fee” frames in green advertisements: The influence of self-transcendence in reusable bag usage. *Journal of Promotion Management*, 2017, 23(6), 851–871.
- [21] Cherrier, H. Consumer identity and moral obligations in non-plastic bag consumption: A dialectical perspective. *International Journal of Consumer Studies*, 2006, 30(5), 515–523.
- [22] Carrigan, M., Moraes, C., Leek, S. Fostering responsible communities: A community social marketing approach to sustainable living. *Journal of Business Ethics*, 2011, 100(3), 515–534.
- [23] Musa, H.M., Hayes, C., Bradley, M.J., Clayson, A., Gillibrand, G. Measures aimed at reducing plastic carrier bag use: A consumer behaviour focused study. *Natural Environment*, 2013, 1, 17.
- [24] Ari, E., Yilmaz, V. Consumer attitudes on the use of plastic and cloth bags. *Environment, Development and Sustainability*, 2017, 19(4), 1219–1234.
- [25] Ajzen, I., Fishbein, M. Understanding attitudes and predicting social behaviour. Prentice Hall, Englewood Cliffs, 1980.
- [26] Kaiser F, Gutscher H. The proposition of a general version of the theory of planned behavior: Predicting ecological behavior. *Journal of Applied Social Psychology*, 2003, 33(3), 586–603.
- [27] Taylor, S., Todd, P. Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. *International Journal Research in Marketing*, 1995, 12(2), 137–155.
- [28] Moser, A.K. Thinking green, buying green? Drivers of pro-environmental purchasing behavior. *Journal of Consumer Marketing*, 2015, 32, 167–175.
- [29] Maichum, K., Parichatnon, S., Peng, K.C. Application of the extended theory of planned behavior model to investigate purchase intention of green products among Thai consumers. *Sustainability*, 2016, 8(10), 1–20.
- [30] Adane, L., Muleta, D. Survey on the usage of plastic bags, their disposal and adverse impacts on environment: A case study in Jimma City, Southwestern Ethiopia. *Journal of Toxicology and Environmental Health Sciences*, 2011, 3(8), 234–248.
- [31] Avallone, I.V., Giraldi, J.D.M.E., de Oliveira, S.V.W.B. Conscious consumption: A study on plastic bags' consumers in Brazil. *International Journal of Psychological Studies*, 2012, 4(1), 122–134.
- [32] Otsyina, H.R., Nguhiu-Mwangi, J., Mogo, E.G.M., Mbuthia, P.G., Ogara, W.O. Knowledge, attitude, and practices on usage, disposal, and effect of plastic bags on sheep and goats. *Tropical Animal Health and Production*, 2018, 50(5), 997–1003.
- [33] Chang, S.H., Chou, C.H. Consumer intention toward bringing your own shopping bags in Taiwan: An application of ethics perspective and theory of planned behavior. *Sustainability*, 2018, 10(6).

- [34] Lam, S.P., Chen, J.K. What makes customers bring their bags or buy bags from the shop? A survey of customers at a Taiwan hypermarket. *Environment and Behavior*, 2006, 38, 318–332.
- [35] Hohmann, R., Wattana, C., Sracheam, P., Siriapornsakul, S., Ruckthum, V., Clapp, R. An exploration of the factors concerned with reducing the use of plastic carrier bags in Bangkok, Thailand. *ABAC ODI Journal: Vision. Action. Outcome*, 2016, 3(2), 162–181.
- [36] Ohtomo, S., Ohnuma, S. Psychological interventional approach for reduce resource consumption: Reducing plastic bag usage at supermarkets. *Resources Conservation and Recycling*, 2014, 84, 57–65.
- [37] Romero, C.B.A., Laroche, M., Aurup, G.M., Ferraz, S.B. Ethnicity and acculturation of environmental attitudes and behaviors: A cross-cultural study with Brazilians in Canada. *Journal of Business Research*, 2018, 82, 300–309.
- [38] Chan, R.Y., Wong, Y.H., Leung, T.K. Applying ethical concepts to the study of “green” consumer behavior: An analysis of Chinese consumers’ intentions to bring their own shop bags. *Journal of Business Ethics*, 2008, 79, 469–481.
- [39] Zen, I.S., Ahamad, R., Omar, W. No plastic bag campaign day in Malaysia and the policy implication. *Environment, Development and Sustainability*, 2013, 15(5), 1259–1269.
- [40] Bartolotta, J.F., Hardy, S.D. Barriers and benefits to desired behaviors for single use plastic items in northeast Ohio’s Lake Erie basin. *Marine Pollution Bulletin*, 2018, 127, 576–585.
- [41] Skinner B. F. Utopia through the control of human behavior. In *Readings in the Philosophy of Education*, ed. John Martin Rich. Belmont, CA: Wadsworth, 1972.
- [42] Verplanken, B., Walker, I., Davis, A., Jurasek, M. Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *Journal of Environmental Psychology*, 2008, 28, 121–127.
- [43] Tietenberg, T., Button, K., Nijkamp, P. *Environmental instruments and institutions*. Cheltenham: Edward Elgar, 1999.
- [44] Thomas, G.O., Sautkina, E., Poortinga, W., Wolstenholme, E. The english plastic bag charge changed behavior and increased support for other charges to reduce plastic waste. *Frontiers in Psychology*, 2019, 10, 1–12.
- [45] Convery, F., McDonnell, S., Ferreira, S. The most popular tax in Europe? Lessons from the Irish plastic bags levy. *Environmental and Resource Economics*, 2007, 38, 1–11.
- [46] Dikgang, J., Leiman, A., Visser, M. Analysis of the plastic-bag levy in South Africa. *Resources, Conservation and Recycling*, 2012, 66, 59–65.
- [47] Lally, P., van Jaarsveld, C., Potts, H., & Wardle, J. How habits are formed: Modelling habit formation in the real world. *European Journal of Social Psychology*, 2010, 40, 998-1009.
- [48] Thongplew, N., Kotlakome, R. Getting a drink: An experiment for enabling a sustainable practice in Thai university settings. *Journal of Cleaner Production*, 2019, 218, 294-303.
- [49] Heidbreder, L.M., Bablok, I., Drews, S., Menzel, C. Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of the Total Environment*, 2019, 668, 1077–1093.
- [50] Campbell-Arvai, V., Arvai, J., Kalof, L. Motivating sustainable food choices: The role of nudges, value orientation, and information provision. *Environment and Behavior*, 2014, 46, 453–475.

- [51] Vining, J., Ebreo, A. Predicting recycling behavior from global and specific environmental attitudes and changes in recycling opportunities. *Journal of Applied Social Psychology*, 1992, 22, 1580–1607.
- [52] van Diepen, A., Voogd, H. Sustainability and planning: Does urban form matter? *International Journal of Sustainable Development*, 2001, 4(1), 59–74.
- [53] Santos, G., 2008. The London experience. In: Verhoef, E., Van Wee, B., Steg, L., Bliemer, M. (eds.), *Pricing in road transport: A multi-disciplinary perspective*. Cheltenham: Edgar Elgar, 2008, 273–292.
- [54] Synthia, I.J., Kabir, S. An investigation of consumer attitudes towards new varieties of shopping bags: Exploring eco-awareness and the possibility of behavior change. *The Journal Developing Areas*, 2015, 49, 183–196.
- [55] Kamaruddin, R., Yusuf, M.M. Selangor Government's "No plastic Bag Day" Campaign: Motivation and acceptance level. *Procedia - Social Behavioral Sciences*, 2012, 42, 205–211.
- [56] Afroz, R., Rahman, A., Masud, M.M., Akhtar, R. The knowledge, awareness, attitude and motivational analysis of plastic waste and household perspective in Malaysia. *Environmental Science and Pollution Research*, 2017, 24(3), 2304–2315.
- [57] Ryan, P.G., Swanepoel, D., Rice, N., Preston, G.R. The "free" shopping-bag debate: Costs and attitudes. *South African Journal Science*, 1996, 92, 163–164.
- [58] Sharp, A., Høj, S., Wheeler, M. Proscription and its impact on anti-consumption behaviour and attitudes: The case of plastic bags. *Journal of Consumer Behaviour*, 2010, 9, 470–484.
- [59] Madigele, P.K., Mogomotsi, G.E.J., Kolobe, M. Consumer willingness to pay for plastic bags levy and willingness to accept eco-friendly alternatives in Botswana. *Chinese Journal of Population Resources and Environment*, 2017(3), 15, 255–261.
- [60] Spranz, R., Schlüter, A., Vollan, B. Morals, money or the master: The adoption of eco-friendly reusable bags. *Marine Policy*, 2018, 96, 270–277.
- [61] Kurisu, K.H., Bortoleto, A.P. Comparison of waste prevention behaviors among three Japanese megacity regions in the context of local measures and socio-demographics. *Waste Management*, 2011, 31(7), 1441–1449.
- [62] Tanyaphicha, S. The Impact of Chula Zero Waste scheme on using ecological bag attitude and behavior of Chulalongkorn University student. Faculty of Economics, Chulalongkorn University Research Paper, 2017, (in Thai).
- [63] [dataset] National Statistical Office (NSO), 2018. Average Monthly Income per Household by Province: 2002-2017, 2018. [Online] Available from: http://statbbi.nso.go.th/staticreport/Page/sector/EN/report/sector_08_4_EN_.xlsx [Accessed 14 June 2019].
- [64] Nunnally, J.E., 1978. *Psychometric theory*. 2nd edition. New York: McGraw-Hill, 1978.
- [65] Awang, Z. *A handbook on structural equation modeling using AMOS*, 2nd edition. Univeristi Sultan Zainal Abidin, 2012.
- [66] Hasan, S.N.M.S., Harun, R., Hock, L.K. Application of theory of planned behavior in measuring the behavior to reduce plastic consumption among students at Universiti Putra Malaysia, Malaysia. *Procedia Environmental Sciences*, 2015, 30, 195–200.

- [67] Selley, D.S. Thailand to ban single-use plastic bag by 2021. BK Magazine, 2019. [Online] Available from: <https://bk.asia-city.com/city-living/news/thailand-to-ban-single-use-plastic-bags-2021> [Accessed 21 November 2019].
- [68] Nhamo, G. March. Regulating plastics waste, stakeholder engagement and sustainability challenges in South Africa. Urban Forum, 2008, 19, 83–101.
- [69] Clapp, J., Swanston, L. Doing away with plastic shopping bags: International patterns of norm emergence and policy implementation. Environmental Politics, 2009, 18(3), 315-332.
- [70] Houreld, K., Ndiso, J., 2017. Kenya imposes world's toughest law against plastic bags, 2017. [Online] Available from: <https://af.reuters.com/article/africaTech/idAFKCN1B80PHOZATP> [Accessed 14 June 2019].
- [71] Nielsen, T.D., Holmberg, K., Stripple, J. Need a bag? A review of public policies on plastic carrier bags – Where, how and to what effect? Waste Management, 2019, 87(15), 428–440.
- [72] Satararuji, K., Sutummakid, N., Aroonruengsawat, A., Prasitwisate, G., 2017. Final report: A study on plastic bag management measures. Commissioned report submitted to Department of Environmental Quality Promotion. (in Thai)
- [73] Sornil, W. Policy measures on plastic bag reduction: International experiences and applications for thailand. NIDA Journal of Environment Management, 2012, 8, 95–108. (in Thai)