

Article

Internal and External Influential Factors on Waste Disposal Behavior in Public Open Spaces in Phnom Penh, Cambodia

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Abstract: Over the last decade, municipal solid waste generation in Phnom Penh has increased noticeably; however, the waste management system is far from satisfactory. Considerable amount of waste is left uncollected, as well as intentionally disposed of in public open spaces. External and internal factors can trigger these problems. Possible external factors are low collection frequency, low cleaning services, and insufficient facilities such as small dumpsters. Possible internal factors, which also play an important role in this issue, include low awareness, insufficient knowledge, and low responsibility for personal waste. To examine the influences of these internal and external factors on people's waste disposal behaviors, we selected and conducted a questionnaire survey at four sites in Phnom Penh that differ in waste collection frequency and population density. A total of 413 valid responses were obtained. We developed a structural equation model to explain people's intentions not to dispose of waste in public open spaces. The results showed that personal and social norms, such as perception of social pressure from friends and family and from the government, had significant influences on intention, whereas the influence of external factors was much smaller.

Keywords: waste disposal in public open space; waste collection service; psychological factor; questionnaire survey; path analysis; hypothetical model

1. Introduction

Phnom Penh, the capital city of Cambodia, has faced a significant increase in waste generation. Waste management systems have not been developed well and urgent improvement is considered necessary [1,2]. In Phnom Penh, waste is frequently disposed of and seen to remain in public open spaces. For example, many bags containing waste are disposed of right beside signs proclaiming “no waste dumping”. Residents also leave their bags of waste in front of their houses, even when collection trucks are not expected. This harms human health and the city landscape, and the dumped and scattered waste clogs drains and causes flooding [3]. Frequent disposal of waste in public open spaces may be caused by poor waste management systems, such as irregular collection, insufficient containers, poor cleaning services, and so on. Another potential reason is low awareness about waste disposal among residents. Therefore, to address this issue, external conditions and internal awareness should be considered together. Thondhlana and Hlatshwayo (2018) also suggested that understanding people's internal conditions can be one of the effective methods to achieve environmental sustainability as well as taking into consideration the external conditions [4].

Many studies have focused on one or the other aspect—external or internal—with respect to waste-related behaviors, especially recycling behavior. Nguyen et al. (2019) showed that laws and regulations were more influential than other determinants as well as the inconvenience and cost related to recycling intention [5]. Xu et al. (2017) focused on the influence of external conditions on people's

recycling behaviors in China and showed that government interventions, such as the improvement of segregation infrastructure and the provision of recycling bins, had positive influences on recycling intention [6]. Conke (2018) focused on the influence of collection service on recycling behavior in Brazil. He compared two cities in which collection schedules were regular and irregular, respectively. The results showed that the city with regular collection reached 90% of recycling participation, in contrast to 45% recycling participation in the irregular-collection city [7]. With respect to internal influences, many studies have focused on psychological factors for determining recycling behaviors and intentions [8–13]. Strydom (2018) showed that subjective norms had the largest substantial positive effects on the recycling intention of the residents in South Africa [14]. Hornik et al. (1995) noted that in addition to internal facilitators, external facilitators had some influence on recycling behavior [15]. Barr (2003) proposed “curbside bins” as a factor to explain recycling and waste minimization behaviors, in addition to psychological factors, and it showed significant influence on recycling behavior [16]. Stoeva and Alriksson (2017) evaluated local waste management service conditions, such as collection and waste bins, under the term “satisfaction with the local service”. They showed that the perception of external conditions had an important role in predicting waste recycling intentions, in addition to other psychological factors, and suggested that satisfactory service conditions could increase the recycling rate [17].

Few studies have focused specifically on waste disposal behaviors in open spaces. Some have focused on the related behaviors of “littering”. Cialdini et al. (1990) focused on the influence of social norms, such as injunctive and descriptive norms, on littering behavior [18]. Schultz et al. (2013) investigated littering behaviors in the United States and showed that the availability of existing litter and trash receptacles had significant influence on the behavior [19]. They also revealed the significant influence of age and smoking behavior. Al-Khatib et al. (2009) also focused on the sociodemographic effects on littering behavior in the Nablus district of the West Bank, demonstrating that religious convictions had a clear influence on littering habits [20].

Waste disposal behavior in open spaces is not the same as littering and recycling behaviors, but are similar to some extent. This behavior can be influenced by norms and waste management conditions, such as collection frequency and waste bin provision. Therefore, in this study, we focused on the influences of external conditions and internal psychological factors on residents’ intentions not to dispose of waste in public open spaces, and revealed the factors with significant influence in reducing open-space waste disposal in Phnom Penh. In previous studies, the influences from internal factors and external factors were separately discussed and a comparative evaluation was not well conducted. This study shows the influential pathways and their strength quantitatively by using model analysis, and gives insight into the influential factors on waste disposal in public open spaces.

2. Methods

2.1. Study Area

Phnom Penh consists of 9 districts and 36 communes, and the provision of waste collection services varies by location. To determine the study sites, we sought a holistic understanding of current waste management service conditions, such as collection frequency and facility provision. Cintri, a private company in charge of collection services for the whole city, provided information on waste collection in each district in the city [21]. These data were compiled into a digital map by a geographic information system (GIS; ArcGIS Desktop ver. 21, ESRI, Tokyo, Japan), shown in Figure 1. As Figure 1 illustrates, the central part of the city receives daily waste collection services; in contrast, rural areas receive collection services only two or three days a week. Two types of dumpsters with 4 ton capacity (4T) and 10 ton capacity (10T) are provided, and the latter ones are located mainly in the central area.

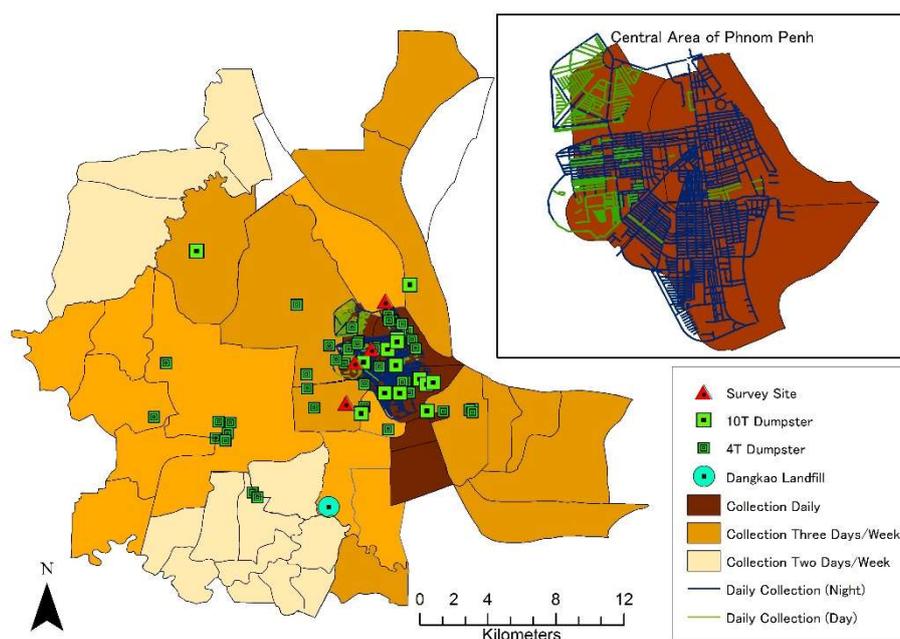


Figure 1. Waste service data map of Phnom Penh.

We assembled the data and calculated population density by population [22] and area (calculated by GIS). The index “collection frequency/population density” was used to select the study sites. As shown in Table 1, four sites were selected, HH, LH, HL, and LL, which represent varying levels of collection frequency (H: high, L: low) and population density (H: high, L: low).

Table 1. Study sites.

Commune		Collection Frequency (Times/Week)		Population Density (pop/km ²)	Streets Surveyed	
HH	Phsar Depou Ti Pir	High	7	High	53,700	St. 134, 138, 146, 221, 225, 233
LH	Tuol Sangka	Low	3	High	19,060	St. 103, 105, 273, 518, 590
HL	Toek Laak I	High	7	Low	14,858	St. 132, 138, 261, 265
LL	Steung Mean Chey	Low	3	Low	7864	St. 23, 38, 62, 217, 371

2.2. Theoretical Framework and Research Hypotheses

A number of theories have attempted to explain why people do or do not engage in a certain behavior. One of the most applauded was the theory of reasoned action (TRA). TRA, first introduced by Ajzen and Fishbein, proposed that “behavior” was determined by “intention,” which was in turn determined by “attitude toward the behavior” and “subjective norms” [23]. Attitude refers to the degree that people value the behavior positively or negatively. Subjective norms are the perceived social pressure from those a person is close to, such as family and friends, regarding whether to engage in the behavior or not. This model implied that if people valued a behavior positively and perceived that their friends and family expected them to perform the behavior, they would intend to perform the behavior. However, although many research findings agree with this theory (e.g., Park et al., 2009 [24]), it has also received a great deal of criticism for its assumption that people’s behavior is determined solely by their intention. Such criticism noted that the model applies only when the behavior is under volitional control. Thus, Ajzen (1991) introduced another theory to predict people’s behavior: the theory of planned behavior (TPB) [25]. This theory, a revision of the controversial TRA, introduced one more predictor, perceived behavioral control (PBC), which determines intention and behavior. PBC represents how much the target behavior can be controlled by an actor himself/herself.

In other words, PBC refers to the degree to which people perceive the behavior as easy or difficult to perform. TPB has become the most popular theory to predict people's behaviors and it has been widely applied to waste-related behaviors such as recycling [26–28] and prevention [29,30].

Schwartz introduced the norm activation model, which explained that the activation of personal norms is an important process in determining altruistic behavior [31,32]. Personal norms are the “expectations people hold for themselves” regarding whether they should or should not perform a certain behavior [31]. This model also explained that personal norms are created through the internalization of social norms [32,33]. Bortoleto et al. (2012) showed the significant influence of personal norms on waste prevention behaviors [29].

In addition to the TPB variables and personal norms, other variables that predict waste-related behaviors have been reported. Hornik et al. (1995) showed that besides attitude and intention, laziness and ignorance also played a crucial role in predicting people's recycling behavior [15]. Davies et al. (2002) reported that the evaluation of effectiveness was an important predictor of recycling behavior [11]. Knowledge, concern, and obligation to environmental issues have also been identified in determining recycling and waste prevention intentions [30,34]. Chiang et al. (2019) suggested that locus of control is a key determinant to promote pro-environmental behavior [35]. For waste littering, locus of control has also been proposed as an influential determinant as well as altruism and self-efficacy (e.g., Ojedokun, 2011; Ojedokun and Balogun, 2011) [3,36]. Self-efficacy is a belief in one's ability to accomplish a task or succeed in specific situations. Locus of control refers to whether people believe that they or external powers are in control of their life.

Based on these theoretical frameworks, the present study developed a hypothetical model involving key internal and external factors for waste disposal behavior in public, as shown in Figure 2. This model set “(a) intention not to dispose of waste in public” (Int_nd) as the target dependent variable. In addition, the variable “(b) intention to keep house and outdoor surroundings clean” (Int_kc) was assumed to have an influence on Int_nd (H1).

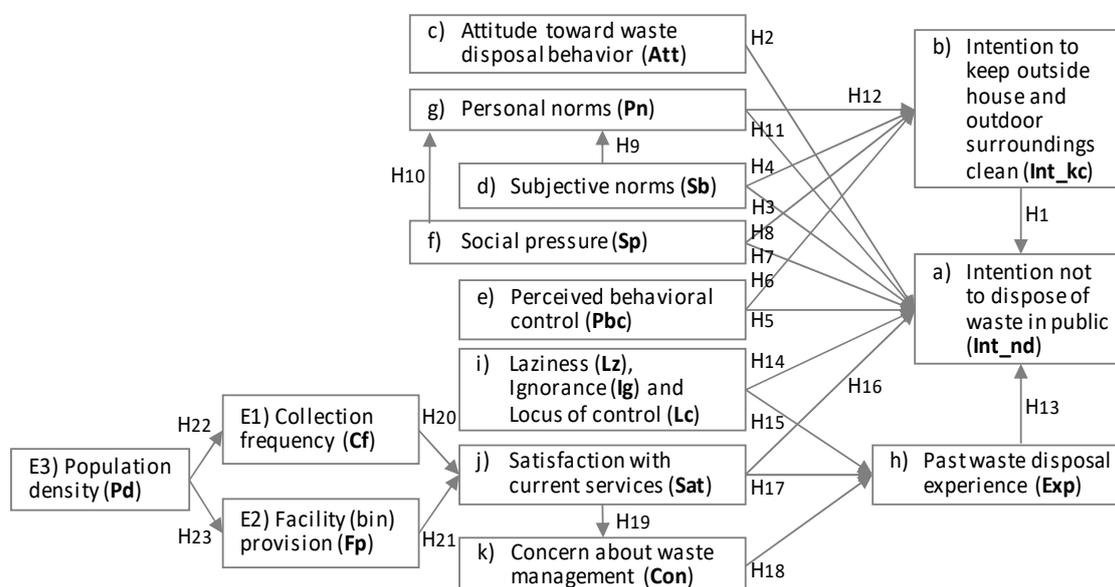


Figure 2. Hypothetical model for public waste disposal behaviors.

The TPB model was adopted with respect to internal factors determining intentions. This model postulates three conceptual determinants, such as “(c) attitude toward the behavior” (Att), “(d) subjective norms” (Sb), and “(e) perceived behavioral control” (Pbc), that predict people's intentions and behavior. Our model assumed that positive Att has a positive influence on Int_nd (H2), and that Sb and Pbc have influences on both Int_nd (H3, H5) and Int_kc (H4, H6). Our model also assumed some additional internal factors, namely, “(f) social pressure” (Sp) and “(g) personal norms” (Pn).

In addition to perception of social pressure from friends and family, perception of institutional and community-level social pressures can influence people's intentions. Therefore, we involved Sp as well as Sb and assumed that Sp has positive influences on Int_nd (H7) and Int_kc (H8). The model also assumed that Pn has positive influences on Int_nd (H11) and Int_kc (H12), and that social norms such as Sb and Sp are internalized into Pn (H9, H10).

Past experiences and behaviors have been reported to influence current intentions and behaviors. For example, Tonglet et al. (2004) showed that the main determinants of recycling behavior were recycling attitude, previous recycling experience, concern for the community, and consequences of recycling [37]. Thus, our model assumed the influence of "(h) past experience of waste disposal in public" (Exp) on Int_nd (H13).

Ojedokun (2011) found that personal attributes, such as altruism and locus of control, had impacts on people's attitude toward littering and responsible environmental behaviors [3]. Hornik et al. (1995) suggested that the basic problems of recycling were internal barriers such as ignorance, laziness, and inconvenience [15]. McCarty and Shrum (1994) showed that the inconvenience of recycling strongly influenced people's recycling behavior [38]. Based on these previous studies, we assumed that "(i) laziness, ignorance, and locus of control" (Lz, Ig, and Lc) have influences on Int_nd (H14) and Exp (H15).

In considering influences from external factors, two possible aspects were involved. First was the objective condition of waste management, indicated by "(E1) collection frequency" (Cf) and "(E2) facility (bin) provision" (Fp); second was people's perception of waste management based on current external conditions, indicated by "(j) satisfaction with current waste management services" (Sat) and "(k) concern about waste management" (Con). We assumed that "(E3) population density" (Pd) determines Cf and Fp (H22, H23), Cf and Fp affect Sat (H20, H21), Sat influences Con and Int_nd (H19, H16), and Sat and Con influence Exp (H17, H18).

2.3. Questionnaire Design

The questionnaire consisted of three parts. The first part (I_1–9) measured demographic information: age (I_1), gender (I_2), address (I_3), family income (I_4), education level (I_7), family size (I_8), and house type (I_9). To validate the appropriateness of the answer for family income, car (I_5) and motorbike (I_6) ownership were also recorded.

The second part (II_1–14) included questions about current waste collection services and how people managed the waste they generated: awareness of current waste management (II_1, 2), collection and disposal frequency (II_3, 8), person responsible for waste disposal (II_4), usual number of waste bags disposed (II_5), disposal location (II_6, 9), method of disposal for recyclable wastes (II_7), satisfaction with current services (II_10), any experience of disposing of waste in public open spaces (II_11) and the reason for doing so (II_12), perception of the sufficiency of facility provision (II_13), and free opinions on current waste collection services (II_14).

The third part (III_1–22) included questions concerning the main internal variables (a–g, i): Int_nd (III_16), Int_kc (III_20), Att (III_1, 21), Sb (III_2), Pbc (III_3, 9, 13, 18), Sp (III_4, 7, 10, 11, 17, 19), Pn (III_8), Lz (III_12, 22), Ig (III_6, 15), and Lc (III_5, 9). For each of the 22 statements shown, respondents expressed their opinions using a 6-point scale ranging from 1 "strongly disagree" to 6 "strongly agree".

2.4. Questionnaire Survey

Target streets were selected for each study site as shown in Table 1, and respondents were selected by fixed intervals of blocks along the street. For structural equation modeling with more than 10 variables, it is recommended that the sample size be 100 or greater, as a smaller sample could produce unstable and insignificant results [29,39]. The total population of Phnom Penh is 1.6 million; according to Yamane's (1967) formula, 400 samples are needed for this population to obtain a 95%

confidence level with significance at the level of 5% [40]. Thus, a sample size of 100 was used for each of the four sites, resulting in a total sample size of 400.

Waste disposal is a sensitive issue; therefore, face-to-face interviews were considered to be an appropriate method for the survey, allowing an interviewer to give supplemental explanations if the interviewee could not understand a question's meaning. Nine Cambodian university students were employed to help conduct the interview survey. Prior to the interview campaign, two training sessions were conducted from 10 January to 11 January 2018. In the first session, all questions were explained to ensure that the interviewers understood all materials clearly. In the second session, a mock interview survey was conducted to determine whether the interviewers understood all questions well and how flexibly they could handle a real situation. After these training sessions, the main survey was conducted from 12 January to 19 January 2018, collecting a total of 425 samples.

2.5. Analytical Method

All obtained data sheets were coded and input into Excel (Microsoft, Albuquerque, NM, USA). For statistical and path analysis, SPSS ver. 21 and SPSS Amos ver. 22 (IBM Co., Armonk, NY, USA) were used, respectively. The obtained data did not follow a normal distribution; therefore, nonparametric tests including the Kruskal–Wallis and Mann–Whitney U tests were used to compare the average scores among groups of three or more and groups of two, respectively. For the post hoc (paired comparison) test, the Dunn–Bonferroni method was used, as provided by SPSS.

3. Results

3.1. Sample Distribution

A total of 413 valid responses were obtained out of the 425 samples. Table 2 shows the sociodemographic data for the samples with the newest available information about Cambodia from the national census [22,41]. The sample data show a higher ratio of women than do the census data; this might be because the survey was conducted during daytime hours on weekdays. With respect to age distribution, the majority of respondents were in their 20s (31.2%) and 30s (26.5%). In comparison to the census data, the sample data show a relatively smaller proportion of people over 60. Among the four survey sites, HL shows a relatively higher ratio of women (67.3%) and LL shows a larger proportion of people over 50 compared with other regions. According to the national census, 20.7% of people above age 25 have no or lower education, and only 4.7% of people currently attend university or hold a degree. In comparison, whereas the ratio of female respondents was relatively high, the educational level of the respondents is seen to be much higher than that of the census data. Of the four survey sites, respondents in HH, LH, and HL were more educated than those in LL. With respect to monthly family income, similar to the census data (about 400 USD/month per family), 43.1% of people reported a family income ranging from 200 to 500 USD/month. In HH, LH, HL, and LL, 38.4%, 33.0%, 27.9%, and 19.2% of respondents reported a monthly income of more than 500 USD, respectively. This order among the four survey sites corresponds to the reported educational level of each region. Additionally, answers regarding car and motorbike ownership, which were obtained to check the validity of reported income data, also supported the income conditions of the four sites. When discussing the average scores of the total area or each site, careful consideration is necessary based on the sociodemographic characteristics of the respondents and the differences among the four sites.

Table 2. Sociodemographic data for respondents.

Item	Category	Sample (%)					Cambodia Average
		Total (<i>n</i> = 413)	Urban		Rural		
			HH* (<i>n</i> = 101)	LH* (<i>n</i> = 104)	HL* (<i>n</i> = 104)	LL* (<i>n</i> = 104)	
Gender	Male	39.7	40.6	46.2	32.7	39.4	48.64 [41]
	Female	60.3	59.4	53.8	67.3	60.6	51.36 [41]
Age	<20	5.3	6.9	7.7	4.8	1.9	34.8 [22]
	20s	31.2	23.8	50.0	35.6	15.4	19.4 [22]
	30s	26.5	36.6	14.4	26.9	27.9	11.5 [22]
	40s	15.8	19.8	13.5	12.5	17.3	10.3 [22]
	50s	13.8	9.9	9.6	8.7	26.9	6.6 [22]
	≥60	7.5	3.0	4.8	11.5	10.6	17.4 [22]
Education level	Uneducated	6.0	5.9	3.8	3.8	10.6	20.7 [41]
	Primary school	19.8	18.8	16.3	11.5	32.7	57.9 [41]
	Secondary school	18.8	7.9	15.4	24.0	27.9	11.4 [41]
	High school	22.5	21.8	11.5	34.6	22.1	5.3 [41]
	Bachelor's degree	31.8	43.6	51.9	25.0	6.7	
	Master's degree	0.8	1.0	1.0	1.0	0.0	4.7 [41]
	Doctorate	0.3	1.0	0.0	0.0	0.0	
Monthly family income	<200 USD	26.4	19.8	37.5	18.3	29.8	
	200–500 USD	43.1	37.6	29.8	53.8	51.0	
	500–800 USD	19.9	27.7	18.3	19.2	14.4	About 400 USD [41]
	>800 USD	10.7	14.9	14.4	8.7	4.8	
Cars owned	None	80.1	70.3	84.6	78.8	86.5	
	1	16.0	21.8	11.5	19.2	11.5	
	2	3.7	7.9	3.8	1.0	1.9	None: 96% [41]
	3 or more	0.3	0.0	0.0	1.0	0.0	
Motorbikes owned	None	7.3	9.9	5.8	4.8	8.7	
	1	36.3	36.6	28.8	38.5	41.3	
	2	30.1	31.7	31.7	28.8	28.3	None: 36% [41]
	3 or more	23.0	21.8	33.7	27.9	8.7	

3.2. Summary of Obtained Data

Answers regarding internal variables were given as a score from 1 (“strongly disagree”) to 6 (“strongly agree”). Valid question items were extracted on the basis of the single correlation coefficients with Int_nd and Int_kc and the consistency of the items, checked by Cronbach’s $\alpha > 0.70$. Sp was divided into two variables: “social pressure from the government” (Sp_g; III_11) and “social pressure from surrounding people” (Sp_s; III_7, 10, 17, 19; $\alpha = 0.704$). The average value of items for Sp_s are described below. For Pbc and Lc, only one item showed significant correlation with intentions; therefore, the answers for those items (Pbc: III_13, Lc: III_5) were selected. The items for Att, Ig, Lz, and Sat did not show significant correlation with intentions.

Figure 3 shows the average scores of the valid internal variables involved in the hypothetical model. For Int_nd, the total average score was 5.23, and 95% of respondents answered between “strongly agree” and “slightly agree” regarding avoidance of disposing of waste in public open spaces. Of the four sites, HL showed the highest (5.35) and LL the lowest (5.13) scores. Significant difference was observed between LL and HL on using the post hoc test ($p = 0.00$). For Int_kc, the total average score was 5.52, slightly higher than that of Int_nd. HL showed a slightly higher score than the other sites, but the differences among the four sites were not significant ($p = 0.11$). The average Sb score was 5.01; the difference among the four sites was quite small and not significant ($p = 0.49$). The average score for Sp_s was 4.72, the lowest among the three types of social norms (Sb, Sp_s, and Sp_g). The lowest score was seen in LL, and significant differences were observed with the other three areas: HL ($p = 0.00$), LH ($p = 0.00$), and HH ($p = 0.00$). The total average score for Sp_g was 5.15, the highest among the three social norms. The difference among the four sites was not significant ($p = 0.45$). Pn showed the highest average score (5.30) among the norms, and the difference among the four regions was not significant

($p = 0.94$). The average score for Pbc was 4.50. LH showed the highest score (4.68), and a significant difference was observed between LL and LH ($p = 0.00$). The average score for Lc was 3.87, the lowest among the variables shown in Figure 3. HL showed the lowest score (3.62), but the difference among the four regions was not significant ($p = 0.10$).

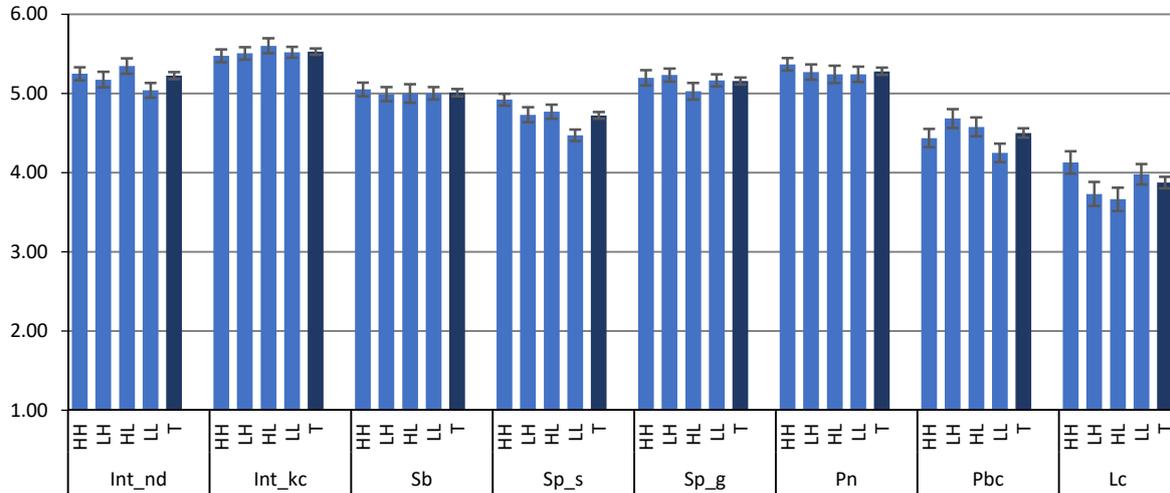


Figure 3. Average scores of variables in the hypothetical model by site. Error bars represent the standard error values. The letter pairs represent each site’s collection frequency and population density (H: high, L: low). T represents the total average score.

Figure 4 shows respondents’ concerns about different environmental issues, such as water pollution, air pollution, global warming, and waste management. Answers were given as a score from 1 (“not concerned at all”) to 4 (“highly concerned”). The average scores of the total sample ($n = 413$) for water pollution, air pollution, global warming, and waste management were 3.33, 3.10, 2.84, and 3.00, respectively. Respondents indicated the highest concern about water pollution and the lowest about global warming. The residents of LH, who receive low collection frequency in a more densely populated area, indicated the highest concern for each issue. Waste management was the third highest concern in all regions expect for HL, in which it was second highest.

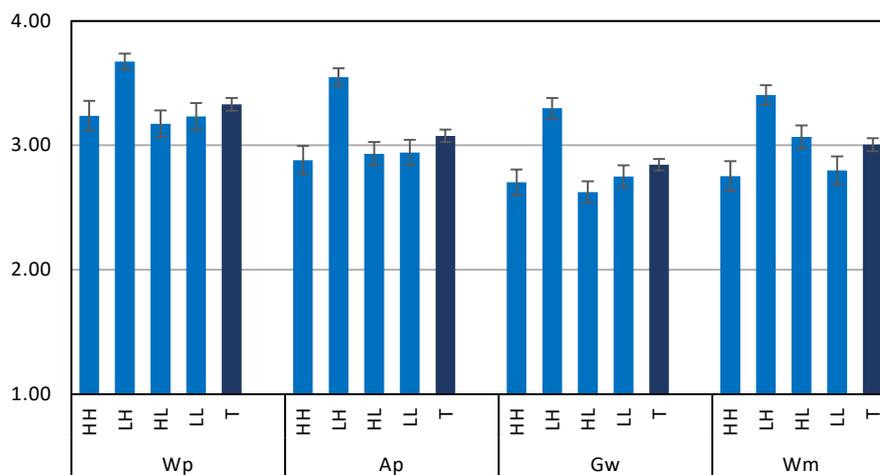


Figure 4. Average scores of environmental concern by site. Error bars represent the standard error values. Wp, Ap, Gw, and Wm represent the four target issues: water pollution, air pollution, global warming, and waste management. The letter pairs represent each site’s collection frequency and population density (H: high, L: low).

Figures 5 and 6 show average scores by gender and age, respectively. As seen in Figure 5, women showed higher scores for all the variables compared with men. Statistically significant differences were observed for Int_nd ($p = 0.05$), Int_kc ($p = 0.00$), Sp_g ($p = 0.04$), and Pbc ($p = 0.00$); differences were not significant for Sb ($p = 0.33$), Sp_s ($p = 0.06$), Pn ($p = 0.24$), or Lc ($p = 0.06$).

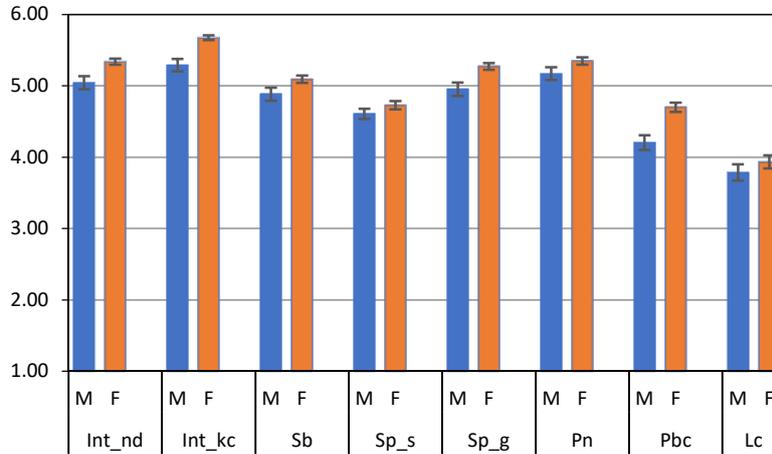


Figure 5. Average scores of variables in the hypothetical model by gender. Error bars represent the standard error values.

As shown in Figure 6, respondents in their 30s showed relatively lower scores for Int_nd, Sb, Sp_g, and Pn. Significant differences were observed for Int_nd ($p = 0.04$), Pn ($p = 0.05$), and Pbc ($p = 0.03$); differences were not significant for Int_kc ($p = 0.72$), Sb ($p = 0.14$), Sp_s ($p = 0.63$), Sp_g ($p = 0.09$), or Lc ($p = 0.86$). For Int_nd, the youngest (<20) and the oldest (≥ 60) groups showed the highest scores. The post hoc test found significant differences between <20 and 30s ($p = 0.01$), 20s and 30s ($p = 0.02$), and <20 and 50s ($p = 0.02$). For Pbc, the highest and lowest scores were found in the youngest (<20) and oldest (≥ 60) groups, respectively. The post hoc test found significant difference between <20 and 30s ($p = 0.01$), 40s ($p = 0.03$), 50s ($p = 0.04$), and ≥ 60 ($p = 0.00$) age groups. Significant difference was also found between 20s and 30s ($p = 0.05$) and ≥ 60 ($p = 0.03$) age groups. For Pn, relatively higher values were seen in the youngest (<20) and the oldest (≥ 60) groups. The post hoc test showed significant difference between the youngest group and all others (20s, $p = 0.02$; 30s, $p = 0.00$; 40s, $p = 0.01$; 50s, $p = 0.02$) except for the oldest group.

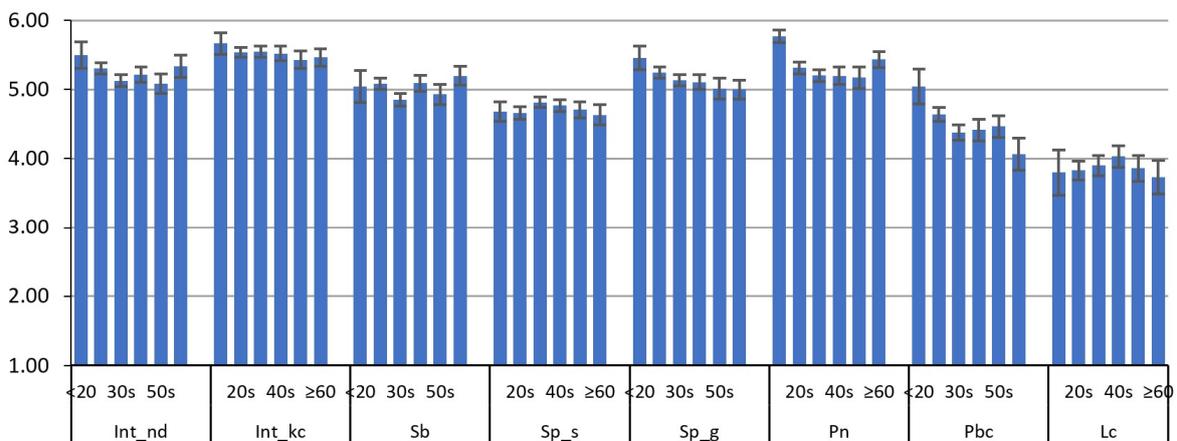


Figure 6. Average scores of variables in the hypothetical model by age. Error bars represent the standard error values.

3.3. Model Estimation

The hypothetical model was modified and estimated by path analysis. For internal variables, the variables shown in the previous sections were used. For Exp, answers were given on a scale from 1 (“never”) to 5 (“always”). For external variables such as Pd, Cf, and Fp, the objective data prepared in Section 2.1 were used. For Fp, the indicator “total facility volume (L)/area (km²)” was used. Total facility volume was calculated by totaling the volume of each waste container in the target street. Sat was excluded from the model, and perceived external conditions were newly added. Dis_per referred to the perceived distance of the disposal site (III_12) and Fp_per to the perceived sufficiency of facility provision (II_14).

Figure 7 depicts the estimated model to explain intention not to dispose of waste in public. Only the significant ($p < 0.01$) paths are shown. The model fit indices were acceptable; the comparative fit index (CFI) was 0.909 (>0.90), and the root mean square error of approximation (RMSEA) was 0.071 (<0.080). The explained variance (R²) of Int_nd was 0.65, as seen to the upper-right of Int_nd in Figure 7, which was high enough for model acceptance.

Int_kc had a substantial positive effect (0.37) on Int_nd. Among the constituents of TPB, two types of social norms (Sb and Sp_g) showed higher direct influences (0.22 and 0.20, respectively) on Int_nd, whereas Att had no significant influence. In addition, personal norms (Pn) and Pbc showed significant direct influences on Int_nd (Pn: 0.12; Pbc: 0.11). The internalization effects of social norms (Sb and Sp) on personal norms (Pn) were observed as significantly large path coefficients between these variables (Sb→Pn: 0.36; Sp_s→Pn: 0.14; Sp_g→Pn: 0.23). Lz, Ig, and Lc did not show significant influences on Int_nd or Int_kc, and were excluded from the model. Other influential variables on Int_nd included Exp (−0.10).

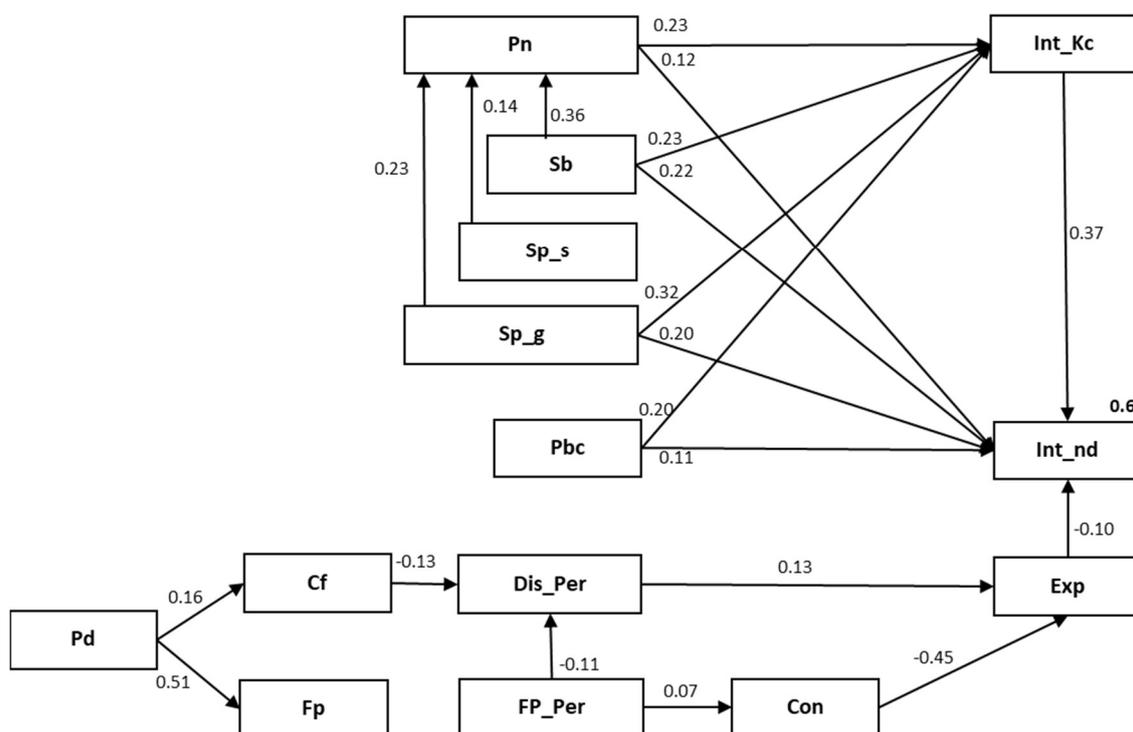


Figure 7. Model estimation results. Model fit indices were CFI = 0.909 and RMSEA = 0.071. The lines represent significant (<0.01) paths. The value shown beside each path is the standardized path coefficient value.

People's perception of the existing waste service provision also had significant influences ($\text{Dis_per} \rightarrow \text{Exp}$: 0.13; $\text{Fp_per} \rightarrow \text{Con}$: 0.07). External factor Cf showed a negative influence on perceived distance of the disposal site ($\text{Cf} \rightarrow \text{Dis_per}$: -0.13).

Table 3 shows the total effect of each variable on Int_nd and Int_kc, involving indirect and direct effects. With respect to total effects, social norms showed high influences at the same level of direct influence of Int_kc (0.37) on Int_nd (Sb: 0.38; Sp_g: 0.36). Pn and Pbc showed significantly large influences on Int_nd (Pn: 0.20; Pbc: 0.18). Compared with the effects of the internal variable, the influences on Int_nd and Int_kc of external variables such as Cf and Fp, as well as the influences of their perception, such as Dis_per and Fp_per, were small.

Table 3. Direct and total effects on intentions.

Independent Variables		Dependent Variables					
		Int_nd			Int_kc		
		Direct	Indirect	Total	Direct	Indirect	Total
(b)	Int_kc	0.37	-	0.37			
(d)	Sb	0.22	0.16	0.38	0.15	0.08	0.23
(e)	Pbc	0.11	0.07	0.18	0.20	-	0.20
(f-1)	Sp_s	-	0.03	0.03	-	0.03	0.03
(f-2)	Sp_g	0.20	0.16	0.36	0.26	0.05	0.31
(g)	Pn	0.12	0.08	0.20	0.23	-	0.23
(h)	Exp	-0.10	-	-0.10	-	-	-
(k)	Con	0.04	-0.02	0.02	-	-	-
(l-1)	Dis_per	-0.01	-0.03	-0.04	-	-0.07	-0.07
(l-2)	Fp_per	-	0.01	0.01	-	0.01	0.01
(E1)	Fp	-	-0.01	-0.01	-	-	-
(E2)	Cf	-	0.01	0.01	0.	0.01	0.01
(E3)	Pd	-	-0.01	-0.01	-	-0.01	-0.01

4. Discussion

Our findings suggest that TPB is a good framework for predicting intention not to dispose of waste in public. Social norms, such as Sb and Sp_g, and Pbc were found to have significant effects on behavioral intention, which is supported by the TPB framework. In contrast, Att did not demonstrate any significant influences on intention. Attitude here refers to the degree to which people value avoiding public waste disposal positively or negatively. This indicates that such perceptions do not connect with actual behavioral intentions. More normative right-or-wrong perceptions, like personal norms, had a significant effect on intention. Previous studies (e.g., Bortoleto et al., 2012 and Barr et al., 2001) demonstrated that environmental attitude did not always have a direct effect on environmental behavior, but also had indirect effects on behavioral intention [29,34]. Bortoleto et al. (2012) found no significant direct influence of attitude on intention to prevent waste, but did find a relationship between attitude and PBC. This leads to the conclusion that attitude has a potential indirect effect on intention [29].

The substantial positive influences of norms coincided with the findings of many other studies, which showed the important role of personal and subjective norms in environmental behaviors [42–45]. Chan and Bishop (2013) found that moral and subjective norms had influential effects on the intent to recycle [26]. Matthies et al. (2012) concluded that subjective norms not only had a direct effect on recycling and re-use behavior, but also had an additional indirect effect through personal norms [42]. They also noted that this would be reasonable because the past behaviors of parents and other close friends or family could impact the development of personal norms. The results of our model also found significant indirect effects of Sb through Pn. Bortoleto et al. (2012) also indicated that subjective norms interacted with personal norms to create a large influential effect on prevention behavior, rather than having a direct effect [29].

In addition to subjective norms, perceived social pressure from the government (Sp_g) showed significant direct and indirect influences on intentions. This social norm can be categorized as an injunctive norm. The influence of injunctive norms has been well investigated and has been found to have substantial influence on recycling behavior [42]. Thøgersen (2006) found that descriptive, injunctive, subjective, and personal norms have a statistically significant positive correlation with environmentally responsible behavior [33]. The significant influence of this type of norm indicates that governmental regulations can enhance people's intentions not to dispose of waste in public.

Pbc was also found to have a direct effect on Int_{nd}. Pbc here referred to people's perceptions of the ease or difficulty of avoiding public waste disposal. This result was consistent with the TPB framework and other studies about environmental behaviors, especially waste recycling and waste prevention (e.g., [16,29,46,47]). However, although significant influence from PBC was demonstrated by many previous studies, the size of the influence has been controversial. Some previous studies showed significantly large influence of PBC on intention—for example, Chan and Bishop (2013) found the influence of PBC on recycling behavior to be 0.27 [26]—whereas numerous others showed a relatively smaller relationship between PBC and intention.

Influence of past experience on Int_{nd} was also found. This indicates that people who do not have any experience disposing of waste in public open spaces will highly intend to continue to perform this good behavior. Past experience was mainly determined by awareness of waste management, as seen in the higher path coefficient from Con to Exp (−0.45). This indicates that people with lower concern about waste management have greater experience disposing of waste in public open spaces, and this connects with future disposal intentions. Therefore, increase of awareness about waste management is considered important to avoid waste disposal behaviors in public open spaces.

5. Conclusions

Focusing on external and internal factors determining people's intention not to dispose of waste in public open spaces, we conducted a face-to-face questionnaire survey in Phnom Penh, Cambodia. A total of 413 valid samples were gained from the four targeted sites, which differed in collection frequency and population density. A model based on a modification of TPB was developed and estimated using the obtained data. The model estimation results indicated that the influence of internal factors was much larger than that of external factors in predicting the target behavioral intention. Among the internal factors, influences from social and personal norms were largest. Social pressure from friends and family and from the government showed significantly large influences on the target intention. Additionally, the personal norms internalized from these social norms showed significant influence on the target intention. For the policy makers, top-down interventions, such as regulations and laws, have been usually considered effective. The higher path strength from the social pressure from the government can fit with this kind of intervention. On the other hand, higher path strengths from personal norms and subjective norms indicate that bottom-up interventions stimulating residents' norms can also have the potential to reduce waste disposal in public open spaces. Comparison of the effectiveness of different interventions can give more insights into reducing waste disposal in public open spaces as future research.

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