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A Cross-region Analysis of Commercial Food Waste Recycling Behaviour

Tiffany M.W. Mak[1], Iris K.M. Yu[2], Xinni Xiong[1], Nastaein Q. Zaman[3], Nurashikin Yaacof[3], Shu-Chien Hsu[1], Chi Sun Poon[1], Daniel C.W. Tsang[1,*]

[1] Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China.

[2] Green Chemistry Centre of Excellence, The University of York, York YO10 5DD, United Kingdom.

[3] School of Civil Engineering, Universiti Sains Malaysia, Engineering Campus, 14300 Nibong Tebal, Pulau Pinang, Malaysia.

[*] *Corresponding author: dan.tsang@polyu.edu.hk*

Abstract

To tackle the crisis associated with the rising commercial food waste generation, it is imperative to comprehend how corporates' recycling behaviour is influenced by different industry structures and economies. This study aims to fill in the information gap that various factors might be affecting corporates' recycling behaviour in two different economies due to environmental inequality by comparing upper-middle-income region (Malaysia) and high-income region (Hong Kong), respectively. A questionnaire survey regarding food waste management according to the Theory of Planned Behaviour was conducted with representatives coming from diverse industries of the hotel, food and beverage, and property management. The questionnaire responses were evaluated based on quantitative structural equation modelling and correlation analysis. The analysis results showed that the model fit the data well, explaining 78% of the variance in recycling behaviour. The findings demonstrated that the most substantial factor on individual's recycling intention by Malaysian commercial food waste generators was perceived behavioural control, and logistics and management incentives. Subjective norms demonstrated significant and adverse effects on the behaviour of food waste recycling. The variable of administrative incentives and corporate support presented

strong positive correlations with moral attitudes as well as logistics and management incentives. Hotel industries from both Hong Kong and Malaysia have a higher acceptance level on human resources regarding food waste recycling. In comparison, food and beverage industries from both regions have a lower acceptance level. These findings could enrich our knowledge of the concerns in establishing regional policy strategies to encourage economic behavioural changes for sustainable development.

Keywords: waste management; food waste recycling; structural equation modelling; sustainable development; behavioural change.

1 Introduction

Globally, food and green waste is the most significant municipal solid waste (MSW) generation, which amounts to 44% of global waste (Kaza et al., 2018). The food loss accounts for 30% of the food produced globally, equating to 1.3 billion tonnes annually (FAO, 2015). In East Asia regions that have relatively high Gross Domestic Product (GDP) per capita, such as Hong Kong (USD$45,180), Malaysia (USD$10,190), and Singapore (USD$58,480) (IMF, 2020), the MSW generation rates are 2.14, 1.21, and 3.72 kg per capita per day, respectively. The amounts are much higher than that of the average in East Asia (i.e., 0.56 kg per capita per day) (Kaza et al., 2018). National and local governments have reacted to the waste escalation by initiating regulations and campaigns. France passed legislation to forbid supermarkets from disposing or destroying unsold food, while compulsory food donation was proposed for charities or food banks (Chrisafis, 2015). Other jurisdictions such as the United States and China required food waste composting for tourists and some residents (McClellan, 2017), such as treated at anaerobic digestion facilities (Lee et al. 2014). Non-monetary motivations are also crucial as the determinants of human behaviour in recycling (Bénabou and Tirole, 2006). New models to explain individual actions were built, which included models of motivations other than the

pursuit of self-interest. Recent studies suggested the substantial relationships between different types of motivations (D'Amato et al., 2016). They recognised the interactions between external rewards (e.g., unit price systems) and internal motivation (e.g., pro-environmental behaviour) (Gilli et al., 2018).

According to the 6Rs' principle, rethink, refuse, reduce, reuse, recycle, and replace are of emerging importance when designing waste strategies (Green Triangle Blog, 2012). In particular, rethink comes first as individuals consider and question their habits. Drivers such as materialism values were proposed (Abdelradi, 2018; Diaz-Ruiz et al., 2018) and the complexity of food waste generation was suggested as a function of cultural, personal, political, geographic, and economic forces (Thyberg and Tonjes, 2015; Hebrok and Boks, 2017). Tackling the food waste problem would require multi-faceted policy levers for sustainable policy development (Thyberg and Tonjes, 2015; Schanes et al., 2018), based on the understanding of the combined effects of economic and regulatory factors (Chalak et al., 2016) and connections between intentions and recycling behaviour (Mak et al., 2018) across different countries. Previous studies also proposed the concept of environmental inequality in waste management and health due to various socio-economic status (Martuzzi et al., 2010). The correlation between residence and income affected some environmental outcomes, for example, the possibility of exposure to environmental hazards, unbalanced impacts from ecological policies, and inequalities of the supply of environmental facilities such as waste disposal and recycling services (Taylor, 2000; Margai, 2001). However, it remains uncertain how corporates' recycling behaviour varies with different industry structures and economies. Moreover, due to the recent outbreak of COVID-19 pandemic, food supply sectors and industries have been severely suffering from the global food safety issues and the lockdown of food systems (Galanakis, 2020). The blockage of food supply and outlet leads to massive food dumping as well as shortage, thus appealing for the

77 urgent policies regarding to food assistance and administrative support. In this regard, the
78 arising challenge motivates to explore state-of-the-art insights on the structural analysis on the
79 behaviour of food waste recycling. Therefore, this research aims to fill in the information gap
80 that various factors might be influencing corporates' recycling behaviour in two different
81 economies due to environmental inequality by comparing Malaysia and Hong Kong, which
82 represent the upper-middle-income region and high-income region, respectively. The
83 classification of economies is based on Gross National Income (GNI) per capita, current US$
84 of the region (World Bank Group, 2018a), and the recent GNI per capita of Malaysia and Hong
85 Kong were US$11,230 and US$50,800.
86
87 The observation based on a structural and operational fact that organisations (as physical
88 realities) are made by, and are composed of, people (Carley and Behrens, 1999). Therefore, it
89 is fundamental to understand individuals' behaviour to achieve a change in recycling culture
90 within corporates. It is widely accepted that individuals' behaviour including attitudes,
91 perceived behavioural control, and subjective norms can be interpretated through the
92 convention Theory of Planned Behaviour (TPB) (Ajzen, 1993) (Figure 1), which has clearly
93 explained and elucidated various environmentally responsible behaviour including waste
94 recycling (William and Kelly, 2002; Davis et al., 2006; Omran et al., 2009). The applications
95 of TPB extend to elucidating transportation in public (Bamberg and Schmidt, 2003) and
96 convention conservation behaviour (Kaiser et al., 2005; Mattar et al., 2018). In previous
97 literatures, the path analysis was adopted to elucidate the substantial correlations between
98 constructs and recycling behaviour. Attitude and personality (Arbuthnot, 1977; Chan and
99 Bishop, 2013; Ghani et al., 2013), perceived behavioural control (Visschers et al., 2016; Gilli
100 et al., 2018), and moral norms (Conner and Sparks, 2005; Russell et al., 2017) are correlated
101 with household food waste behaviour. Besides, administrative incentives and corporate support

as a varible was found to present intervening relationship on food waste recycling behaviour (Mak et al., 2018; Lang et al., 2020). Recycling behaviour within commercial industries can be associated with amenity problem and low awareness as well as interest in waste management (Papargyropoulou et al., 2014).

This study aims to explain and compare corporates' intentions about food waste recycling under different industry structures and economies. The objectives of this study include (i) identifying major drivers and their relationships of recycling behaviour in the commercial sector in Malaysia, and (ii) discovering generic differences in recycling behaviour of commercial food waste management systems in Malaysia and Hong Kong. New perspectives on the management of food waste across various economies would be beneficial for improving regional policy strategies. Commercial behavioural changes could also be fostered for the sake of more robust sustainable policy development.

2 Methods

2.1 Background of questionnaire design

Latent variables (LVs) were inferred from other measurable variables through a mathematical model (Jan, 1986), and employed to extend the existing TPB framework by quantitative modelling. In the commercial sector, new variables affecting the intention and behaviour of food waste recycling were identified and prioritised. Employees' acceptability on the consumption of food waste recycling as well as indispensable human resources were assessed to reveal the discrepancy in employees' awareness and concerns on food waste recycling in various industries and regions by means of questionnaire. The questionnaire was designed to quantify and compare the determinants of recycling behaviour of different regional employees, based on previous research in Hong Kong under the TPB framework (Mak et al., 2018). This

Hong Kong-based study carried on semi-structured in-person interviews with 9 management representatives coming from several relevant industries involving (i) hotel, (ii) food and beverages, (iii) and the property management. Accordingly, this work newly adopted and evaluated three TPB factors, including logistics & management incentives, economic incentives, and administrative incentives & corporate support (Mak et al., 2018). In the original TPB theory (Ajzen, 1993), 'attitude' is the belief about the likely consequences of the behaviour (Ajzen, 1991). If individuals have deep egoistic concerns, the costs and benefits of environmental practices will be evaluated by the individuals (Schultz, 2001). 'Subjective norms' is a normative belief that the perception of a particular behaviour is affected by the judgment of significant others, e.g., friends and parents (Ajzen and Fishbein, 1972). 'Perceived behavioural control' is the belief that the presence of factors tend to encourage or obstruct the behavioural performances (Ajzen, 1991) (Figure 1), consisting of two highly related variables that are perceived self-efficacy (one's belief about their own ability) (Bandura, 1991) and perceived controllability (the belief that one's behaviour is volitional) (Ajzen, 2002, Barlett, 2019).

There were two sections in the questionnaire, which included the sub-questions associated with each LV and demographic characteristics of respondents (i.e. age, gender, work experience, education, industry, and roles in the corporate sector) (Table 1). The samples of invited interviewees were collect randomly from respective sectors to guarantee the representativeness and accuracy of the assessing performances. The results interpreted the responses by means of five-point Likert-type scale to measure the degree of the perspectives from sampled respondents in various LVs. A substantial positive perception was represented by the highest number '5', a neutral opinion was represented by '3', and a substantial negative attitude was represented by '1'.

152

153 2.2. Questionnaire data analysis

154 The importance of factors that govern the six TPB LVs in individual's environmental
155 behaviour was examined by the Partial least squares structural equation modelling (PLS-SEM).
156 This modelling identified a set of proxy indicators, known as LVs (Table 1), which directly
157 measured indirect behavioural factors to explain consumer behaviour and attitudes by
158 analysing variance (Results discussed in Section 3.2). The correlations of independent and
159 dependent LVs were revealed in the identified inner submodel (Figure 2), while the outer
160 submodel elucidated the relationships among different LVs and respective examined indicators
161 (Monecke and Leisch, 2012).

162

163 The LVs' indicator reliability and internal consistency reliability could be evaluated to address
164 the authenicity of the PLS-SEM. Indicator reliability higher than 0.4 in an investigational study
165 confirmed the relationships between the reflective LVs and observed indicator variables
166 (Henseler et al., 2012). An exploratory research explored a problem with unclear definition and
167 failed to provide conclusive results (Shield and Rangarjan, 2013). Composite reliability is
168 similar to Cronbach's alpha that varies from 0 to 1 (perfectly estimated reliability) and measures
169 the internal consistency in scale items, which is adequate for exploratory research if it is no
170 less than 0.6 (Chin, 1998; Höck and Ringle, 2006).

171

172 The convergent and discriminant validity are used to quantifiably indicate construct validity of
173 this model. Specifically, when the average variance extracted (AVE) is more significant than
174 0.5 and the error variance is within the explained variance, both convergent and discriminant
175 validity can be assured (Chin, 1998; Höck and Ringle, 2006). Evaluation on the square root of
176 AVE values along with LV correlations can assess the discriminant validity of LVs, which is

known as the Fornell-Larcker test. The model is supposed to fit well if the standardised root mean square residual (SRMR) is within 0.8 (Hu and Bentler, 1998). Besides, the coefficients for determining constructs (i.e., R^2 value), path coefficients, and correlations of LVs were estimated as well. Meanwhile, the 'substantial', 'moderate', and 'weak' of R^2 values are specifically determined at 0.67, 0.33, and 0.19, respectively (Chin, 1998; Höck and Ringle, 2006), which assesses how well a model explains and projects future outcomes. To prioritise the factors that drive commercial food waste recycling, the path coefficients should be compared to represent the direct outcome from a certain variable as a cause while another variable assumed to be an effect. LV correlations vary from 0 to 1 (*i.e.,* variables that show no impact on any other LVs in the model).

3 Results and Discussion

3.1 Reliability and validity of the reflective TPB model

An equal distribution of respondents (206 questionnaire responses) were received, which were from the targeted Malaysian industries including hotel (30.6%), food and beverages (36.4%), and property management (33.0%) (Table S1a). The questions asked were shown in Table 1. The majority worked in the management (43.2%) and operation (27.2%) divisions, which was comparable to the Hong Kong-based study (24.5% and 20%, respectively; Mak et al., 2018) (Table S1b). Over 70% of the Malaysian respondents mentioned a lack of food waste reduction/recycling schemes in their organisations. The mean values of respective indicators in the questionnaire with mesurement scales were disintegrated and presented in Table S3.

As most of the reliability factors were scored between 0.44 and 0.86, the validity as well as reliability of this model could be assured (Table 2). The values of the composite reliability ranging from 0.769 to 0.901 verified the internal consistency reliability of all the eight LVs.

As the AVE values were between 0.606 and 0.745, the convergent validity of this model was therefore confirmed. Meanwhile, the square root of the AVE value of respective LV exceeded its strongest correlation with other LVs, thus the discriminant validity was assured as well (for example, 0.803 of LV1 > 0.513 of LV1-LV2 correlation) (Table 3). Furthermore, the model demonstrated a good fit with an SRMR at 0.076.

3.2 Priorities in critical LVs of food waste recycling behaviour and correlation analysis

The extended TPB is sufficient for explaining the behaviour of food waste recycling, in which 78% of the variance was elucidated by the independent LVs (Figure 2a). With the complexity of food waste recylcing behaviour, the model was considered to be of substantial strength (Quested et al., 2013). The most visible factor on employees' recycling intention was perceived behavioural control (0.351), followed by the incentives from logistics and management (0.149) and as well as economic benfits (0.129) when compared with the other three suggested LVs. It is probabley because the external factors, such as resource availability and past experiences, govern the beliefs or confidence of the Malaysian respondents in their ability to recycle. Such observation echoed with the literature that Europe's food waste sorting and recycling were mainly determined by perceived behavioural control (Visschers et al., 2016; Stancu et al., 2016) and it could drive behaviour through food-related routines (Stefan et al., 2013). Besides, incentives were significant towards recycling intention, such as the space and equipment for recycling as well as the associated costs and savings in procurement and operation. A similar observation was noted in Barcelona, demonstrating that the materialism values of individuals directly influenced the generation of food waste in families (Diaz-Ruiz et al., 2018).

However, there are considerable discrepancy between Malaysia and Hong Kong in regards to the primary determinant of recycling intention. Commercial industries in Hong Kong emphasised administrative incentives and corporate support as the most critical LV while

perceived behavioural control had a less critical impact (Mak et al., 2018). This result may due to the intensive labour and resources need to meet the competitive commercial environment in Hong Kong.

Similar to Hong Kong, negative impact on recycling intention was observed in subjective norms (-0.16) and administrative incentives & corporate support (-0.073), which indicated that subjective norms and administrative incentives & corporate support might lead to a decrease in recycling intention. Similarly, in the United Kingdom (Stefan et al., 2013; Graham-Rowe et al., 2015) and Denmark (Stancu et al., 2016), subjective norms were moderately associated with the intention to decrease the amount of food waste in household. The potential reason might be that invisible occurrence of food waste could be hardly judged over by others (Quested et al., 2013). The majority of the respondents from both Hong Kong and Malaysia did not experience any social pressure to recycle. It is believed that the recyclers tap their motivation from a source independent of the public expectation. The small influence of moral attitudes (0.077) on recycling intention suggested that even people's positive attitude towards food waste recycling cannot ensure the actual recycling behaviour. A moral component should be included in awareness-raising initiatives to enhance the chances of exercising recycling. For instance, a tailor-made recycling scheme that incorporates the concept of personal evaluation can be implemented (Strydom, 2018). Political strategies that provide sufficient opportunities and resources have been demonstrated significant in determining employee perceptions of recycling behaviour.

Indirect effects on food waste recycling behaviour have yet been discussed in the available literature. The indirect effects appear in the pathway from the exogenous variable to the outcome through the mediator (Chan, 2007), where recycling behaviour is the outcome, and recycling intention is the mediator in this study. The substantial indirect effect was identified

252 on perceived behaviour control (0.028), logistics & management incentives (0.012), and
253 economic incentives (0.01) towards positive recycling intention, which proposed an
254 intervening effect on recycling behaviour (Table 4). In contrast, an intermediate indirect impact
255 on recycling behaviour in Hong Kong was found only for administrative incentives & corporate
256 support (-0.012). Such observation reinforced our understanding of the indirect relationship of
257 perceived behavioural control in household recycling in the United Kingdom (Stefan et al.,
258 2013; Graham-Rowe et al., 2015). Both direct and indirect effects are recommeded to be taken
259 into account during designing food waste policies to induce positive behavioural changes in
260 the commercial sector.
261
262 Among all the relationships, moral attitudes (LV4) and administrative incentives & corporate
263 support (LV3) showed substantial positive correlations (0.622) (Table S2), which corroborates
264 the results in Hong Kong (Mak et al., 2018). This echoed with the previous reports that
265 institutional factor might promote the formation of positive attitudes and improve the behaviour
266 of food waste recycling (Refsgaard and Magnussen, 2009). The availability of resources in an
267 institution could affect individuals' social values, as demonstrated in a previous study
268 concluding amenity problem as a hurdle to managing commercial food waste in Malaysia
269 (Papargyropoulou et al., 2014). Therefore, administrative incentives and corporate support
270 should be well-considered in developing moral attitudes among the commercial sector.
271 Administrative incentives and corporate support were also positively correlated to logistics and
272 management incentives (0.608), whereas the latter might have a positive correlation with moral
273 views (0.622). These findings highlight that the determination of moral attitudes should not
274 only be influenced by perceived costs and benefits, as suggested in the original TPB framework.
275

276 3.3 Comparison of employees' varying perceptions of key LVs in Hong Kong and Malaysia
277 In the commercial sector, the three industries in Malaysia expressed similar considerations over
278 the priorities of recycling behaviour. Respondents from the hotel (3.99), food and beverage
279 (3.62), and property management (3.94) industries valued administrative incentives and
280 corporate support the most, all of which had the highest mean score among the six LVs (Figure
281 3). The above observation only considered the scoring of respondents from different sectors,
282 while the structural relationship that estimated the multiple and interrelated dependency
283 between these variables were discussed in Section 3.2. The responses of the Malaysian
284 commercial industry are in agreement with previou studies conducted by Papargyropoulou et
285 al. (2014) and Jereme et al. (2016). Corporates should implement incentive and supporting
286 schemes to actively raise the public awareness on the potential risks or benefits of food waste,
287 which is regarded as the primary driver to improve commercial and household food waste
288 management in Malaysia. Similar to Malaysia respondents, the administrative incentives and
289 corporate support in Hong Kong also obtained a relatively high score among the representatives
290 and experts in the industries of hotel (3.68) as well as food and beverages (3.67), respectively
291 (Mak et al., 2018). However, logistics & management incentives (3.70) was emphasised by the
292 property management industry in Hong Kong more than that in Malaysia. This result is
293 probably associated with the space constraints in Hong Kong residential buildings, which
294 hampers the effort by property management companies in providing sufficient area for food
295 waste collection, separation, temporary storage, and recycling equipment.
296
297 In Malaysia, the hotel industry showed the highest acceptance level (41.3%) in recycling cost
298 at RM90-120/tonne (US$21.7-29/tonne), compared to the food and beverage (49.3%) and
299 property management (36.8%) which tended to accept RM60- 90/tonne (US$14.5-21.7/tonne)
300 (Figure 4a). As compared with Hong Kong, the hotel (34.8%) as well as food and beverage

301 (49.1%) industries presented the largest ratio of the respondents who tended to accept a higher
302 cost for recycling food waste at HKD 350-500/tonne (US$44-63/tonne) (Mak et al., 2018),
303 suggesting the notable differences across the two regions. As indicated from the World Bank
304 Group (2018b), Malaysia is grouped as upper-middle-income economies (US$3,896-$12,055),
305 while Hong Kong is ranked as high-income economies (> US$12,056). For the former, the
306 solid waste management cost was estimated at US$24 billion, which is substantially lower than
307 that in a high-income economy (US$159 billion) (World Bank Group, 2012). Therefore,
308 corporates in Hong Kong generally found the recycling cost more affordable than those in
309 Malaysia did.
310
311 The hotel industry (44.4%) in Malaysia demonstrated a higher level of acceptance in arranging
312 extra human resources in food waste handling (3-4% of total manpower), compared to food
313 and beverage (42.7%) and property management (29.4%) industries who preferred 1-2% of
314 total manpower (Figure 4b). At the moment, Malaysia has yet to have the policy to regulate
315 commercial solid waste, not to mention a plan on the recycling of food waste. Corporates have
316 their right to outsource the waste collection and source separation schemes to any licensed
317 contractors or manage all the solid waste themselves. Property managers, therefore, are less
318 likely to perform recycling, unlike hoteliers or food and beverages sectors, who value the
319 corporate social responsibilities and environmental policies and are eager to build a 'green'
320 image for brand marketing and sales. This strategy is in line with the previous findings that
321 government policy should be given a high priority to motivate commercial food waste
322 management in Malaysia (Jereme et al., 2016).

323 Limitations on this kind of behavioural study include the issue of sample self-selection bias.
324 Since the pro-environmental individuals were more proactive to participate in the survey, an
325 over-representation of that party in the selected samples would exist (Hage et al., 2009).

Besides, self-reported behaviour of this study would lead to potential upward bias (Thøgersen, 1996) like an overestimation/overstatement according to a statistical measure (Econterms, 2019). The reliability and validity of the self-reported items might be compromised (Chan and Bishop, 2013). Having identified limitations associated with self-selection and self-reported behaviour, a more diverse and random sample should be acquired that would be more indicative of the commercial sector. Another limitation is that the TPB assumes that behaviour depends on a static decisive activity, which could not elucidate the change in behaviour over time (McEachan et al., 2011; Sutton, 1994). Changing conditions of different variables should be evaluated to study the dynamic interrelationships for projection. Lastly, other determinants such as religious culture and dietary differences could be considered in future studies.

4 Conclusions

This study elucidates and compares individuals' intentions within corporates about food waste recycling under different economies (i.e., Hong Kong and Malaysia) through the extension of the convention TPB model with the identified vital LVs in the commercial sector in the previous study conducted in Hong Kong. It further consummates the understanding and promotes the 6Rs principle within corporates. In particular, rethinking is of the utmost importance when it comes to waste management, and it should be well-considered before recycling. A survey-based SEM referred to the theories on environmental psychology and analysed the pratical situations of both Hong Kong and Malaysia as a cross-region case.

The results illustrated the major roles of perceived behavioural control, logistics & management incentives, and economic incentives on food waste recycling in Malyasia, which had substantial indirect effects on recycling behaviour. Significant differences were observed in Hong Kong, as the local commercial industries greatly emphasised the essential role of

administrative incentives and corporate support issues, while perceived behavioural control showed the most critical impact in Malaysia. In this work, the latent variable of administrative incentives & corporate support was found to present strong positive correlations with moral attitudes as well as with another variable of logistics & management incentives. In contrast, an intermediate indirect impact on recycling behaviour in Hong Kong was found only for administrative incentives & corporate support.

The invited representatives and professionals in this study from the industries of hotel, food and beverages as well as property management shared similar perceptions over administrative incentives and corporate support, demonstrating it as the most critical variable compared with other LVs. Over 40% of hotel representatives presented a higher acceptance level on the cost for recycling food waste in the range of RM90-120/tonne (US$21.7-29/tonne), and they preferred to designate 3-4% of total human resources for on-site handling of food waste. With known determinants and stakeholders' perceptions identified in this study, a region-specific tailor-made waste policy can encourage food waste recycling behaviour of the corporates, and also enhance the culture of rethink and refuse before consumption. This research provides in-depth analysis and scientific guidance to optimise policies and strategies on food waste recycling, which may help alleviate the food crisis during the undergoing pandemic situation.

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