



Urban Agriculture: The Feasibility of Rooftop Farming in Penang Island, Malaysia

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Abstract. By 2050, over 60 percent of the global population will live in cities, the majority in high-rise residential buildings. Thus, rooftop farming as part of urban agriculture will be highly important in building sustainable cities. It brings plenty of benefits and opportunities to the environment and society, as well as food supply to urban residents. Singapore, as a land-scarce state, has been very successful in implementing rooftop farming. Even though having a similar geographical condition as Singapore, rooftop farming has yet to be popularized in Penang Island. Rapid development and industrialization are deteriorating air quality and occupying arable land on the island, while the population is highly dependent on imported food. Rooftop farming may be a good option to reduce these problems, seeing there are so many high-rise residential buildings on the island. Therefore, this study aimed to investigate the likelihood of rooftop farming by island residents, and its determinants. Data collected from 323 Penangites that live in high-rise residential buildings revealed that 65 percent of respondents were likely to participate in rooftop farming. The ordered Probit model estimated that awareness of the potential benefits of rooftop farming, environmental knowledge and awareness, environmental consciousness and perception are important factors that determine the likelihood of participating in rooftop farming. The findings of this study may be important for Penang state policy makers, and may also be useful for similar economies globally, to promote, encourage and implement rooftop farming in urban areas, and achieve sustainable cities for future generations.

Keywords. Penang; Rooftop farming; Sustainable city; Urban agriculture.

Abstrak. Pada tahun 2050, lebih dari 60 persen populasi global akan tinggal di perkotaan, mayoritas di gedung tempat tinggal bertingkat tinggi. Dengan demikian, pertanian di atas atap sebagai bagian dari pertanian perkotaan akan menjadi sangat penting dalam membangun kota yang berkelanjutan. Hal ini membawa banyak manfaat dan peluang bagi lingkungan dan masyarakat, begitu juga untuk pasokan makanan bagi penduduk perkotaan. Singapura, sebagai negara dengan lahan yang terbatas, sangat sukses dalam menerapkan pertanian di atas atap. Meski memiliki kondisi geografis yang mirip dengan Singapura, pertanian di atas atap masih belum populer di Pulau Penang. Perkembangan pesat dan industrialisasi memperburuk kualitas udara dan menempati lahan subur di pulau itu, sementara penduduknya sangat bergantung pada makanan impor. Pertanian di atas atap mungkin bisa menjadi pilihan yang baik untuk mengurangi masalah ini, mengingat ada begitu banyak bangunan tempat tinggal bertingkat di pulau itu. Oleh karena itu, penelitian ini bertujuan untuk mengetahui kemungkinan dilakukannya pertanian di atas atap oleh penduduk pulau, dan determinannya. Data yang dikumpulkan dari 323 orang Penang yang tinggal di bangunan tempat tinggal bertingkat tinggi mengungkapkan bahwa 65 persen responden kemungkinan besar akan berpartisipasi dalam pertanian atap. Model ordered Probit memperkirakan bahwa kesadaran akan manfaat potensial dari pertanian atap,

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40 *pengetahuan dan kesadaran lingkungan, kesadaran dan persepsi lingkungan adalah faktor*
 41 *penting yang menentukan kemungkinan partisipasi dalam pertanian di atas atap. Temuan*
 42 *penelitian ini mungkin penting untuk pembuat kebijakan di negara bagian Penang, dan mungkin*
 43 *juga berguna untuk ekonomi serupa secara global, untuk mempromosikan, mendorong dan*
 44 *menerapkan pertanian di atas atap di daerah perkotaan, dan mencapai kota yang berkelanjutan*
 45 *untuk generasi mendatang.*

46 **Kata kunci.** *Penang; pertanian di atas atap; kota berkelanjutan; pertanian perkotaan.*

47 **Introduction**

48 “To make cities and human settlements inclusive, safe, resilient and sustainable” states
 49 Sustainable Development Goal (SDG) 11 of the United Nations (Goals, 2019). This is a challenge
 50 when urbanization is occurring rapidly. The United Nations (2018) estimates that about two-third
 51 of the population will be living in cities by 2050. Rapidly urbanized cities have fewer space for
 52 green infrastructure due to obstacles that constrain the amenity of vegetation, combined with a
 53 crowded and congested living ecosystem and resource competitiveness. Besides, a huge effort is
 54 required to provide sufficient food supply to more than six billion urban residents (Adnan, Nordin,
 55 & Ali, 2018). The issues of food and resource deficiency have become apparent during the
 56 lockdowns in many cities in the world due to Covid-19, including Malaysia (Pandiyan, 2020).

57 Moving towards a circular economy is required to achieve SDG11. The principles of the circular
 58 economy enable cities to maximize resource utilization and minimize their ecological footprint,
 59 consequently reducing heat and optimizing space usage. Urban agriculture has been recognized
 60 as an effective innovation to support the circular economy (Grard, Claire, Nastaran, 2018).
 61 Among the variety of urban agriculture initiatives, rooftop farming (RTF) is an efficient solution
 62 in view of the lack of space and the greenhouse problem in congested cities (Appolloni et al.,
 63 2021). Telosa, a built-from-scratch city in the United States is one of the first models of a
 64 sustainable city protected by urban farming as one of the core metrics.

65 RTF is the cultivation of fresh produce on top of a building (Fernandez-Cañero et al., 2013), also
 66 referred to as ‘crops in the cloud’. This pro-environmental activity has gained enormous
 67 popularity in Japan, Canada and Germany in recent years (Stadler, Baganz, Vermeulen, &
 68 Keesman, 2017). RTF mitigates heat, reduces air pollution, saves energy, and increases the food
 69 supply for urban residents (Akaeze & Nandwani, 2020; Bevilacqua, 2021; Karachaliou,
 70 Santamouris & Pangalou, 2016). Also, it may induce positive emotions, improve pro-environment
 71 behavior of residents, and the social connection and well-being of neighborhoods through
 72 collective greenery activities (Nelli, 2020).

73 Despite these benefits, RTF is limitedly applied in most urbanizing cities in Asia, where
 74 particularly rooftop spaces of residential buildings are largely unused. Urban expansion in Asia
 75 is concentrated in metropolitan areas; the rapid emergence of the high-rise residential building
 76 environment has contributed to increased carbon dioxide emissions, and has made residents aware
 77 that appropriate action must be taken to reduce the damage to the environment (Tong, 2018). It is
 78 necessary to revamp urban planning and policies to allow for RTF (Appolloni et al., 2021; Loo,
 79 2015).

80 The benefits of RTF for cities have been widely acknowledged, but the level of acceptance by the
 81 public and residents needs further investigation (Sanyé-Mengual et al., 2020). To implement RTF,
 82 understanding the likelihood of urban individuals participating in RTF is pivotal (Zhang, Fukuda
 83 & Liu, 2019). Behavioral concepts, such as perception and attitude, awareness and pro-

84 environment behavior play important roles in determining the likelihood of participating in RTF
85 (Everett & Lamond, 2019). According to Khan et al. (2020), there is an urgent need to examine
86 the role of awareness, knowledge and attitudes of consumers and motivational factors that affect
87 their willingness to improve pro-environment behavior.

88 This study investigated the likelihood and determinants of RTF by residents of high-rise buildings
89 in Penang Island (hereafter, 'Penangites' is used to refer to the residents of Penang Island),
90 Malaysia. Several studies have been conducted to examine the feasibility of RTF, mainly from an
91 engineering and technology point of view (Ledesma, Nicolich and Pons-Valladares, 2020) and in
92 developed countries, namely, the USA, Japan and Germany (Appolloni et al., 2021). Behavioral
93 studies on RTF at the societal group level need further attention (Sanyé-Mengual et al., 2020;
94 Stroka et al., 2021), especially from an Asian perspective. As such, this paper may provide an
95 insightful look at ways in which Asian cities move towards a circular economy system, especially
96 through RTF, which does not only emphasize environmental benefits but also offers plenty of
97 social and economic prospects (Akaeze & Nandwani, 2020). More importantly, successful RTF
98 could assist rapidly urbanized cities in achieving sustainable city status.

99 **Literature Review**

100 Behavior is defined here according to the theory of planned behavior (TPB) (Icek Ajzen, 1991).
101 This theory argues that intention is determined by perception and attitude/behavior control (Icek
102 Ajzen, 1991; Forward, 2009). The intentions of individuals are stimulated by the perceived ease
103 or difficulty of performing the behavior of interest or social pressure from people that are
104 important or influential in their lives, and not only based on their attitudes towards certain types
105 of behavior. Individual moral norms play an essential role in examining individual intention
106 towards certain behavior. When individual moral norms are enhanced, it can increase the
107 explanatory power of the TPB model (Beck & Ajzen, 1991).

108 The Extended TPB has been employed extensively in understanding the transition towards the
109 adoption of more sustainable and pro-environmental lifestyles (Yeh, Guan, Chiang, Ho and Huan,
110 2021). Specifically, the theory has been applied to examine the relationship between
111 environmental knowledge and awareness and environmental consciousness in the transition to
112 cleaner forms of pro-environmental behavior; the role of the individual environmental awareness
113 and knowledge towards finding solutions; the relationship between attitudes and pro-
114 environmental actions (Yadav & Pathak, 2017; Emekci, 2019; Liu, Liu & Mo, 2020; Liu, Ma, Qu
115 & Ryan, 2020; Xu, Wang & Yu, 2020; Fu, 2021). In Beijing, Zhang et al. (2019) found that
116 attitude, perceived behavioral control, and social norms significantly affected the
117 respondents' willingness to participate in a 'green roof' initiative. Liu et al. (2020) proposed to
118 add daily pro-environment behavior as a construct to the TPB model.

119 Pro-environment behavior, also called 'green behavior' is a set of planned activities that minimize
120 harm to the environment or fulfill social and individual needs arising from environmental
121 conservation (Khan et al., 2020; Steg & Vlek, 2009). Chan et al. (2014) suggest that the pro-
122 environment behavior of an individual can be developed under different environmental
123 inspirations, i.e., concern, awareness and knowledge.

124 Knowledge and awareness play a significant role in individual decision making towards
125 environmental and sustainability concerns (Kaplan, 1991; Zsóka et al., 2013). They can be applied
126 interchangeably. According to Xu et al. (2020), environmental awareness is highly correlated with
127 pro-environment behavior. The pro-environment behavior of consumers grows with their level of
128 environmental awareness (Tudor, Barr & Gilg, 2008; Zsóka et al., 2013). For instance, individuals

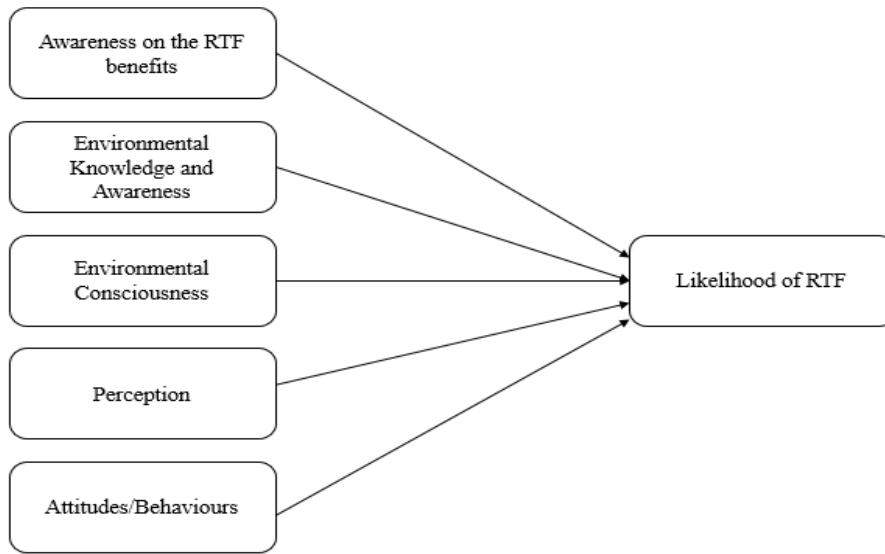
129 with higher environmental awareness tend to buy eco-labelled products and organic fruits, and
130 participate in pro-environment activities such as recycling (Xu et al., 2020). Thus, it could be
131 hypothesized that the higher the environmental knowledge and awareness of individuals, the
132 higher the likelihood of participating in RTF.

133 Environmental consciousness is an individual feeling towards environmental issues (GuoMin,
134 2019). The general public's consciousness of the impact of development on the environment has
135 increased due to the serious deterioration of the environment and ecology. Some individuals spend
136 efforts to correct harm to the environment by participating in sustainability-related activities and
137 fulfilling corporate social responsibility through companies they work with (Sabokro et al., 2021).
138 Thus, consumers' environmental consciousness is crucial in pro-environment behavior (Chuah et
139 al., 2020). Consumers with high environmental consciousness are highly likely to prefer green
140 products, for example, staying at green hotels (Verma & Kumar, 2018). Hence, the following
141 hypothesis was developed: environmental consciousness of individuals towards RTF increases
142 the likelihood of participating in RTF.

143 The insight into a product or service to a user is known as its perception. Product perception is
144 developed when a user analyzes, identifies, gathers, organizes and evaluates a product (Greibitus,
145 Printezis, & Printezis, 2017). Individual perceptions are necessary when evaluating the well-being
146 advantages provided by urban green spaces (Zambrano-Prado, 2021). Public perception refers to
147 the consciousness of stakeholders in an urban city. Generally, it is critical for further
148 implementation of the perception of innovative products and services (Specht & Sanyé-Mengual,
149 2017). Studies have revealed that consumers may perceive RTF as a productive activity or merely
150 a socially oriented activity (Kim et al., 2018; Specht & Sanyé-Mengual, 2017; Karachaliao et al.,
151 2016; Li et al., 2019). However, during the initial stages, the innovation of RTF relies heavily on
152 public perception and acceptance (Specht, Siebert, & Thomaier, 2016). Thus, the following
153 hypothesis was developed: a positive perception of RTF of individuals increases the likelihood of
154 participating in RTF.

155 TPB argues that the intention and attitudes towards a behavior drive the behavior (Ajzen, 2008).
156 Attitudes represent what an individual likes and dislikes (Verma, Chandra, & Kumar, 2019). The
157 relationship between the environmental attitudes of the public and their support for the
158 conservation of the environment has been proven. Liu et al. (2020) state that consumer intention
159 towards purchasing green products is influenced by their environmental point of view. In a
160 competitive atmosphere, a greater understanding of the public's attitude is useful in trying to
161 increase public awareness and sustainability behavior (Owens & Driffill, 2008). In particular,
162 urban stakeholders' attitudes are crucial for its successful implementation and represent one of
163 the key factors influencing urban development (Fiore, Specht & Zanasi, 2021). Thus, the
164 following hypothesis was developed: positive attitudes/behaviors of individuals towards RTF
165 increase the likelihood of participating in RTF.

166 Figure 1 illustrates the research framework of this study. The hypotheses are stated as the
167 likelihood of participating in RTF being influenced by the individual awareness of the benefits of
168 RTF, environmental knowledge and awareness, environmental consciousness, perception and
169 attitudes/behaviors.

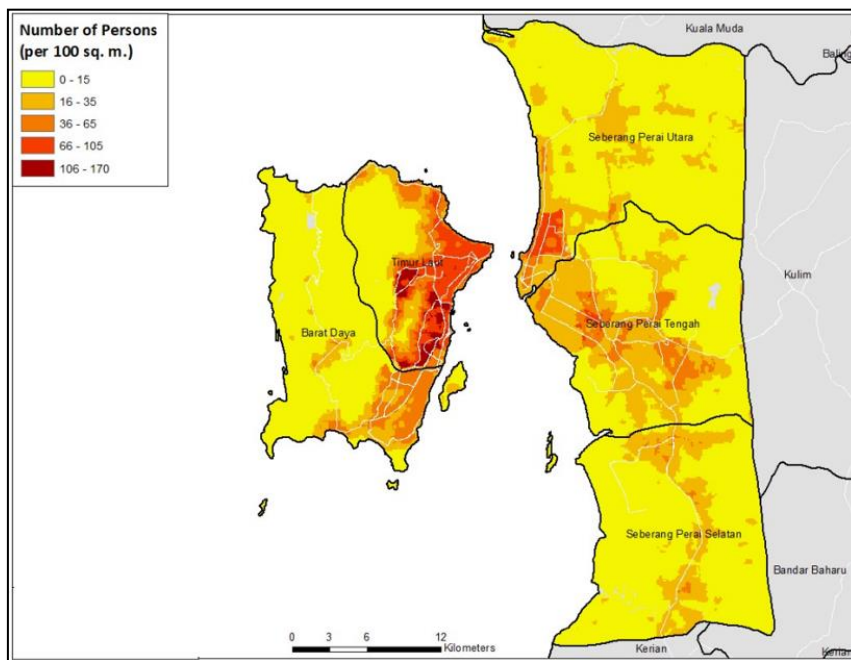


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Figure 1. Research Framework.

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Method and Data



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Figure 2. Population distribution, Penang Island. Source: World Bank, 2020

176 Penang Island is the constituent island of the second smallest state in Malaysia, with the
 177 population estimated at 794,292 people in 2020 (City Population, 2021). The island consists of
 178 two districts: Timur Laut (Northeast) district and Barat Daya (Southwest) district, with a
 179 population density of 4,677/km² and 1,374/km² respectively (City Population, 2021). There are

180 approximately 988 buildings on the island, mainly distributed along the east coast. Among those
181 buildings, about 87% are used for residential purposes (Emporis, 2022).

182 The unit of analysis of this study were Penangites who live in high-rise residential buildings,
183 namely, flats, apartments, and condominiums, ranging in age between 18 and 65 years old. Data
184 were collected from the densest cities located on the east side of Penang Island, namely,
185 Georgetown, Jelutong, Gelugor, Bayan Lepas, and Air Itam. These cities have high numbers of
186 residential buildings. To safeguard the sufficiency and statistical power of the sample size, Krejcie
187 and Morgan's calculator was employed to determine the sample size. As the population of Penang
188 Island is just under 800,000, the sample size needed was 323 respondents. The non-probability
189 sampling method was used to collect the data using a well-structured questionnaire.
190 Questionnaires were distributed among residents of high-rise residential buildings across Penang
191 Island. Prior to the survey, the questionnaire was pretested with six respondents, consisting of
192 residents and the management team of a high-rise residential building.

193 The independent variables of the study were: awareness of the benefits of RTF, environmental
194 knowledge and awareness, environmental consciousness, perception, and attitudes/behaviors. The
195 relationship between the likelihood of participating in RTF and its determinants was estimated
196 using an ordered Probit model. This is an analysis with a two-step approach. First, factor analysis
197 is conducted to obtain factor scores by using dimension reduction in SPSS; next, the ordered
198 Probit model is estimated using Stata. A description of the independent variables is shown in
199 Table 1.

200 **Table 1** Variable Abbreviations and Description

Abbreviation	Explanation	Type of Data
<i>RTFBenefit</i>	<i>RTFBenefit</i> measures if the respondent is aware of the benefits that may brought by RTF.	6 Likert scale
<i>EnvAware</i>	Environmental awareness indicates the knowledge and awareness of the respondent of environmental matters and solutions.	6 Likert scale
<i>EnvConscious</i>	Environmental consciousness measures the respondent's feeling towards environmental issues.	6 Likert scale
<i>Attitude</i>	<i>Attitude</i> measures what the respondent likes and dislikes and the respondent's decisions based on their environmental attitude.	6 Likert scale
<i>Perception</i>	<i>Perception</i> measures the consciousness of innovative products and services of stakeholders in an urban city.	6 Likert scale

201 In the ordered Probit model, it is implicitly assumed that ε follows a normal distribution. Suppose
202 the underlying relationship to be characterized is:

$$203 \quad y^* = X^T \beta + \varepsilon$$

204 where y^* is the exact but unobserved dependent variable (perhaps the likelihood of using click-
205 and-drive), X is the vector of independent variables, and β is the vector of regression coefficient
206 to be estimated. Further suppose that while y^* cannot be observed, instead the categories of
207 response can be observed as:

$$y = \begin{cases} 0 & \text{if } y^* < 0 \\ 1 & \text{if } 0 < y^* \leq u_1 \\ 2 & \text{if } u_1 < y^* \leq u_2 \\ \vdots & \\ \vdots & \\ N & \text{if } u_{N-1} < y^* \end{cases}$$

209 Then the ordered Probit technique will use the observations on y , which are a form of censored
210 data on y^* , to fit the parameter vector β .

211

212 **Results**

213 Table 2 presents the respondent profile of the study. Specifically, the sample consisted of 41
214 percent male and 59 percent female respondents. This is slightly below the statistics of males in
215 Penang, who account for half of the population (Department of Statistics Malaysia Official Portal,
216 2019). The median age of the participants was 27 years, with respondent age ranging from 15
217 years to 64 years. About 29 percent of respondents were married. Two-thirds of respondents were
218 employed while one-third were in the category of 'others'. Most respondents were private
219 employees (60 percent); five percent were public servants.

220

Table 2. Respondent Profile

Demographic variables		Frequency	Percentage (%)
Gender	Male	133	41
	Female	191	59
Age	15-64 years	320	99
	65 years and older	4	1
Marital status	Single	230	71
	Others	94	29
Occupation	Employed	212	65
	Self-employed and others	112	35
Income	B40	193	60
	M40	120	37
	T20	11	3
Employment	Private employee	196	60
	Public servant	16	5
	Self-employed	30	9
	Farmer	1	1
	Pensioner	5	2
RTF feasibility	Employed	53	16
	Housewife	17	5
	Unemployed	6	2
Likelihood of RTF	Yes	206	64
	No	118	36
Likelihood of RTF	Likely	210	65
	Unlikely	114	35

221 Self-employed accounted for 9 percent of respondents, while 2 percent were unemployed.
222 Farmers, pensioners, housewives and 'others' formed the remainder. The income segments of the
223 sample consisted for 60 percent of B40 (household income below US\$ 1170), 37 percent of M40
224 (US\$ 41170 to US\$ 2650), and 3 percent of T20 (above US\$ 2650).

225 Two-thirds of respondents expressed their interest to participate in RTF and thought that it is
 226 feasible in Penang Island. Females seemed to be more interested compared to males. Respondents
 227 without children had a higher likelihood of participating in RTF compared with respondents with
 228 children. Finally, the likelihood of participating in RTF among condominium residents was 7
 229 percent higher compared to residents living in an apartment, and 4 percent higher compared to
 230 residents living in a flat.

231 Table 3 presents the result from the ordered Probit model. The Chi-square statistics (Table 3) is
 232 significant, which implies that the model is statistically significant in terms of explaining the
 233 likelihood of participating in RTF. However, the relatively low pseudo R² (0.0883) suggests that
 234 a relatively large proportion of the variation in the likelihood of participating in RTF of the current
 235 sample was unexplained by the model. This may indicate (in common with many previous
 236 studies) that important potential explanatory variables were not included in the analysis.

237

Table 3. Ordered Probit Model Estimation Result

Variable	Coefficient	Robust Std. Err.
<i>RTFBenefit</i>	0.1773 ***	0.0569
<i>EnvAware</i>	0.1016 *	0.0598
<i>EnvConscious</i>	-0.1270 **	0.0558
<i>Attitude</i>	0.0970	0.0673
<i>Perception</i>	0.1051 **	0.0518
Number of observations		324
Wald chi ² (5)		93.34
Prob > chi ²		0.0000
Pseudo R ²		0.0883
Log pseudolikelihood		-481.16295

238

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

239 Among the five variables, *RTFBenefit*, *EnvAware*, *EnvConscious*, and *Perception* were
 240 significant, while *Attitude* was not significant. *RTFBenefit* was significant at 1 percent level,
 241 *EnvConscious* and *Perception* were significant at 5 percent level, while *EnvAware* was significant
 242 at 10 percent level.

243 Respondents that were aware of the benefits of RTF had a higher likelihood of participating in
 244 RTF. With a one-unit increase in *RTFBenefit* score, the likelihood of participating in RTF will
 245 increase by 0.18, when the other variables are held constant. With a one-unit increase in
 246 *EnvAware* score, the likelihood of participating in RTF will increase by 0.10, ceteris paribus.
 247 Further, with a one-unit increase in *EnvConscious* score, the likelihood of participating in RTF
 248 will decrease by 0.13, while the other variables are held constant. Moreover, with a one-unit
 249 increase in *Perception* score, the likelihood of participating in RTF will increase by 0.11, ceteris
 250 paribus.

251 The result revealed that *Attitude* plays no role in the likelihood of participating in RTF, which
 252 indicates that the likelihood of participating in RTF is not determined by individuals' attitude. In
 253 other words, the likelihood of participating in RTF is an interest that can be cultivated, since it is
 254 not based on the natural characteristics of individuals.

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Table 4. Multicollinearity Estimation Result

	<i>RTFBenefit</i>	<i>EnvAware</i>	<i>EnvConscious</i>	<i>Attitude</i>	<i>Perception</i>
<i>RTFBenefit</i>	1				
<i>EnvAware</i>	0.5314	1			
<i>EnvConscious</i>	0.4714	0.6221	1		
<i>Attitude</i>	0.6558	0.5366	0.4943	1	
<i>Perception</i>	0.7287	0.6017	0.5344	0.7520	1

258 Table 4 shows the multicollinearity among the variables. Except for *Perception* and *Attitude*
 259 (0.7520), correlations between most variables were modest (less than 0.7).

260 Discussion and Implications

261 The result from the ordered Probit model revealed that awareness of the benefits of rooftop
 262 farming, environmental knowledge and awareness, environmental consciousness and perception
 263 are important factors that determine the likelihood in participating in the RTF. Interestingly,
 264 although environmental consciousness is significant, it had an inverse relationship with RTF.
 265 Possibly, environmentally conscious individuals are less likely to be involved in RTF. This may
 266 due to a lack of information provided by the local government on the procedure and requirements
 267 in implementing RTF (Penang Green Council, 2020). Penangites may worry that RTF will
 268 damage the roof and cause water leaking or hygienic problems for the residents. This is in line
 269 with the result of the interview that was conducted between the investigator and building
 270 management officers. According to the building management officers, RTF will not be
 271 encouraged without proper technical and legal guidelines on the implementation.

272 Besides, the descriptive model analysis done with the data collected shows that females have a
 273 higher likelihood of participating in RTF compared to males. This is consistent with the Food and
 274 Agriculture Organization of the United Nations (2020), which states that women may be able to
 275 understand the fundamental knowledge of agriculture more efficiently than man, which leads
 276 them to be interested in this field, thus increasing productivity, reducing hunger, and improving
 277 children's nutrition and health. Also, respondents who are single are more likely to participate in
 278 RTF than those who are married or 'others'. Probably, the number of children and time limitations
 279 are associated with marital status. Single respondents would have more time, money and energy
 280 to spend on farming. Others may be committed more heavily to family matters than social and
 281 environmental benefits. Thus, campaigns or initial RTF plans may begin to target these groups
 282 and later extend the attention to their families and friends. The local authority may assist the
 283 female community group by providing knowledge, equipment, and advance the technology of
 284 RTF to those who like to grow vegetables in a rooftop garden.

285 Likewise, the likelihood of participating in RTF of residents from condominiums was higher than
 286 that of residents living in an apartment or flat. Compared to flats or apartments, those who live in
 287 condominiums may be more highly educated and have a higher income. These people may have
 288 deeper knowledge of the benefits of RTF, more concern about the environment and sustainable
 289 issues. Hence, the RTF initiative or campaign could start with condominium residents. Once there
 290 are successful cases, the RTF model could be applied in flats and apartment residentials,
 291 especially government quarters flats and apartments. The local authority should start considering
 292 producing RTF guidelines to assist Penangites in implementing RTF, since about two-thirds of
 293 Penangites are likely to participate.

294 **Conclusion**

295 This study identified important determinants of likelihood to participate in RTF, namely,
 296 awareness of the RTF benefits, environmental knowledge and awareness, and perception.
 297 Residents that possess environmental knowledge and awareness, and a positive perception
 298 towards the benefits of RTF are more likely to participate in RTF. The findings also showed that
 299 RTF is generally acceptable for residents in Penang. Hence, it should be promoted and widely
 300 implemented on the island. RTF will enhance fresh food output and utilization of empty spaces
 301 in Penang Island for greeneries. It may also benefit consumers towards self-sustainability in a
 302 long-term perspective.

303 This study found that environmental consciousness may hinder the interest in RTF. Hence, to
 304 further promote RTF, especially to the environmentally conscious group, an RTF implementation
 305 guideline is crucial at this moment. Such a guideline is important to ensure that RTF is legally
 306 and properly implemented without creating leakages and damages to rooftops. The local authority
 307 has an important role to play in putting forward policies to support RTF.

308 To obtain a more in-depth understanding of the potential and possibility of RTF in the community,
 309 future research on urban agriculture/RTF areas may utilize different research methods. Research
 310 may apply a qualitative method to gauge detailed information from building management, local
 311 authorities, and even from the commercial buildings. The experimental research method will also
 312 be useful as it could yield tangible results that are able to convince the participants to continue
 313 efforts of their own initiative.

314 **References**

- 315 Adnan, N., Nordin, S. M., and Ali, M. (2018). A Solution for the Sunset Industry: Adoption of
 316 Green Fertiliser Technology amongst Malaysian paddy farmers. *Land Use Policy* 79, 575–
 317 584. <https://doi.org/10.1016/j.landusepol.2018.08.033>
- 318 Ajzen, I. (2008). Consumer attitudes and behavior 20. *Handbook of Consumer Psychology*, (July),
 319 525–548.
- 320 Ajzen, Icek. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human*
 321 *Decision Processes* 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- 322 Akaeze, O, Nandwani, D. Urban agriculture in Asia to meet the food production
 323 challenges of urbanization: A review. *Urban Agriculture and Regional Food System* 5.
 324 <https://doi.org/10.1002/uar2.20002>
- 325 Appolloni, E., Orsini, F., Specht, K., Thomaier, S., Sanyé-Mengual, E., Pennisi, G., and
 326 Gianquinto, G.G. (2021). The Global Rise of Urban Rooftop Agriculture: A review of
 327 Worldwide Cases. *Journal of Cleaner Production*, 296.
 328 <https://doi.org/10.1016/j.jclepro.2021.126556>
- 329 Astee, L. Y., and Kishnani, N. T. (2010). Building Integrated Agriculture Utilising Rooftops for
 330 Sustainable Food Crop Cultivation in Singapore. *Journal of Green Building* 5(2), 105–113.
 331 <https://doi.org/10.3992/jgb.5.2.105>
- 332 Bansal, P., and Roth, K. (2000). Why Companies Go Green: A Model of Ecological
 333 Responsiveness. *Academy of Management Journal* 43(4), 717–736.
 334 <https://doi.org/10.2307/1556363>
- 335 Beck, L., and Ajzen, I. (1991). Predicting Dishonest Actions Using the Theory of planned
 336 behavior. *Journal of Research in Personality*, 25(3), 285–301. [https://doi.org/10.1016/0092-6566\(91\)90021-H](https://doi.org/10.1016/0092-6566(91)90021-H)
 337

- 338 Bevilacqua, P. (2021). The Effectiveness of Green Roofs in Reducing Building Energy
339 Consumptions Across Different Climates. A Summary of Literature Results. *Renewable and*
340 *Sustainable Energy Reviews*, 151, <https://doi.org/10.1016/j.rser.2021.111523>
- 341 Bruhn, C., Vossen, P., Chapman, E., and Vaupel, S. (1992). Consumer attitudes toward locally
342 grown produce. *California Agriculture* 46(4), 13–16.
- 343 Chan, E. S. W., Hon, A. H. Y., Chan, W., & Okumus, F. (2014). What drives employees’
344 intentions to implement green practices in hotels? The role of knowledge, awareness, concern
345 and ecological behaviour. *International Journal of Hospitality Management*, 40, 20–28.
- 346 Chandran, R. (2019). With few green spaces, Bangkok plants Asia’s biggest rooftop farm.
347 Retrieved April 12, 2020, from <https://news.trust.org/item/20191210054949-uczwr>
- 348 City Population. (2021) Pulau Pinang. Retrieved April 5, 2022, from
349 https://www.citypopulation.de/en/malaysia/admin/07__pulau_pinang/
- 350 Clinton, N., Stuhlmacher, M., Miles, A., Uludere Aragon, N., Wagner, M., Georgescu, M., and
351 Gong, P. (2018). A Global Geospatial Ecosystem Services Estimate of Urban Agriculture.
352 *Earth’s Future* 6(1), 40–60. <https://doi.org/10.1002/2017EF000536>
- 353 Chuah, S. H-W., El-Manstrly, D., Tseng, M-L., and Ramayah, T. (2020). Sustaining customer
354 engagement behavior through corporate social responsibility: the roles of environmental
355 concern and green trust. *Journal of Cleaner Production*, 262,
356 <https://doi.org/10.1016/j.jclepro.2020.121348>
- 357 Department of Statistics Malaysia Official Portal. (2019). Department of Statistics Malaysia
358 Official Portal. Retrieved April 19, 2020, from
359 [https://www.dosm.gov.my/v1/index.php?r=column/cthemByCat&cat=430&bul_id=UDc0e](https://www.dosm.gov.my/v1/index.php?r=column/cthemByCat&cat=430&bul_id=UDc0eVJ4WEJiYmw0Rmt5cjYvWHFkdz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUT09)
360 [VJ4WEJiYmw0Rmt5cjYvWHFkdz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhU](https://www.dosm.gov.my/v1/index.php?r=column/cthemByCat&cat=430&bul_id=UDc0eVJ4WEJiYmw0Rmt5cjYvWHFkdz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUT09)
361 [UT09](https://www.dosm.gov.my/v1/index.php?r=column/cthemByCat&cat=430&bul_id=UDc0eVJ4WEJiYmw0Rmt5cjYvWHFkdz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUT09)
- 362 Emekci, S. (2019), “Green consumption behaviours of consumers within the scope of
363 TPB”, *Journal of Consumer Marketing* 36(3), pp. 410-
364 417. <https://doi.org/10.1108/JCM-05-2018-2694>
- 365 Emporis. (2022). Penang Island | EMPORIS. Retrieved April 5, 2022, from
366 <https://www.emporis.com/city/101334/penang-island-malaysia/status/all-buildings>
- 367 Everett, G. and Lamond, J. (2019), “Green roof perceptions: Newcastle, UK CBD
368 owners/occupiers”, *Journal of Corporate Real Estate* 21(2), pp. 130-
369 147. <https://doi.org/10.1108/JCRE-11-2017-0044>
- 370 Fernandez-Cañero, R., Emilsson, T., Fernandez-Barba, C., and Herrera Machuca, M. Á. (2013).
371 Green roof systems: A study of public attitudes and preferences in southern Spain. *Journal of*
372 *Environmental Management*. <https://doi.org/10.1016/j.jenvman.2013.04.052>
- 373 Food and Agriculture Organization of the United Nations. (2020). The female face of farming |
374 Gender | Food and Agriculture Organization of the United Nations. Retrieved May 7, 2020,
375 from <http://www.fao.org/gender/resources/infographics/the-female-face-of-farming/en/>
- 376 Food Tank. (2015). Food Tank in Japan Agriculture. Retrieved October 30, 2019, from Food Tank
377 website: [https://foodtank.com/news/2015/02/tokyos-ten-most-notable-urban-agriculture-](https://foodtank.com/news/2015/02/tokyos-ten-most-notable-urban-agriculture-projects/)
378 [projects/](https://foodtank.com/news/2015/02/tokyos-ten-most-notable-urban-agriculture-projects/)
- 379 Forward, S. E. (2009). The Theory of Planned Behaviour: The role of Descriptive Norms and Past
380 Behaviour in the Prediction of drivers’ intentions to violate. *Transportation Research Part F:*
381 *Traffic Psychology and Behaviour* 12(3), 198–207. <https://doi.org/10.1016/j.trf.2008.12.002>
- 382 Fu, X. (2021). A Novel Perspective to Enhance the role of TPB in Predicting Green Travel: The
383 moderation of affective-cognitive congruence of attitudes. *Transportation* 48, 3013–3035
384 (2021). <https://doi.org/10.1007/s11116-020-10153-5>
- 385 Gatersleben, B., Steg, L., and Vlek, C. (2002). Measurement and Determinants of
386 environmentally significant consumer behavior. *Environment and Behavior* 34(3), 335–362.

- 387 Gianluca Di Fiore, Kathrin Specht and Cesare Zanasi (2021) Assessing motivations and
 388 perceptions of stakeholders in urban agriculture: a review and analytical
 389 framework. *International Journal of Urban Sustainable Development*, 13(2), 351-
 390 367. [10.1080/19463138.2021.1904247](https://doi.org/10.1080/19463138.2021.1904247)
- 391 Goals, S. D. (2019). Goal 11 :: Sustainable Development Knowledge Platform. Retrieved
 392 December 5, 2019, from <https://sustainabledevelopment.un.org/sdg11>
- 393 Google. (n.d.). Urban Farm in Malaysia - Google Maps. Retrieved November 8, 2019, from
 394 <https://www.google.com/maps/search/urban+farm+malaysia/@5.2607213,98.2550908,7z/data=!3m1!4b1>
- 396 Graeub, B. E. (2016). The State of Family Farms in the World. *World Development*.
 397 <https://doi.org/10.1016/j.worlddev.2015.05.012>
- 398 Grard, Claire, and Nastaran, S. (2018). Rooftop Farming on Urban Waste Provides Many
 399 Ecosystem services. *Agronomy for Sustainable Development* 38(1).
 400 <https://doi.org/10.1007/s13593-017-0474-2>
- 401 Grebitus, C., Printezis, I., and Printezis, A. (2017). Relationship between Consumer Behavior and
 402 Success of Urban Agriculture. *Ecological Economic* 136, 189–200.
 403 <https://doi.org/10.1016/j.ecolecon.2017.02.010>
- 404 GuoMin, L. (2019). Influence of Environmental Concern and Knowledge on Households'
 405 Willingness to Purchase Energy-Efficient Appliances: A Case Study in Shanxi, China.
 406 *Sustainability* 11(4), 1073.
- 407 Halid, A. S. Z. and S. (2018). Sanusi Junid, a man with unique ideas | New Straits Times.
 408 Retrieved November 14, 2019, from
 409 <https://www.nst.com.my/news/nation/2018/03/343377/sanusi-junid-man-unique-ideas>
- 410 He, J., Yi, H., and Liu, J. (2016). Urban Green Space Recreational Service Assessment and
 411 Management: A Conceptual Model Based on the Service Generation Process. *Ecological*
 412 *Economics* 124, 59–68. <https://doi.org/10.1016/j.ecolecon.2016.01.023>
- 413 Ismail, W. Z. W., Abdullah, M. N., Hashim, H., and Rani, W. S. W. (2018). An Overview of
 414 Green Roof Development in Malaysia and a way forward. *AIP Conference Proceedings*,
 415 2016(September). <https://doi.org/10.1063/1.5055460>
- 416 Jawahir, I. S., and Bradley, R. (2016). Technological Elements of Circular Economy and the
 417 Principles of 6R-Based Closed-loop Material Flow in Sustainable Manufacturing. *Procedia*
 418 *CIRP* 40, 103–108. <https://doi.org/10.1016/j.procir.2016.01.067>
- 419 Jim, C. Y., and Shan, X. (2013). Socioeconomic effect on perception of urban green spaces in
 420 Guangzhou, China. *Cities* 31, 123–131. <https://doi.org/10.1016/j.cities.2012.06.017>
- 421 Jones, R. E., Davis, K. L., and Bradford, J. (2013). The Value of Trees. *Environment and Behavior*
 422 45(5), 650–676. <https://doi.org/10.1177/0013916512439409>
- 423 Kaplan, S. (1991). Beyond Rationality: Clarity-Based Decision Making. *Environment, Cognition,*
 424 *and Action: An Integrative Multidisciplinary Approach*, 171–190.
- 425 Karachaliou, P., Santamouris, M., and Pangalou, H. (2016). Experimental and Numerical
 426 Analysis of the Energy Performance of a Large Scale Intensive Green Roof System Installed
 427 on an office Building in Athens. *Energy and Buildings*, 114.
 428 <https://doi.org/10.1016/j.enbuild.2015.04.055>
- 429 Khan, M. S., Saengon, P., Alganad, A. M. N., Chongcharoen, D., and Farrukh, M.
 430 (2020). Consumer green behaviour: An approach towards environmental sustainability.
 431 *Sustainable Development* 28(5), 1168–1180. doi:10.1002/sd.2066
- 432 Kim, E., Jung, J., Hapsari, G., Kang, S., Kim, K., Yoon, S., and Choe, J. K. (2018). Economic
 433 and environmental sustainability and public perceptions of rooftop farm versus extensive
 434 garden. *Building and Environment* 146, 206–215.
 435 <https://doi.org/10.1016/j.buildenv.2018.09.046>

- 436 Ledesma, G., Nikolic, J., and Pons-Valladares, O. (2020). Bottom-up model for the sustainability
437 Assessment of Rooftop-Farming Technologies Potential in Schools in Quito, Ecuador. *Journal*
438 *of Cleaner Production*, 274. <https://doi.org/10.1016/j.jclepro.2020.122993>
- 439 Leiserowitz, A. A., Kates, R. W., and Parris, T. M. (2006). Sustainability Values, Attitudes, and
440 Behaviors: A Review of Multinational and Global Trends. *Annual Review of Environment and*
441 *Resources* 31(1), 413–444. <https://doi.org/10.1146/annurev.energy.31.102505.133552>
- 442 Li, H. C. (2011). Environmental consciousness and intellectual capital management: Evidence
443 from Taiwan’s manufacturing industry. *Management Decision* 49(9), 1405–1425.
444 <https://doi.org/10.1108/00251741111173916>
- 445 Liu, M.T., Liu, Y. and Mo, Z. (2020), “Moral Norm is the Key: An Extension of the Theory of
446 Planned Behaviour (TPB) on Chinese Consumers’ Green Purchase Intention”, *Asia Pacific*
447 *Journal of Marketing and Logistics* 32(8), 1823-1841. [https://doi.org/10.1108/APJML-05-](https://doi.org/10.1108/APJML-05-2019-0285)
448 2019-0285
- 449 Liu, T., Yang, M., Han, Z., and Ow, D. W. (2016). Rooftop Production of Leafy Vegetables can
450 be Profitable and Less Contaminated than Farm-Grown Vegetables. *Agronomy for Sustainable*
451 *Development*. <https://doi.org/10.1007/s13593-016-0378-6>
- 452 Liu, A., Ma, E., Qu, H., and Ryan, B. (2020). Daily Green Behavior as an Antecedent and a
453 Moderator for Visitors’ Pro-Environmental Behaviors. *Journal of Sustainable Tourism*
454 28(9), 1390-1408, DOI: 10.1080/09669582.2020.1741598
- 455 Loo. (2015). Tackling land scarcity issues in KL | The Star Online. Retrieved November 8, 2019,
456 from [https://www.thestar.com.my/metro/community/2015/11/21/tackling-land-scarcity-](https://www.thestar.com.my/metro/community/2015/11/21/tackling-land-scarcity-issues-in-kl-seminar-highlights-challenges-and-solutions-to-property-develop)
457 [issues-in-kl-seminar-highlights-challenges-and-solutions-to-property-develop](https://www.thestar.com.my/metro/community/2015/11/21/tackling-land-scarcity-issues-in-kl-seminar-highlights-challenges-and-solutions-to-property-develop)
- 458 Mail, M. (2018). Sanusi Junid: A leader who thought outside the box | Malaysia | Malay Mail.
459 Retrieved November 14, 2019, from
460 [https://www.malaymail.com/news/malaysia/2018/03/09/sanusi-junid-a-leader-who-thought-](https://www.malaymail.com/news/malaysia/2018/03/09/sanusi-junid-a-leader-who-thought-outside-the-box/1594713)
461 [outside-the-box/1594713](https://www.malaymail.com/news/malaysia/2018/03/09/sanusi-junid-a-leader-who-thought-outside-the-box/1594713)
- 462 Ministry of Health Malaysia. (2013). *Malaysian Dietary Guidelines for Children and Adolescents*
463 *National Coordinating Committee on Food and Nutrition Ministry of Health Malaysia 2013*
464 *Malaysian Dietary Guidelines For Children and AdolescentS Second printing 2014.*
- 465 Mostafa, M. M. (2009). Shades of green: A Psychographic Segmentation of the green consumer
466 in Kuwait using self-organizing maps. *Expert Systems with Applications*, 36(8), 11030–11038.
467 <https://doi.org/10.1016/j.eswa.2009.02.088>
- 468 Nefej, Ruaf, F., and Un, H. (2014). *Policy For Roof Top Gardening In Kathmandu Metropolitan*
469 *City*. 14.
- 470 Owens, S., and Driffill, L. (2008). How To Change Attitudes and behaviours in the context of
471 energy. *Energy Policy* 36(12), 4412–4418. <https://doi.org/10.1016/j.enpol.2008.09.031>
- 472 Pandiyan, V. (2020). We need a Food Security Body | The Star Online. Retrieved April 27, 2020,
473 from [https://www.thestar.com.my/opinion/columnists/along-the-watchtower/2020/04/15/we-](https://www.thestar.com.my/opinion/columnists/along-the-watchtower/2020/04/15/we-need-a-food-security-body)
474 [need-a-food-security-body](https://www.thestar.com.my/opinion/columnists/along-the-watchtower/2020/04/15/we-need-a-food-security-body)
- 475 Penang Building Emporis. (2019). Penang Island | Buildings | EMPORIS. Retrieved November
476 8, 2019, from <https://www.emporis.com/city/101334/penang-island-malaysia>
- 477 Penang Emporis. (2019). Penang Island | EMPORIS. Retrieved November 8, 2019, from
478 <https://www.emporis.com/city/101334/penang-island-malaysia/type/high-rise-buildings>
- 479 Penang Green Council. (2020). Penang Green Council. Retrieved May 10, 2020, from
480 <https://www.pgc.com.my/>
- 481 Sabokro, M., Masud, M.M., and Kayedian, A. (2021). The Effect of Green Human Resources
482 Management on Corporate Social Responsibility, Green Psychological Climate and
483 Employees’ Green Behavior. *Journal of Cleaner Production* 313,
484 <https://doi.org/10.1016/j.jclepro.2021.127963>

- 485 Safari, A., Salehzadeh, R., Panahi, R., and Abolghasemian, S. (2018). Multiple Pathways Linking
 486 Environmental Knowledge and Awareness to Employees' Green Behavior. *Corporate*
 487 *Governance (Bingley)* 18(1), 81–103. <https://doi.org/10.1108/CG-08-2016-0168>
- 488 Sanyé-Mengual, E., Specht, K., Vávra, J., Artmann, M., Orsini, F. and Gianquinto, G. (2020).
 489 “Ecosystem Services of Urban Agriculture: Perceptions of Project Leaders, Stakeholders and
 490 the General Public” *Sustainability* 12(24), 10446. <https://doi.org/10.3390/su122410446>
- 491 Specht, K., and Sanyé-Mengual, E. (2017). Risks in Urban Rooftop Agriculture: Assessing
 492 Stakeholders' Perceptions to Ensure Efficient Policymaking. *Environmental Science and*
 493 *Policy* 69, 13–21. <https://doi.org/10.1016/j.envsci.2016.12.001>
- 494 Specht, K., Siebert, R., and Thomaier, S. (2016). Perception and Acceptance of Agricultural
 495 Production in and on Urban Buildings (ZFarming): a Qualitative Study from Berlin, Germany.
 496 *Agriculture and Human Values* 33(4), 753–769. <https://doi.org/10.1007/s10460-015-9658-z>
- 497 Stadler, M. M., Baganz, D., Vermeulen, T., and Keesman, K. J. (2017). Circular Economy and
 498 Economic Viability of Aquaponic Systems: Comparing Urban, Rural and peri-Urban
 499 Scenarios Under Dutch Conditions. *Acta Horticulturae* 1176, 101–114.
 500 <https://doi.org/10.17660/ActaHortic.2017.1176.14>
- 501 Steg, L., and Vlek, C. (2009). Encouraging pro-environmental behaviour. *Journal of*
 502 *Environmental Psychology* 29, 309–317. <https://doi.org/10.1016/j.jenvp.2008.10.004>
- 503 Sroka, W., Bojarszczuk, J., Satola, Ł., Szczepańska, B., Sulewski, P., Lisek, S., Luty, L. and
 504 Ziolo, M. (2021). Understanding residents' acceptance of professional urban and Peri-Urban
 505 Farming: A Socio-Economic Study in Polish metropolitan areas. *Land Use Policy* 109,
 506 <https://doi.org/10.1016/j.landusepol.2021.105599>
- 507 Swanwick, C. (2009). Society's Attitudes to and Preferences for Land and Landscape. *Land Use*
 508 *Policy*, 26(SUPPL. 1). <https://doi.org/10.1016/j.landusepol.2009.08.025>
- 509 Teng, Y.-M., Wu, K.-S., and Liu, H.-H. (2015). Integrating Altruism and the Theory of Planned
 510 Behavior to Predict Patronage Intention of a Green Hotel. *Journal of Hospitality & Tourism*
 511 *Research* 39(3), 299–315. <https://doi.org/10.1177/1096348012471383>
- 512 Tong. (2018). Scarcity of Land for Affordable Housing? | The Star Online. Retrieved November
 513 8, 2019, from [https://www.thestar.com.my/business/business-news/2018/09/08/scarcity-of-](https://www.thestar.com.my/business/business-news/2018/09/08/scarcity-of-land-for-affordable-housing)
 514 [land-for-affordable-housing](https://www.thestar.com.my/business/business-news/2018/09/08/scarcity-of-land-for-affordable-housing)
- 515 Tudor, T. L., Barr, S. W., and Gilg, A. W. (2008). A Novel Conceptual Framework for Examining
 516 Environmental Behavior in Large Organizations: A Case Study of the Cornwall National
 517 Health Service (NHS) in the United Kingdom. *Environment and Behavior* 40(3), 426–450.
- 518 United Nations. (2018). 2018 Revision of World Urbanization Prospects | Multimedia Library -
 519 United Nations Department of Economic and Social Affairs. Retrieved May 16, 2020, from
 520 [https://www.un.org/development/desa/publications/2018-revision-of-world-urbanization-](https://www.un.org/development/desa/publications/2018-revision-of-world-urbanization-prospects.html)
 521 [prospects.html](https://www.un.org/development/desa/publications/2018-revision-of-world-urbanization-prospects.html)
- 522 Verma, V. K., Chandra, B., and Kumar, S. (2019). Values and ascribed responsibility to predict
 523 consumers' attitude and concern towards green hotel visit intention. *Journal of Business*
 524 *Research*, 96(November 2018), 206–216. <https://doi.org/10.1016/j.jbusres.2018.11.021>
- 525 Verma, V. K., and Chandra, B. (2018). An application of theory of planned behavior to predict
 526 young Indian consumers' green hotel visit intention. *Journal of Cleaner Production*, 172.
 527 <https://doi.org/10.1016/j.jclepro.2017.10.047>
- 528 World Bank. (2020). City Scan, Penang, Malaysia- City Resilience Program. Washington,
 529 D.C. : World Bank Group.
- 530 Xu, X., Wang, S., and Yu, Y. (2020). Consumer's Intention to Purchase Green Furniture: Do
 531 health consciousness and environmental awareness matter? *Science of the Total Environment*,
 532 704. <https://doi.org/10.1016/j.scitotenv.2019.135275>

- 533 Yadav, R., and Pathak, G.S. (2017). Determinants of Consumers' Green Purchase Behavior in a
534 Developing Nation: Applying and Extending the Theory of Planned Behavior. *Ecological*
535 *Economics* 134. <https://doi.org/10.1016/j.ecolecon.2016.12.019>
- 536 Yeh, S-S., Guan, X., Chiang, T-Y., Ho, J-L., and Huan, T-C. (2021). Reinterpreting the Theory
537 of Planned Behavior and Its Application to Green Hotel Consumption Intention, *International*
538 *Journal of Hospitality Management* 94, <https://doi.org/10.1016/j.ijhm.2020.102827>
- 539 Zambrano-Prado, P., Pons-Gumí, D., Toboso-Chavero, S., Parada, F., Josa, A., Gabarrell, X., and
540 Rieradevall, J. (2021). Perceptions on barriers and opportunities for integrating urban agri-
541 green roofs: A European Mediterranean compact city case. *Cities*, 114,
542 <https://doi.org/10.1016/j.cities.2021.103196>
- 543 Zhang, L., Fukuda, H., and Liu, Z. (2019). Households' Willingness to pay for Green Roof for
544 Mitigating Heat Island Effects in Beijing (China). *Building and Environment* 150.
545 <https://doi.org/10.1016/j.buildenv.2018.12.048>
- 546 Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to Environmental
547 Education? Environmental Knowledge, Attitudes, Consumer Behavior and Everyday Pro-
548 Environmental Activities of Hungarian High School and University Students. *Journal of*
549 *Cleaner Production* 48, 126–138.