RELATIONSHIP MODEL BETWEEN PSYCHOLOGICAL FACTORS AND ECOLOGICAL FOOTPRINT OF RESEARCH UNIVERSITY STUDENTS TOWARDS SUSTAINABLE CAMPUS IN MALAYSIA

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RELATIONSHIP MODEL BETWEEN PSYCHOLOGICAL FACTORS AND ECOLOGICAL FOOTPRINT OF RESEARCH UNIVERSITY STUDENTS TOWARDS SUSTAINABLE CAMPUS IN MALAYSIA

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A thesis submitted in fulfilment of the
requirements for the award of the degree of
Doctor of Philosophy (Real Estate)

Faculty of Built Enviroment and Surveying
Universiti Teknologi Malaysia

JANUARY 2022

DEDICATION

To my dearest family members and friends, thank you for all the support and encouragement given

ACKNOWLEDGEMENT

I would like to take this opportunity to thank those that have directly and indirectly given generous contribution towards the completion of this thesis.

First and foremost, I would like to express the deepest appreciation to my supervisor, Assoc. Prof. Sr. Dr. Choong Weng Wai. Without his guidance and persistent help, this thesis would not have been successfully completed. Special thanks to the panels of viva.

Last but not least, I would like to thank my family members and friends for their support during the preparation of this thesis.

ABSTRACT

Malaysian research universities aspire to become sustainable campuses but face challenges in managing and reducing environmental impact. While technology and policy reforms contribute to this effort, few studies have been conducted on how the psychological factors influence university students in practising pro-environmental behaviour that impacts their ecological footprint and achievement of a sustainable campus. This study aimed to investigate the link between the psychological aspect of university students and the level of the ecological footprint for the university campus. The first objective of this study was to identify psychological factors that influence the ecological footprint of research university students in Malaysia. The second objective was to determine the level of the ecological footprint of research university students in Malaysia. The third objective was to investigate the relationship between the identified psychological factors and the ecological footprint of research university students in Malaysia. A questionnaire survey that involved 2,000 students from five research universities in Malaysia has been conducted. Data obtained were analysed using ecological footprint online calculator, frequency analysis, descriptive analysis, normality test, independent samples t-test, one-way analysis of variance and partial least squares structural equation modeling. The ecological footprint results revealed that research university students have a lower ecological footprint level than Malaysians. Universiti Teknologi Malaysia recorded the highest ecological footprint, followed by Universiti Malaya, Universiti Kebangsaan Malaysia, Universiti Putra Malaysia and Universiti Sains Malaysia. This study also investigated the relationship between the psychological factors and level of ecological footprint for research university students in Malaysia through a validated structural equation model. The findings suggested that seven psychological factors including altruistic values, biospheric values, egoistic values, the new ecological paradigm scale, awareness of consequences, ascription of responsibility and personal norms have significant effects on ecological footprint. The findings of this study can be used to assist the university management team in developing strategic action plans to foster better environmental practices to reduce environmental impacts among students.

ABSTRAK

Universiti penyelidikan di Malaysia beraspirasi untuk menjadi kampus lestari tetapi menghadapi cabaran dalam pengurusan dan pengurangan impak alam sekitar. Walaupun pembaharuan teknologi and polisi menyumbang kepada usaha ini, beberapa kajian telah dijalankan tentang bagaimana faktor psikologi mempengaruhi pelajar universiti dalam pengamalan tingkah laku mesra alam sekitar yang akan memberi impak kepada jejak ekologi mereka dan pelaksanaan kampus lestari. Kajian ini bertujuan untuk mengkaji hubungan antara aspek psikologi pelajar dan tahap jejak ekologi untuk kampus universiti. Objektif pertama dalam kajian ini adalah untuk mengenal pasti faktor psikologi yang mempengaruhi jejak ekologi pelajar universiti penyelidikan di Malaysia. Objektif kedua adalah untuk menentukan tahap jejak ekologi pelajar universiti penyelidikan di Malaysia. Objektif ketiga adalah untuk mengkaji hubungan antara faktor psikologi yang dikenal pasti dengan jejak ekologi pelajar universiti penyelidikan di Malaysia. Tinjauan soal selidik yang melibatkan 2,000 pelajar dari lima universiti penyelidikan di Malaysia telah dijalankan. Data yang diperoleh dianalisis dengan kalkulator jejak ekologi atas talian, analisis frekuensi, analisis deskriptif, ujian normaliti, ujian t sampel tidak bersandar, analisis varians sehala dan pemodelan persamaan struktur penganggaran kuasa dua terkecil separa. Hasil kajian jejak ekologi menunjukkan bahawa pelajar universiti penyelidikan mempunyai tahap jejak ekologi yang lebih rendah berbanding dengan rakyat Malaysia. Universiti Teknologi Malaysia mencatatkan jejak ekologi yang tertinggi, diikuti oleh Universiti Malaya, Universiti Kebangsaan Malaysia, Universiti Putra Malaysia dan Universiti Sains Malaysia. Kajian ini juga mengkaji hubungan antara faktor psikologi dan tahap jejak ekologi untuk pelajar universiti penyelidikan di Malaysia melalui model persamaan struktur yang telah disahkan. Hasil kajian mencadangkan bahawa tujuh faktor psikologi termasuk nilai altruistik, nilai biosperik, nilai egoistik, skala paradigma ekologi baru, kesedaran tentang akibat, rasa bertanggungjawab dan norma peribadi mempunyai kesan yang signifikan terhadap jejak ekologi. Penemuan kajian ini boleh digunakan untuk membantu pihak pengurusan universiti dalam membangunkan pelan tindakan strategik untuk memupuk amalan alam sekitar yang lebih baik untuk mengurangkan impak alam sekitar dalam kalangan pelajar.

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LIST OF ABBREVIATIONS

AC	-	Awareness of Consequences
ALT	-	Altruistic
ANOVA	-	One-Way Analysis of Variance
APEX	-	Accelerated Programme for Excellence
AR	-	Ascription of Responsibility
ASEAN	-	Association of Southeast Asian Nations
ASEP	-	Asian Students Environmental Platform
AVE	-	Average Variance Extracted
BC	-	Bias Corrected
BFF	-	Best Foot Forward
BIO	-	Biospheric
CB-SEM	-	Covariance-Based Structural Equation Modeling
CGSS	-	Centre for Global Sustainability Studies
COE	-	Centre of Excellence
CR	-	Composite Reliability
df	-	Degrees of Freedom
EDN	-	Earth Day Network
EF	-	Ecological Footprint
EGO	-	Egoistic
EPRD	-	Educational Planning and Research Division
GFN	-	Global Footprint Network
HEMA	-	Office of Student Affairs and Alumni
HESI	-	Higher Education Sustainability Initiative
HTMT	-	Heterotrait-Monotrait Ratio of Correlations
IPA	-	Importance-Performance Analysis
IPMA	-	Importance-Performance Matrix Analysis
LESTARI	-	Institute for Environment and Development
LL	-	Lower Level
LPI	-	Living Planet Index
LPR	-	Living Planet Report

M	-	Mean
ML	-	Maximum Likelihood
MOE	-	Ministry of Education Malaysia
MOHE	-	Ministry of Higher Education
MS	-	Mean Square
NAM	-	Norm Activation Model
NAT	-	Norm Activation Theory
NEP	-	New Ecological Paradigm
NFA	-	National Footprint and Biocapacity Accounts
NGO	-	Non-Governmental Organisation
OLS	-	Ordinary Least Squares
PBC	-	Perceived Behavioural Control
PEB	-	Pro-Environmental Behaviour
PHB	-	Office of Asset and Development
PLS-SEM	-	Partial Least Squares Structural Equation Modeling
PN	-	Personal Norms
RP	-	Redefining Progress
SAES	-	Self-Assessed Environmental Sustainability
SD	-	Standard Deviation
SDG	-	Sustainable Development Goal
SEM	-	Structural Equation Modeling
SID	-	Sustainability and Institutional Development
SPSS	-	Statistical Package for the Social Sciences
SS	-	Sum of Squares
STARS	-	Sustainability Tracking, Assessment and Rating System
SVI	-	Schwartz's Value Inventory
THE	-	Times Higher Education
TPB	-	Theory of Planned Behaviour
TRA	-	Theory of Reasoned Action
UAE	-	United Arab Emirates
UI	-	Universitas Indonesia
UK	-	United Kingdom
UKM	-	Universiti Kebangsaan Malaysia

UL	-	Upper Level
UM	-	Universiti Malaya
UMCares	-	Universiti Malaya Community and Sustainability Centre
UMECB	-	Universiti Malaya Eco Campus Blueprint
UMP	-	Universiti Malaysia Perlis
UMS	-	Universiti Malaysia Sabah
UMSLLS	-	Universiti Malaya Sustainability and Living Labs Secretariat
UN	-	United Nations
UNCED	-	United Nations Conference on Environment and Development
UNCSD		United Nations Conference on Sustainable Development
UNEP	-	United Nations Environmental Programme
UPM	-	Universiti Putra Malaysia
UPSI	-	Universiti Pendidikan Sultan Idris
USA	-	United States of America
USM	-	Universiti Sains Malaysia
UTAR	-	Universiti Tunku Abdul Rahman
UTHM	-	Universiti Tun Hussein Onn Malaysia
UTM	-	Universiti Teknologi Malaysia
UiTM	-	Universiti Teknologi Mara
UTMCS	-	UTM Campus Sustainability
UUM	-	Universiti Utara Malaysia
VBN	-	Value Belief Norm Theory
VIF	-	Variance Inflator Factor
WAZAN	-	Centre for Management of Waqf, Zakat and Endowment
WCED	-	World Commission on Environment and Development
WHO-EPI	-	World Health Organisation-Environmental Performance Index
WWF	-	World Wide Fund for Nature

LIST OF SYMBOLS

f^2	-	Effect Size
ha	-	Hectare
ga	-	Global Acre
gha	-	Global Hectare
Q^2	-	Predictive Relevance
q^2	-	Effect Size
R^2	-	Coefficient of Determination
β	-	Path Coefficient

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background of Study

It is inevitable for humanity to exert its influence on the Earth whether it is on the level of individual, city or country (Wackernagel et al., 1999; Wackernagel & Rees, 1996). The rationale behind this is that although the global economy and population continue to grow, the Earth remains the same size. The consumption rate of humans has outpaced the regeneration rate of the Earth and the situation would persist until corrective actions are taken (Galli et al., 2012). Due to this situation, the Sustainable Development Goals (SDGs) were introduced by the United Nations with 17 sustainable development goals and 169 targets in 2015. It is an action plan over 15 years that target people, planet and prosperity to promote sustainable development globally (Assembly, 2015).

If we cannot measure, we cannot manage (Wackernagel, Monfreda, & Deumling, 2002). Thus, there is a need to determine where we are and how far we are from sustainability. According to Taylor (2013) and Kimmet (2008), sustainability revolves around three main elements which are environment, economy and social. It can also be represented by 3Ps which are planet, profit and people (Taylor, 2013). In terms of real estate especially investment, sustainability is seen as a way to add value to the property. This is demonstrated when sustainable real estate produces benefits such as reduced operating cost, improved occupant productivity, overall improvement in quality of life, comfort and health, improved air and water quality and even conservation of natural resources (Taylor, 2013). While stakeholders can easily understand the financial aspect of sustainable real estate, the environmental and social aspects are less visible to them. It is noted that the interaction between humans and the space which is provided by real estate is a crucial component in pursuing sustainable real estate. Ultimately, the most valuable

aspect of real estate is the ability to offer the most desirable human outcomes into the future (Kimmet, 2008).

It was proposed that systematic measurement and reporting of sustainability can aid in the understanding of the benefits of sustainability (Kimmet, 2008). Furthermore, sustainability in real estate has started using the triple bottom line practice which focuses on the aspects of people, planet and profit in the evaluation of real estate performance. Profit can be evaluated based on the financial returns of the property (Boyd & Kimmet, 2005). For planet or environment aspect, the evaluations can be based on resource consumption, design and use, and governance. For people or social aspect, the evaluations can be based on various criteria such as accessibility, community engagement, cultural issues, health and safety, local impacts, productivity, satisfaction and stakeholder relations. Triple bottom line is an integrated performance evaluation which suggested that the three aspects have at least equal importance (Kimmet, 2008). Thus, the social and environment outcomes are as important as the financial outcome in a real estate performance evaluation and this warrants further investigations into the social and environment aspects in sustainable real estate. This has encouraged a number of sustainability indicators to arise, among them including ecological footprint (Wackernagel & Rees, 1996).

In the early 1990s, William Rees and Mathis Wackernagel proposed an indicator to measure human impact on the environment called ecological footprint (EF) (Wackernagel & Rees, 1996). EF is a quantitative tool for assessing the sustainability and impact of human activities (Nunes, Catarino, Ribau Teixeira, & Cuesta, 2013). It is based on two fundamental concepts; footprint and carrying capacity. According to Wackernagel and Rees (1996), EF measures the amount of land and water area that are required to support human consumption, production and waste assimilation at current or projected levels. EF is often referred to as eco-footprint or environmental footprint (Eaton, Hammond, & Laurie, 2007). EF is regarded as an indicator, method or tool which functions to measure and evaluate the environmental impact of goods and services consumption. Besides, EF can be considered as an indicator as it offers a simplified description of the significant environmental impacts based on the different types of consumption. Furthermore, EF

can be utilized as a tool in different contexts and for various purposes to understand environmental impacts on the Earth.

1.2 Problem Statement

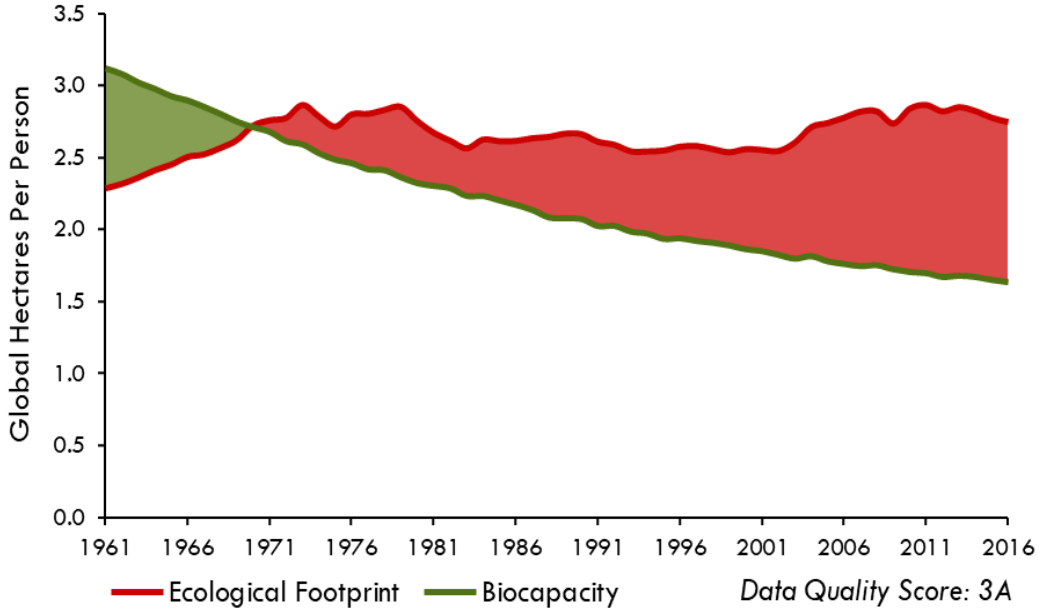

Figure 1.1 World ecological footprint and biocapacity (1961-2016) (Global Footprint Network, 2019)

In order to sustain human society, EF must not exceed the biocapacity of the Earth. Figure 1.1 shows the world EF and biocapacity from 1961 to 2016. Both EF and biocapacity are measured in global hectare (gha) per capita. The lower right corner of Figure 1.1 shows the data quality score comprising of two elements which are time series score (1-3) and latest year score (A-D). Data quality 3A means no component of EF or biocapacity is unreliable or unlikely for any year. According to the Figure 1.1, humanity only used about two-thirds of Earth available resources in 1961. As global demand and population have been increasing since the early 1970s, the resources that the planet can renewably generate began to be outpaced by the human demand for resources. In 2016, global EF has reached 2.7 gha per capita but what is available on the Earth is only 1.6 gha per capita (Global Footprint Network, 2019). It has been reported that the human demand for resources has exceeded 50%

more than the current resources that the Earth can provide and it would take 1.5 years for the Earth to regenerate the resources that are consumed by humanity in a year (Grooten, Almond, & McLellan, 2012; Pollard et al., 2010). It is expected by 2030, two planets would not be enough to support the demand for resources.

Each country has its own EF profile. As EF differs across the world, the countries can be categorized into ecological creditors or reserves (biocapacity greater than EF) or debtors (EF greater than biocapacity) as presented in Figure 1.2. However, the majority of them are ecological debtors and running ecological deficit, including the United States of America (USA) and the United Kingdom (UK). This is because the resources are consumed faster than they are regenerated (Grooten et al., 2012; Pollard et al., 2010). However, there are still opportunities for improvement. Ecological debtors can obtain benefits from reducing their resource dependence while ecological creditors are motived economically, politically and strategically to preserve their ecological capital. Developed nation such as Canada has a large EF but it is considered as ecological creditor because it has a larger biocapacity than its EF.

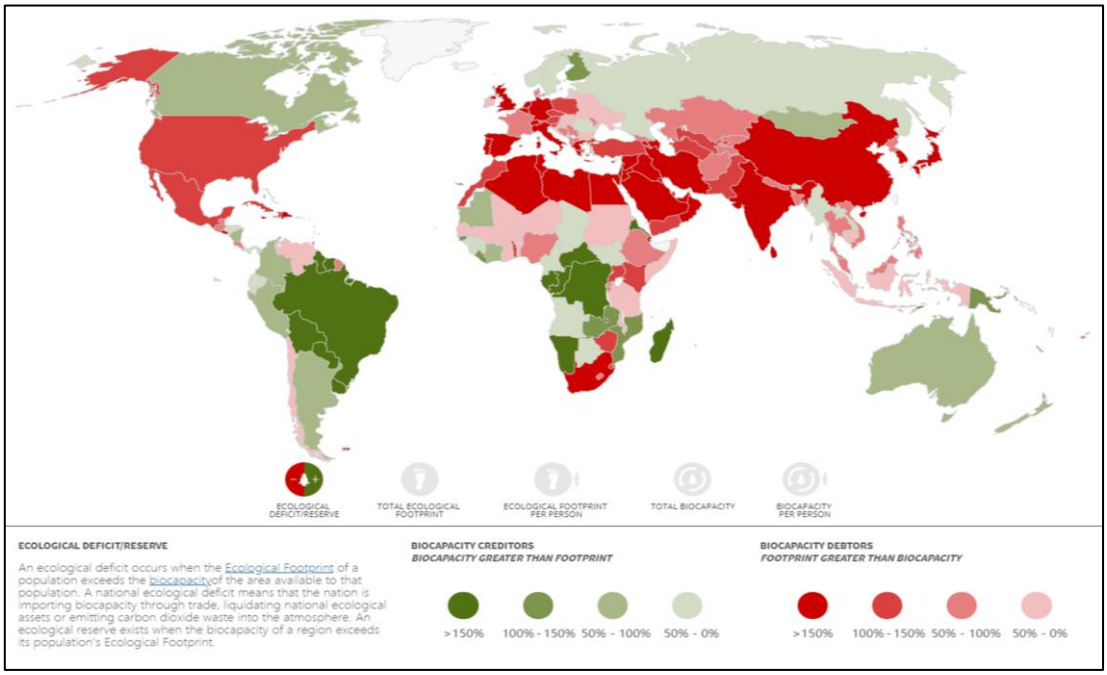

Figure 1.2 Ecological creditors and debtors (Global Footprint Network, 2019)

Malaysia EF calculation is provided by Living Planet Report (LPR) and National Footprint and Biocapacity Accounts (NFA). LPR is published every two

years by the World Wide Fund for Nature (WWF) in partnership with the United Nations Environmental Programme (UNEP) and Global Footprint Network (GFN) since 1998. It is based on the Living Planet Index (LPI) and EF calculation. The LPR is the global leader for science-based studies on the health of the Earth and the impact of human activities. The newest issue of LPR was released in 2020. Another significant report, the NFA is released by GFN annually. The report provides comprehensive data on human demand for resources to support their activities. They track how this demand compares across several over 200 countries, territories and regions and examine the relationship between the demand and the biocapacity of the planet. NFA 2021 edition is the most current published edition at the moment. This edition provides EF and biocapacity data from 1961 to 2017.

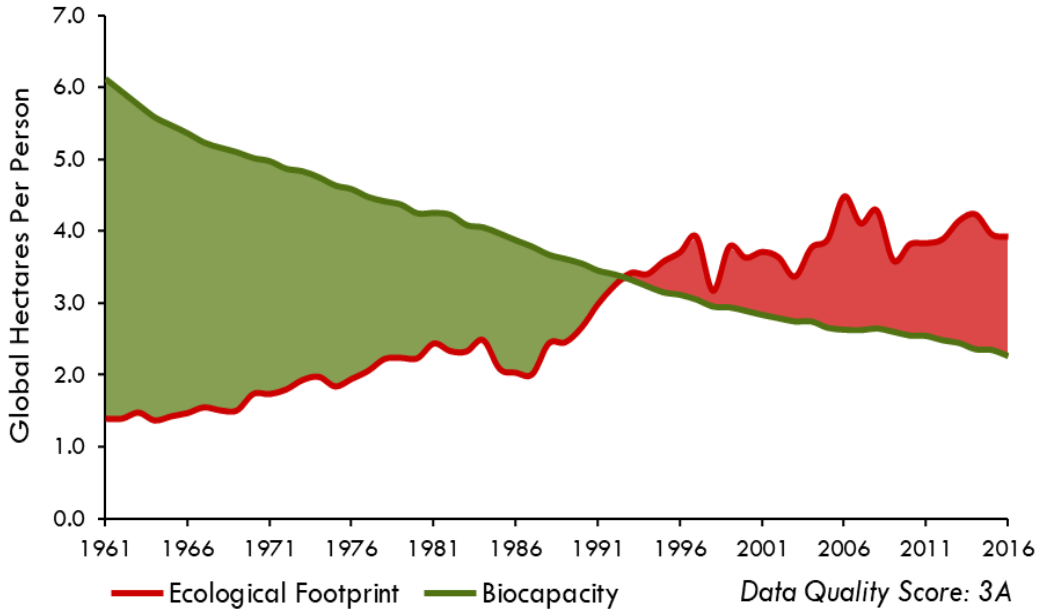

Figure 1.3 Malaysia ecological footprint and biocapacity (1961-2016) (Global Footprint Network, 2019)

Figure 1.3 shows EF and biocapacity in Malaysia from 1961 to 2016. The lower right corner of Figure 1.3 shows the data quality score comprising of two elements which are time series score (1-3) and latest year score (A-D). Data quality 3A means no component of EF or biocapacity is unreliable or unlikely for any year. According to Figure 1.3, Malaysia EF has exceeded its biocapacity around 1992. In 2016, Malaysia EF recorded at 4.0 gha per capita and biocapacity at 2.3 gha per

capita (Global Footprint Network, 2019). In other words, a Malaysian would require about four hectares of land to sustain their current living standards. Malaysia has ecological deficit of about 1.7 gha per capita in 2016. Up to now, Malaysia EF has exceeded the global average of 2.7 gha per capita.

According to Table 1.1, Malaysia has a smaller EF compared to the developed countries such as Canada, the United States of America (USA) and the United Kingdom (UK) because these countries contain market economies that consume more natural resources. However, Malaysia has larger EF compared to other Association of Southeast Asian Nations (ASEAN) countries such as Indonesia, Thailand and Philippines.

Table 1.1 Ecological footprint and biocapacity of certain countries in 2016 (Global Footprint Network, 2019)

Country	**Ecological Footprint**	**Biocapacity**	**Ecological Deficit**	**Ecological Reserve**	**Earth**
	Global hectares (gha) per capita				
World	2.7	1.6	1.1	-	1.7
Malaysia	4.0	2.3	1.7	-	2.4
The United States of America	8.1	3.6	4.5	-	5.0
Canada	7.7	15.1	-	7.4	4.7
The United Kingdom	4.4	1.1	3.3	-	2.7
Singapore	5.9	0.1	5.8	-	3.6
Thailand	2.5	1.2	1.3	-	1.5
Indonesia	1.7	1.3	0.4	-	1.0
Philippines	1.3	0.5	0.8	-	0.8

EF study is mainly applied at global, nation or sub-nation level. Researches of EF have been developed further from nation (Monfreda, Wackernagel, & Deumling, 2004; Wackernagel et al., 2002) to city and region level (Hopton & White,

2012; Wackernagel, Kitzes, Moran, Goldfinger, & Thomas, 2006). Other EF studies included industry or product level such as wines (Niccolucci et al., 2008), ethanol (Marcelo, Vaughan, & Rykiel, 2005), mobile phones (Frey, Harrison, & Billett, 2006), tourism (Peeters & Schouten, 2006), international trade (H. Li, Pei Dong, Chunyu, & Wang, 2007), university campus (Conway, Dalton, Loo, & Benakoun, 2008; Dawe, Vetter, & Martin, 2004; Flint, 2001; G. J. Li et al., 2008; Venetoulis, 2001) and others. Besides, EF is utilized as a communication and management tool by various types of organisations such as businesses, educational institutions, governments and non-governmental organisations (NGOs). EF also can be used to compare the impacts of different lifestyles (Flint, 2001). It is only able to calculate specific components of a lifestyle (Holland, 2003; Hunter & Shaw, 2007) and it cannot account for all lifestyle components and products yet (Purvis, 2008). In addition, it makes self-sufficiency, equity and behavioural change towards sustainable future (Guo, Vale, & Vale, 2011).

In terms of built environment, EF can be applied to buildings (Bastianoni et al., 2006). Houses, buildings, roads and infrastructure require a large amount of resources (Bastianoni et al., 2006; Sol ś-Guzm án, Marrero, & Ram írez-de-Arellano, 2013). However, buildings are more difficult to be evaluated in comparison to others due to the unique character of each building. Buildings are the locus of consumption as there would be disposal of computers, paper, equipment, furniture, energy and so on. Everything that the buildings consume has a footprint that can be expressed in terms of land area. Buildings represent the possible opportunity for reducing EF and generating energy savings.

Universities are comprised of various types of building such as assembly hall, health care, laboratory, lecture hall, office and residential buildings. They are complex institutions made up of many buildings that serve multiple purposes (Klein-Banai & Theis, 2013). Besides, universities are comparable to other types of complex building such as hospital and hotel in terms of electricity, transportation, water, waste and others (Mat et al., 2009). Large universities are very similar to small cities (Alshuwaikhat & Abubakar, 2008; Klein-Banai & Theis, 2011; Zhu, Zhu, & Dewancker, 2020) with a significant environmental impact at local level. They have

large land area, growing populations, increasing number of traffics and engage educational and research activities which would have direct and indirect impacts to the environment and sustainability. Direct impacts are caused by the usage of resources such as paper, energy, water and waste (Bennett, Hopkinson, & James, 2006). Universities are the largest resource consumers in a location as they use a huge amount of paper, energy and water. Indirect impacts include the possible shifts in environmental behaviour through education and research (Chang, 2007).

Universities help to shape society and promote sustainable development through education (Leal Filho et al., 2019). Education is considered to be highly related to the SDGs as it was found to be linked to 16 out of 17 sustainable development goals (Vladimirova & Le Blanc, 2016). In order to achieve sustainable development, universities strive to transition into sustainable universities for the past 30 years (Suwartha & Sari, 2013). A sustainable university is a higher education institution that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, social and health effects generated in the use of its resources in order to fulfil its functions of teaching, research, outreach and partnership to help society make the transition to sustainable lifestyles (Velazquez, Munguia, Platt, & Taddei, 2006). Universities around the world are increasingly focused on promoting sustainable development research and campus sustainability. However, there are exceptions where research and education activities do not contribute to the effort of becoming a sustainable university (Lukman, Krajnc, & Glavič, 2010). In a previous research, Baboulet and Lenzen (2010) argued that research-intensive universities have a higher level of resource consumption when compared to conventional universities.

In order to achieve sustainable university in Malaysia, a sustainable committee or unit is usually established to plan, coordinate and monitor the sustainable efforts in a university (Najad, Ahmad, & Zen, 2018). In terms of operation, the maintenance department integrates sustainable development or cooperates with the sustainable unit in the university to include sustainable initiatives into their planning and management of the university (Alsharif, Peters, & Dixon, 2020). The sustainable efforts in university can be in terms of waste management,

energy management, water management, transportation, education and others (Alsharif et al., 2020; Alshuwaikhat, Adenle, & Saghir, 2016). The sustainable unit needs to be closely associated with the maintenance department of the university to implement these sustainable efforts. This is because the maintenance department carries out the operation and maintenance such as waste disposal, energy management, water management and others of the university while the sustainable unit is the policy planner and coordinator for anything related to sustainable development (Alsharif et al., 2020).

Various approaches such as frameworks and guidelines development, awareness programs, education, research, sustainable assessments and reports were used to achieve sustainable university (Mazon, Pereira Ribeiro, Montenegro de Lima, Castro, & Guerra, 2020). One of the common approaches from the built environment perspective is to focus on energy efficiency and carbon footprint through building design and construction (Alsharif et al., 2020). However, the implementation of sustainable initiatives into the facility and project management departments can also be hindered by individual behaviours and interests (Alsharif et al., 2020). According to Seyler and Mutl (2019), building user behaviour can have a bigger effect in minimizing environmental impact as compared to technological efficiency measures. Furthermore, it was also suggested that there exists a need to understand the behaviours of the users to encourage environmental real estate user behaviours such as reduction in water and energy consumption (Seyler & Mutl, 2019). There are also other studies such as Fernández, Cebrián, Regadera, and Fernández (2020) and Chuvieco, Burgui-Burgui, Da Silva, Hussein, and Alkaabi (2018) that advocated for campus community behaviour to be emphasized as well in the study of EF. Furthermore, identifying and trying to instil pro-environmental behaviour is considered low hanging fruit because it mainly requires raising awareness, minimal change in habit and obvious impact on the conservation of resources (Rashid et al., 2018). According to Duke (2010), environmental degradation is common but preventable if the right choices are made. This proves that the environment is affected by the actions and choices that humans make daily. Human behaviour contributes to the major threats to the environment. It is crucial to have a deeper understanding of how people treat the environment as they do. Thus, this establishes

the need to understand the psychological aspect of the users in order to achieve sustainable development.

The goal to improve university sustainability is to decrease the EF of campus (Jauch, Ogden, Betzen, Stumpff, & Bigley, 2009). The application of EF to university is not new. EF calculations have been undertaken in some campuses at overseas such as University of Redlands (1998), University of Newcastle (1999), University of Toronto at Mississauga (2006), University of Otago (2007) and Macquarie University (2011). EF is a quantified index to show the environmental degree of a campus and it is important to understand the impact of the campus on the natural resources of the country for making better decisions for the future. In other words, it means that EF is a quantitatively estimated footprint index that is used as a scale to measure the campus environmental impact (Choi, 2007). There are multiple advantages in using EF as an indicator to measure campus sustainability. Firstly, EF is capable of highlighting the current level and the desired level for campus operations to achieve ecological sustainability. Secondly, EF presents a direct comparison for the impacts of different components on a single arrogated scale (Bekmann, Rickards, & Noller, 2013). Calculating the EF can be the first step towards becoming a more sustainable campus. Thus, knowing the footprint of campus can help in planning for a sustainable future (Thattai, 2007).

There is an apparent research gap for studies that relate the psychological aspect of the campus community with the EF of Malaysian universities. Studies of EF in Malaysia are limited notably at the national, state and city levels (Begum, Pereira, Jaafar, & Al-Amin, 2009). There are only a few published articles and theses studying EF in Malaysia such as effects of globalization on EF in Malaysia (Ahmed, Wang, Mahmood, Hafeez, & Ali, 2019; Suki, Sharif, Afshan, & Suki, 2020); urban metabolism and EF of Shah Alam, Selangor (Yami, Ahmad, Yatim, & Shafie, 2021) and observation of land changes using EF and remote sensing in Borneo (Yan et al., 2020). This is partly caused by the data limitation required to calculate the EF (Begum & Pereira, 2012). There are some overseas studies such as Lin (2016) which investigated the role of behavioural theory with carbon footprint management in a high school at Kaohsiung, Taiwan while Fernández et al. (2020) studied the

relationship of connection to nature and pro-environmental attitude between EF of Spanish university students. In another study of EF for overseas universities, the awareness, attitude and behaviour of Libyan university students' on EF were investigated (Gündüz & Alsagher, 2018). While there are previous overseas studies that relate behaviour and EF of university students, there seems to be a lack of studies that focused on the psychological aspect of the campus community in EF especially in the context of Malaysian university. The only published evidence of institutional EF found in Malaysia is in the Universiti Pendidikan Sultan Idris (2009). However, the study only focused on the aspect of sustainability measurement of campus. According to Lambrechts, Mulà, Ceulemans, Molderez, and Gaeremynck (2013), Gündüz and Alsagher (2018) and Fernández et al. (2020), there is a need to look into the development of the psychological aspect such as values, skills and attitudes of university students in promoting university sustainable development. Thus, this shows that there is a research gap for a study to investigate the relationship between psychological factors and EF of Malaysian universities.

EF is an innovative way to measure environmental impact of human activities which can be difficult on a global scale. Thus, impact studies that focused on a smaller scale such as individual, household, local and regional needed to be simplified. The calculation of EF tool uses pro-environmental behaviour as its main focus. It helps in promoting pro-environmental behaviour in individuals while collecting quantifiable data and measuring behavioural change at the same time (Cordero, Todd, & Abellerra, 2008; Ryu & Brody, 2006). EF can be utilized to indirectly measure the impact of different behaviours (Conway et al., 2008). For example, Ryu and Brody (2006) used EF as a pre and post-test method to study pro-environmental behaviour.

Anthropogenic activities are the main causes of resources depreciation as humans consume the Earth's resources at increasingly unsustainable rates. If a person uses more than his or her share of the resources on the Earth, those resources would be lesser for someone else. However, there are also signs of changes as humanity began to realise the consequences of damaging the biosphere. They are transitioning to stewarding nature as a resource. This can be seen through the

application of technology, renewable energy and other sustainable efforts. The technology advancement plays a crucial part in saving the environmental but it is still limited and requires human behaviours to implement (Duke, 2010). Therefore, human behaviour plays an important role in keeping the environment sustainable.

As Malaysian universities are promoting sustainable campus, the application of EF can contribute and in parallel with the effort. There is a need to measure how much is consumed by campus community in Malaysian universities. As the campus community behavioural can have an impact on the overall campus sustainability, this warrants an investigation into how the psychological aspect of the campus community can affect the campus environmental impact in Malaysian universities. The campus environmental impact can be identified through the measurement of EF. Therefore, this research is conducted to compute EF and investigate psychological factors that influence EF of research university students in Malaysia as students formed the majority of the community on a campus. By understanding the psychological factors among campus community and how the psychological factors relate to EF, it can prompt sustainable campus management to strategize the efforts to reduce EF through fostering pro-environmental behaviour among the campus community.

1.3 Research Questions

This research attempts to answer the following questions:-

(a) What are the psychological factors that influence ecological footprint of research university students in Malaysia?

(b) What is the ecological footprint of research university students in Malaysia?

(c) What is the relationship between psychological factors and ecological footprint of research university students in Malaysia?

1.4 Research Objectives

The objectives of this research are as below:-

(a) To identify psychological factors that influence ecological footprint of research university students in Malaysia.

This objective is to identify psychological factors that influence EF of research university students. These factors play a role in affecting pro-environmental behaviour and thus, it is important to understand what are the factors interacting with EF of research university students.

(b) To determine the level of ecological footprint of research university students in Malaysia.

Objective two is to calculate the EF of research university students. The environmental impact of research university students can be measured by calculating their EF. It is important to identify the elements that are needed to compute EF of research university students before the calculation is conducted.

(c) To investigate the relationship between the identified psychological factors and ecological footprint of research university students in Malaysia.

After identifying psychological factors that influence EF and calculating EF of research university students in objectives one and two, a structural model is developed to understand how these factors influence EF of research university students. Lastly, model validation is conducted on the relationship model between psychological factors and EF of research university students.

1.5 Scope of Study

This study focuses on identifying psychological factors, computing EF and developing a structural model for research university students in Malaysia. Universiti Malaya (UM), Universiti Sains Malaysia (USM), Universiti Kebangsaan Malaysia (UKM), Universiti Putra Malaysia (UPM) and Universiti Teknologi Malaysia (UTM) are selected as the case studies. The five selected public research universities are among the oldest, popular and leading research universities of Malaysia. These research universities have substantial achievement in sustainable rankings compared to other universities in Malaysia. The sustainable rankings are Universitas Indonesia (UI) GreenMetric World University Ranking and Times Higher Education (THE) Impact Rankings as shown in sub-section 2.3.3. Besides, each of them has a sustainable unit in their campus namely Eco Campus @ Universiti Malaya Community and Sustainability Centre (UMCares), Centre for Global Sustainability Studies (CGSS), Institute for Environment and Development (LESTARI), SDG and Green Campus Unit and UTM Campus Sustainability (UTMCS).

1.6 Significance of Study

In order to achieve sustainable development in Malaysian universities, a good way to measure the current level of sustainability and the gap to close in is important. EF is useful in its assessment of sustainability for current human activities, reduction of energy use, promotion of public awareness and assistance in decision-making. Thus, a practical method is needed to measure the consumption rates of individuals, products and services at variety of scales (Bekmann et al., 2013). This study offers insights regarding the current EF level of research university students in Malaysia and which psychological aspects to focus on to reduce the EF of research universities. The results can act as a basis to guide Malaysian universities in measuring EF and formulating sustainable strategies to achieve sustainability. The sustainable unit and maintenance department can plan, justify or suggest sustainable solutions that have considered the psychological perspective of the campus community. This is because

behavioural changes especially in pro-environmental behaviour can produce an impact on the campus sustainability efforts.

There are EF studies in Malaysia such as Ahmed et al. (2019); Suki et al. (2020); Yan et al. (2020) and Yami et al. (2021), but most of them focused on the effect of globalization or urbanization on EF at the national, state and city levels. Similarly, the existing EF study at institutional level only focused on EF measurement of the university. In terms of knowledge gap, there seems to be a lack of studies related to the psychological factors of the campus community when measuring the EF of a university particularly in Malaysia. According to Gündüz and Alsagher (2018) and Fernández et al. (2020), there is a need to include the psychological aspect of university students into the EF measurement. To date, EF studies in Malaysia did not investigate the psychological factors in relation to EF for Malaysian universities. Thus, this study fills the knowledge gap for exploring the relationship between the psychological factors and EF in the current literature.

1.7 Research Methodology

Figure 1.4 shows the research methodology overview in this study. This study consists of five stages including literature review, survey instrument establishment, data collection, data analysis as well as findings and conclusion. They are explained briefly as follow:-

(a) Stage 1 - Literature Review

At the first stage of this research, a study was carried out to find a suitable research topic. This stage consisted of literature review which was needed to review the concept of EF, psychological theories and definition of important terms.

(b) Stage 2 - Survey Instrument Establishment

For second stage, information collected from literature review was used to develop the survey instrument. The questionnaires were used to collect the data needed for EF calculation and psychological factors that influence EF of research university students in Malaysia.

(c) Stage 3 - Data Collection

The questionnaires were subjected to a reliability test to ensure the internal consistency before being used for data collection. Generally, a reliability test is performed to indicate the extent to which different items or measures are consistent with each other, which refers to the consistency of a multiple item scale. Cronbach's alpha assisted by Statistical Package for Social Sciences (SPSS) was used to confirm the internal consistency of the scale in this study. Reliability was established by using a pilot test. The feedbacks gathered from pilot study were used to improve the questionnaires. Then, the revised questionnaires were distributed to the sample in this study.

(d) Stage 4 - Data Analysis

In this stage, the data collected from questionnaires were analysed. The data analyses are interpreted in chapter four, five and six. Statistical Package for the Social Sciences (SPSS) was used for objective one. Redefining Progress (RP) ecological footprint online calculator and SPSS were used for objective two while the SmartPLS software or partial least squares structural equation modeling (PLS-SEM) for objective three. Frequency analysis and descriptive analysis were used as data analysis for objective one. Frequency analysis, descriptive analysis, normality test, independent samples t-test and one-way analysis of variance (ANOVA) were conducted for objective two whereas algorithm, bootstrapping, blindfolding, mediation and importance-performance matrix analysis (IPMA) for objective three. Lastly, model

validation was carried out on the relationship model. The analysis methods are further discussed in chapter three.

(e) Stage 5 - Findings and Conclusion

This is the final stage of the study which derived from the previous stage. Conclusion and some suggestions for further research were made.

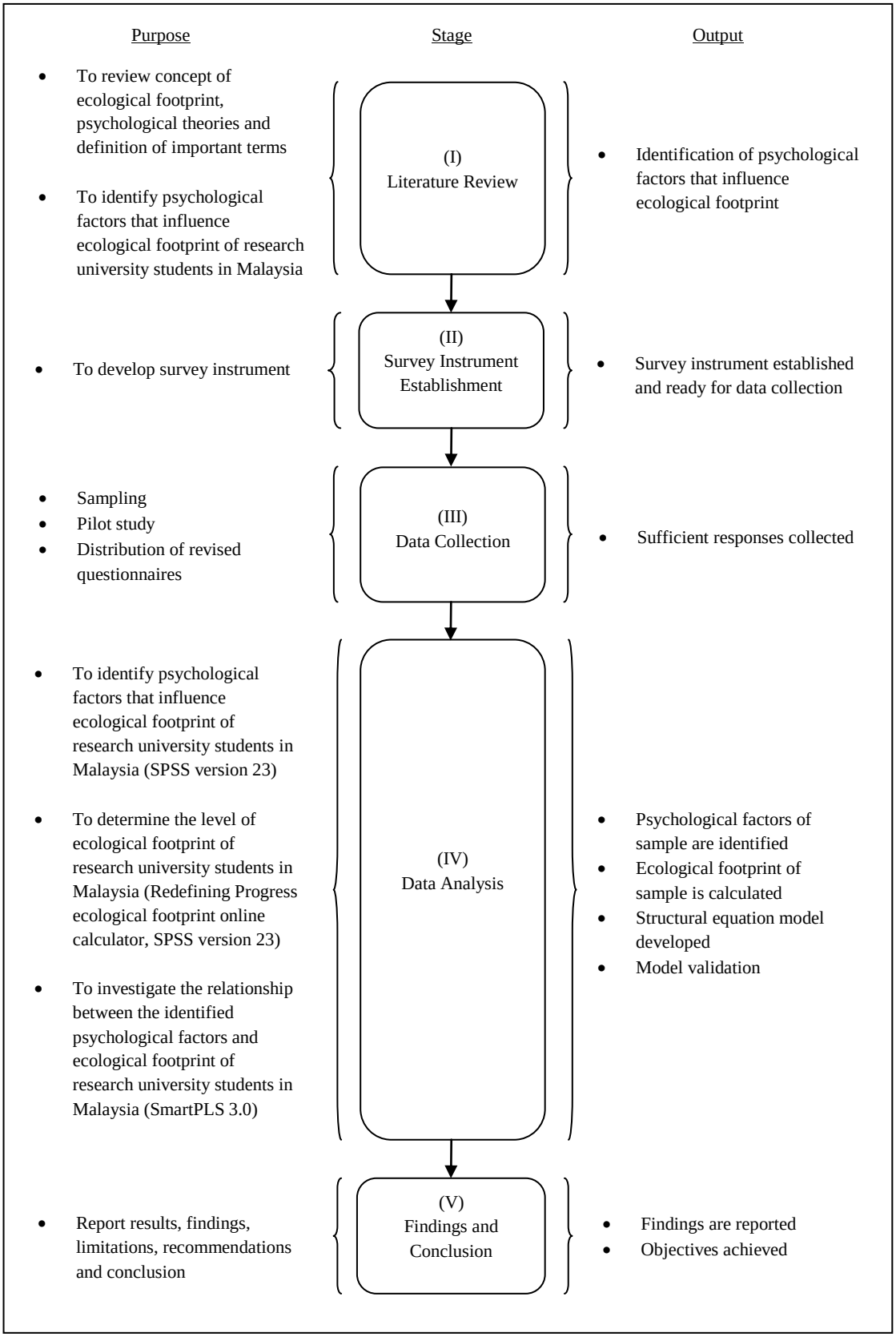

Figure 1.4 Summary of research methodology

1.8 Operational Definition

Operational definition is a definition of a variable in a study (Leavy, 2017).

(a) Altruistic Values

A value of displaying concern or showing consideration for the welfare of others (Schwartz, 1994).

(b) Biospheric Values

A value emphasizing the environment and the biosphere (Schwartz, 1994).

(c) Egoistic Values

A value focusing on maximizing individual outcomes (Schwartz, 1994).

(d) The New Ecological Paradigm Scale

A standardized measurement of environmental beliefs which measures the relationship between human and environment (Dunlap, 2008).

(e) Awareness of Consequences

The awareness of the consequences of carrying out a behaviour (Schwartz, 1977).

(f) Ascription of Responsibility

The degree in which a person feels responsible for the consequences of his or her behaviour regarding to the environment (Schwartz, 1977).

(g) Personal Norms

The feeling of personal obligation associated with behaviour (Schwartz, 1977).

(h) Ecological Footprint

The area of biologically productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces, wherever on Earth the land and water is located (Wackernagel & Rees, 1996).

1.9 Organisation of Chapters

This study consists of seven chapters, the arrangement of chapters is as below:-

(a) Chapter 1 - Introduction

Chapter one gives an outline of the study. Background and problems of this study were stated. Objectives, scope, methodology, significance and structure of the study were included in this chapter.

(b) Chapter 2 - Literature Review

Chapter two is the literature review in this study. Literature searches were obtained from books, journal articles, theses and internet. Journal articles were used as main references of this study.

(c) Chapter 3 - Research Methodology

Chapter three is about the methodology that is used in the research. This chapter emphasized on the rationale of using the choice of research methods and data analysis techniques.

(d) Chapter 4 - Psychological Factors that influence Ecological Footprint of Research University Students in Malaysia

In chapter four, analysis of the data collected for objective one was carried out. Findings of the objective were discussed in this chapter.

(e) Chapter 5 - Ecological Footprint of Research University Students in Malaysia

In chapter five, analysis of the data collected for objective two was carried out. Findings of the objective were discussed in this chapter.

(f) Chapter 6 - Relationship between the Identified Psychological Factors and Ecological Footprint of Research University Students in Malaysia

In chapter six, analysis of the data collected for objective three was carried out. Findings of the objective were discussed in this chapter. A model validation was carried out as well.

(g) Chapter 7 - Conclusion and Recommendations

As for the final chapter of the study, conclusion was drawn and the main points that were discussed in the earlier chapters were highlighted. Problems that were encountered during the study were clarified. Recommendations for future study were made.

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1. **Tan, A. S.**, Choong, W. W., Zen, I. S. (2016). Ecological Footprint of Research University Students: A Pilot Case Study in Universiti Teknologi Malaysia. In *MATEC Web of Conferences*. EDP Sciences. doi: 10.1051/matecconf/20166600073

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1. **Tan, A. S.**, Choong, W. W., Zen, I. S. (2019). The Ecological Footprint of Research University Students in Malaysia. *1st International Graduate Conference of Built Environment and Surveying*. 24 – 26 June, 2019. Universiti Teknologi Malaysia, Johor Bahru, Malaysia.

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