UNIVERSITI PUTRA MALAYSIA

ASSESSING THE AWARENESS LEVEL ABOUT CARBON FOOTPRINT AMONG HIGHER EDUCATION STUDENTS AND THE LEVEL OF CARBON FOOTPRINT THEY PRODUCED

NURUL SYAFIQAH BINTI AHMAD

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ABSTRACT

ASSESSING THE AWARENESS LEVEL ABOUT CARBON FOOTPRINT AMONG HIGHER EDUCATION STUDENTS AND THE LEVEL OF CARBON FOOTPRINT THEY PRODUCED

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Introduction: Carbon footprint is the main effect of climate change. Carbon is one of the greenhouse gases which contribute to warming the planet. **Objective:** A cross-sectional study was conducted at Higher Education University in Selangor to study the awareness level about carbon footprint among higher education students and level of carbon footprint they produced. **Methodology:** A total 262 respondents were selected and the online survey was blast through the email of the students and also through the portal of the University that were selected. **Results:** Majority of the students in this research has good knowledge on carbon footprint (N = 204, 77.9%), positive attitude (N = 209, 79.8%) but poor practice (N = 153, 58.4%). Private university students produce significantly higher total carbon footprint (2295.91 ± 955.21 kg CO_2-e) compared to public non RU (1455.20 ± 1316.62 kg CO_2-e) and RU students (1333.55 ± 1121.11 kg CO-e). Student in private university produced significantly higher emission for transportation (1231.09 kg CO_2-e) and electricity (651.10 ± 397.88 kg CO_2-e) compared to public non-RU and RU's. The results shows that the male, age between 24 to 35 years old and monthly allowances above RM400 produced the highest level of carbon footprint. Knowledge, attitude, practices, type of university, age, gender, and monthly allowances influence significantly to the total carbon footprint. **Conclusion:** The higher education students shows good knowledge, positive attitudes but negative practices towards the carbon footprint. Significant higher emission of carbon footprint emission for electricity and transportation among private university students. Respondents with monthly allowance above RM401, age between 24 to 35 and male produced higher level carbon footprint compared to other groups. The age, gender, monthly allowances, type of university, knowledge, attitudes, practices influence 20.6% of the total level of carbon footprint.

Keywords: Carbon Footprint, Knowledge, Attitude, Practices, Higher Education University

ABSTRAK

MENILAI KESEDARAN MENGENAI TAHAP JEJAK KARBON KARBON DI KALANGAN PELAJAR PENGAJIAN TINGGI DAN TAHAP JEJAK KARBON MEREKA HASILKAN

NURUL SYAFIQAH BINTI AHMAD

Pengenalan: Jejak karbon adalah kesan utama perubahan iklim. Karbon adalah salah satu daripada gas-gas rumah hijau yang menyumbang kepada pemanasan planet ini. **Objektif:** Satu kajian keratan rentas telah dijalankan di Universiti Pengajian Tinggi di Selangor untuk mengkaji tahap kesedaran mengenai kesan karbon di kalangan pelajar pendidikan tinggi dan tahap kesan karbon mereka hasilkan. **Metodologi:** Sebanyak 262 responden telah dipilih dan kaji selidik dalam talian adalah hebahan melalui e-mel pelajar dan juga melalui portal Universiti yang dipilih. **Keputusan kajian:** Majoriti pelajar dalam kajian ini mempunyai pengetahuan yang baik pada jejak karbon (N = 204, 77.9%), sikap positif (N = 209, 79.8%) tetapi amalan negatif (N = 153, 58.4%). Pelajar universiti swasta menghasilkan jumlah jejak karbon yang lebih tinggi (2295,91 ± 955,21 kg CO_2-e) berbanding bukan RU awam (1455,20 ± 1316,62 kg CO_2-e) dan pelajar RU (1333,55 ± 1121,11 kg CO_2-e). Pelajar di universiti swasta menghasilkan pelepasan jauh lebih tinggi untuk pengangkutan (1231,09 kg CO_2-e) dan elektrik (651,10 ± 397,88 kg CO_2-e) berbanding awam bukan RU dan RU. Keputusan menunjukkan bahawa lelaki, umur antara 24 hingga 35 tahun elaun bulanan melebihi RM400 menghasilkan tahap tertinggi jejak karbon. Pengetahuan, sikap, amalan, jenis universiti, umur, jantina, dan elaun bulanan pengaruh ketara kepada jumlah jejak karbon. **Kesimpulan:** Pelajar pendidikan tinggi menunjukkan pengetahuan yang baik, sikap yang positif tetapi amalan negatif terhadap pembebasan karbon. Pelepasan yang ketara lebih tinggi pelepasan karbon untuk elektrik dan pengangkutan kalangan pelajar universiti swasta. Responden dengan elaun bulanan melebihi RM401, umur antara 24 hingga 35 dan lelaki menghasilkan jejak tahap karbon yang lebih tinggi berbanding dengan kumpulan lain. Umur, jantina, elaun bulanan, jenis universiti, pengetahuan, sikap, amalan mempengaruhi 20.6% daripada jumlah tahap jejak karbon.

Kata kunci: Jejak Kabon, Pengetahuan, Sikap, Amalan, Universiti Pengajian Tinggi

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CO_2	Carbon dioxide
LCA	Life Cycle Assessment
GHG	Greenhouse Gases
GDP	Gross Domestic Product
CFL	Compact Fluorescent Light
FRIM	Malaysia Forest Research Institute Malaysia
LGA	Local Government Area
WHO	World Health Organization
USEPA	US Environmental Protection Agency

CHAPTER 1

INTRODUCTION

1.1 Background

Based on time for change organisation, the total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO_2) called as carbon footprint. In other words, when driving a car, the engine burns fuel which creates a number of CO_2, depending on fuel consumption and driving distance. While heating your home with electricity, electricity generation may also have been a number of CO_2 emitted (Rohrer, 2007).

According to Janes (2015), the activities related to the transportation and electricity generation account for over half of the increase of 14% in greenhouse gas emissions in the United States from 1990 to 2008. The Federal Transit Administration estimates that switching to public transportation instead of driving will allow the average American to reduce her carbon footprint by 10%. Americans also can reduce their collective carbon footprint by changing their incandescent bulbs to compact fluorescent bulbs, preventing the release of 9 billion pounds of greenhouse gases.

University of Cape Town's (UCT) carbon footprint for 2007 was approximately 83,400 tonnes of CO_2-equivalent, with campus energy use, transportation and the goods and services accounts for about 81%, 18% and 1% each track. Electricity consumption only accounts for about 80% of all emissions related to the activities of the university. UCT per-capita emissions for 2007 amounted to about 4.0 tonnes of CO_2-equivalent emissions per student. In comparison, only 2007 emissions per capita in South Africa is estimated at 10.4 tonnes of CO_2-e (Letete, 2011).

There are limited information with regards to carbon footprint in Malaysia. For example, Malaysia Forest Research Institute Malaysia (FRIM) estimated the total carbon footprint for 2011 was 5,332 metric ton CO_2-e or 6.1 metric ton CO_2-e per capita (FRIM, 2012).

Theoretically, average of knowledge, attitudes and practices towards environment in Malaysia are less than Singapore which is 4.8143 compared to the attitudes of Singaporean toward the environment which is 4.8210 (Wong et al, 2012). Hassan et al. (2016) mention that 375 of University Kebangsaan Malaysia (UKM) students had high level of knowledge (79.72%), awareness(78.32%) and attitudes (81.76%) but the level of environmental practices was low(60.0%).

Regard to this issue, there are many universities all around the world that has been addressing the challenges of ecological sustainability in their own environment such as Colorado State University, Stanford University, Emory University, Universiti Putra Malaysia and others. The program was named as Eco Campus, Sustainable

Campus or Green Campus (Hussin & Kunjuraman, 2015). In Malaysia, there are several Universities that had been implemented Eco Campus programs which include University Putra Malaysia, University Malaysia Sabah, University Technology Malaysia and others. Eco campus was implemented to reduce on-campus waste and energy consumption, promote alternative transportation and take other measures to benefit the environment.

Universiti Putra Malaysia (UPM) managed to improve its ranking in the UI-Green Metric World University Ranking 2013 from 19th place in the previous year to 16th place. The increase in this year's ranking marks UPM excellence in actively promoting sustainability through environmental conservation and the use of green technology in recent years. The rating also factored in the commitment and efforts taken by UPM in ensuring sustainability, green campus and environmental conservation such as the size and amount of green space reserve along with its infrastructure, as well as on-campus energy efficiency. The rating also evaluated the adaptation of green technology, enforcement of sustainability policy and on-campus vehicles and waste management (Noh, 2016).

According to the National Climate Assessment (2014), climate change can give the impact to the environment and health. The primary impact of climate change is Earth's water systems thrown off the balance. For example, the frozen water on Earth is melting. Besides, the weather of all kinds is getting more extreme and the oceans are getting hotter, expanding, and becoming more acidic. It also places many added burdens on people and society. The climate change is a major threat to agriculture. Besides, warmer and polluted air affects our health. A warmer atmosphere increases

chemical reactions that form ground-level ozone, also known as smog. Smog is a well-known lung irritant and a major trigger of asthma attacks.

1.2 Problem Statement

The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product. The standard unit of measurement for carbon footprints is carbon dioxide equivalents (CO_2e) (Shueb and Mir, 2014).

Based on the Carbon Neutral (2015), the emissions category can be classified into several scopes which are scope 1 emissions, mostly generation of electricity, heat or steam, transportation of staff in business owned or controlled vehicles and lastly fugitive emissions which is result from intentional or unintentional during the use of refrigeration and air conditioning equipment. Scope 2 emissions which resulting from the generation of purchased electricity that is consumed at owned or controlled equipment or operations. Scope 3 emissions comprises all other indirect emissions which is materials use, waste disposal to landfill, transport of people and goods with vehicles not owned or controlled by the reporting company (business travel, third-party shipping), food, staff commuting, paper use and others.

Carbon footprint can be calculated by several techniques. The most common method used is the factors of production, Life Cycle Assessment (LCA) or Input-Output Life Cycle Assessment (IO-LCA). Every calculation involves a degree of

uncertainty. Even the soles of fuel or electricity usage can be quite accurate, calculate the trace of products and services involves a number of assumptions that limit our ability to make accurate calculations (Kim et al. 2008).

Carbon footprint is the main effect of climate change (Zhuang et al., 2011). Carbon is one of the greenhouse gases which contribute to warming the planet. From 1990 to 2005, carbon dioxide emissions has increased by 31% and 35% increase in radiation heating or a change in the energy balance of the earth towards the warming in 2008. According to the the U.S. Environmental Protection Agency's Climate Change Indicators Report (2010), the 2000-2009 was the warmest decade on record globally.

The current knowledge about carbon footprint and the level of carbon produced among University students in the country is not yet explore. For example, a study by Yoke and Phang (2011) among secondary science students in Selangor, Malaysia shows the students have fairly low knowledge level (31.2%) and fairly positive attitude (63.03%) of Low Carbon Society. It is very limited report on carbon by high education institution in Malaysia. UCSI University for example, uses 280,805 kWh of electricity per month which is estimated 150 ton of CO_2 monthly, 800 reams of white A4 paper a month which is equivalent to 1600kg of paper and causes the emission of an estimated 5 tons of CO_2/month. University's fleet diesel vehicles used an estimated 3132.192 litres/month, which causes the emission of an estimated 8.2 tons of CO_2 per month. But, there is no CO_2 release from water used at UCSI University (Hooi et al. 2011).

Whitmarsh et al. (2009A) state that minority of the United Kingdom citizens sample know 'nothing' about 'climate change' (5%), CO_2 or carbon dioxide emissions(7%), rising to 12% of participants for the term 'carbon footprint'. While over half of the sample indicates they know 'a lot' or 'a fair amount' about the term 'carbon footprint', only one in ten of those surveyed had actually used a carbon calculator to work out their carbon footprint. Regard to the knowledge on carbon footprint, Watson et al. (2012) mention that students in the one of the building in Dalhousie University, Canada rated their knowledge of carbon footprints as 1 out of 4 is 11% and 33% rated as 2 out of 4. The students who rated their knowledge of carbon footprints as 4 out of 4 were 37.5%.

Previous study (Larsen et al., 2011, Li et al. 2011, and Utaraskul, 2015, Letete, 2011, Hooi et al. 2011), shows that emission category relevant to the students are transportation, electricity, food and paper. Among those emissions, electricity is the highest emission among students. The carbon footprint of Norwegian University of Technology and Science (NTNU) in Norway is very significant with an average contribution of 4.6 tonnes per student. The results show that the carbon footprint is distributed fairly equally among the aggregated categories, with energy, buildings, and equipment each contribute to 19% of the carbon footprint. Further contributions include travel (16%), consumables (11%) and services (5%) (Larsen et. al., 2013).

Malaysia aims to reduce its greenhouse gas (GHG) emissions intensity of Gross Domestic Product (GDP) by 45%, by the year 2020 (Chik and Rahim, 2012). According to the Zaid et al. (2015), Malaysia emitted 6.68 tonnes of carbon dioxide per capita in 2007. The GHG emissions from higher education institutions also

contribute to the increase in these harmful gases. While higher education is selected in these study because it is a fast growing service sector. This sector is a growing, consumer of energy and resources and generator of emission and waste (Roy et al., 2008).

According to the Environmental Protection Agency (2016), climate change can affect human health in two main ways. First, by changing the severity or frequency of health problems that are already affected by climate or weather factors. Second, by creating unprecedented or unanticipated health problems or health threats in places or times of the year where they have not previously occurred. For example, heat stroke and dehydration, as well as cardiovascular, respiratory, and cerebrovascular disease. Meanwhile, the environmental effects include temperatures will continue to rise, frost-free season and growing season will lengthen, changes in precipitation patterns, more droughts and heat waves and others.

Therefore this study aimed to determine the awareness level about carbon footprint among higher education students and the level of carbon footprint they produced. A cross sectional study was conducted and students in higher education institution in Selangor were samples. Selangor is purposely selected because the state authorities have been working in a concerted effort towards greener, sustainable and environmentally friendly states (Kiernan, 2017). Through the effort it was expected the students have some knowledge on the carbon footprint and the level of carbon footprint produced can be documented.

1.3 Study Justification

It is important to do this study because based on the previous study, it shows that it is very limited data on knowledge, attitudes and practices and also the level of carbon footprint among students that we can get in Malaysia. Thus, by doing this study, the data on level and knowledge, attitudes and practices will be obtained. There are several universities that assessing the level carbon footprint for example UCSI University, University Technology Malaysia and others. Most of the study only focusing on one institution. Therefore, there is a need to do research at the state level among higher education.

Students is purposely selected because in the previous study state that students of University Capetown contribute to the emission of carbon footprint per-capita emissions for 2007 amount to about 4.0 tons CO_2-eq emissions per student. For comparison only, South Africa's 2007 per capita emissions were estimated at 10.4 tons CO_2-eq (Letete, 2011). Selangor is purposely selected because Selangor governments have been working in a concerted effort towards greener, sustainable and environmentally friendly states (Kiernan, 2017).

The importance of this study is because to assess the awareness and level of carbon footprint among students. Human activities can emit greenhouse gaseous which can lead to global climate change. Global climate change will affect environment and health. Thus, it is important to know the level of carbon footprint

that we produce, so that people will realize and reduce the level of carbon footprint that they produced.

1.4 Conceptual Framework

Figure 1.1 shows the conceptual framework of this study. It can be concluded that community of higher education can be categorized into three groups and one of them is students. Student activities may contribute to the carbon footprint which is dependent variables in this study. Carbon footprint can be produced by the category of emission such as transportation, water, paper, electricity and others. All of this can lead to global climate change and give the impact to the environment and human health. Besides, the independent variables also which are knowledge, attitude, practices and socio demographic status (gender, monthly allowances and age) will affect the level of carbon footprint produced.

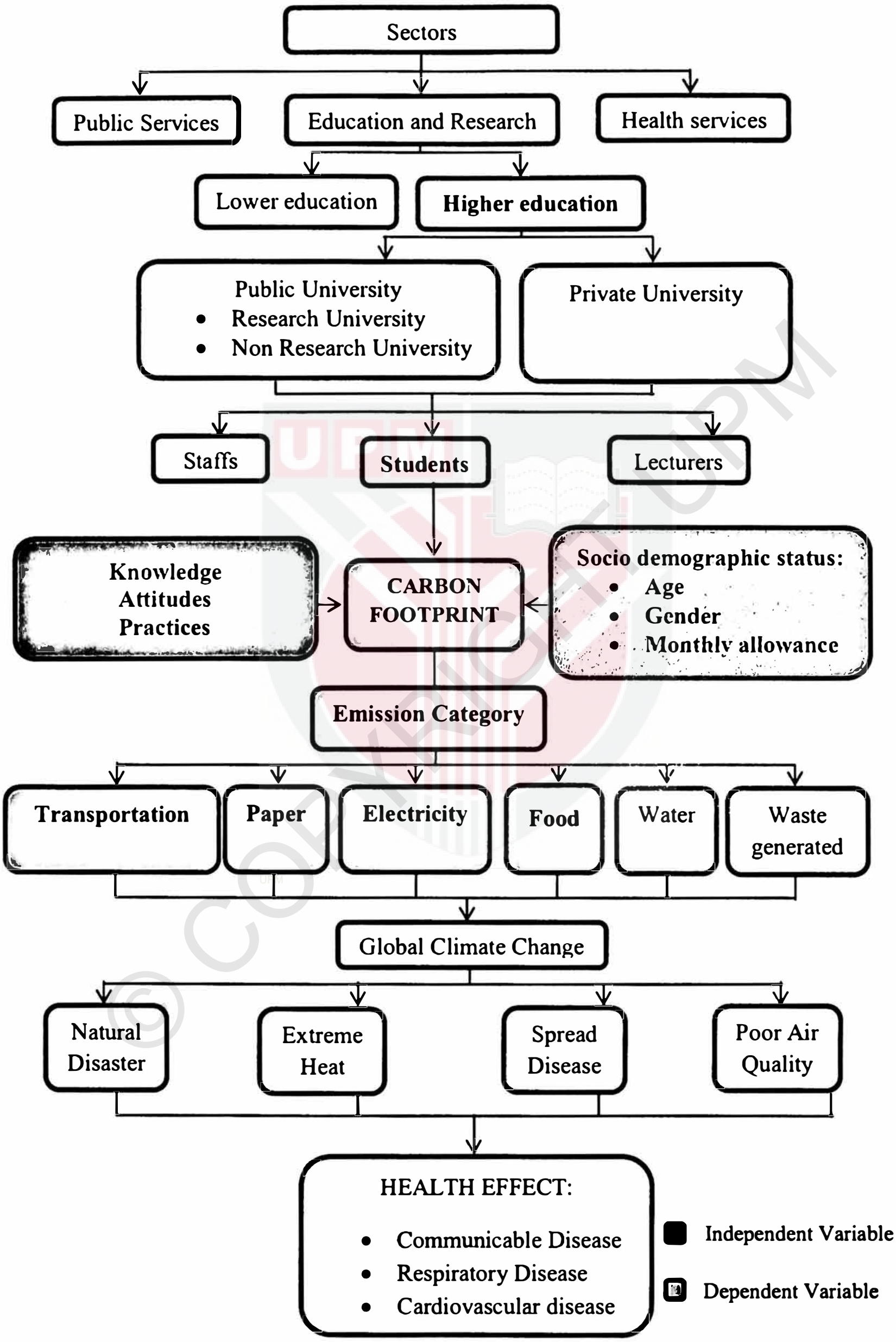


Figure 1.1: Conceptual Framework of the Study

1.5 Research Objectives

1.5.1 General Objectives

To study the awareness level about carbon footprint among higher education students and level of carbon footprint they produced.

1.5.2 Specific Objectives

1. To determine and compare the knowledge of carbon footprint among higher education students in three groups university (public research, public non-research and private university).
2. To determine and compare the attitudes and practices of carbon footprint among higher education students in three groups university (public research, public non-research and private university).
3. To compare the level of carbon footprint produced in three groups of university (public research university, public non-research university and private university).
4. To determine and compare the level of carbon footprint produced by emission categories (i.e.: transportation, electricity, paper and food) and socio demographic status (i.e.: age, gender, monthly allowances).
5. To investigate the relationship between socio demographic status (age, gender, and monthly allowances), type of university, knowledge, attitudes, practices and total level of carbon footprint among higher education students.

1.6 Hypothesis

1. There is significant difference of mean rank between knowledge of carbon footprint among higher education students in three groups university (public research, public non-research and private university).
2. There is significant difference of mean rank between attitudes and practices of carbon footprint among higher education students in three groups university (public research, public non-research and private university).
3. There is significant difference of mean rank between level of carbon footprint produced in three groups of university (public research university, public non-research university and private university).
4. There is significant difference of mean rank between level of carbon footprint produced by emission categories (i.e.: transportation, electricity, paper and food) and socio demographic status (i.e.: age, gender, monthly allowances).
5. There is significant association between socio demographic status (age, gender and monthly allowances), type of university, knowledge, attitudes, practices and total level of carbon footprint among higher education students.

1.7 Definition of terms

1.7.1 Conceptual Definition

i. Carbon footprint

Carbon Footprint is the representation of the effect of an entity or organization on the Earth's climate in terms of the total amount of greenhouse gases produced expressed in units of carbon dioxide (Carbon Footprint, 2012).

ii. Knowledge, Attitudes and Practices

According to Asia Pacific Disability Rehabilitation Journal, **Knowledge** is the capacity to acquire, retain and use information, a mixture of comprehension, experience, discernment and skill. **Attitudes** refer to inclinations to react in a certain way to certain situations, to see and interpret events according to certain predispositions or to organise opinions into coherent and interrelated structures and **practices** mean the application of rules and knowledge that leads to action (Lakhan R., 2010).

iii. Higher Education University

According to Oxford dictionaries, higher education refers to the education at universities or similar educational establishments, especially to degree level.

1.7.2 Operational Definition

i. Carbon footprint

Carbon footprint is categorized into several emission categories which are food, transportation, paper and electricity. Carbon footprint level is calculated by using carbon footprint formula due to the study conducted by Hooi et al. (2011) as shown in Table 2.1.

ii. Knowledge, Attitudes and Practices

Knowledge, Attitudes and Practices was assessed based on the scale by Ahmed (2007). The knowledge scale is divided into three levels which is good, fair and poor level. Meanwhile, the attitude and practices is using likert scale and the total scores is divided into three which is positive, neutral and negative level.

iii. Higher Education University

Higher Education University in this study was referring to the six university that was take part in this research which Universiti Putra Malaysia, Universiti Kebangsaan Malaysia, Universiti Tenaga Nasional, Universiti Kuala Lumpur, Universiti Islam Antarabangsa and Universiti Teknologi MARA.

CHAPTER 2

LITERATURE REVIEW

2.1 Definition of Carbon Footprint

Carbon footprint can be defined as a measure of the greenhouse gas emissions that are directly and indirectly caused by an activity or are accumulated over the life stages of a product or service, expressed in carbon dioxide equivalents (Wiedmann and Minx, 2007). According to the Paliamentary Office of Science and Technology (2006), carbon footprint refers to the total amount of CO_2 and other greenhouse gases, emitted over the full life cycle of a process or product. It is expressed as grams of CO_2 equivalent per kilowatt hour of generation (gCO_2eq/kWh), which accounts for the different global warming effects of other greenhouse gases.

Grub and Ellis (2007) state that a carbon footprint is a measure of the amount of carbon dioxide emitted through the combustion of fossil fuels. In the case of a business organization, it is the amount of CO_2 emitted either directly or indirectly as a result of its everyday operations. It also might reflect the fossil energy represented in a product or commodity reaching market. The carbon footprint was calculated by

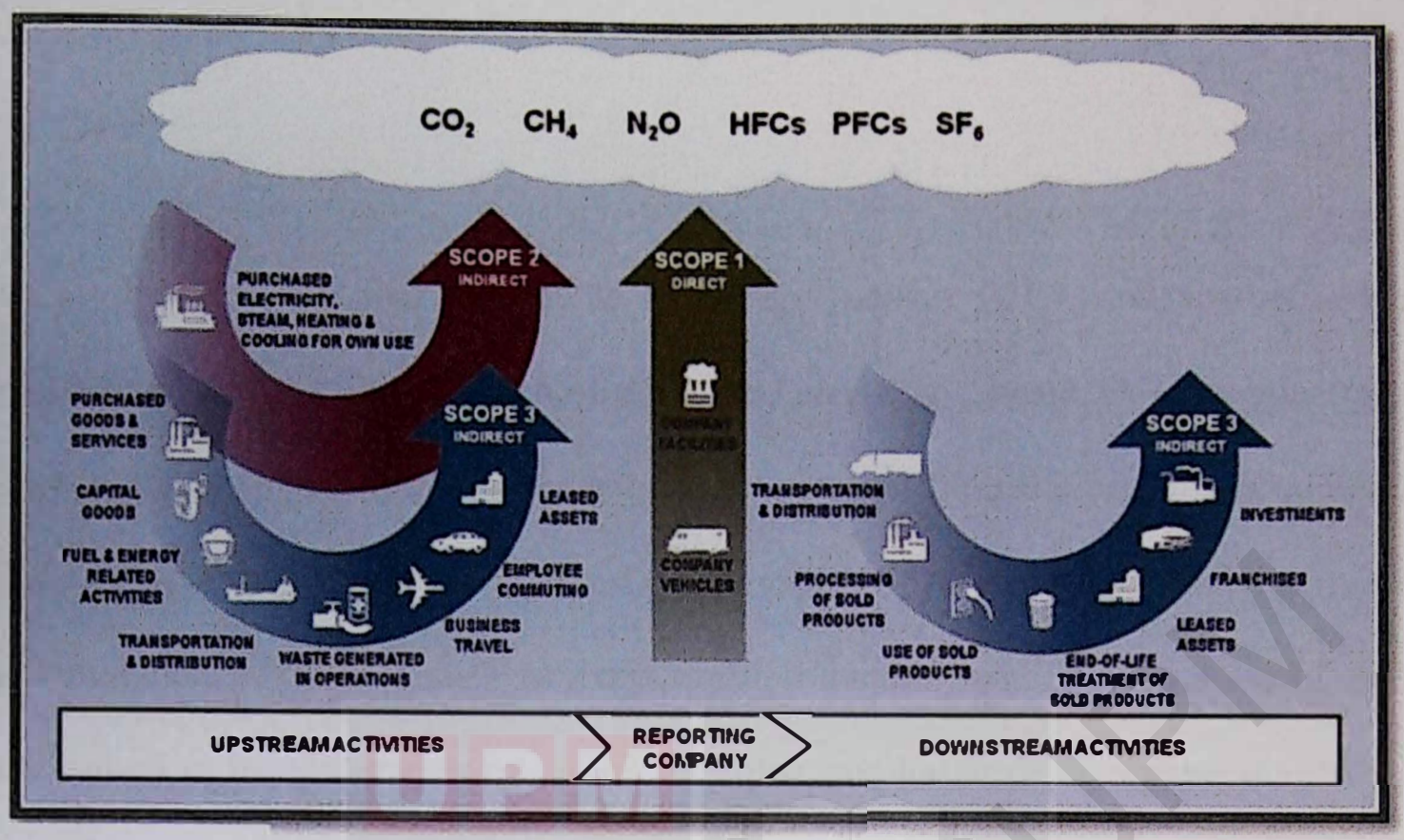
measuring the CO_2 equivalent emissions from its premises, company-owned vehicles, business travel and waste to landfill (Patel, 2006).

Sources:
www.google.com

Figure 2.1: Concept of carbon footprint

2.2 Category of emissions

Based on the Greenhouse Gas Protocol (2012), carbon emission is separated into three different categories, or 'scopes'. Scope 1 is from all direct Greenhouse Gases (GHG) emissions. Scope 2 is indirect GHG emissions from consumption of purchased electricity, heat or steam while scope 3 is other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in scope 2, outsourced activities, food, waste disposal, paper use and others.



Sources:
www.google.com

Figure 2.2: Scope emission of carbon footprint

2.2.1 Scope 1

Based on the Boles (2015), scope 1 is also referred to as direct GHG, and are defined as emissions from sources that are owned or controlled by the organization, such as stationary combustion which is from the combustion of fossil fuels such as natural gas, fuel oil, and propane for comfort heating or other industrial applications. Next is mobile combustion which is from the combustion of fossil fuels such as gasoline and diesel used in the operation of vehicles or other forms of mobile transportation. Other than that, process emissions which are emissions released during the manufacturing process in specific industry sectors such as cement, iron and steel and ammonia. Lastly, fugitive emissions which is from an unintentional release of GHG from sources including refrigerant systems and natural gas distribution. For the majority of organizations, the stationary and mobile combustion sources of scope 1 GHG will be the most relevant.

2.2.2 Scope 2

Scope 2 are also referred to as energy indirect GHG, and are defined as emissions from the consumption of purchased electricity, steam, or other sources of energy, for example chilled water generated upstream from the organization (Boles, 2015). According to the University of Cambridge (2017), electricity related activities not included in scope 2 such as extraction, production, and transportation of fuels consumed in the generation of electricity either purchased or own generated by the reporting company, purchase of electricity that is sold to an end user reported by utility company and generation of electricity that is consumed in a transmission and distribution system reported by end-user.

2.2.3 Scope 3

Scope 3 is also referred to as other indirect GHG, and is defined as emissions that are a consequence of the operations of an organization, but are not directly owned or controlled by the organization. Scope 3 includes a number of different sources of GHG including employee commuting, business travel, third-party distribution and logistics, production of purchased goods, food, paper use, emissions from the use of sold products, and several more. Based on data from many companies that have conducted comprehensive assessments of their Scope 3 emissions, it is evident that Scope 3 GHG is by far the largest component of most organizations' carbon footprint (Boles, 2015).

2.3 Knowledge, Attitude and Practices

According to the Ebuehi and Olusanya (2015), the level of knowledge, attitudes and practices toward climate change related to the issue of carbon footprint is low that is almost six out of ten (57.6%) of respondents had poor knowledge about climate, 48% have a positive, while more than two-thirds (69.8 %) had a poor practice on the mitigation of climate change among population of Local Government Areas (LGA) Ifo, Ogun State, South West, Nigeria. The study reveals insufficient knowledge and practices towards mitigation of climate change among the population, while their attitude was fairly positive.

Loon, Y.W. (2004) mention that the study on measuring environmental literacy among students of Faculty of Science in University Putra Malaysia showed that more than 80% of all students had high level of attitude and knowledge of environmental education. This might be due to the difference of their personality, influenced by their lifestyle and family further because of emphasizing on environmental attitude and knowledge by the government and the media in these later years. Besides, the high level of knowledge might be depending on teacher's knowledge about the environment.

Meanwhile, the study on awareness, knowledge and attitudes towards environmental education among secondary school students in Malaysia showed that most of students were often influenced by environmental issues (72.1%) where 67.7% of respondents had better perception about environmental subjects. Moreover, the students were concerned (61.1%) about their local environmental issues. 82.8% of

respondents were agreed towards environmental subjects. This means that the majority of student's attitude was positive about environmental issues (Aminrad et al., 2013).

2.3.1 Awareness and Knowledge

In a study done in Jamaica by The Planning Institutes of Jamaica, over 82.6% of people surveyed have heard of climate change. Additional 49.5 % of respondents were concerned about climate change with 31.2% having a moderate view about climate change, while 14 % were not concerned (The Planning Institute of Jamaica 2012).

Furthermore, most people (85.6%) agree with the statement 'climate change is caused by both natural processes and human activity'. However, this proportion seems rather high when compared with responses to other questions in this survey on skepticism and uncertainty about climate change, which suggest a sizeable minority continue to doubt whether human activities influence climate. For example, 25.2% of the sample agreed that 'Climate change is just a natural fluctuation in earth's temperatures' and 22.4% agreed that 'I am uncertain about whether climate change is really happening'; furthermore, most participants are skeptical about claims made in the media about climate change and feel they need more information to form a clear opinion about it (Whitmarsh et al., 2009).

Based on the Ochieng and Koske (2013), results of the study shows that the level of climate change awareness among primary school teachers in Kisumu Municipality is not significantly low which is (X^2= 62. 818, df = 2, n = 89, p = 0.000). The respondents recorded a medium level of climate change awareness (score of 3.61 in the awareness scale) showing that primary school teachers in Kisumu Municipality are relatively aware of climate change, but there exist gaps in their knowledge and understanding of the same.

2.3.2 Attitude and Practices

Based on the Whitmarsh et al. (2009), UK respondents had taken actions to reduce their emissions. The results show domestic energy conservation is relatively common, but changing travel and shopping habits are less popular. For example, 67% claim they 'always' turn off lights they are not using, whereas only 33% walk, cycle or take public transport for short journeys (i.e., trips of less than 3 miles) and 13% eat food which is organic, locally grown or in season.

Consistent with the widely reported reluctance to change travel habits, most participants in our survey (62%) use a car at least 3 times per week and 51% have taken at least one flight for social or leisure reasons in the past year. Further, consistent with previous research (e.g., Lorenzoni et al., 2007), people are more willing to recycle (71% say they always do so) than to take any direct energy conservation actions.

Regarding on perception of top environmental issues in Nigeria, the participants were asked to select the top three environmental priorities for Nigeria out of nine possible choices with an option to write their own responses for environmental issues they prioritized over the choices given. Student respondents most often chose pollution (56.3%) and overpopulation (37.6%), with climate change being the third most selected response (35.9%). In contrast, ministry officials most frequently chose climate change (60.7%) as the top environmental priority of the country, followed by environmental education (45.2%) and pollution (44.0%) (Ojomo et al. 2015).

2.4 Relationship between knowledge attitude and practices with theory of human behaviour

The theory of human behaviour deals with the relationships among beliefs, attitudes, intentions and behaviour. It has been used extensively to study and explain a wide variety of behaviours. The many studies that have used the Theory of Reasoned Action as a framework reflect its robust nature to understand, explain and predict behaviours, and also to provide a useful guide for designing intervention strategies to replace, alter, or maintain behaviours (Aipanjiguly, 2001).

Knowledge-Attitudes-Practices (KAP) model are a common method for understanding and analysing human responses to particular phenomena, especially in the field of health studies. The connection between people's attitudes and practices is well established in psychology, explained through the Theory of Planned Behaviour.

The role of various antecedents, mediators and moderators in the relationship between attitude and practices has been investigated, with special importance given to knowledge in relation to environment- and health-related attitudes and behaviour. Links between knowledge, attitude and practices have been derived internationally in relation to health issues, and there is support for a knowledge-practices link among Malaysians (Pretto et al. 2015).

2.5 Level of Carbon Footprint

University Campus in China indicated that the average annual carbon footprint was 3.84 tons of CO_2-e per student, with 65% attributable to daily life, 20% to transportation, and 15% to academic activities. Meanwhile, students from metropolitan areas had higher footprints than students from rural areas. The results shows that the average of the carbon footprint emission students in metropolitan area is 3.84 tons of CO_2-e while the average of the carbon footprint emission students in rural area is 3.13 tons of CO_2-e (Zhuang et al. 2011).

Based on the Utaraskul (2015), the carbon footprint was evaluated based on three criteria which are transportation, food consumption and energy consumption by using electric appliances at Suan Sunandha Rajabhat University, Thailand. The results revealed that students generate greenhouse gas emissions between 0.39 – 8.25 tCO_2e/year. An average GHG emission is approximately 2.16 tons CO_2e/year. The mainly student's activities generated greenhouse gas were using electric appliance

1.05 tCO_2e/year follow by food consumption 0.7 tCO_2e/year and transportation 0.4 tCO_2e/year, respectively.

Meida et al. (2013) state that the consumption based carbon footprint for De Monfort University United Kingdom was collected from different departments of the University. The scope 3 emissions comprised around 79% of the total university's greenhouse gas emissions, which supports the rationale for the consumption-based methodology. Procurement emissions were 38% of the overall estimated footprint and 48% of total scope 3 emissions which, as the largest emissions sector.

Total CO_2 emissions in Malaysia's four sectors which is electricity, transport, industrial and residential sector in 2000 in all four sectors were 88.97 million tonnes. In 2020, these emissions will reach 285.73 million tonnes if no control options have been exercised. The major sector which discharge the most CO_2 in 2020 will come from electricity generation (43.45%) sector since coal have been utilized as the main fuel for combustion followed by transport sector (30.25%), industrial sector (26.26%) and finally residential sector (0.03%) For transport sector, only road transport included passenger and freight transport involved in this calculation (Belosevic. et al., 2014).

2.6 Effect of Carbon Footprint to Environment

According to the World Health Organization (2016), climate change affects the social and environmental determinants of health, such as clean air, safe drinking water, adequate food and safe shelter. Extreme high air temperatures contribute directly to deaths from cardiovascular and respiratory diseases, especially among the elderly. Globally, the number of natural disasters related to weather reported having more than tripled since the 1960s. Each year, the disaster caused more than 60,000 deaths, mainly in developing countries. Rising sea levels and more extreme weather events will destroy homes, medical facilities and other essential services. More than half of the world's population lives within 60 km of the sea. People may be forced to move, which in turn can increase the risk of various health effects, mental disorders to infectious diseases.

Floods are also increasing in frequency and intensity and the frequency and intensity of extreme rainfall is expected to continue to rise during the current century. Floods contaminate freshwater supplies, increasing the risk of water-borne diseases, and creating a breeding ground for disease-carrying insects such as mosquitoes. Rising temperatures and variable precipitation may reduce food production in most of the poorest areas. This will increase the prevalence of malnutrition and undernutrition, which currently cause 3.1 million deaths each year (WHO, 2016).

Carbon emissions contribute to climate change, which can have serious consequences for environment. These carbon emissions raise global temperatures by trapping solar energy in the atmosphere. This alters water supplies and weather patterns, changes the growing season for food crops and threatens coastal communities with increasing sea levels (Cairoli, 2016).

Climate change is already having a significant impact on ecosystems, economies and communities. Rising average temperatures do not simply mean balmier winters. Some regions will experience more extreme heat while others may cool slightly. Flooding, drought and intense summer heat could result. Violent storms and other extreme weather events could also result from the increased energy stored in our warming atmosphere. One of the most serious impacts of climate change is how it will affect water resources around the world. Water is intimately tied to other resource and social issues such as food supply, health, industry, transportation and ecosystem integrity (Suzuki, 2014).

Climate change models predict significant climate effects throughout the region. Dry areas will become drier and wet areas will become wetter. Coastal storms will increase in frequency and intensity. The monsoon may transform in dramatic ways (Matthew, 2010).

The planet is warming, from North Pole to South Pole, and everywhere in between. Some impacts from increasing temperatures are already happening. For example, ice is melting worldwide, especially at the Earth's poles. This includes mountain glaciers, ice sheets covering West Antarctica and Greenland, and Arctic sea ice. Besides, researcher Bill Fraser has tracked the decline of the Adélie penguins on Antarctica, where their numbers have fallen from 32,000 breeding pairs to 11,000 in 30 years and also sea level rise became faster over the last century (National Geographic, 2007).

2.7 Effect of Carbon Footprint to Human Health

According to the National Institute of Environmental Health Sciences (2015) state that changes in the greenhouse gas concentrations and other drivers alter the global climate and bring about myriad human health consequences. Environmental consequences of climate change, such as extreme heat waves, rising sea-levels, changes in precipitation resulting in flooding and droughts, intense hurricanes, and degraded air quality, affect directly and indirectly the physical, social, and psychological health of humans. For instance, changes in precipitation are creating changes in the availability and quantity of water, as well as resulting in extreme weather events such as intense hurricanes and flooding. Climate change can be a driver of disease migration, as well as exacerbate health effects resulting from the release of toxic air pollutants in vulnerable populations such as children, the elderly, and those with asthma or cardiovascular disease.

Certain adverse health effects can be minimized or avoided with sound mitigation and adaptation strategies. Strategies for mitigating and adapting to climate change can prevent illness and death in people now, while also protecting the environment and health of future generations. Mitigation refers to actions being taken to reduce greenhouse gas emissions and to enhance the sinks that trap or remove carbon from the atmosphere. Adaptation refers to actions being taken to lessen the impact on health and the environment due to changes that cannot be prevented through mitigation. Appropriate mitigation and adaptation strategies will positively affect both climate change and the environment, and thereby positively affect human health. Some adaptation activities will directly improve human health through changes in our public health and health care infrastructure (NIEHS, 2015).

There are several categories of human health consequences of climate change. For example, asthma, respiratory allergies, and airway diseases, cancer, cardiovascular disease and stroke, foodborne diseases and nutrition, heat-related morbidity and mortality, human developmental effects, mental health and stress-related disorders, neurological diseases and disorders, vector borne and zoonotic diseases, waterborne diseases and weather-related morbidity and mortality (NIEHS, 2010).

According to the Ortigas (2013), global warming has various effects on humans. It is not only a threat to our future health. Global warming has already contributed to more than 150,000 deaths and five million illnesses every year. A

team of health and climate scientists at the World Health Organization and the University of Wisconsin at Madison say those numbers could double in 2030.

Ortigas (2013) further explained that the effects on infectious diseases are detected worldwide, but the degree and types of effects are different, depending on the location of the respective countries and socio economic situations. Ironically, the research data published in the Journal Nature shows that it will be particularly hard for poor countries. Warmer northern countries invite disease carrying insects to migrate up north, and with them come the diseases they carry. Malaria, for example, has not been eradicated due to global warming, their scope widens, their virus spreads longer, and some bacteria can mutate to even deadlier strains.

Besides, when the warm climate arrives, so does the spread of deadly diseases that affect millions of people across the world. Premature arrival of warmer months can trigger early onset of lethal diseases such as dengue and malaria. Longer hot days can lengthen the exposure to infections and spread to broader areas. Unprepared communities can overwhelm the public health services and can result to diminished medical supply. Warmer climate can also trigger diseases, such as avian flu, tuberculosis, cholera, Ebola, and skin diseases (Ortigas, 2013).

Sources:
www.google.com

Figure 2.3 Effects of carbon footprint

2.8 Carbon Footprint Calculation

Based on the Hooi et al. (2011), to estimates how many tons of carbon dioxide and other greenhouse gases that were created, we referred to carbon footprint formula below. Hooi et al. (2011) was studied about assessing the carbon footprint level based on the emission categories among the community of the UCSI University Malaysia.

Table 2.1: Carbon footprint formula

Emission category	Carbon footprint formula	Notes
Electricity	CO_2 = (average amount of electric bill per month ÷ price per kwh) × electricity emissions factor × months in a year	It is better to use the average EEF of West Malaysia 0.585 CO_2e/mWh Price per kwh average for Malaysia = RM0.3853
Paper	CO_2 = AMP X PEF AMP: Average Monthly Paper Used (Kg) PEF: Paper Emission Factor (CO_2e/Kg)	1 Kg of virgin paper produces 3.24 Kg of CO_2. 1 Kg of recycle paper produces 1.76 Kg of CO_2. The weight of one A4 standard paper is 5 gram.
Fuel	CO_2 = AMF X FEF AME: Average Monthly Fuel Used (Litres) FEF: Fuel Emission Factor (CO_2e/Litres)	Every litre of gasoline burnt releases 2.5 kg of CO_2. Every litre of diesel releases 2.85 kg of CO_2.
Food	CO_2 = Sum of food categories [(dollars spent on each category per month × emissions factor for each category × months in a year) × gram to pound conversion]	Meat, fish, & eggs emissions factor = 1452 Cereals & Bakery Products emissions factor = 741 Dairy emissions factor = 1911 Fruits & vegetables emissions factor = 1176 Eating out emissions factor = 368 Other foods emissions factor = 467 Gram to pound conversion = 0.0022

CHAPTER 3

METHODOLOGY

3.1 Study Location

This study was conducted in Higher Education University in Selangor. Selangor was selected because it has the most institution of higher learning in Malaysia. There are 41 University in the Selangor consist of 35 private universities and six public universities, three research universities and three non-research universities. In this study, six universities were involved. There were two public research universities (UPM, UKM), two public non research universities (UIAM, UITM) and two private universities (UNITEN, UNIKL). This study was conducted within three months, starting from December 2016 until February 2017.

3.2 Study Design

The cross sectional study was conducted by concerning the carbon footprint at Higher Education University in Selangor.

3.3 Sampling

3.3.1 Sampling method

Higher education University in Selangor was purposely selected in this study because Selangor has the most number of institution of higher learning in Malaysia. There are 41 private and public universities in Selangor. Stratified random sampling was used to divide population into smaller groups which is Research University, Non-research University and Private University. Online survey is the main tool via convenience sampling in this study. A convenience sample is made up of people who are easy to reach. The online survey was blast through the email of the students and also through the portal of the University that were selected. The results of the survey were obtained when the respondents click the submit button. Purposive sampling was used to select the University in each strata by concerning the sample criteria which are the university was established more than 20 years and the number of the students more than 10 000.

3.3.2 Sampling Population

The population of respondent consists of students of higher education students in Selangor. The sample was selected by convenience sampling. A convenience sample is made up of people who are easy to reach. The convenience sampling was used because the main tool in this study was online survey. The online survey was blast through the email of the students and also through the portal of the University that were selected.

3.3.3 Study Sample

The sample in this study is higher education students in Selangor.

3.3.4 Sample Size

The Krejcic & Morgan (1970) formula was used to calculate the sample size estimation as follow:

$$s = X^2NP\,(1-P) \div d^2(N-1) + X^2P(1-P)$$

Where;

s= required sample

X^2 = the table value of chi- square for 1 degree of freedom at the desired confiidence level

(1.96 x 1.96 = 3.8416)

N = the population size (168000 of total population of 6 university that have been selected)

P = 82% prevalence of awareness level of carbon footprint among students in Dalhousie University, Canada (Watson et al. 2011)

d = the degree of accuracy expressed as a proportion (0.05)

Therefore;

$s = (1.96)^2\ x\ 168000\ x\ 0.82\,(1-0.82) \div 0.05^2(168000-1) + (1.96)^2\ x\ 0.82(1-0.82)$

$s = 227.38$

An additional of 10% is made to the sample size to overcome the problem of non-responses. Thus, the total sample is 262. The 262 sample of respondents were stratified by 3 groups which is non research university, research university and private university.

Table 3.1 shows the number of respondents from different university's group, percentage and number of sample from each university's group. The precentage of respondents was determined by divided the number of respondents based on the University's group with total population (n=168000) and times with 100. Then, the percentage of respondents for each University's group divided by 100 and times with sample size estimation to identify the number of sample for each university's group. A total of 262 respondents was calculated by added all number of sample from each university's group.

Table 3.1: Stratification of students for selected University using a formula of proportional allocation

University's Group (N)	Percentage (%) (No of students based on University's group/ total populationx100)	No of sample for each University group (Percentage / 100 x sample size)
Research University (50000)	50000/168000x100= 29.76	29.76/100x262= 79
UPM = 24000		UPM = 38
UKM = 26000		UKM = 41
Non research University (85000)	85000/168000x100= 50.60	50.60/100x262= 129
UIA = 13400		UIA = 20
UITM = 71600		UITM = 109
Private University (33000)	33000/168000x100= 19.64	19.64/100x262= 54
UNITEN = 10000		UNITEN = 17
UNIKL = 23000		UNIKL = 37
	Total	262

3.4 Research Flow

Higher Education University in Selangor was purposely selected in this study because Selangor has the highest number of institution of higher learning in Malaysia. There are 41 private and public universities in Selangor. Then, stratified random sampling was used to divide population into smaller groups which is Research University, Non-research University and Private University. Two universities were purposely selected in each strata according to the some criteria which are the university was established more than 20 years and the number of the students more than 10 000. Online survey is the main tool via convenience sampling in this study. A convenience sample is made up of people who are easy to reach. The online survey was blast through the email and portal of the university that were chosen. The questions of online survey are on knowledge, attitudes and practices and also level of carbon footprint. Then, it was calculated in Microsoft Excel 2010 and IBM SPSS 22 was used to record the statistical analysis.

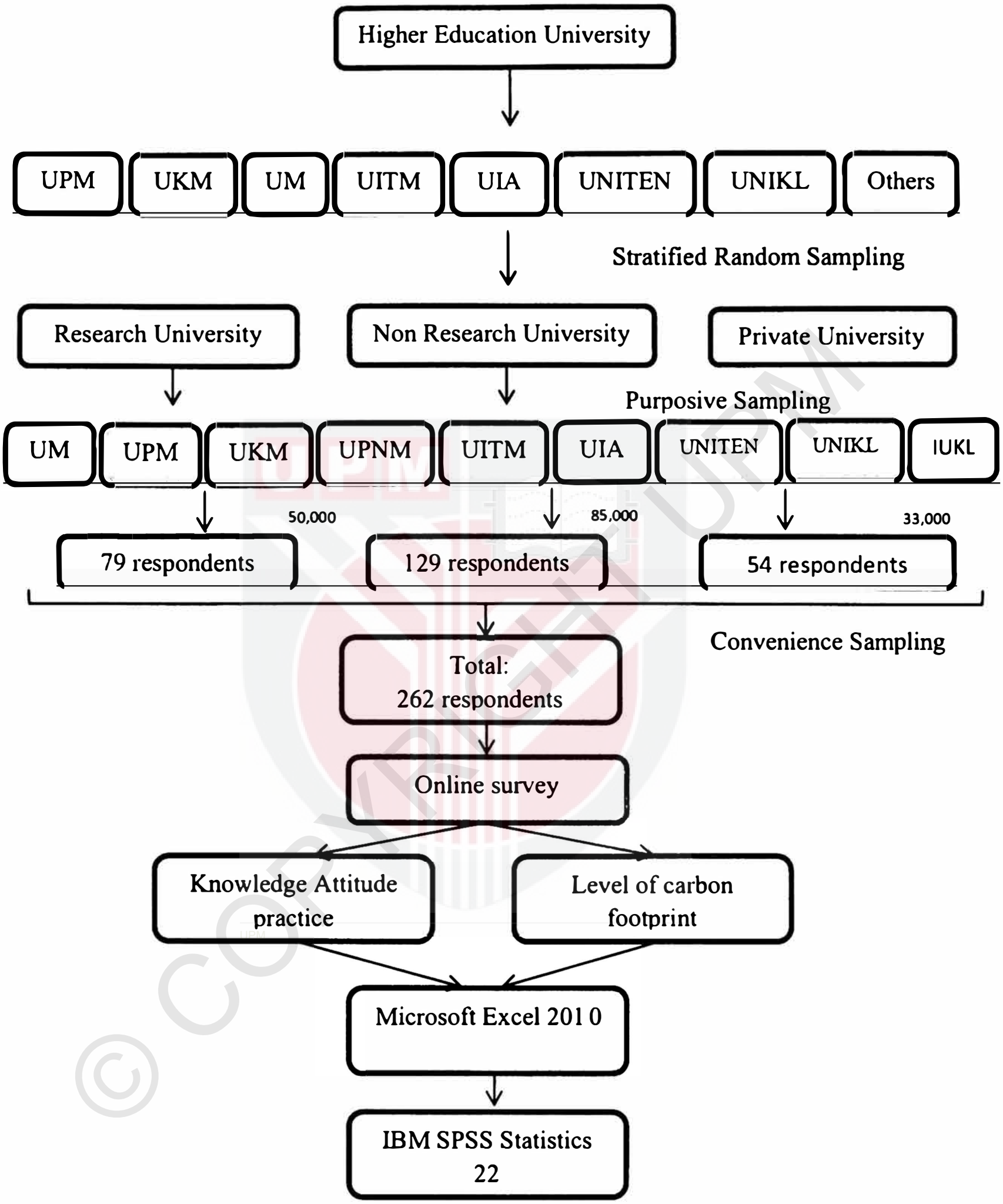


Figure 3.1: Research flow

3.5 Data Collection and Instrumentation

3.5.1 Online Survey

The online survey was blast through the portal of University that was chosen and also through the email and online communication application such as Whatsapp group. The online survey consists of consent form and also the questionnaire. The questionnaire was adapted from International Student Carbon Footprint Challenge, (2016), California. The scoring measure was referred to other study (Ahmed, 2007) with some modification for example type of food and type of electrical appliances that were common used in Malaysia. The total number of questions is 34 questions. The questions were divided into five sections:

1. Section A contain socio demographic information such as:

   Gender, age, education level, name of the university, monthly allowances and course taken.

2. Section B contain question about the carbon footprint knowledge:

   This section consists of 5 questions which are related to general knowledge on carbon footprint. For example, the definition, the emissions and the impacts. The scores for each question was assessed by giving 1 score for "yes" answer and 0 score for "no" answer.

   - Good level (80% - 100%): 4-5 scores
   - Fair level (60% - 79%): 3 scores
   - Poor level (less than 59%): 0-2 scores

3. Section C is about the students attitudes towards carbon footprint:

   This section consists of 5 questions which more focusing on the perception and beliefs. For example, I think meat can increase the level of carbon footprint, global climate change has related to the carbon footprint and others. This score was rated by using a likert scale 1 to 5 where;

Table 3.2: Likert scale for attitudes scores

Positive statement / Negative statement	
Choice	**Scores**
Strongly agree	5
Agree	4
Neither agree nor disagree	3
Disagree	2
Strongly disagree	1

These rating scales have range of 5-25 points of scores where the individual answers was summed up into total scores and the mean calculated. The scores were categorized into 3 levels as follows:

- Positive attitude (71% - 100%): 18-25 scores
- Neutral attitude (60% - 70%): 15-17 scores
- Negative attitude (less than 59%): 5-14 scores

4. Section D is about the practices to reduce the level of carbon footprint produced.

This part consists of 5 questions on what they usually do in daily life. For example, I switch off the electrical equipment whenever I am done using it, I prefer to take public transport or carpool and others. The likert rating scale was used for these questions.

Table 3.3: Likert scale for practices scores

Positive statement / Negative statement	
Choice	**Scores**
Always	5
Often	4
Sometimes	3
Rarely	2
Never	1

These rating scales have range of 5-25 points of scores where the individual answers was summed up into total scores and the mean calculated. The scores were categorized into 3 levels as follows:

- Positive practices (71% - 100%): 18-25 scores
- Neutral practices (60% - 70%): 15-17 scores
- Negative practices (less than 59%): 5-14 scores

5. Section E is to calculate the level of carbon footprint produced by the emission categories as follow:

- Electricity
  - This part consists of 2 questions.
  - Questions: types of bulbs used and duration of bulbs consumption.

- Paper
  - This part consists of 2 questions.
  - Questions: Type of paper used and number of paper used.

- Transportation
  - This part consists of 3 questions.
  - Questions: average amount of fuel used.

- Food
  - This part consists of 4 questions.
  - Questions: Types of food, how much spend on food, how many times consumed food and average amount of food consumed.

3.5.2 Carbon footprint calculation

Microsoft Excel 2010 was used to determine the level of carbon footprint by emission category among higher education students. It estimates how many tons of carbon dioxide and other greenhouse gases that were created. In this study, we will refer carbon footprint formula due to the study conducted by Hooi et al. (2011):

Table 3.4: Carbon footprint formula

Emission category	Carbon footprint formula	Notes
Electricity	CO_2 = (average amount of electric bill per month ÷ price per kwh) × electricity emissions factor × months in a year	It is better to use the average EEF of West Malaysia 0.585 CO_2e/mWh Price per kwh average for Malaysia = RM0.3853
Paper	CO_2 = AMP X PEF AMP: Average Monthly Paper Used (Kg) PEF: Paper Emission Factor (CO_2e/Kg)	1 Kg of virgin paper produces 3.24 Kg of CO_2. 1 Kg of recycle paper produces 1.76 Kg of CO_2. The weight of one A4 standard paper is 5 gram.
Fuel	CO_2 = AMF X FEF AME: Average Monthly Fuel Used (litres) FEF: Fuel Emission Factor (CO_2e/litres)	Every litre of gasoline burnt releases 2.5 kg of CO_2. Every litre of diesel releases 2.85 kg of CO_2.
Food	CO_2 = Sum of food categories [(dollars spent on each category per month × emissions factor for each category × months in a year) × gram to pound conversion]	Meat, fish, & eggs emissions factor = 1452 Cereals & Bakery Products emissions factor = 741 Dairy emissions factor = 1911 Fruits & vegetables emissions factor = 1176 Eating out emissions factor = 368 Other foods emissions factor = 467 Gram to pound conversion = 0.0022

3.6 Data Analysis

Table 3.5: Data analysis

Objectives	Hypothesis	Statistical analysis
To determine and compare the knowledge of carbon footprint among higher education students in three groups university	There is significant difference of mean rank between knowledge of carbon footprint among higher education students in three groups university	**Descriptive analysis** Non parametric: **Kruskal Wallis Test**
To determine and compare the attitudes and practices of carbon footprint among higher education students in three groups university	There is significant difference of mean rank between attitudes and practices of carbon footprint among higher education students in three groups university	Descriptive analysis Non parametric: **Kruskal Wallis Test**
To compare the level of carbon footprint produced in three groups of university	There is significant difference of mean rank between level of carbon footprint produced in three groups of university	Non parametric: **Kruskal Wallis test**
To determine and compare the level of carbon footprint produced by emission categories (i.e.: transportation, electricity, paper and food) and socio demographic status (i.e.: age, gender, monthly allowances).	There is significant difference of mean rank between level of carbon footprint produced by emission categories (i.e.: transportation, electricity, paper and food) and socio demographic status (i.e.: age, gender, monthly allowances).	**Gender:** Non parametric: **Mann Whiney-U** **Age and monthly allowances:** Non parametric: **Kruskal Wallis Test**
To investigate the relationship between socio demographic status (age, gender, and monthly allowances), type of university, knowledge, attitudes, practices and total level of carbon footprint among higher education students.	There is significant association between socio demographic status (age, gender, and monthly allowances), type of university, knowledge, attitudes, practices and total level of carbon footprint among higher education students.	**Regression analysis**

3.7 Quality Assurance and Quality Control

Quality assurance and quality control can be defined as those aspects of laboratory, policy and practice, which ensure that all test results are reported accurately. Explanation of the study and questionnaire is given to the respondents prior to administering the questionnaire. Further clarification on the questions in the questionnaire also explained to the respondents who did not understand the questions.

Pre-testing was conducted among 10% of the same sample population and in the location that was likely representing this study population. Corrections and modifications to the questionnaire were done before data collection.

3.8 Ethical Concern

1. The code number of ethic approved was FPSK(EXP16-OSH)U054. After been approved by Ethics Committee of University Putra Malaysia, the researcher officially applies for permission to perform the study at the higher education in Selangor.
2. Respondents were given an explanation about the study procedure.
3. All information about the respondents was confidential.
4. Written consent was obtained from the respondents prior to the assessment.

CHAPTER 4

RESULTS

4.1 Socio demographic background

In total 262 respondents were recruited in this research and returned all the questionnaires. The response rate was 100%.

Table 4.1 shows the distribution of socio demographic characteristics of respondents. More than half of the respondents were in the age of 22-23 years old (59.5%), female (64.5%) and stay in the accommodation provided by the university (71.4%). Majority of the respondents in this study are from public non-research university (non-RU) (N = 129, 49.2%), followed by public research university (RU) (N = 79, 30.2%) and private university (N = 54, 20.6%). Respondents from University Technology MARA dominate the number of respondents (N = 109, 41.6%). Most of the respondents are undergraduate students (N = 259, 98.9%) and in their second year of study (N = 84, 32.1%). Majority of the students have monthly allowance between RM201 to RM400 (N = 128, 48.9%).

Table 4.1: Distribution of Socio Demographic Characteristics among respondents (N=262)

Socio Demographic Characteristics		N (%)
Gender		
	Male	93 (35.5)
	Female	169 (64.5)
Age		
	19-21	78 (29.8)
	22-23	156 (59.5)
	24-35	28 (10.7)
Type of University		
	Public Research	79 (30.2)
	Public Non Research	129 (49.2)
	Private	54 (20.6)
Name of university		
	UPM (public RU)	38 (14.5)
	UKM (public RU)	41 (15.6)
	UITM (public non-RU)	109 (41.6)
	UIAM (public non-RU)	20 (7.6)
	UNITEN (private)	17 (6.5)
	UNIKL (private)	37 (14.1)
Education Level		
	Degree	259 (98.9)
	Master	2 (0.8)
	PhD	1 (0.4)
Year of study		
	First year	38 (14.5)
	Second year	84 (32.1)
	Third year	62 (23.7)
	Forth year	78 (29.8)
Accommodation		
	University accommodation (hostel)	187 (71.4)
	Rent's house	48 (18.3)
	Family's house	27 (10.3)
Monthly allowance		
	Less than RM200	53 (20.2)
	RM201-RM400	128 (48.9)
	Above RM401	81 (30.9)

4.2 The comparison of carbon footprint knowledge among higher education students by type of university

The carbon footprint knowledge scores were divided into good, fair and poor level in Table 4.2. More than half of the respondents have good knowledge (N = 204, 77.9%), 13.4% (N = 35) students have fair level and 8.8% (N = 23) students have poor knowledge.

Table 4.2: Knowledge scoring level of Carbon footprint

Scoring Level	Frequency (N)	Percentage (%)
Good (4-5)	204	77.9
Fair (3)	35	13.4
Poor (0-2)	23	8.8

*the scoring level was based on Ahmed, (2007)

Students from public non-RU have the higher mean rank of knowledge scores compared to other universities. The mean rank of knowledge score for public non-RU university was 4.32 (N = 115) followed by 4.31 (N = 54) for private university and 4.20 (N = 79) for public RU university. There was no significant difference of mean rank for the level of knowledge by type of university in this study. It indicates types of university do not influence the knowledge level of the respondents.

Table 4.3: Knowledge of carbon footprint in three groups of university

Scoring Level	Type of University	N (%)	Mean Rank (SD)	Min	Max	X^2 (df)	*p*-value
Good (3-5)	Public research university (RU) (n=79)	76 (96.20)	4.20 (0.731)	3	5	1.446 (2)	0.485
	Public Non research university (RU) (n=129)	115 (89.15)	4.32 (0.695)	3	5		
	Private (n=54)	48 (88.89)	4.31 (0.689)	3	5		
Poor (0-2)	Public RU	3 (3.80)	1.00 (0.000)	1	1	2.472 (2)	0.291
	Public Non RU	14 (10.85)	1.43 (0.646)	0	2		
	Private	6 (11.11)	1.17 (0.408)	1	2		

Kruskal Wallis Test, *p<0.001 is significant, N = 262

Students from public RU have the higher mean rank of knowledge scores compared to other universities. The mean rank of knowledge for public RU university was 4.08 (N = 79) followed by 4.01 (N = 129) for Public non-RU university and 3.96 (N = 54) for private university. There was no significant difference of mean rank for the knowledge scores by universities in this study.

Table 4.4: Knowledge of carbon footprint in three groups of university

Type of University	Mean Rank (SD)	Min	Max	X^2 (df)	*p*-value
Public research university (RU) (n=79)	4.08 (0.944)	1	5	0.028(2)	0.986
Public Non research university (RU) (n=129)	4.01 (1.135)	0	5		
Private (n=54)	3.96 (1.197)	1	5		

Kruskal Wallis Test, *p<0.001 is significant, N = 262

4.3 The comparison of the attitudes and practices of carbon footprint among higher education students by type of universities

Table 4.5 represents the attitudes and practices score level that were divided into positive, neutral and negative. Majority of the respondents have positive attitudes (N = 209, 79.8%) on carbon footprint. Table 4.6 shows that more than half of them agree that global climate change is related to carbon footprint (N = 145, 55.3%), speeding and unnecessary acceleration of car can increase the carbon footprint (N = 141, 53.8%), paper usage can contribute to the carbon footprint (N = 130, 49.6%) and switch off all electrical appliances when not in use can reduce the carbon footprint (N = 114, 43.5%). Majority of them are not sure about meat can decrease the level of carbon footprint (N = 116, 44.3%).

In the practices sections, table 4.7 state that more than half of the respondents have negative level (N=153, 58.4%) followed by neutral level (N=91, 34.7%) and positive level (N=18, 6.9%). Almost half respondents (N = 113, 43.1%) always

switch off the electrical appliances after using it. Apparently, majority of them (N = 231, 88.2%) have never checked their carbon footprint level before.

Table 4.5: Attitudes and Practices scoring level of Carbon Footprint

Scoring Level	Attitudes		Practices	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Positive (18-25)	209	79.8	18	6.9
Neutral (15-17)	45	17.2	91	34.7
Negative (5-14)	8	3.1	153	58.4

*the scoring level was based on Ahmed, (2007)

Table 4.6: Attitudes survey statement and descriptive statistics of Likert-scale variables

Survey statement	Percentage distribution of response				
	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
Meat can decrease the level of carbon footprint.	13(5.0)	58(22.1)	116(44.3)	65(24.8)	10(3.8)
Global climate change is related to carbon footprint.	81(30.9)	145(55.3)	28(10.7)	7(2.7)	1(0.4)
Speeding and unnecessary acceleration of car can increase the carbon footprint.	65(24.8)	141(53.8)	40(15.3)	12(4.6)	4(1.5)
Paper usage can contribute to the carbon footprint.	67(25.6)	130(49.6)	42(16.0)	21(8.0)	2(0.8)
Switch off all the electrical appliances when not in use can reduce the carbon footprint.	89(34.0)	114(43.5)	45(17.2)	12(4.6)	2(0.8)

Table 4.7: Practices survey statement and descriptive statistics of Likert-scale variables

Survey statement	Percentage distribution of response				
	Always	Often	Sometimes	Rare	Never
I switch off the electrical equipment whenever I am done using it.	113(43.1)	77(29.4)	53(20.2)	14(5.3)	5(1.9)
I prefer to use virgin paper rather than recycle paper.	40(15.3)	52(19.8)	79(30.2)	40(15.3)	51(19.5)
I include meat in my diet.	55(21.0)	91(34.7)	68(26.0)	37(14.1)	11(4.2)
I usually ride bicycle or walk.	38(14.5)	73(27.9)	89(34.0)	50(19.1)	12(4.6)
I had checked my carbon footprint level before.	1(0.4)	5(1.9)	12(4.6)	13(5.0)	231(88.2)

Table 4.8 represents the attitudes scores in three groups of university. The highest positive scores were determined among students in public RU (20.39 ± 2.021) followed by public non-RU (19.97 (1.687) and private university (19.53 (1.601). The neutral attitude scores were significantly higher among public RU's students (16.50 (0.674), compared to public non-RU (15.57 (0.676) and private (15.73 (1.009) (X^2 = 9.399, $p < 0.05$). The highest negative scores were obtained among students from public non-RU (13.00 (1.414), followed by private (12.67 (2.642) and public RU (11.00 (4.359). There was no significant difference of mean rank for the positive and negative attitude scores by type of university.

Table 4.8: Attitudes of carbon footprint in three groups of university

Scoring Level	Type of University	N (%)	Mean Rank (SD)	Min	Max	X^2 (df)	*p*-value
Positive (18-25)	Public research university (RU) (n=79)	64 (81.01)	20.39 (2.021)	18	25	4.735 (2)	0.094
	Public Non research university (RU) (n=129)	106 (82.17)	19.97 (1.687)	18	24		
	Private (n=54)	40 (74.07)	19.53 (1.601)	18	24		
Neutral (15-17)	Public RU	12 (15.19)	16.50 (0.674)	15	17	9.399 (2)	<0.05*
	Public Non RU	21 (16.28)	15.57 (0.676)	15	17		
	Private	11 (20.37)	15.73 (1.009)	15	17		
Negative (5-14)	Public RU	3 (3.80)	11.00 (4.359)	6	14	0.123 (2)	0.940
	Public Non RU	2 (1.55)	13.00 (1.414)	12	14		
	Private	3 (5.56)	12.67 (2.642)	12	14		

Kruskal Wallis Test, *$p<0.05$ is significant, N = 262

*the scoring level was based on Ahmed, (2007)

Table 4.9 describes there were no significantly difference of the practices scores by type of university. Public research university have higher mean rank of positive practice score (18.25) compared to public non research university (18.15) and private university (18.00). But for the neutral level, public non research university have the higher mean rank 15.79 compared to public research university 15.70 and private 15.59. The results show different in negative level whereas private university have higher mean rank which is 12.81 compared to the others. Table 4.9 showed there was no significant difference of mean rank between the practices level (positive, neutral and negative) towards the carbon footprint among higher education students in three Groups University (public research, public non-research and private university). The results show that the types of university do not affect the respondent's practices towards the carbon footprint.

Table 4.9: Practices of carbon footprint in three groups of university

Scoring Level	Type of University	N (%)	Mean Rank (SD)	Min	Max	X^2 (df)	*p*-value
Positive (18-25)	Public research university (RU) (n=79)	4 (5.06)	18.25 (0.500)	18	19	0.392 (2)	0.822
	Public Non research university (RU) (n=129)	13 (10.08)	18.15 (0.376)	18	19		
	Private (n=54)	1 (1.85)	18.00 (0.000)	18	18		
Neutral (15-17)	Public RU	30 (37.97)	15.70 (0.877)	15	17	1.214 (2)	0.545
	Public Non RU	34 (26.36)	15.79 (0.687)	15	17		
	Private	27 (50.00)	15.59 (0.572)	15	17		
Negative (5-14)	Public RU	45 (56.96)	12.56 (1.439)	9	14	0.253 (2)	0.881
	Public Non RU	82 (63.57)	12.50 (1.597)	8	14		
	Private	26 (48.15)	12.81 (1.132)	10	14		

Kruskal Wallis Test, *$p<0.001$ is significant, N = 262
*the scoring level was based on Ahmed, (2007)

4.4 The comparison of carbon footprint level produced by type of university

Kruskal Wallis test was used to analyse the difference between total carbon footprint by type of university (unit carbon footprint, kg CO_2-e). The total carbon footprint produced by the respondents in this study was significantly higher among students in private university with the mean rank (SD) of (2295.906 (955.208) kg CO_2-e) compared to respondents in public non RU (1455.203 (1316.623) and RU students (1333.546 (1121.109) ($X^2 = 44.671$, $p < 0.001$).

Table 4.10: Total Carbon Footprint in three university groups (unit carbon footprint, kg CO_2-e)

Type of University	N (%)	(Mean Rank, kg CO_2-e) (SD)	Min	Max	X^2 (df)	*p*-value
Public RU	79 (30.15)	1333.546 (1121.109)	165.716	8724.538	44.671 (2)	<0.001*
Public Non RU	129 (49.24)	1455.203 (1316.623)	167.919	8286.770		
Private	54 (20.61)	2295.906 (955.208)	636.400	5172.565		

Kruskal Wallis Test, *p<0.001 is significant, N = 262

The emission categories of carbon footprint were divided by four categories; food, transportation, paper and electricity in Table 4.11. Only transportation and electricity emission shows significant difference by type of university. The emission level for transportation was significantly higher among respondents in private university (1231.09 kg CO_2-e) compared to public non-RU (589.738 (922.257) and RU's (528.313 (629.839) at X^2 = 35.840, and p <0.001. The emission for electricity was significantly higher among respondents in private university (651.10 (397.882) kg CO_2-e) compared to public non-RU (369.216 (478.221) and RU's (321.895 (929.671) at X^2 = 47.302 and p <0.001. The level of emission by food category of the public non research was (516.17 kg CO_2-e) followed by public RU (508.664 (322.168) and private university (462.523 (344.182). For paper emission level, the mean rank carbon produced for public non-RU was (62.26 (66.004) kg CO_2-e), followed by private (54.554 (20.567) and RU's (51.763 (54.310).

Table 4.11: Level of Carbon Footprint by emission categories in three university groups (unit carbon footprint, kg CO_2-e)

Level Carbon Footprint	Type of University	N (%)	Mean Rank (SD)	Min	Max	X^2 (df)	*p*-value
Food	Public RU	79 (30.15)	508.664 (322.168)	30.630	1645.700	1.151 (2)	0.562
	Public Non RU	129 (49.24)	516.167 (440.853)	52.146	2676.975		
	Private	54 (20.61)	462.523 (344.182)	30.629	1834.444		
Transportation	Public RU	79 (30.15)	528.313 (629.839)	0.000	2397.443	35.840 (2)	<0.001*
	Public Non RU	129 (49.24)	589.738 (922.257)	0.000	5916.424		
	Private	54 (20.61)	1231.089 (880.204)	0.000	3173.086		
Paper	Public RU	79 (30.15)	51.763 (54.310)	0.000	212.646	5.800 (2)	0.055
	Public Non RU	129 (49.24)	62.259 (66.004)	0.000	399.116		
	Private	54 (20.61)	54.554 (20.567)	0.000	88.178		
Electricity	Public RU	79 (30.15)	321.895 (929.671)	6.353	8144.76	47.302 (2)	<0.001*
	Public Non RU	129 (49.24)	369.216 (478.221)	30.624	3257.904		
	Private	54 (20.61)	651.101 (397.882)	57.013	1920.046		

Kruskal Wallis Test, *p<0.001 is significant, N = 262

4.5 Comparison of carbon footprint level by emission categories and socio demographic characteristics

Mann Whitney U test was used to determine and compare the level of carbon footprint produced by gender. Male produced significantly higher carbon emission for transportation (926.210 (1005.866) and electricity (490.005 (550.281) compared to female ($p < 0.05$). There were no significant difference of mean rank obtained for emission level for food and paper between genders (Table 4.12).

Table 4.12: Level of carbon footprint by emission categories and gender (unit, kg CO_2-e)

Level Carbon Footprint	Gender	N (%)	Mean Rank (SD)	Min	Max	z	*p*-value
Food	Male	93 (35.5)	544.273 (454.854)	30.629	2676.975	-0.615	0.538
	Female	169 (64.5)	480.052 (345.749)	30.629	1945.982		
Transportation	Male	93 (35.5)	926.210 (1005.866)	0.000	4733.139	-3.250	<0.05*
	Female	169 (64.5)	580.794 (770.595)	0.000	5916.424		
Paper	Male	93 (35.5)	55.582 (51.743)	0.000	244.788	-0.133	0.894
	Female	169 (64.5)	58.565 (58.210)	0.000	399.116		
Electricity	Male	93 (35.5)	490.005 (550.281)	6.353	3257.904	-2.275	<0.05*
	Female	169 (64.5)	370.695 (691.487	30.624	8144.760		

Mann-Whitney U Test, *p<0.05 is significant, N = 262

Figure 4.1 showed that male respondents contribute the higher transportation emission of carbon footprint which is 926.21 kg CO_2-e followed by food emission (544.27 kg CO_2-e), electricity (490.01 kg CO_2-e) and paper (55.58 kg CO_2-e). Female respondents also showed the similar pattern. The female respondents contribute the highest emission of carbon footprint in transportation which is 580.79 kg CO_2-e followed by food (480.05 kg CO_2-e), electricity (370.7 kg CO_2-e) and paper (58.57 kg CO_2-e).

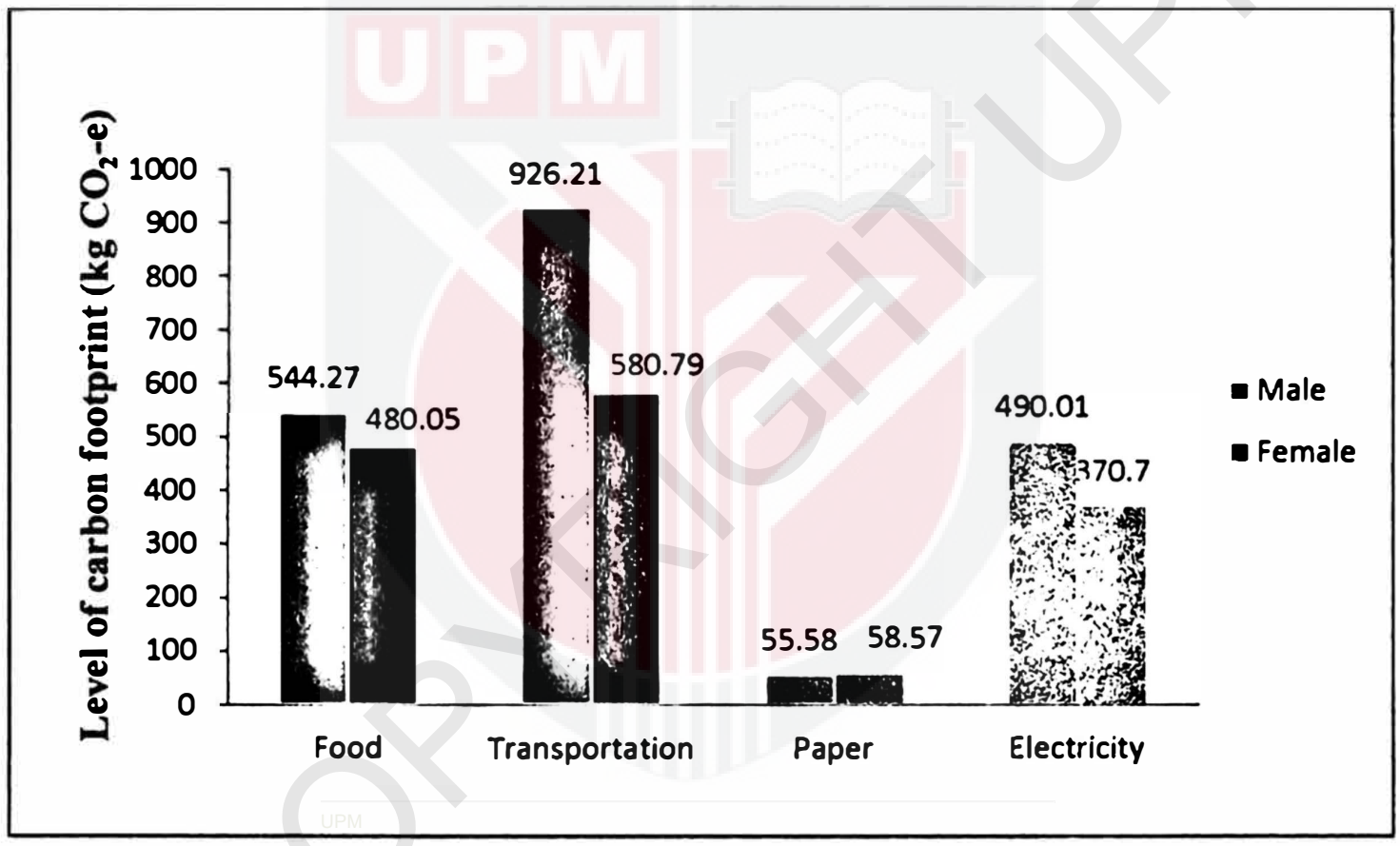


Figure 4.1: Average level of carbon footprint by emission categories between gender

Table 4.13 show the level for each emission categories by respondent's age. The age between 24 to 35 years old produced significantly higher emission on transportation (883.491 (1334.294) compared to other age group (X^2 = 6.078, p <0.05). There were no significant difference on the emission levels by aged for food, paper and electricity.

Table 4.13: Level of carbon footprint by emission categories and age group (unit, kg CO_2-e)

Level Carbon Footprint	Age Group	N (%)	Mean Rank (SD)	Min	Max	X^2 (df)	*p*-value
Food	19-21	78 (29.77)	515.038 (445.437)	30.629	2348.088	0.260 (2)	0.878
	22-23	156 (59.54)	491.081 (328.363)	30.629	1834.444		
	24-35	28 (10.69)	534.453 (520.438)	90.907	2676.975		
Transportation	19-21	78 (29.77)	507.139 (616.437)	0.000	2839.884	6.078 (2)	<0.05*
	22-23	156 (59.54)	769.213 (872.830)	0.000	4733.139		
	24-35	28 (10.69)	883.491 (1334.294)	0.000	5916.424		
Paper	19-21	78 (29.77)	58.889 (55.055)	0.000	243.024	2.892 (2)	0.235
	22-23	156 (59.54)	53.366 (51.133)	0.000	320.055		
	24-35	28 (10.69)	76.722 (78.006)	7.716	399.116		
Electricity	19-21	78 (29.77)	387.501 (420.144)	6.353	2115.276	0.944 (2)	0.624
	22-23	156 (59.54)	403.763 (725.739)	40.154	8144.760		
	24-35	28 (10.69)	535.925 (702.507)	37.059	3257.904		

Kruskal Wallis Test, *p<0.05 is significant, N = 262

The highest emission of carbon footprint in food (534.45 kg CO_2-e), transportation (883.49 kg CO_2-e), electricity (535.93 kg CO_2-e) and paper emission (76.72 kg CO_2-e) was contributed by respondents in the range of age 24 to 35. Transportation dominant the emission level in all age group with the average of 883.49 kg CO_2-e for respondents in 24 to 35 and 769.21 kg CO_2-e for respondents with the age of 22 to 23. The second highest emission was food majority of the respondents in all age produced about the same level (Figure 4.2).

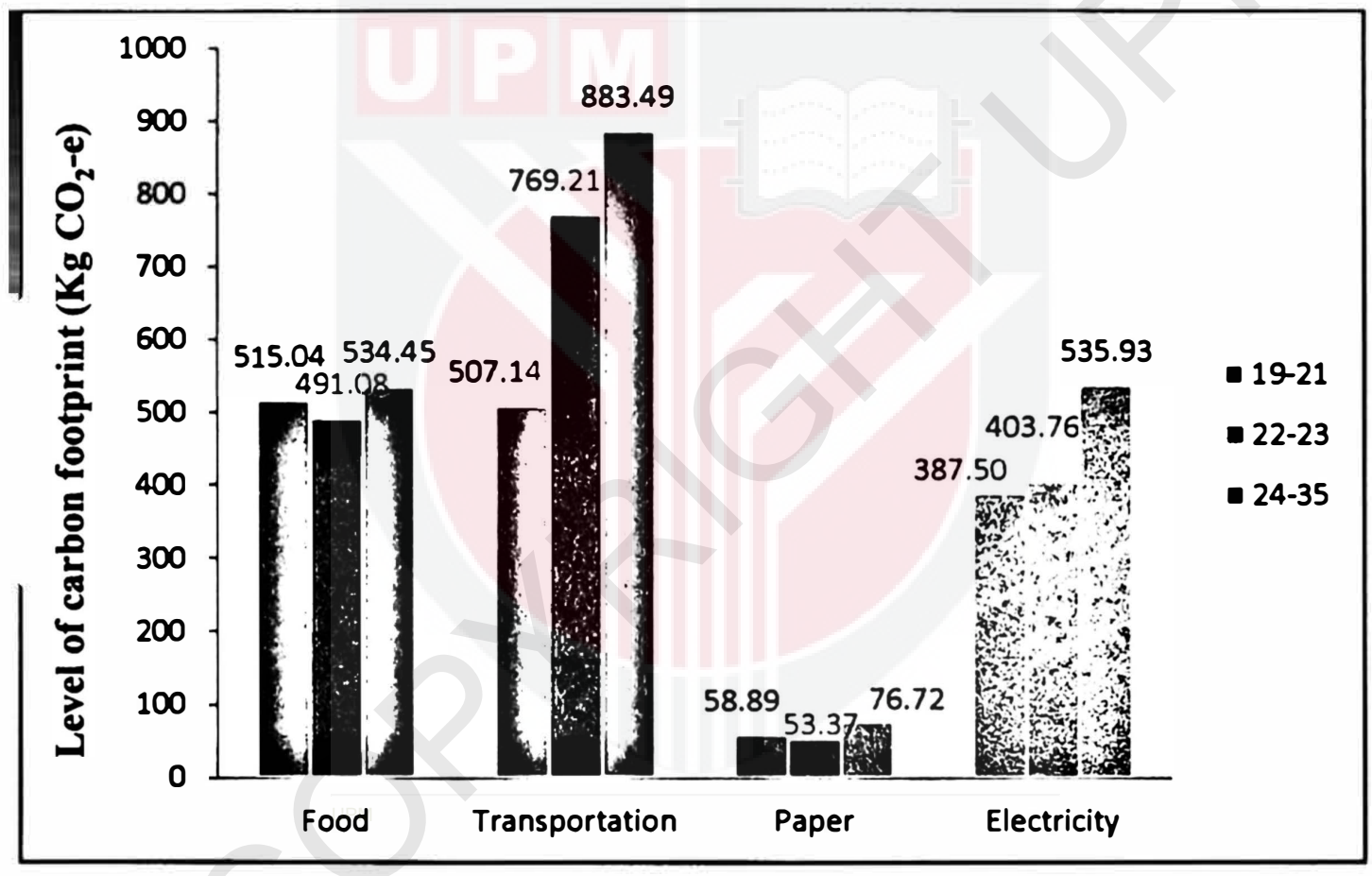


Figure 4.2: Average level of carbon footprint by emission categories between age group

The monthly allowances were categorized in three groups as follow; below RM200, between RM201 to RM400 and above RM401. Respondents with monthly allowance above RM401 produced significantly higher emission under food (545.85 kg CO_2-e), transportation (977.53 kg CO_2-e), and electricity (602.91 kg CO_2-e) ($p < 0.05$). Paper emission was not significantly difference by allowance ($X^2 = 1.307$, $p = 0.520$).

Table 4.14: Level of carbon footprint by emission categories and monthly allowances (unit, kg CO_2-e)

Level Carbon Footprint	Monthly allowances	N (%)	Mean Rank (SD)	Min	Max	X^2 (df)	*p*-value
Food	<RM200	53 (20.23)	423.441 (410.421)	30.629	1945.982	7.086 (2)	<0.05*
	RM201-RM400	128 (48.85)	508.514 (353.124)	30.629	2676.975		
	>RM401	81 (30.92)	545.852 (422.506)	45.944	2348.088		
Transportation	<RM200	53 (20.23)	455.188 (706.412)	0.000	4733.139	19.442 (2)	<0.05*
	RM201-RM400	128 (48.85)	632.710 (790.776)	0.000	3173.086		
	>RM401	81 (30.92)	977.530 (1028.614)	0.000	5916.424		
Paper	<RM200	53 (20.23)	55.355 (55.504)	0.000	320.055	1.307 (2)	0.520
	RM201-RM400	128 (48.85)	55.526 (53.331)	0.000	243.024		
	>RM401	81 (30.92)	62.043 (60.445)	0.000	399.116		
Electricity	<RM200	53 (20.23)	337.066 (349.935)	30.624	1547.504	15.929 (2)	<0.05*
	RM201-RM400	128 (48.85)	324.356 (417.735)	6.353	3257.904		
	>RM401	81 (30.92)	602.914 (976.473)	57.013	8144.760		

Kruskal Wallis Test, *p<0.05 is significant, N = 262

The findings showed the respondents in the range of monthly allowances above RM401, contribute to the highest carbon emissions in this study. The highest carbon emission was determined for transportation (977.53 kg CO_2-e), followed by electricity (602.91 kg CO_2-e), food (545.85 kg CO_2-e) and paper (62.04 kg CO_2-e). The second highest carbon emission was recorded for respondents with monthly allowance RM201 to RM400 where the highest emission was recorded for transportation (632.71 kg CO_2-e) followed by food (508.51 kg CO_2-e), electricity (324.36 kg CO_2-e) and paper (55.53 kg CO_2-e). The less carbon was emitted by those respondents with allowance less than RM200 per month, with the emission for transportation was 455.19 kg CO_2-e followed by food (423.44 kg CO_2-e), electricity (337.07 kg CO_2-e) and paper (55.36 kg CO_2-e) (Figure 4.3).

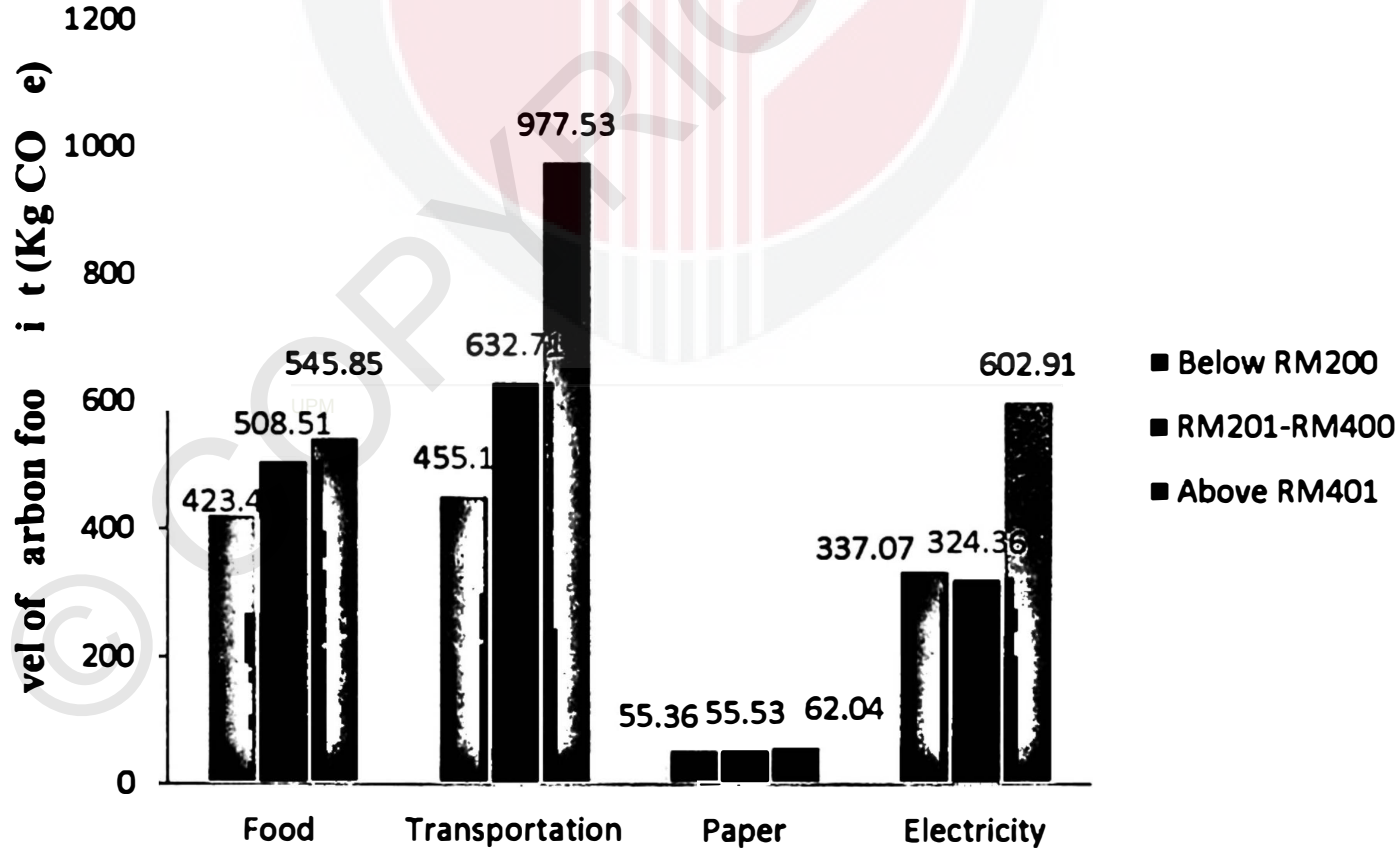


Figure 4.3: Average level of carbon footprint by emission categories between monthly allowances

4.6 Relationship between socio demographic status, type of university, knowledge, attitudes, practices with the carbon footprint level

Table 4.15 describes the relationship between socio demographic characteristics (i.e. age, gender, and monthly allowance), type of university, and knowledge, attitudes, and practices with the level of carbon footprint. The multiple linear regressions showed that the socio demographic factors (i.e. gender), knowledge, attitude and practices model were negative value of standardized coefficients (B) which were – 0.133, – 0.008, – 0.040 and -0.237 respectively. It indicates that the lower the level of knowledge, attitudes, practices and gender, the higher the level of carbon footprint. The other model which is age group, monthly allowances and type of university showed the positive value of standardized coefficients (B) which were 0.091, 0.187 and 0.198 respectively. It indicate that the higher the level of age group, monthly allowances and type of university, the higher the level of total carbon footprint. Multiple linear regression showed that there was significant association between gender, monthly allowances, type of university and practices with the total carbon footprint (p<0.05). But there was no significant association between age group, knowledge and attitudes with the total carbon footprint. The value of R^2 was 0.206. It indicates that the age, gender, monthly allowances, type of university, knowledge, attitudes, practices influence 20.6% of the variance in total level of carbon footprint.

Table 4.15: Relationship between age, gender, monthly allowances, type of university, knowledge, attitudes, practices and total level of carbon footprint

Model	Standardized Coefficients (B)	t	*p*-value	95.0% Confidence Interval for B	
				Lower Bound	Upper Bound
Age Group (AG)	0.091	1.604	0.110	-42.444	415.375
Gender (G)	-0.133	-2.320	<0.05*	-637.065	-52.032
Monthly allowances (MA)	0.187	3.210	<0.05*	126.829	529.379
Type of University (TOU)	0.198	3.349	<0.05*	142.947	551.040
Knowledge (K)	-0.008	-0.138	0.890	-137.763	119.735
Attitude (A)	-0.040	-0.691	0.490	-73.156	35.134
Practices (P)	-0.237	-4.132	<0.05*	-196.825	-69.758

R Square	Adjusted R Square	F	df
0.206	0.184	9.393	7

Multiple Linear Regression, *p<0.05 is significant

*Note: Method= enter

Total Carbon Footprint = 2739.661 + 0.091 (AG) – 0.133 (G) + 0.187 (MA) + 0.198 (TOU) – 0.008 (K) – 0.040 (A) – 0.237 (P)

CHAPTER 5

DISCUSSION, CONCLUSION & RECOMMENDATION

5.1 Knowledge of carbon footprint among higher education students by universities

The knowledge score about carbon footprint were divided into good, fair and poor level based on Ahmed, (2007). In general, more than half of the respondents have good knowledge. This is consistent with a study done by Hassan et al. (2016) with a high level of knowledge and awareness level towards environment was recorded among research university students in Malaysia. Hassan et al. (2016) did a study on knowledge, awareness, attitudes and practices towards environment among students. The study was conducted at Universiti Kebangsaan Malaysia (UKM) involving 375 respondents (n=375).

Altin et al. (2014) reported that secondary school student's awareness of environmental issues and problems have been investigated. The study was carried out in Balikesir city centre by conducting a survey on senior students consisting of 6 classes from three secondary schools. The results of the study showed a high level of environmental awareness (63%) among participant students.

Students from public non-RU have slightly higher mean rank of knowledge scores compared to other universities, but no significant difference was obtained statistically. This possibly due to the environment of where the students are. For example, Hussin & Kunjuraman (2015) indicates that there are many universities all around the world that has been addressing the challenges of ecological sustainability in their own environment. The program was named as Eco Campus or Green Campus. In Malaysia, there are several Universities that had been implemented Eco Campus programs which include University Putra Malaysia, University Malaysia Sabah, University Technology Malaysia and others. Eco campus was implemented to reduce on-campus waste and energy consumption, promote alternative transportation and take other measures to benefit the environment.

5.2 Attitudes and practices of carbon footprint among higher education students by universities

Majority of the respondents in this study have positive attitudes on carbon footprint but have low level of environmental practice. Among the component with positive attitude is more than half of them agree that global climate change is related to carbon footprint, speeding and unnecessary acceleration of car can increase the carbon footprint, paper usage can contribute to the carbon footprint and switch off all electrical appliances when not in use can reduce the carbon footprint. However, majority of the students are not sure about meat can decrease the level of carbon footprint. This possibly something new to them.

As for the component in environmental practices, almost half respondents always switch off the electrical appliances after using it but majority of them have never checked their carbon footprint level.

This was also supported by Wahida et al. (2004) who stated that the awareness towards environmental issues and awareness about the need to maintain the environment had increased among the society, but the level of individual involvement in the activities of environmental protection still at low level. A study done in University Kebangsaan Malaysia also indicate the that high level of attitudes among UKM students (81.76% of 375 of the respondents) but low level of environmental practices (60.0%) (Hassan et al., 2016).

Public Research University had high level of attitudes and practices compared to the others type of university. This possibly due to the exposure of the students on the environmental issues for example the green campus that was implemented in the university. They had learnt in those cultures, thus it will benefit the environment (Zen et al., 2013). This finding was supported by Loon, Y.W. (2004) which mentions that the study on measuring environmental literacy among students of Faculty of Science in University Putra Malaysia which is one of the public research universities showed that more than 80% of all students had high level of attitude of environmental education. This might be due to the difference of their personality, influenced by their lifestyle and family further because of emphasizing on environmental attitude by the government and the media in these later years. Meanwhile, the study on attitudes towards environmental education among secondary school students in Malaysia showed that majority of student's attitude was

positive about environmental issues (Aminrad et al., 2013). This study involved 470 students. The study has focused on the students of 9 secondary schools at the age of 16 who attend "Form Four" classes in Kajang town, Selangor, Malaysia.

This finding was related to the theory of planned behaviour. According to the theory of planned behaviour (Ajzen, 1985; Ajzen, 1991), the behavioural intention is defined as the persons' thought of self-readiness to perform the behaviour, and it is the best predictor of the actual behaviour. Also, based on this theory, the intention to perform the behaviour is determined by three factors which are attitude towards the behaviour, subjective norm and perceive behavioural control.

5.3 Level of carbon footprint level by universities

Carbon footprint was emitted by several emissions. In this study, we measure four emissions categories which are food, transportation, paper and electricity. In overall emissions the total carbon footprint was significantly higher among private university students (2295.906 kg CO_2-e) compared to other university. These possibly because of the students have to commute to the university as they live outside campus. Majority of the private university students stay outside of the campus thus increased the monthly allowances. This is consistent with the level of carbon produce by emission in Table 4.10, where transportation were the highest carbon produced.

Other factors that influence the result is the lifestyle. The most obvious activity that may contribute to carbon footprint is travelling and uses of high energy light bulbs and appliances. Another factor to consider is how your food and diet impact the atmosphere. It is more sustainable to eat vegetables and starches than it is to consume meat. Finally, we need to consider the amount of waste we generate and what we do with that waste (NASPA, 2008).

When comparing level of carbon footprint produced by emission categories (food, transportation, paper and electricity) in three groups of university (public research university, public non-research university and private university), private university have the highest mean rank of transportation (1231.09 kg CO_2-e) and electricity (651.10 kg CO_2-e) emission of carbon footprint. There was significant difference between emission of carbon footprint for electricity and transportation in three university groups (public research, public non-research and private university) except for food and paper emissions. This is due to the fact that the students are staying outside from college and they have to pay for their own electrical bills. Besides, accommodating outside the university area required them to own transportation whereby this lead to the contribution of carbon footprint emission.

The finding shows that Public Research University have lower mean rank paper emission and transportation emission of carbon footprint compared to other universities. One of the public research universities is University Putra Malaysia (UPM). In Noh (2016), the study stated that UPM managed to improve its ranking in the UI-Green Metric World University Ranking 2013 from 19th place in the previous year to 16th place. The increase in this year's ranking marks UPM excellence in

actively promoting sustainability through environmental conservation and the use of green technology in recent years. The rating also factored in the commitment and efforts taken by UPM in ensuring sustainability, green campus and environmental conservation such as the size and amount of green space reserve along with its infrastructure, as well as on-campus energy efficiency. The rating also evaluated the adaptation of green technology, enforcement of sustainability policy and on-campus vehicles, paper used and waste management.

5.4 Comparison of carbon footprint level by emission categories and socio demographic status

Socio demographic status that we examine was age, gender and monthly allowances. Male produced significantly higher carbon emission for transportation and electricity compared to female. This finding consistent with the WECF, (2017) which state that men's and women's give different impact on climate. Men consume between 70 and 80% more energy than women in Germany and Norway, 100% more in Sweden, and up to 350% more in Greece. Thus, male tend to produce higher carbon footprint emission than female.

Li et al. (2014) study on carbon footprint analysis of student behaviour for a sustainable university campus in China. It state that male students did have significantly higher footprints from transportation (0.83 tCO_2-e), because their vacation travel distances were much longer than those of female students. Men (4.08 tCO_2e) had higher footprints than women (3.29 tCO_2e). This study shows women

emit 32.3 kg of carbon per day, men compare at a whopping 39.3kg because of inefficient use of transport. In transportation, for example, men make more trips in airplane and automobile, raising considerably their ecological footprint, according to the two experts. That difference could be balanced out in the future to the extent that equal opportunity allows women to climb the labour ladder, while men take on more household duties (Walsh, 2011).

The age between 24 to 35 years old produced significantly higher emission on transportation compared to other age group. The finding shows more than half of the respondents in age between 24 to 35 years old own transportation. This possibly due to the automobile use (which could be consumption or an input to production) varies by age. This finding was supported by Jensen et al. (2012) which is about an estimate of the age distribution's effect on carbon dioxide emissions. The US National Household Travel Survey (2011) reports that prime working age individuals drive the most on average. Changes in a population's age structure might generate changes in the aggregate amount of driving. Since burning fuel creates CO_2 emissions, motor vehicles could be the mechanism connecting the age distribution to emissions.

Result of this study also indicates respondents with monthly allowance above RM400 produced higher food, transportation, paper, and electricity carbon emission. This was possibly due to the privilege to afford the food, fuel for transportation and electricity bills. The higher the monthly allowance the higher the level of carbon footprint produced. This findings was supported by the statement which stated that the deliberately investment on human activities may contributes to greater carbon footprint emission due to unthoughtful decision making. Every transaction causes

ripples of economic activity and emissions, though depending on how you spend your cash, the impact will vary widely (The Guardian, 2017).

5.5 Relationship between socio demographic status (age, gender, monthly allowances), type of university, knowledge, attitudes, practices and total level of carbon footprint among higher education students.

While investigate the relationship between socio demographic status (type of university, knowledge, attitudes, practices and total level of carbon footprint among higher education students, we found that the gender, knowledge, attitude and practices model were negative value of standardized coefficients (B). It indicates that the lower the level of knowledge, attitudes, practices and gender, the higher the level of carbon footprint. According to Alzghoul & Abdullah (2015), knowledge, attitude and practices (KAP) model is one of the most used models in the medical field. According to Launiala (2009), this model was first used during the middle of the nineteenth century to assess the family planning and population (Launiala, 2009). The KAP model suggests that any practices (behaviours) are determined by the person's attitude towards the behaviours. Also, this model suggests that the person's attitude towards any behaviour is based on the knowledge about this behaviour. Thus, the level of carbon footprint was decreased when they have good knowledge, attitudes and practices towards the carbon footprint.

For genders, there are study that supporting this findings. According to Cohen (2014), there are gendered differences in the work associated with climate change.

Men, as a group, are more involved with work that contributes to GHG emissions than are women. This is evident by their direct work in industries that are identified as the major sources of GHG emissions in Canada.

The other model which is age group, monthly allowances and type of university showed the positive value of unstandardized coefficients (B). It indicate that the higher the level of age group, monthly allowances and type of university, the higher the level of total carbon footprint. Max Planck Institute for demographic research (2017) state that Carbon dioxide (CO_2) emissions of the population will keep increasing until around age 65, then start to decrease while for the monthly allowances, it state that when we spend more money, automatically we will increase the level of carbon footprint (The Guardian, 2017).

Meanwhile, there was significant association between gender, monthly allowances, type of university and practices with the total carbon footprint. But there was no significant association between age group, knowledge and attitudes with the total carbon footprint.

For gender, Li et al. (2014) were mentioning that male produced higher level of carbon footprint than female. This might be because male students eat in off-campus restaurants more often, while female students most frequently eat at the school dining halls. Because the school dining halls are large centralized facilities, they are more energy efficient. Besides, male students more often reported studying in their dorm rooms, leading to more per-capita energy use. Female students, on the

other hand, strongly preferred to study in the library, where lighting and space conditioning needs are shared among many more occupants.

Male students did have significantly higher footprints from transportation, because their vacation travel distances were much longer than those of female students. This findings was consistently with the study by Rastogi (2010) which state that the most significant difference between the genders came in the transport category which is single men's driving habits have a carbon footprint of 13 metric tons of CO_2e, compared with women's 9.4 tons.

For the monthly allowances, the increasing level of carbon footprint depends on the how much do you spend the money monthly. The higher the monthly allowance the higher the level of carbon footprint produced (The Guardian, 2009). Type of university also influence the level of carbon footprint produced. The research university was less producing carbon footprint since it implements green campus in the university (Hooi et al. 2012). Thus, the students are more aware of these issues. While the practices also influence the carbon footprint level. Although the students are aware and have good knowledge, but the students did not practice well of this issues.

5.6 Conclusions

These studies have been conducted to assess the awareness level about carbon footprint among higher education students and the level of carbon footprint they produced. The higher education students show good knowledge, positive attitudes but negative practices towards the carbon footprint. The total level of carbon footprint in three university groups (public research, public non-research and private university) shows significant difference in this study. There was significant higher emission of carbon footprint for electricity and transportation in the private university. Respondents with monthly allowance above RM401, age between 24 to 35 and male produced higher level carbon footprint compared to other groups. The age, gender, monthly allowances, type of university, knowledge, attitudes, practices influence 20.6% of the total level of carbon footprint.

5.7 Recommendations

5.7.1 Study limitation

In this study, we used convenience sampling because the method used was online survey. A convenience sample is made up of people who are easy to reach. This method does not consider the confounder that may be effect the findings of the results. For example, the background of the respondents which is marital status, the study field of the respondents whether they familiar with the carbon footprint issues. Besides, the questions that were asked in the questionnaire were very general.

5.7.2 Recommendation to overcome limitation of study

For the recommendation for uses of convenience sampling, the future study should ask more details on each issue. For example, about the behaviour of the respondents whether they prefer to eat inside of the college or outside the college, or they liked to study in library or study in dorm rooms because these behaviour can affects the level of carbon footprint produced by the respondents. Next, there must be inclusion and exclusion criteria of the respondents in order to strengthen the study research to overcome the general questions that were asked in the questionnaire.

5.7.3 Recommendation to reduce carbon footprint

The level of carbon footprint can be reduced if the students changed their attitudes and practices in their daily lives. What we can do is eat locally produced and organic food. Transporting food requires petroleum-based fuels, and many fertilizers are also fossil fuel-based. Besides, we need to cut the beef and dairy to reduce the carbon footprint level. It takes a lot of resources to raise cows and it was grazed on land that used to be tropical forest but was cleared for agricultural use. Deforestation is a top contributor to carbon emissions and thus climate change.

Next, find the alternatives to driving. When possible, walk or ride your bike in order to avoid carbon emissions completely. Carpooling and public transportation drastically reduce CO_2 emissions by spreading them out over many riders. Besides, drive a low carbon vehicle can reduce the carbon footprint.

Make your home and household energy efficient. Turn off lights you are not using and when you leave the room and also can replace incandescent light bulbs with compact fluorescent or LED ones. Compact fluorescent light bulbs (CFLs) use 75% less energy than incandescent and last up to 10 times longer. Besides, power your computer down when you are away. A computer turned off uses at least 65% less energy than a computer left on or idles on a screen saver. Lastly, use recycle paper rather than virgin paper. Besides, we also can save the paper used by print and copy on two sides, save single-sided pages for notes, and print only what you need.

Reflections

This study enables me to gain some experiences that we cannot get in somewhere else. Through this study, I get the experience to communicate with the top management and also with the university students in order to distribute the questionnaires. This will increase my communication skills that I can apply it in futures.

Besides, I also gain experiences to key in the data in the IBM SPSS. It needs a lot of focus when during it and need to be patient. This study also teaches me to find the initiative to finish it before the deadline. With this initiatives, I will able to see the opportunities and to set the achieve goals. I also gain the problem solving skills that I need to think things through in a logical way in order to determine issues, often also including creative thinking.

Along the journey, there must be up and down moments. I have to do the calculation of the level carbon footprint for each of the respondents. Then I need to do all over again because the formula changes. Besides, I also have been through a hard situation when all my data that had been key in were gone. In this situation, I need to keep calm and relax. All this happen for a reason. Thus, I will appreciate those moments to shape me into a better person. I love the challenges that I had to gone through in order to complete my thesis. Besides, I am very satisfied that everything is going well according to the timeline given by the course coordinator.

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APPENDIX 1

- **Respondent Information Sheet**
- **Respondent Consent Letter**
- **Questionnaires**

RESPONDENT'S INFORMATION SHEET AND CONSENT

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE :

Assessing the awareness and level of carbon footprint produced among higher education students in Selangor

2. INTRODUCTION:

Carbon footprint is the total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO2). The study want to determine the knowledge, attitudes and practices and also level of higher education students on carbon footprint. This study want to assess the level of carbon footprint produced by higher education students which can contribute to the global climate change.

3. WHAT WILL YOU HAVE TO DO?

As a respondent, you are needed to sign the consent form which indicated you are interested and willing to cooperate with this study. Then, the respondent are asked to complete the questionnaire as per instruction.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?

Lecturers and staffs of the University are not included in this study.

5. WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECT?

The respondent will obtain the knowledge of carbon footprint.

(b) TO THE INVESTIGATOR?

The researcher hope that the finding of this study will provide evidence based data regarding the knowledge, attitude and practice of carbon footprint and also level of carbon footprint produced by the students in order to reduce the emission greenhouse gaseous which can lead to global climate change.

6. WHAT ARE THE POSSIBLE RISKS?

There are no possible risks known for joining this study.

7. WILL THE INFORMATION THAT YOU PROVIDE AND YOUR IDENTITY REMAIN CONFIDENTIAL?

All the information and identity that are provided by the respondents will remain confidential.

8. WHO SHOULD YOU CONTACT IF YOU HAVE ADDITIONAL QUESTIONS DURING THE COURSE OF THE RESEARCH?

If you have any inquiries you can contact the researcher responsible for the study or the project supervisor of the researcher.

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*Please initial here if you have read and understood the contents of this page*_____

9. CONSENT

I ..... Identity Card No. .....
address.....
....hereby voluntarily agree to take part in the research stated above *(clinical /drug trial/video recording/ focus group/interview-based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible adverse effects and complications (as written in the Respondent's Information Sheet). I understand that I have the right to withdraw from this research at any time without giving any reason whatsoever. I also understand that this study is confidential and all information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature ..... Signature .....
(Respondent) (Witness)

Date :..... Name :.....

I/C No. :.....

I confirm that I have explained to the respondent the nature and purpose of the above-mentioned research.

Date ..... Signature .....
(Researcher)

DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH

FACULTY OF MEDICINE AND HEALTH SCIENCES

UNIVERSITI PUTRA MALAYSIA

ASSESSING THE AWARENESS LEVEL ABOUT CARBON FOOTPRINT AMONG HIGHER EDUCATION STUDENTS AND THE LEVEL OF CARBON FOOTPRINT THEY PRODUCED

The instruction to participant:

1. Please read the instruction clearly.
2. The question consist of 5 parts (Part A, B, C, D and E).
3. You are required to answer all the questions.

PART A: SOCIO DEMOGRAPHIC

Please read each statement carefully and tick (/) your answer.

1. **Age** : _____ years old
2. **Gender** : ☐ Male ☐ Female
3. **University** : _____
4. **Education level** : ☐ Degree ☐ Master ☐ PhD ☐ Others: _____
5. **Course taken** : _____
6. **What year** : ☐ 1st yr ☐ 2nd yr ☐ 3rd yr ☐ 4th yr ☐ Others: ___
7. **Stay in** : ☐ College ☐ Rent's house ☐ Family's house ☐ Others: _
8. **Monthly Expenses** : ☐ < RM200 ☐ RM201-400 ☐ > RM401 ☐ Others: _____

PART B: KNOWLEDGE ON CARBON FOOTPRINT

Please read each statement carefully and tick (/) your answer.

		YES	NO
1.	The carbon footprint and ecological footprint are the same		
2.	The carbon footprint is the total amount of greenhouse gases produced to directly and indirectly support human activities		
3.	The standard unit of measurement for carbon footprints is equivalent tons of carbon dioxide (tons CO2-eq)		
4.	Carbon footprint can be emitted through activities related to transportation, electricity, paper and food		
5.	Carbon footrpint can give impact to the environment and human health such as global warming and heat stroke		

PART C: ATTITUDES ON CARBON FOOTPRINT

Please read each statement carefully and tick (/) your answer.

		Strongly disagree	Disagree	Agree	Strongly agree	Not sure
1.	Meat can decrease the level of carbon footprint					
2.	Global climate change is related to carbon footprint					
3.	Speeding and unnecessary acceleration of car can increase the carbon footprint					
4.	Paper usage can contribute to the carbon footprint					
5.	Switch all of the electrical equipment when not in use can reduce the carbon footprint					

PART D: PRACTICES ON CARBON FOOTPRINT

Please read each statement carefully and tick (/) your answer.

		Never	Rarely	Sometimes	Often	Always
1.	I switch off the electrical equipment whenever I am done using it					
2.	I prefer to use virgin paper rather than recycle paper					
3.	I include meat in my diet					
4.	I usually ride bicycle or walk					
5.	I had checked my carbon footprint level before.					

PART E: EMISSION CATEGORY

i. FOOD

1. How would you best describe your diet?
   *You may choose more than one answer.

No.	Diet	Tick (/)	No.	Diet	Tick (/)
1.	Rice		6.	Bakery products	
2.	Meat		7.	Dairy	
3.	Fish		8.	Fruits	
4.	Eggs		9.	Vegetables	
5.	Cereals		10.	Others:_____	

2. In a month, how much do you spend on food:

No.	Diet	RM	No.	Diet	RM
1.	Rice		6.	Bakery products	
2.	Meat		7.	Dairy	
3.	Fish		8.	Fruits	
4.	Eggs		9.	Vegetables	
5.	Cereals		10.	Others:_____	

3. How many times do you consume the food in a week:

No.	Diet	Times/week	No.	Diet	Times/week
1.	Rice		6.	Bakery products	
2.	Meat		7.	Dairy	
3.	Fish		8.	Fruits	
4.	Eggs		9.	Vegetables	
5.	Cereals		10.	Others:_____	

4. Average amount of food consumed, in serving:

*1 serving rice, meat, fish, dairy = ½ cup

*1 serving egg = 2 eggs

*1 serving cereals = ¾ cup

*1 serving bakery products = 2 slices

*1 serving fruits, vegetables = 1 cup

No.	Diet	Serving/day	No.	Diet	Serving/ day
1.	Rice		6.	Bakery products	
2.	Meat		7.	Dairy	
3.	Fish		8.	Fruits	
4.	Eggs		9.	Vegetables	
5.	Cereals		10.	Others:_____	

ii. TRANSPORTATION

1. Do you own any transport?

a. Yes

b. No

*If yes, please anwer question 2.

2. In a month, average amount of fuel used : RM_____

3. In a month, the type of public transport that you use is/are:

*You may choose more than one answer.

No.	Public transport	times/month	RM/month
1.	Bus		
2.	Train		
3.	Flight		

iii. PAPER

1. **The number of paper per month that you use on average:**

   a. **Virgin paper : _____ream /month**

   b. **Recycle paper : _____ream/month**

   c. **Others: _____ : _____ream/month**

2. **The thickness of A4 papers that you use:**

a. **70gsm**

b. **80gsm**

c. **Others: _____**

iv. ELECTRICITY

1. **Do you have your own bill?**

a. **Yes**

If yes, please state your bill in average: RM_____/month

b. **No**

If no, please answer question 2.

2. **In your room or home, you have:**

No.	Electrical Equipment	Quantity	Kilowatt (kW)	Average use (hours/day)
1.	Bulbs: i. Incandescent light bulb			
	ii. Fluorescent light bulb			
	iii. Compact fluorescent bulbs (CFLs)			
	iv. Light-emitting diode (LED) light bulb			
2.	Fan			
3.	Computer/ Laptop			
4.	Iron			
5.	Others:_____			

APPENDIX 2

○ Ethical Approval Letter

ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS
(JKEUPM)
UNIVERSITI PUTRA MALAYSIA

Research title	:	**Assessing The Awareness Level About Carbon Footprint Among Higher Education Students And The Level Of Carbon Footprint They Produced**
Study Site	:	**Selangor**
JKEUPM Ref No.	:	**FPSK(EXP16-OSH)U054**
Researcher	:	**Nurul Syafiqah Ahmad**
Supervisor	:	**Dr. Sharifah Norkhadijah Syed Ismail**

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 18/10/2016
2. Respondent Information Sheet & Consent (English) Version 2 dated 9/1/2017
3. Proposal (English), Version 2 dated 9/1/2017
4. Questionnaire (English), Version 1 dated 18/10/2016
5. Curriculum Vitae of:
   a. Dr. Sharifah Norkhadijah Syed Ismail

The University Research Ethics Committee, Universiti Putra Malaysia (JKEUPM) operates in accordance to the ICH-GCP Guidelines.

Decision by JKEUPM:

[X] Approved

[X] **Permission MUST BE OBTAINED from the respective hospitals/ institutions before conducting the research**

[ ] Disapproved

Please note that the approval is valid until 6 February 2018

Researchers should comply with the following:

I. Complete a Study Final Report upon study completion (Form D).

II. Ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.