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Evaluating The Usage of Domestic Water for Good Health and Well Being

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Abstract
All life depends on water. It is one of the most important natural resources and a core of sustainable development as it is critical for socio-economic development. Given the rapid pace of economic development and urbanisation, the United Nation Development Programme has identified water scarcity as one of the major environmental issues that require urgent attention. Hence, on 1st January 2016, the 17 Sustainable Development Goals (SDGs) were officially launched with a collective effort to eradicate poverty and achieve sustainability. Specifically, goal number six (6) of SDG is to ensure availability and sustainable management of water and sanitation for all. This highlights the importance of water issue. As for Malaysia, the water issue has long been extensively discussed by the government since the 8th Malaysia Plan (2001–2005). Average Malaysian uses between 220 and 240 litres of water per day, which is higher than the recommended usage of 165 litres by World Health Organisation (WHO). Accordingly, the objectives of this research are to assess domestic water consumption behaviour in Malaysia and to further investigate their perception towards sustainability of water resources. Using questionnaire survey, the result indicates that majority of the respondents realise that the water consumption is high and they still believe that Malaysia has enough water supply. Therefore, the result of this study will contribute to the effort in ensuring a long-term balance between available water resources and water demand. Accordingly, initiatives can be created to assist in reducing the water usage until the target usage of 180 litres per capita per day can be achieved. It also provides policy makers with input and direction for them to design a holistic model on water demand management. This in turn will help in sound movement towards establishing a resilient and sustainable water resources.
Keywords: Domestic consumption, Resources, Sustainable, Sustainable Development Goals (SDGs), Water

Introduction

In Malaysia, a proactive action has been placed by the government to address water issue by placing it at the central concern for national policies. The 8th Malaysia plan marks the important milestone in the journey towards developing a long-term strategic plan for water resource management. Concerted effort to reform the water sector was initiated in 2004 to ensure adequate supply of clean water to the public and industry.

As the demand for water due to population growth and economic development increases, the availability of fresh water in many regions is likely to decrease. According to Saad and Harun (2017), in Malaysia, the demand for water has increased and inefficient water management has led to water shortage. Climate change is compounding the problem due to greater water scarcity relative to demand. This places greater pressure on the water supply system and could lead to water crisis. In addition, higher per capita water consumption in domestic and industrial water sector could worsen this situation. Based on World Health Organisation (WHO), it is recommended that a person needs 165 litres of water per day to meet their basic needs. In Malaysia, the average domestic consumption per capita per day for 2015 and 2016 is 209 litres, higher by 27% than the recommended usage (SPAN, 2018). As for 2018, average Malaysian uses between 220 and 240 litres of water per day. Hence, integrated, and holistic policy directions and strategic plans with regard to water demand management need to be intensified to ensure long term balance between available water resources and water demand (refer Figure 1: Water consumption per capita per day).

In addition, according to Ahmed, Siwar and Begum (2014), the demand for water in Malaysia has increased steadily from 8.9 billion m3in 1980 to 15.5 billion m3in 2000 for agricultural, industrial, and domestic purposes. This highlights the critical issue for water consumption and management in Malaysia. Further, the unprecedented stress on water supply could be due to the growing population that drives the increase in demand for food. This put pressure on the water consumption. It is projected that the domestic water consumption in Peninsular Malaysia will increase from 3,862 million meter cubic (mil m^3 per year) in 2020 to 4,606 mil m3 per year in 2030 and further to 5,251 (mil m^3 per year) in 2040 (National Water Resource Study 2020 – 2050).

With industrialisation competing for diminishing water, visionary effort and cooperation from various parties are of urgent need to ensure water sustainability. Importantly, in tandem with the 12th Malaysia Plan (2021-2025) that focuses on shared prosperity and environmental sustainability, efficient and sustainable water resource management would be the catalyst for social well-being to ensure environmental and economic sustainability.

In addition to these measures, the government also has initiated The National Green Technology Master Plan 2017-2030 that provides a framework to place Malaysia as a high-income nation by 2020 and to position Malaysia as a Green Technology hub by 2030. This initiative focuses on five key areas: energy, transports, building, waste, and water sectors. As for the water sectors, it is expected that the implementation of Green Technology Master Plan would reflect operational efficiency and provide long term dynamics of capacity building for water management. This is to ensure that people have access to clean, safe, reliable, and affordable water to facilitate economic growth and social development. Ideally, this would create an environment to facilitate prosperous and sustainable future.

Accordingly, the objectives of this paper are to assess the domestic water consumption behaviour in Malaysia and to assess the perception towards sustainability of water resources. This paper could provide contribution to various areas. This study will contribute to the literature on water resource management. As for now, the number of studies on this issue,

specifically in the Malaysian context, is very minimal (searching using Mendeley generates only 147 studies on water in Malaysia). The study investigates the drivers that lead to high water consumption in Malaysia as compared to other emerging countries. This is very important as the water consumption rate in Malaysia is higher compared to other countries. Specifically, in Malaysia, the average domestic consumption per capita per day for 2015 and 2016 is 209 litres, higher by 27% than the recommended usage. As for 2018, the figure increases to somewhat between 220 and 240 litres of water per day. Hence, the integrated water resource management as presented in this study will contribute to the effort in ensuring the long term balance between available water resources and water demand.

As for the society, this study will identify the drivers that lead to higher domestic demand for water. Accordingly, initiatives can be created to assist in reducing the water usage until the target usage of 180 litres per capita per day.

This study will also contribute to the policy makers by presenting a holistic model on water demand management. This in turn will provide a strategic input and direction for achieving sustainability.

The paper is organized as follows. The next section describes the literature review on the topic. Following that, the method of analysis and sources of data are presented. After that, the findings are presented. The last section includes the discussion and interpretation of the empirical results before the paper draws to a close.

Literature Review

This section presents the related literature on water issues, domestic water consumption and sustainable water resources. This also includes the synthesis of the gap for this study in terms of defined concept and operationalisation.

Water Issues

Nowadays an increase in water demands, impaired by climate change and the tightening of environmental factors, leads to a reduction in available water resources for economic and domestic uses. Water scarcity problems run across various sectors including industries, farmers, and domestic users in which increased the interests on how water is allocated and consumed (Perry, 2011). Few series of factors contributing to water scarcity including projected climate change, and decrease in river water flow. The latter recorded a 19% decrease in river water flow in the years 2030–2050, compared to the period between 2010 and 2030. Other factors that may pose additional stress to the water problem includes demographic changes, socio-economic and water-related trends (Apostolaki et al., 2019).

Besides, growing water scarcity due to increasing demands for products had generate much debate about improving the water use efficiency and productivity (Van Halsema & Vincent, 2012). As a results, safe water sanitation and sound management of freshwater ecosystems has emerged as an appropriate tool to improve water management (Momblanch, Andreu, Paredes-Arquiola, Solera, & Pedro-Monzonís, 2014). According to Vardon et al. (2007) water is a resource about which there is often a lack of high quality data. Hence, water data is of urgent need so that water resource can be effectively managed and ensure sufficient quality water for present and future generations. Besides, understanding water resource management is also believed to act as a key tool to effectively manage the national limited water supply in support of a healthy economy and environment (Escriva-bou, Mccann, Hanak, Lund & Jezdimirovic, 2016).

Domestic Water Consumption

Typically, clean water uses can be divided into domestic and non-domestic water use. The former includes household daily activities like bathing, drinking, cooking, and gardening. While the latter refers to commercial, industrial, agricultural and livestock breeding purposes (Khalid, 2018).

Due to the increasing population and urbanisation as well as the improved living standard, the domestic use for water is higher than other activities (Hassan et al., 2021). This poses a new challenge for the water resources in the country to meet per capital consumption target for water. Accordingly, this paper focuses on the domestic water consumption.

According to Rajeevan and Kumar (2020) if the current consumption patterns continue, there will be an unmet demand of 51.7 million cubic meters (MCM) of water in the year 2030. On the demand side, as the population rapidly growing, the demand for domestic and industrial water will increase significantly (Xi & Leng, 2013) Moreover, water supply and demand is one of the hot topics that is highly discussed among the community. This scenario is worsened by the higher population growth rate and increased urbanisation (Ali et al., 2014). Hence, by implementing the management interventions, such as reducing per capita consumption, the water demand for the year 2030 can be met.

According to Inman and Jeffrey (2006), domestic water consumption is dependent on numerous factors, including the number of people residing in the house, the age of the residents, the education levels of the residents, the size of the property, the residents' incomes, the efficiency of water consuming devices (i.e., washing machines, shower heads, tap fittings, dishwashers and toilets) and residents' attitudes, beliefs and behaviours. Individual behaviours, lifestyles, gender preferences and other factors may also influence household water consumption (Yu et al., 2011).

While key drivers influencing public water demand are population and household size, income, consumer behaviours, tourist activities, technological developments (including water saving devices) and the measures used to address leakages in public water supply systems (Werner and Collins, 2012). Lorek (2004) noted that the determinants of general consumption patterns identified in sustainable consumption can be categorised as either biological/psychological, sociological, technological, demographic or politico economic. Al-Ghuraiz and Enshassi (2006) confirmed that water consumption is directly affected by the economic status of consumers such that water consumption increases as household income increases. Further, water consumption also increases as water price decreases and vice versa.

Sustainable Water Resources

In Malaysia, the water services face issues which need to be tackled immediately for it to be viable and sustainable (Malek et al., 2013). Currently the approach embedded in the water management system and its transformation towards "Integrated Water Resources Management" (IWRM), is still in a state of inertia.

Besides, understanding sustainable and availability of water is also believed to act as a key tool to effectively manage the national limited water supply in support of a healthy economy and environment (Escriva-bou et al., 2016).

According to Saad and Harun (2017), water resource management in Malaysia needs to be restructured to ensure sustainability. Accordingly, the need for transparent, high-quality, credible, and comparable water resource management and disclosure are crucial for stakeholders (i.e., domestic users, government, industries, environmentalists, NGOs, etc.)

New indicators are proposed for water sustainability which includes consideration of water reuse and aim to assist in identifying and providing clear distinctions between beneficial and non-beneficial water uses (Pereira, Cordery & Iacovides, 2012).

The sustainability concept for water means maintaining the supply of fresh water that will be available to the current society and future generations to use. As water acts as the core of sustainable development and important for a balanced ecological system, a holistic water resource management is very crucial.
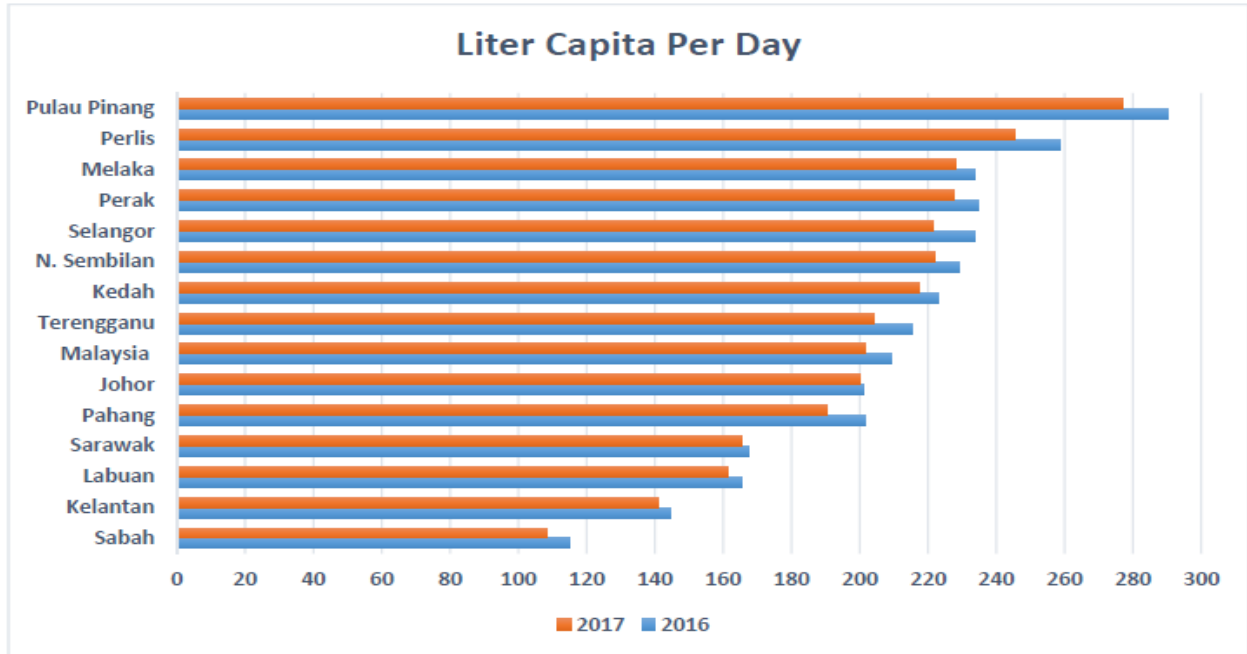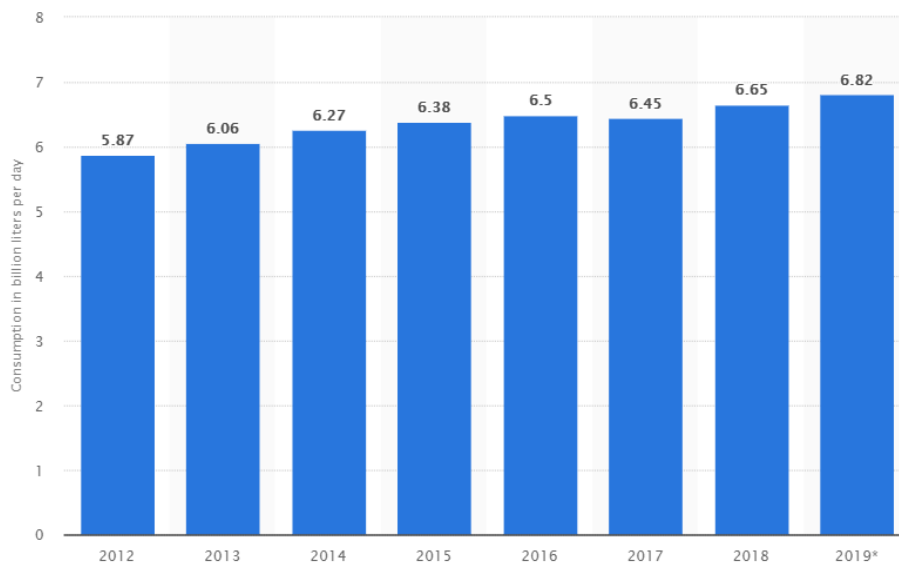

Figure 1A: Domestic water consumption per capita per day in Malaysia 2016-2017
Source: National Water Services Commission (SPAN)
https://www.span.gov.my/article/view/domestic-consumption-2015-2016

Domestic metered water consumption in Malaysia from 2012 to 2019 *(in billion liters per day)*

State	Consumption Per Capita Per Day l/cap/d	
	2016	2017
Johor	201	200
Kedah	223	217
Kelantan	144	141
F.T. Labuan	165	161
Melaka	234	228
N. Sembilan	229	222
Pulau Pinang	290	277
Pahang	202	190
Perak	235	227
Perlis	259	245
Sabah	115	108
Sarawak	168	165
Selangor	234	222
Terengganu	215	204
MALAYSIA	209	201

https://www.statista.com/statistics/796354/domestic-metered-water-consumption-malaysia/

Domestic water consumption in Malaysia is increasing at an alarming rate. There are many factors contributed to the increase in water consumption per capita in the Malaysia which include consumer attitude, low water tariffs and home-based trades like car-wash shops and laundrettes (Legacy Times, 2020).

Research Methodology

The investigation of domestic water uses and habits involved questionnaire survey. Simple random sampling method is used. The population of this study comprised of Malaysian people age above 18 years old. The questionnaire contains information on social demographic characteristics, occupational information and household information. It also includes the indoor and outdoor water use activities and their respective frequencies and duration. The survey results were analysed using SPSS where descriptive statistics, t-test and analysis of variance (ANOVA) were used.

Results

Descriptive Statistics

The below table shows the descriptive and univariate statistics of the respondent.

Table 1
Descriptive and univariate statistics (Respondent profile)

PANEL A: SOCIAL DEMOGRAPHIC CHARACTERISTICS		
Statistic	*Frequency*	*%*
CELL 1 - GENDER (n = 258)		
Male	68	26.4
Female	190	73.6
CELL 2 - AGE (n = 258)		
18 – 24	169	65.5
25 – 29	11	4.3
30 – 39	22	8.5
40 – 49	31	12.0
50 – 59	20	7.8
More than 60	5	1.9
CELL 3 – EDUCATION BACKGROUND (n = 258)		
SPM	50	19.4
Certificate	5	1.9
Diploma	102	39.5
Degree	77	29.8
Master	18	7.0
PhD	6	2.3
CELL 4 – MARITAL STATUS (n = 258)		
Single	195	75.6
Married	63	24.4
PANEL B: OCCUPATIONAL INFORMATION		
Statistic	*Frequency*	*%*
CELL 1 – OCCUPATIONAL SECTOR (n = 258)		
Government	109	42.2
Private	31	12.0
Self-employed	118	45.7
CELL 2 – MONTHLY INCOME (n = 258)		
Less than RM1,500	168	65.1
RM1,500 - RM3,000	25	9.7
RM3,001 - RM4,500	20	7.8
RM4,501 - RM6,000	18	7.0
More than RM6,000	27	10.5
PANEL C: HOUSEHOLD INFORMATION		
Statistic	*Frequency*	*%*
CELL 1 – HOUSING TYPE (n = 258)		
Landed	229	88.8
Non-landed	29	11.3
CELL 2 – NUMBER OF HOUSEHOLD (n = 258)		
1 - 3	78	30.2
4 - 6	138	53.5
7 - 9	42	16.3

Respondents profile as depicted in Table 4.1 showed 258 surveys were conducted; 74% of participants in the study were female, 66% were 18 to 25 years old, and 40% with undergraduate level of education. 75% are single, and 65% had family incomes ranging 1,500 to 4,000 where majority of them work either as self-employed or work with government. In order to further investigate the consumption level, respondents were also asked on the type of house and number of household. 80% of the responded are living in landed house with at least 4 number of household.
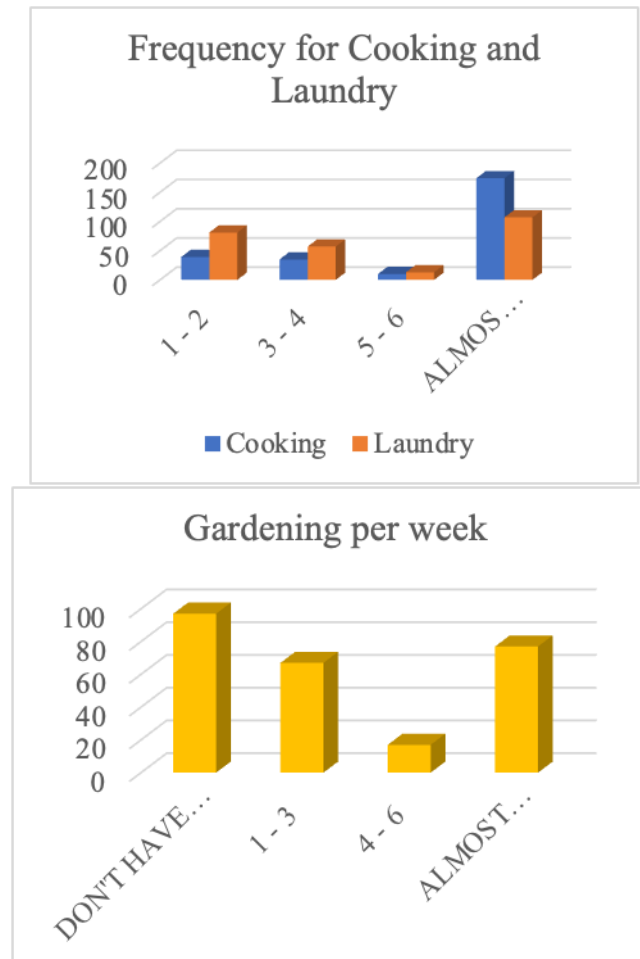

Figure 1: Bar Chart (Major Domestic Household Activities)

In order to investigate the water consumption pattern, four (4) major household activities were identified in this study which are drinking and cooking, shower, laundry, and gardening. As shown in the Figure 1, frequencies for cooking and laundry are almost every day. The result can be predicted since majority of the respondent are government servant and self-employed thus their working schedule might allow them to cook and do laundrette every day. The same pattern can be seen for gardening for those groups that have a garden in their house will do gardening activities using water every day.

Shower per day

Shower Duration

While taking shower, I...

While brushing my teeth, I...
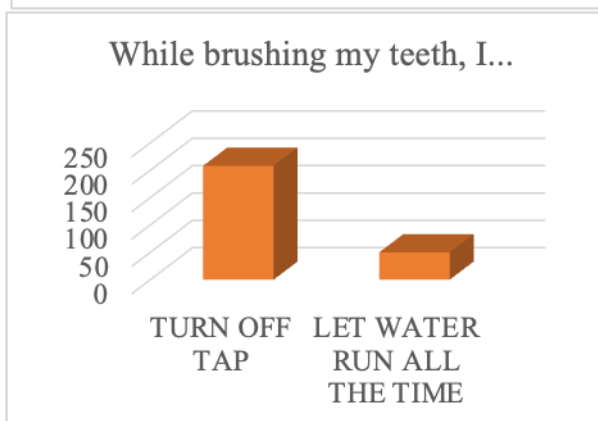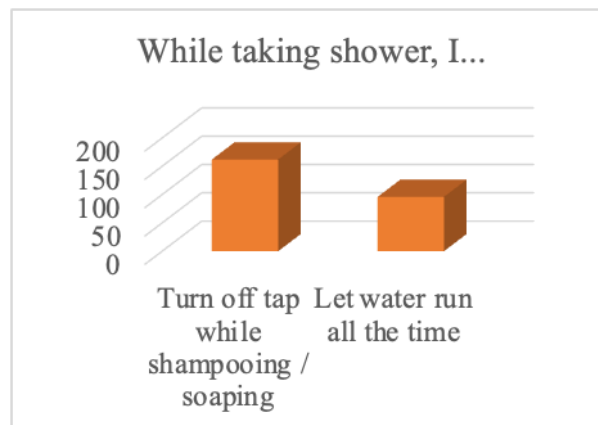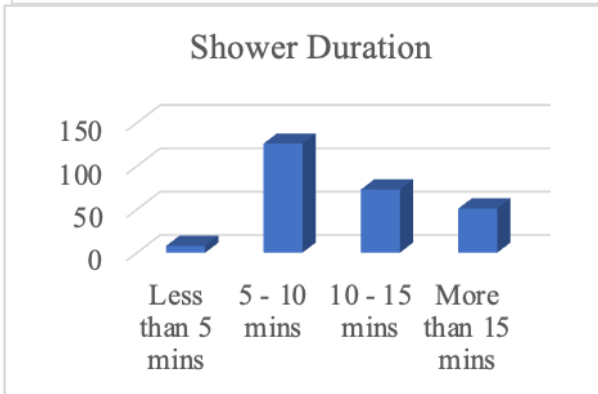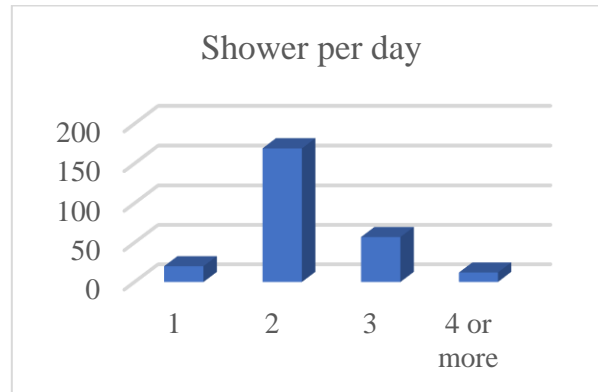
Since shower is considering as daily activities respondent were asked about frequencies of shower per day as well as the duration. The highest frequencies are two times a day with 5-10 minutes as the duration took to shower. In order to examine the reasons for observed

differences, respondents were then asked whether they turn off the tap while shampooing, soaping and brushing teeth or let the water run all the time. The result showed that majority of them did turn off the water but the number of respondents who let the water run all the time is still high. This might explain why Malaysian water usage is still higher than the recommended per capita usage.

Table 2
Compare means – t-test

PANEL A: T-TEST FOR SHOWER DURATION AND GENDER			
Statistic	n	Mean	*Sig*
Male	68	10.38	0.063*
Female	190	11.36	(t–value = -1.867)
Mean difference		-0.976	
PANEL B: T-TEST FOR MONTHLY WATER BILL AND HOUSING TYPE			
Statistic	n	Mean	*Sig*
Landed	229	56.51	0.009*
Non-landed	29	40.69	(t–value = 2.615)
Mean difference		15.817	
PANEL C: T-TEST MONTHLY WATER BILL AND BRUSHING TEETH			
Statistic	n	Mean	*Sig*
Turn off tap	208	52.84	
Let water run all the time	50	62.60	0.046* (t–value = -2.010)
Mean difference		-9.763	
PANEL B: T-TEST FOR MONTHLY WATER BILL			
Statistic	n	Mean	*Sig*
Landed	229	56.51	0.009*
Non-landed	29	40.69	(t–value = 2.615)
Mean difference		15.817	

To further analyse the result, t-test was conducted to compare the shower duration between male and female. Based on the the result in Table 4.2 (Panel A), female takes longer shower duration than male and the difference is statistically significant with a p-value of 0.063. This is in line with study conducted by Yu (2011) where gender differences may also influence domestic water consumption.

In addition, the monthly water bill was compared between landed and non-landed housing type (Table 4.2 Panel B). It was found that, on average, the mean monthly water bill for landed property is much higher (RM56.51) compared to the non-landed property (RM40.69). The difference is statistically significant at 0.01 significant level.

The monthly water bill was also compared between those who turn off the tap and let the water run while brushing their teeth. As expected, it was found that the mean monthly water bill for those who let the water runs while brushing their teeth (RM62.60) is much higher compared to those who turn off the tap (RM52.84). The difference is statistically significant at 0.05 significant level.

Table 3
Analysis of variance (ANOVA)

PANEL A: ONE-WAY ANOVA	
Statistic	*Water Bill*
F	2.921
Significant	0.035*
PANEL B: TUKEY HSD POST HOC TESTS (p-value for each pair)	
1-2 times and 3-4 times	0.982
1-2 times and 5-6 times	0.984
1-2 times and almost everyday	0.032*

Table 4.3 shows the analysis of variance (ANOVA) between monthly water bill and the number of times doing laundry per week. The respondents were asked whether they do laundry (i) 1 or 2 times per week, or (ii) 3 to 4 times per week, or (iii) 5 to 6 times per week or (iv) doing laundry everyday. Based on the ANOVA results, there is a significant different between the monthly water bill and the number of times doing laundry per week. The Tukey HSD Post Hoc Tests indicates that the monthly water bill is significantly different between those who do laundry 1 to 2 times weekly as compared to those who do laundry everyday.

Table 4
Perception towards sustainability of water resources

		Strongly disagree	Disagree	Agree	Strongly Agree	Mean
Water tariff in Malaysia is cheap	f	6	49	170	33	2.89
	%	2.3	19.0	65.9	12.8	
Water shortage rarely happen	f	39	55	88	76	2.78
	%	15.1	21.3	34.1	29.5	
Malaysia has enough water	f	13	83	123	39	2.73
	%	5	32.2	47.7	15.1	
Malaysians' water usage is high	f	0	8	119	131	3.48
	%	0	3.1	46.1	50.8	

Respondent were being asked on their perception towards sustainability of water resources. Table 4. above shows the frequency for each question. 65% of them agreed that water tariff in Malaysia is cheap. They also agree that water shortage rarely happen in their area due to the fact that only few places are affected with water crisis. They also believe that Malaysia has enough water supply and they also acknowledged that water usage in Malaysia is high.

Discussion and Conclusion
Water is one of the most important natural resources as no life could survive without water. It is important for the society and the ecosystem. Given the rapid pace of economic development and urbanisation, the United Nation Development Programme has identified water scarcity as one of the major environmental issues that require urgent attention. Though Malaysia is endowed with abundant water resources, the country's demand for water has increased steadily from 8.9 billion m^3 in 1980 to 15.5 billion m^3 in 2000 for agricultural,

industrial and domestic purposes (Ahmed et al 2014). Increasing population and potential implications of climate change are driving the need to generate water efficient composite strategies to tackle this issue and ensure sustainability.

The Malaysian domestic water consumption pattern is higher compared to other Asian countries (Anang et al. 2017). This highlights that initial measures for saving the domestic water consumption is essential. Undoubtedly, the starting point is the individual awareness coupled with knowledge and positive attitudes towards sustainable water practices.

The objective of this study is to assess the domestic water consumption behaviour in Malaysia. Hence, the finding of this study indicates that the domestic water use includes drinking, bathing, household activities, gardening, and laundry. Cooking and laundry activities are done almost every day. This could be due to the background of the respondents as most of them are government servant and self-employed. Accordingly, they may have the opportunity for a more flexible working schedule and the freedom to work from an alternative location, away from their office. This may allow them to cook and do launderette every day. The same pattern can also be seen from those groups that have a garden in their house. They will do gardening activities and use water every day. It is suggested that water conservation techniques could be implemented in the garden and landscape such as the installation of drip irrigation and harvest rainwater. In addition, water the garden early in the morning or late at night can also be applied so that water does not evaporate in the heat of the day before it reaches the roots.

The findings of this study provide insights into domestic water uses and behaviour. Generally, there are still people who do not turn off the tap while soaping or shampooing when they take their shower or let the water run when brushing their teeth. This indirectly leads to the unnecessary increase in the water usage as well as their monthly water bill.

Most of the respondents simply agree that the water tariff in Malaysia is cheap. Hence, consumers are rarely motivated to reduce their water consumption for purely financial reasons. Accordingly, any water conservation programmes can rarely be justifiable on the basis of economics alone and similarly, institutional water conservation programs are rarely justifiable on the basis of mere financial.

The findings of this study also indicates that despite the fact that majority of the respondent realise that the water consumption is high, they believe that Malaysia has enough water supply. This shed light on the significance of efficient management of water resources to avoid water scarcity and unnecessary water crisis. Hence, it is important to promote positive water consumption behaviour to ensure that the availability of water resources can be sustained.

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