DETERMINANTS OF RESIDENTIAL WATER CONSUMPTION: A CASE STUDY IN BANDAR UNIVERSITI, SERI ISKANDAR, PERAK, MALAYSIA.

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ABSTRACT

Water is an invaluable resource and asset in a country's economic development. Residents in the Klang Valley have experienced prolonged water rationing exercise during the dry season in 2014. In December of 2015, residents in several areas in the state of Johor did not receive normal water supply due to unstable levels of raw water at both Sungai Layang and Sungai Lebam dams. Recently in March of 2016, The Star newspaper has reported that five dams in Negeri Sembilan have water levels nearing critical levels due to heat waves caused by the El Nino phenomenon and consumers have been told to use water prudently. This research was recently conducted in Bandar Universiti, Seri Iskandar to understand the determinants of residential water consumption. The explanatory variables include household income, size of the household and types of house. The stratified sampling method and face-to-face interviews were conducted in this case study. The total number of residents interviewed was 100 and from the SPSS analysis, all the explanatory variables were significant at 5% significance level in determining the residential water consumption. The findings have shown that the major factor that has influenced residential water consumption at Bandar Universiti, Seri Iskandar was the size of the household, which was followed by the types of house and household income. Since water is a basic necessity for everyone, the researchers would like to recommend rainwater collection for irrigation and general cleaning uses, especially in this residential area, to offset the recent increase in the water consumption trend in Perak Tengah.

Keywords: Size of the Household, Residential Water Consumption, Rainwater Collection

Introduction

A survey, conducted in 2011 among Southeast Asian consumers, has revealed that Malaysians use more water than their neighbours do. Malaysians use an average of 226 litres of water per person daily. Singaporeans and Thailanders use 154 litres and 90 litres of water per person in a day, respectively. World Wide Fund for Nature (WWF) has been entrusted to ensure the sustainability of water resources in Malaysia due to the high incidence of water wastage especially in domestic, industrial and agricultural activities. This wastage is considered as unsustainable in the long-run. Malaysians are currently enjoying low water tariffs compared to other countries. This factor may have led some Malaysian families to ignore the importance of using water wisely. A newspaper report dated 18 August, 2015 has stated that Selangor Menteri Besar Datuk Seri Azmin Ali has called for a

review of the state's free 20 cubic metres water scheme. According to this report, the review was meant to help lower income groups to receive free water and lessen their burden. There is a possibility that higher income groups will not be eligible for the state's free water programme. Datuk Seri Azmin Ali has stressed that the free water was not meant for gardening, or washing cars. This scheme was implemented to help the deserving residents of the state of Selangor. It is clear that awareness regarding wise water usage and water conservation should be nurtured among Malaysians. The President of the Association of Water and Energy Research Malaysia, Mr. Piarapakaran S., has clearly stated that all steps should be taken now to secure our water resources for betterment of our future generations.

This research was conducted in Bandar Universiti, Seri Iskandar, Perak. Data of domestic water consumption in Perak Tengah from 2013 to 2015 are listed in Table 1 below:

Table 1: Water consumption (m³) in Perak Tengah

Year	Water consumption (m³)
2013	19,982,741
2014	20,995,760
2015	22,168,449

Source: Lembaga Air Perak Daerah Perak Tengah

As seen in Table 1, water consumption has increased from 19,982,741 m³ in 2013 to 22,168,449 m³ in 2015. This increase may be due to population growth and economic developments. If this trend continues, Perak Tengah may face water related issues within the next few years. The purpose of this research is to investigate the determinants of residential water consumption in Bandar Universiti, Seri Iskandar and to look at the relationships between variables. The explanatory variables in this study include household income, the size of the household and the types of house. The researchers have used the stratified sampling method and conducted face-to-face interviews with 100 residents in this case study. The types of houses that were included in this research can be divided into two categories, which are single storey and double storey terrace houses. The researchers did not focus on semi-detached, houses with gardens or even luxury houses since the majority of houses in Bandar Universiti during the time of interview (2014/2015) were detached houses.

Literature Review

According to Al-Amin et al. (2011), socioeconomic factors, which consist of household size, household income and house quality (types of houses) were statistically significant in determining the households' domestic water demand and consumption in Dorogram, a village in the Manikganj district, Bangladesh. Manikganj is a district in the Dhaka division with an annual rainfall of 2,376mm. Their study had determined the relationships between domestic water usage and the socioeconomic factors at the household level. This area of study is facilitated with piped water supply system. The researchers had used direct observations and household interviews to collect their data. They found that the daily per capita water consumption for the area was 83.17 litres per person per day with a standard deviation of 11.9. They have concluded that water consumption was correlated to socioeconomic factors, such as household size, house quality (houses with good quality materials) and income.

Keshavarzi et al. (2006) have conducted a study regarding rural domestic water consumption behavior in Ramjerd, Iran. They collected data from 653 rural households using a survey based on the simple random sampling technique. Their study has revealed that the sizes of a house and its garden are the other factors associated with high water consumption. In other words, they have found that water consumption was significantly correlated to the size of the house (including the size of the garden), the age of the household head, and the size of the household. However, other descriptive factors, such as number of livestock and household head's education, were found not to be significantly correlated to the amount of water consumed in Ramjerd. Additionally, they have also found that the daily average water consumption for the area was 121.7 litres per person per capita per day with a standard deviation of 59.2.

Salman and Karablieh (2006) have highlighted that household size and the types of houses (with different number of bathrooms) have contributed to the amount of water being used by Jordanian households. In this research, the types of houses have also proved to be the most significant factor. Salman and Karablieh have used a panel of quarterly aggregated data of 10,564 observations to estimate the domestic water demand function. Other than household size and types of house, they have also concluded that the level of welfare and education can significantly affect the household water demand. As such, they have suggested that the low price elasticity of residential water demand and price policies can be used as conservation tools for municipal water.

A study by Ibrahim et al. (2012) in Riyadh City has indicated that there is a significant relationship between household income and residential water demand. The study has revealed that the projection for daily per capita water consumption is expected to increase with increasing income. Similarly, in Schleich and Hillenbrands' research (2007), household income was one of the important factors that influence water demand at significance level of 1%. This means that as income level increases, water consumption may also increase for the higher income community. They may have more facilities related to water, such as swimming pools and dishwashers at home. It was found that an annual real growth rate of 1% per capita income would lead to an increase in per capita water use of 5%, which is approximately 6.5 litres per day. This projection result includes 2020.

Research Objectives

The general objective of this study is to investigate the determinants of residential water consumption in Bandar Universiti, Seri Iskandar.

The specific objectives of this study are:
1. To investigate the relationship between household income and residential water consumption in Bandar Universiti, Seri Iskandar.
2. To examine the relationship between household size and residential water consumption in Bandar Universiti, Seri Iskandar.
3. To identify the relationship between type of house and residential water consumption in Bandar Universiti, Seri Iskandar.

In order to understand these relationships, a set of hypotheses were engineered.
H_1: There is a relationship between household income and residential water consumption in Bandar Universiti, Seri Iskandar.
H_2: There is a relationship between household size and residential water consumption in Bandar Universiti, Seri Iskandar.
H_3: There is a relationship between type of house and residential water consumption in Bandar Universiti, Seri Iskandar.

Research Questions:
1. What are the determinants of residential water consumption in Bandar Universiti, Seri Iskandar?
2. What is the relationship between household income and residential water consumption in Bandar Universiti, Seri Iskandar?
3. What is the relationship between household size and residential water consumption in Bandar Universiti, Seri Iskandar?
4. What is the relationship between type of house and residential water consumption in Bandar Universiti, Seri Iskandar?

Method

The researchers have used the stratified sampling method whereby a questionnaire survey was conducted. The respondents were asked to answer 16 questions divided into three sections, namely personal information (3 questions), water expenses and consumption (3 questions), and determinants of water consumption (10 questions). The researchers have also conducted face-to-face interviews with 100 residents. The reliability test was examined, giving Cronbach's alpha value = 0.886. An alpha score of 0.7 or higher indicates reasonably good reliability. (Sweet and Grace-Martin, 2008).

Respondents' demography includes gender, status, income and age, as listed in Table 2 below.

Table 2: Demographic Characteristic of the Respondents

Variable	Frequency	Percentage (%)
Gender : Male	33	33
: Female	67	67
Status : Single	4	4
: Married	96	96
Income : <RM2,000	22	22
: RM2,001 – RM4,000	42	42
: RM4,001- RM6,000	29	29
: RM6,001- RM8,000	4	4
: RM8,001- RM10,000	3	3
Age : 21-30 years old	30	30
: 31-40 years old	38	38
: 41-50 years old	24	24
: 51-60 years old	7	7
: 61-70 years old	1	1

The gender distribution was 33 percent male respondents and 67 percent female respondents. In terms of marital status, married respondents seem to be the majority with 96 percent, while the remaining 4 percent was made up of single respondents.

Multiple Regression Analysis

The multiple regression analysis was employed because it can provide the most accurate interpretation for the independent variables. According to Sekaran (2013), multiple regression analysis is a statistical technique that simultaneously develops a mathematical relationship between two or more independent variables and an interval-scaled dependent variable.

Table 3: Coefficients of the Study

Model	Unstandardized		Standardized		
	β	Std. Error	Beta	t	Sig.
(Constant)	3.381	3.601		.939	.350
Household income	0.010	.004	.202	2.475	.015
Household size	8.150	.961	.564	8.479	.000
Type of house	5.801	1.565	.243	3.708	.000

According to the results listed in Table 3, the following equation was obtained;
RWC = 3.381 + 0.01HY + 8.15HS + 5.801TH
where,
RWC　= Residential Water Consumption (RM)
　HY　= Household income (RM)
　HS　= Household Size (Person)
　TH　= Type of House (Unit)

Based on this equation, β value of the constant was 3.381. This means without the influence of the independent variables, the value of the residential water consumption would be RM3.38. In other words, an increase in other variables that do not include in this model will lead to increase in residential water consumption by RM3.38. β values of HY, HS and TH were 0.01, 8.15 and 5.801, respectively. In this research, all independent variables have positive relationships with residential water consumption. These results are consistent with the economic theory, where an increase in household size will cause residential water usage to increase while keeping all other variables constant. In addition, the results have indicated that all explanatory variables were significant at 5% significance level in explaining the dependent variable; residential water consumption. The findings have also shown that household size is the main contributing factor in influencing residential water consumption in Bandar Universiti, Seri Iskandar. This is followed by the type of house and household income. Nonetheless, the significance of household income towards residential water consumption is very small and it is not a major factor in this analysis since its β value was only 0.01.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of Estimation
1	.900	.811	.805	10.85618

As shown in Table 4, the R-value that measures the strength of the relationships between the independent variables (HY, HS, TH) and the dependent variable (RWC) was 0.900. It was concluded that there was a strong positive linear relationship between the independent and the dependent variables.

In addition, the R^2 value was 0.811. The R^2 value that is nearer to 1.0 indicates that the model is fit. (Sekaran & Bougie, 2013). This value represents the 81.10 percent of the variations for RWC that can be explained by the independent variables. The remaining 18.90 percent can be explained by other variables that were not included in this study, such as the age of household head and house quality.

Conclusion

The results in this study have shown that all three independent variables, which are, household income, household size and type of house, have been found to be significant and may have affected the residential water consumption in Bandar Universiti, Seri Iskandar. The researchers have chosen a significance level of 5%. Thus, all alternative hypotheses were accepted. The F-test value was high at 137.173 which is good since the value was higher than 1. F-statistics was significant (0.000) when compared with $p < 0.05$. It was concluded that the independent variables were significant and good enough in explaining the model in this analysis.

Based on the regression analysis, household size was found to be the most significant factor and household income was the least significant factor that may have affected residential water consumption. A limitation of the current study was the small, probability sample due to time limit. A larger sample size will decrease the sampling error.

The researchers would like to offer several recommendations for the residents of Bandar Universiti, Seri Iskandar, Perak. In order to save water and save money on their utility bill, they can:

i.   Use water efficient washing machines. The new high-efficiency models can save water usage. Residents should also use the washing machine only at full loads.
ii.   Divert water from the washing machines to the garden to water the yard.
iii. Save water in the bathroom by using buckets to take a bath, or by not leaving the tap running when brushing your teeth.
iv.   Do not run the hose but collect rainwater for irrigation, cleaning the driveways and general cleaning uses.

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