

CONSUMPTION AND EXPENDITURE PATTERN OF ENERGY AND WATER AMONG URBAN CONSUMERS

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Introduction

Electricity and water is a basic need which is important in our life. The importance of electrical energy and water from the aspect of its usefulness is too many to be stated. For electrical energy, the consumption of electrical appliances improves the standard of living, besides increasing the well-being and quality of life. In this modern world, the consumption level of electrical appliances is increasing in which consumers are increasingly reliant on energy resources for carrying out daily activities. Air conditioners are found to be consuming 45 percent of the total annual electrical power consumption, followed by refrigerators (11%). Fans and water heaters respectively consume 10 percent and 9 percent of the total annual energy consumption. Appliances like television, rice cooker, and iron consume the least electricity. In the meantime, the total number of households which uses air conditioners in Malaysia has increased dramatically due to the increase in households income (Mahlia *et al.*, 2004).

For water resources, water pollution has become a serious problem in Malaysia and has negative impact on the sustainability of water resources. Besides that, it also effected plants and living organisms, the health of citizens and the national economy. This situation causes difficulty in obtaining supply of clean water. This is because the cost to treat polluted water is too high and in certain circumstances, the polluted water cannot be treated into water suitable for drinking. However, large quantities of water resources in water catchment cannot guarantee a sufficient supply for all consumers due to the pollution on the rivers (Ling, 2010). Urbanization in catchment area of the rivers has caused an increase in population and activities of urban life. The effect of urbanization usually changes the water

quality in the catchment area. According to a study done by the Department of Environment (DOE) on 116 rivers nationwide, about 10 percent of these rivers in Malaysia are heavily polluted, 63 percent are polluted and only 27 percent are clean. (Afroz *et al.*, 2014). United Nations Educational, Scientific and Cultural Organization (UNESCO) has predicted that by 2025, 1,800 million of the world population will be living in circumstance without water, in fact, almost two-thirds of the world population will be facing water shortage problem (Hamidah, 2013). Despite the difficulties in obtaining clean water, the Malaysian population is found to be consuming water imprudently, as proven by the United Nations (UN) international standard which recommended the rate of water consumption per individual to be at 165 litres per day (Hamidah, 2013). Based on Malaysian statistics, water consumption per individual per day is at 225 litres per day, as compared to Singapore (155 litres per day) and Thailand (90 litres per day).

The objective of this study is to investigate the consumption and expenditure pattern of energy and water among urban consumers. Event hough there are many countries which have acknowledged the importance of the role of urban planning in energy and water savings, the framework of urban planning in Malaysia is still lacking in this aspect. It is proposed that the outcome of this study can contribute to becoming a foundation in which the relevant parties use to build up a prudent urban community on the consumption and expenditure of energy and water.

Literature Review

Electricity consumption and expenditure pattern

Based on the statistic report by International Energy Agency (IEA) 2010, it is shown that Malaysia has recorded increases in electrical energy consumption in 2009 and 2010. In 2010, the electrical energy consumption was 109.82 billion KWH compared with only 102.78 billion KWH in 2009. The increase between the year 2009 to 2010 was 7.04 billion KWH in one year.

In Malaysia, the expenditure of electricity consumption is very high. The consumption of inefficient appliances is the main factor of expenditure increase in a household's electricity bill payment. According to Engku Siti Zaharah, Azlina and Hashim (2013), the government has revised the Electricity Supply Regulations 1994 to ensure efficiency of electricity consumption. Among the measures that have been taken by the government is stopping the consumption of incandescent bulb which is not energy efficiency in 2013. Besides that, the Energy Commission has also launched upgraded systems for electrical appliances in Malaysia to help consumers in

choosing energy-efficient electrical appliances, where in this case it is not only limited to energy-efficient lamps but also other electrical appliances like refrigerators, air conditioners, televisions, fans, washing machines, water heaters and etc. Energy-efficient appliances can assist in lowering monthly electricity bills.

Water consumption and expenditure pattern

Based on Mahdy and Husam (2015) study findings, the average of domestic water consumption was 2.260 m³ monthly compared to the recommended consumption which is only 2.260 m³ monthly. Urban behavior consumption has a strong influence on the increase of water domestic consumption, where increases in water consumption percentage were recorded at 33 percent, 38 percent and 45 percent respectively in 2010, 2011 and 2012. Furthermore, clean water supply consumption is also very high in Malaysia. According to Tuan Pah Rokiah, Hamidi and Wahida (2004), the supply of clean water is convenient and easily obtained, as it is supplied directly to the home, causing consumers to consume the water easily and without feeling guilty in consuming it excessively thus resulting in water wastage. In the population of other countries, there are different issues related to clean water supply. Gbadegesin and Olorunfemi 2011, stated that there are still population which do not have clean water supply, which accounts to 43 percent of the population still not having access to safe and clean water.

According to Akissa (2001), in developing countries, the increase of population are in the urban and suburbs area. The population for developing countries in urban areas is more than 1 million people. A significant increase since 1920 led to an increase in cost of living besides an increase in the consumption of natural resources, namely water resources. The increasing water consumption in urban areas is caused by water resources management and this in turn affects global water consumption. The management of water resources which includes the macro and micro water saving techniques can improve water consumption efficiency in every sectors which consume the water.

On the other hand, data from the Annual Report Economic Growth (2010) on household consumption according to its purpose for 2000–2009 has shown that the expenditure of water consumption is the second highest in 2000–2009, where the expenditure accounts to 18.9 percent from the twelve listed expenditures during the same duration. This demonstrates that households always expend on water resource consumption because it is a basic need for every human being.

Methodology

This study was conducted by using the survey method. This section discusses about the study instruments, sampling and data analysis.

Instruments

Instruments for this study are the questionnaires which consist of two parts, where Part 1 measures the demographic characteristics of the respondents. The characteristics measured are age, gender, occupation, ethnic, religion, education level, marital status, number of households and the estimation of total household income. In Part 2, closed ended questions are answered by the respondents. Instruments in this part is adapted from Teaching Green-The Middle Years which covers energy and water consumption.

Sampling, data collection and data analysis

This study involved 480 representatives of households and who are working in several public agencies in city metropolitan areas which represent the four main zones of Peninsular Malaysia, namely Alor Setar (North Zone), Kuala Terengganu (East Zone), Shah Alam (West Zone) and Johor Baharu (South Zone) using simple random sampling technique. Through this method, the selected households were given a questionnaire to be completed. Descriptive analysis were used for the data analysis.

Data Analysis and Discussion

The background of sociodemographic, socioeconomic and the payment of electricity and water bills are important in understanding the nature, preferences and behavior in relation to the respondents' excessive consumption. Descriptive statistical frequency distribution, percentage and mean were used to describe the respondents' background and brief information about the energy and water consumption pattern.

Respondent's background information

The general profile of sociodemographic characteristics consist of state (Zone), age and number of households. Meanwhile, the socioeconomic characteristics include education level, occupation and monthly household income. Based on statistics view, the respondents distribution for each state are almost equal, with the highest (29.0%) respondents percentage coming from Selangor, and followed by Kedah (24.8%), Terengganu (23.8%) and Johor (22.5%). In this study, the respondents' age pattern ranges from 30 to

50 years old. A majority (69.0%) of the respondents stated that the number of people in their household is at least five people. Meanwhile, 30.2 percent respondent have 6 to 10 household members and only 0.8 percent have more than 10 household members.

With regards to educational achievement of the respondents, almost half of the respondents (48.7%) have diploma as a minimum education qualification. Only a small portion attended up to primary school, while the rest of the respondent were found to have the following secondary education qualifications: PMR (3.6%), SPM (28.8) and STPM (17.3%). For occupation, this study involved those who are working in the public sector. There are two service groups involved, which are the management and professional group, and the executive group. This study is dominated (94.0%) by the executive group, with the rest (6.0%) coming from the management and professional group.

Next, this study also found that there are two highest value in percentage, which account to almost to each other, if viewed from the aspect of monthly household income. The two values are 36.9 percent of households earning income below RM3,000 per month, and 38.3 percent of households earning income in average of RM3,000 to RM5,000. As for monthly household income, the majority (75.2%) can almost be categorized as middle-income household, since the average of monthly household income in this study is RM4,445.69.

Electricity consumption pattern

The energy consumption pattern was measured using seven questions that were adapted from Ecological Footprint measurement scale. Electricity consumption pattern involved in this measurement covered consumption of appliances that facilitate daily activities like dryers and washing machines, along with appliances which can be considered as a necessity in this modern era such as refrigerators, lamps, televisions, computers, and air conditioners. The analysis results of this pattern (Table 1) shown that almost a majority of the respondent did not consume electricity excessively, when they are found to be using the traditional or natural way for drying clothes (76.3%), own only one refrigerator (76.0%), and using energy efficiency refrigerators (74.2%). Next, a majority of the respondents (87.3%) will switch off the lamps, computers and televisions when these appliances are not in use.

Table1: Electricity Consumption Pattern

	Consumption Energy	Answer Options/frequency	n (%)
1.	I hang clothes outside or inside the house.	a) Always b) Sometimes c) Never	366 (76.3) 91 (19.0) 23 (4.8)
2.	I use an energy efficiency refrigerator.	a) Yes b) No	356 (74.2) 104 (21.7)
3.	I have two refrigerators.	a) Yes b) No	89 (18.5) 365 (76.0)
4.	I switch off the lamps, computers and tevisions when not in use.	a) Yes b) No	419 (87.3) 40 (8.3)
5.	To cool the space, I used:	a) Air-cond: indoor b) Electric fan c) None	114 (23.8) 326 (67.9) 22 (4.6)
6.	My washing machine is:	a) Top load b) Front load c) Send to laundry	401 (83.5) 18 (3.8) 29 (6.0)

However, in terms of electrical appliances consumption, the respondents are more likely to adopt the excessive consumption based on the analysis which shown that more than half of them (51.5%) are still using fluorescent lamps which consume more electricity compared to energy efficient lamps readily available in the market. This maybe due to the usage of energy efficient lamps require several modifications that need certain financial costs. Nevertheless, a majority of the respondents (67.9%) use fans to cool rooms, but there are still 23.8 percent of respondents who use air conditioners which surely consume a lot of electricity, thus increasing monthly bills. Other than that, the analysis has shown that a majority of the respondents (83.5%) chooses top load washing machines which has a higher electricity consumption compared to front load washing machine, which accounts to only a small portion of the respondents (3.8%).

Water consumption pattern

Table 2 shows the water consumption pattern which consists of five questions adapted from questions available in the Ecological Footprint measurement scale. With regards to water consumption when taking a bath, the analysis shown that almost half of the respondent (45.0%) practiced taking a short bath twice a day. Actually, taking a bath twice a day is a common practice in Malaysia which is suitable with the hot and humid weather and thus encouraging them to do so. Nonetheless, there are still some of the respondents who tend to adopt excessive consumption behavior by taking showers more than twice a day (23.8%) and even taking a long bath

twice a day (22.1%). Besides that, the findings shown that more than half of the respondents (54.0%) use a small flow of water tap when taking a shower. However, 40.8 percent of the respondents still do not practice the same, where this situation does show a tendency in practicing excessive consumption that may be done unconsciously.

From the aspect of water consumption in the toilet, a majority of the respondents (85.4%) will flush the toilet when done using it and this is also a common practice for hygienic purpose. Meanwhile, only 55.4 percent of the respondents stated that they use water-saving toilets in their household. A majority of the respondents (73.3%) stated that they do not let the tap water running when brushing their teeth, and this is an encouraging behavior to be practiced.

Table 2: Water Consumption Pattern

	Water Consumption	Answer Options / frequency	n (%)
1.	Usually, the frequency I taking a bath is:	a) Taking a short bath, once a day b) Taking a long bath, once a day c) Taking a short bath, twice a day d) Taking a long bath, twice a day e) Taking bath more than twice a day	15 (3.1) 7 (1.5) 216 (45.0) 106 (22.1) 114 (23.8)
2.	I flush the toilet.	a) Everytime I use it b) Sometimes	410 (85.4) 48 (10.0)
3.	When brushing my teeth.	a) I let the tap water run b) I do not let the tap water run	96 (20.0) 352 (73.3)
4.	I use the water-saving toilet.	a) Yes b) No	266 (55.4) 190 (39.6)
5.	When taking a shower, I using a small flow of water tap.	a) Yes b) No	259 (54.0) 196 (40.8)

Table 3 demonstrates the category of electricity and water consumption pattern that can be divided into three; good, moderate and excessive based on the distribution of total score obtained by overall study respondents. The findings shown that the electricity consumption pattern obtained by these three categories is almost the same with the highest percentage (34.8%) being good consumption. This is followed by excessive consumption (33.1%) and 32.1 percent being moderate consumption.

Table3: Category of Electricity and WaterConsumption Pattern

Consumption Pattern	n	%
Electricity		
Good	167	34.8
Moderate	154	32.1
Excessive	159	33.1
Water		
Good	216	46.6
Moderate	99	21.3
Excessive	149	32.1

Meanwhile, the water consumption pattern shows a similar trend as with the electricity consumption pattern. However, there is a difference in respondents percentage where the highest percentage for good water consumption (46.6%) as compared to percentage for electricity consumption (34.8%). This indicates that respondents tend to be more prudent in water consumption compared to electricity. Next, water consumption also categorized respondents who practise excessive consumption to be at 32.1 percent and this percentage is higher than those shown to be in the moderate category (21.3%).

Expenditure information for electricity and water consumption among household

The results, as summarized in Table 4, shown that most households (60.6%) paid less than RM100 per month for their electricity bills. This indicates that the household electricity consumption studied is in a satisfactory condition as the electricity tariff is relatively high in Malaysia nowadays. However, there are still a minority of them (1.1%) having a monthly bill higher than RM1000. If they were asked as to how savings in bills can be done when sustainable consumption is adopted, 3.7 percent stated that there are no further savings that could be done. This may be due to some of them have done the savings which resulting them only paying bills less than RM100 per month has been discussed before. However, almost half of the respondents (42.6%) feel that they can still do a further savings up to 20 percent and there is a small portion (7.1%) who feel than they can save up to more than 30 percent per month. This analysis shows that there is an excessive consumption practiced by the household before.

Table4: Household Expenditure Information for Electricity and Water Consumption

Variables	n	%
Estimated Electricity Bills per Month		
Less than RM100	275	60.6
RM100–RM300	141	31.1
RM301–RM500	15	3.3
RM501–RM1,000	18	4.0
More than RM1,000	5	1.1
Average = RM148.32		
Savings on Electricity Bills if they Adopt Sustainable Consumption		
0%	17	3.7
Less than 10%	160	34.6
10-20%	197	42.6
21-30%	55	11.9
More than 30%	33	7.1
Estimated Water Bills per Month		
Less than RM100	394	90.2
RM100–RM300	34	7.8
RM301–RM500	5	1.1
RM501–RM1,000	2	0.5
More than RM1,000	2	0.5
Average = RM64.05		
Savings on Water Bills if Adopting Sustainable Consumption		
0%	49	10.8
Less than 10%	167	36.9
10-20%	167	36.9
21-30%	45	9.9
More than 30%	25	5.5

For expenditure on water consumption, the results found that the majority of the respondents (90.2%) pay water bills at less than RM100 per month. This is because the state government provides some subsidies, for example in Selangor, and also the rate payment for water bills is not very burdensome compared to the electricity bill. However, 1.0 percent of household still have water bills at more than RM500 per month. Besides that, 10.8 percent of the households stated that there are no savings which can be done if sustainable consumption is adopted. Nevertheless, over a third of them stated that they can still have further savings up to 10 percent and 20 percent with both accounting to 36.9 percent of the household respectively. There is also a small portion of respondents (5.5%) stating that they can save more than 30

percent from their water bill every month. This also illustrates that the possibility of excessive water consumption by the households as discussed above.

Conclusion

In overall, the findings has shown that the respondents mostly do not get involved with excessive consumption of electricity and water. However, there are consumers who consume excessive energy based on the payment billing information for both resources and this can be saved if households adopt sustainable practices. Besides that, the excessive factor of energy and water consumption can be determined from the consumption pattern. For example, consuming inefficient energy from electrical appliances, not switching off lamps, computers and televisions when not in use and the use of air conditioners, are the causes of excessive energy consumption. Meanwhile, taking bath more than twice a day, letting the tap water running when brushing teeth, using non water-saving toilets and using large flows when taking showers, are the factors contributing to excessive water consumption. The wastage on the consumption of these resources will cause increases in expenditure for both resources. Therefore, the results of this study suggest switching off the main switches for electrical appliances and improving the home ventilation system in Malaysia. Finally, prudent consumption of water is encouraged to reduce the consumption of water resources as well as saving tap water resources in order to ensure a sustainable supply of water resources in the future.

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