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Water usage behaviour: Case study in a southern state in Peninsular Malaysia

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Abstract. Generally, Malaysia's per capita water consumption is high. Therefore, this study perform a thorough investigation on a water consumption that is related to a middle-class community in Malaysia, which accounts for the highest income group in the country. Specifically, we focused on three major categories, i.e. domestic water-usage activities, water habits of the community, and water-saving efforts that can be easily adopted. The main source of data was collected using structured interview method. The frequency of indoor water usage of more than four times a day was high, which suggested that most people did not control their water consumption, especially for cooking, bathing/showering, toilet usage, and dish washing. Community awareness in terms of water-saving efforts is low, as indicated by the respondents that uses dual-pump cisterns in their toilets and employs rainwater-harvesting system for non-potable use. Low water tariff in the study area may discouraged the residents to practice water-saving measures. The findings from this study are important, particularly in understanding the activities and habits associated with high water usage. Additionally, the relevant stakeholders can use these findings to formulate a pro-active action plan to achieve the water usage of 165 litres/capita/day recommended by the World Health Organization.

1. Introduction

Malaysia is blessed with abundant raw water owing to its high annual maximum rainfall, which is more than 2,000 mm on average [1-3]. Although rainfall is well known to spatially and temporarily vary throughout the country, the lowest total monthly rainfall, which generally occurs in June and July, is mostly more than 100 mm. However, the abundance of raw water source does not guarantee a constant and uninterrupted water supply. The Malaysian Water Association [4] reported that the domestic water consumption in 2017 was high (201 litres/capita/day) compared with the water usage recommended by the World Health Organization (WHO), i.e. 165 litres/capita/day. According to these figures, 18% of water-usage reduction is required to achieve the ideal value. In general, the most common perceptions on the factors that contribute to the excessive water consumption are the lack of public awareness, high non-revenue water percentage, ineffective water-demand management, and low water tariff.



Nevertheless, through our extensive literature review, we found that studies on public awareness on water consumption in Malaysia received less attention from local researchers.

Past studies found that society perceives that the volume of water on Earth is unlimited [5], resulting in much water wastage [6], water-pipe leakage [7], water pollution [8-10], supply and demand imbalance, negligence, and irresponsible water usages [11]. Furthermore, the importance of water is often not appreciated and is viewed as negligible for a handful of people [12] [13]. These factors have caused further complication to the country's water resources and supply management.

Studies on weather as a factor outside the control of water utilities were conducted by various researchers [14] [15]. These studies concluded that the water-demand rate during hot weather is higher than the water-consumption rate during cold weather. However, the exact nature of weather or the water-demand relationship has some degrees of uncertainty. Weather has been well documented to influence the decisions for short-term water demand (especially for landscape irrigation). Therefore, climate variables are typically controlled in regression-based studies that focus on prices and non-price tools [16] [17].

In addition to the aforementioned weather and socio-economic factors, the authors believe that local culture may also influence water usage and habits [18]. For a tropical and multi-racial country such as Malaysia, investigating the activities and factors that contribute to high domestic water usage as well as the most common practice in daily water usage would be important. Given the importance of this information, the present study includes a thorough investigation on water consumption of a middle-class community in Malaysia, which accounts for the highest income group in the country. Specifically, we focus on three major categories, i.e. domestic water-usage activities, water habits of the community, and water-saving efforts that can be easily adopted. The findings from this study provides an understanding on the activities and habits associated with high water usage. Stakeholders, including government agencies involved in the water supply and water companies, can use the findings from this study to formulate a pro-active action plan in order to achieve the water usage of 165 litres/capita/day recommended by WHO.

2. Methodology

2.1. Questionnaire design

The questionnaire developed for this study contained 11 questions on daily water usage, habits, and conservation effort. In general, this set of questionnaires consisted of multiple-choice questions, and some were formulated to be answered by 'YES' or 'NO'. The questionnaires were designed in accordance with previous research [19] [20] and observations of the researchers.

2.2. Water-usage behaviour

Previous research concluded that water-usage behaviour is related to the household composition, particularly income and age [21] [22]. However, this study concentrates on the community's water-use habits and activities that contributed to the consumption of treated water. The respondents were asked to indicate their daily frequency of treated water use for indoor and outdoor activities, such as cleaning, car washing, cooking, bathing/showering, toilet usage, washing dishes, laundry, and watering of plants. The respondents were required to indicate the frequency of usage by selecting one of the given options, i.e. one to two times, three to four times, or more than four times.

2.3. Water habits

In the present study, each respondent was required to indicate his or her water habits by answering questions pertaining to the average time he/she bathe/showers and if he/she let water flows while tooth brushing, dish washing, and doing other activities. The options for average time for bathing/showering were 5–10 minutes or more than 10 minutes. A 'YES' or 'NO' option was provided to the respondents to indicate their water habits during tooth brushing, dish washing, and other activities.

2.4. Water-saving efforts

The study area is mainly a residential area. Therefore, through our observations and from previous research works [23] [24], three common water-savings efforts could easily be adopted, i.e. bathing/showering equipment, rainwater harvesting, and type of toilet flushing, e.g. single- or dual-pump system. For the bathing/showering equipment, the respondent could select bucket, showerhead, or both. The respondents were required to select either 'YES' or 'NO' for the availability of rainwater harvesting system in their properties and indicate if they were using a single- or dual-pump system for their toilets.

2.5. Face-to-face interview using random sampling technique

The respondents were given up to 10 minutes to answer the questionnaires. Through our observations, the respondents had sufficient time to complete the questionnaires because the questions provided were simple and easy to understand. For the calculation of the sample size, the Cochran formula was used to calculate the ideal sample size given the desired level of accuracy, desired confidence level, and estimated proportions of the population properties. The Cochran formula is considered as particularly suitable in situations where large populations are involved. According to the 1,257 active connections in the study area, the suggested sample size was 300 respondents, and they were randomly selected to fill out the questionnaires.

2.6. Data processing and analysis

Data processing and analysis of the water-usage behaviour, water habits, and water-saving efforts were performed using the IBM SPSS Statistic 23 software. The number of respondents and percentage of each component are presented in the form of graph or tables.

3. Result and discussions

3.1. Water usage behaviour

In general, increasing frequency of daily activities contributes to high water consumption. Figure 1 shows the frequency of water usage for indoor (in a day) and outdoor (in a week) activities. Interestingly, most of the indoor water use occurred three to four times a day. Furthermore, we note that the high frequency of indoor water usage of more than four times a day, which suggested that most people did not control their water consumption, especially for cooking, bathing/showering, toilet usage, and dish washing. Similar finding is also reported by Sadalla [25].

Majority of the respondents indicated that for outdoor activities, the most common frequency of water use was from one to two times a week. Although the frequency of the respondent water usage for outdoor activities of more than four times a week was the lowest, this number needed to be further reduced because of the high volume of water used for watering plants, car washing, and house cleaning, as shown by Loh and Coghlan [26] and Glenn [27].

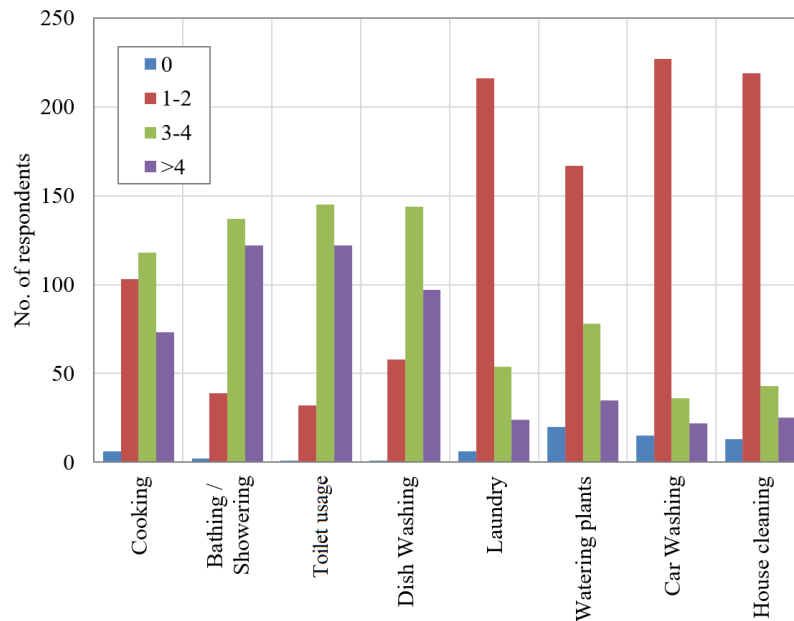


Figure 1. Number of respondents versus frequency of indoor (daily) and outdoor (weekly) water usage.

3.2. Water habits

In this study, water habits were defined as the average time taken for bathing/showering and whether the respondents let water flow during tooth brushing, dish washing, and in other activities. For the average time taken for bathing/showering, the respondents were required to select one of the following options: 5–10 minutes or more than 10 minutes. Meanwhile, their water habits of letting water flow during tooth brushing, dish washing, and other activities were indicated by a ‘YES’ or ‘NO’ option.

The list in table 1 shows that not much difference could be found in terms of the number of respondents taking short and long bath/shower, i.e. 159 and 141, respectively. Interestingly, the high trend of taking a long bath/shower could be influenced by the hot and humid climate experienced in Malaysia. Similar findings were reported by Pedro [15] and Anke [14], especially during summer in four-season countries. The high humidity (up to 80%) and average daily temperature (up to 36 °C) cause the body to easily sweat throughout the day.

Table 1. Number of respondents based on indoor-type activities.

Activities		Number of respondents	Percentage (%)
<i>Bathing/showering time</i>			
	5–10 minutes	141	47
	>10 minutes	159	53
<i>Letting water flow</i>			
Dish washing	Yes	171	57
	No	129	43
Tooth brushing	Yes	238	79
	No	62	21
Other activities	Yes	286	95
	No	14	5

Encouraging results were shown in terms of letting the water flow during tooth brushing, dish washing, and other activities, as listed in table 1. These results indicated that the respondents showed some awareness on water conservation [28]. For dish washing, although 129 (43%) of the respondents answered ‘YES’, this result was expected because it was more convenient to let water flow during this activity [17]. For example, a water tap could drain up to 15 to 25 L/min. If water is allowed to flow for 5 min during these activities, up to 125 L of treated water is wasted.

3.3. Water-saving efforts

Water-saving efforts that can be easily adopted by the community include proper usage of bathing/showering equipment, rainwater harvesting, and toilet flushing, i.e. single- or dual-pump system.

For the bathing/showering equipment, the respondent can select a bucket, showerhead, or both, and the results are listed in table 2. Most of the respondents used showerhead as bathing/showering equipment, as indicated by 151 responses (50%). In contrast, bucket usage was the lowest, as indicated by 69 respondents (23%). The high use of showerhead was expected because it was easier and more convenient [29]. However, the choice of showerhead type was also important to control the day-to-day use of water. The new showerhead model only uses 9 L/min of water compared with the 20 L/min water usage of the old model. If all the respondents use the new showerhead model, more than 30,000 L of treated water per day can be saved by assuming a 7.5-min bathing time. Therefore, it is important for the community to be aware of the importance of choosing the most water-saving bathing/showering equipment to not only reduce water consumption but also teach future generations to adopt a responsible attitude in using treated water.

As listed in table 2, only 44 houses took the initiative of using the dual-pump cistern to save water. The dual-pump cistern can save up to 4.5 L of water per flushing compared with the single-pump cistern. This amount is significant. Therefore, the community needs to be educated and made aware that this simple act can greatly contribute in controlling and saving water [30 - 32].

The use of a rainwater-harvesting system offers large benefits, especially for non-potable water usage, during dry season and reduces reliance on treated water [16], [33]. However, the use rainwater-harvesting system by the respondents was low, i.e. with only 86 respondents (28.7%), as listed in table 2, which means that community awareness on the importance of a rainwater catchment system is low.

Table 2. Number of respondents based on water-saving effort.

Water-saving effort	Number of respondents	Percentage (%)
<i>Bathing/showering equipment</i>		
Bucket	69	23
Shower	151	50
Bucket and shower	80	27
<i>Toilet pump system</i>		
Single pump	256	85
Dual pump	44	15
<i>Rainwater harvesting</i>		
Yes	86	29
No	214	71

The low water tariff in Malaysia may have discouraged the consumers to effectively implement water-saving efforts in their household. For example, a rainwater-harvesting system requires frequent and rigorous maintenance, such as cleaning the gutters to ensure that it is not clogged by leaves and needs to be regularly checked to minimise the risk of mosquito breeding that may cause dengue.

4. Conclusions

This paper has presented the frequency of indoor and outdoor water usage, water habits, and water-saving efforts of a middle-class community in a southern state in Peninsular Malaysia. In general, the most significant conclusions are the following;

- a) High frequency of indoor and outdoor activities is a contributing factor to the high domestic water consumption. This finding suggested that most people did not control their water consumption, especially for cooking, bathing/showering, toilet usage, dish washing, watering plants, car washing and house cleaning.
- b) Community awareness in terms of water-saving efforts is low, as indicated by the low number of respondents that uses dual-pump cisterns in their toilets (15% of total respondents) and employs rainwater-harvesting system (29% of total respondents), especially for non-potable use.
- c) The low water tariff in Malaysia may have discouraged the consumers to effectively implement water-saving efforts in their households. Rainwater-harvesting system requires frequent and rigorous maintenance such as cleaning the gutters to ensure that they are not clogged by leaves and regular checking to minimise the risk of mosquito breeding that may cause dengue.

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