UNDERSTANDING WATER SAVING BEHAVIOR AMONG SUB-URBAN HOUSEHOLDS IN PENANG, MALAYSIA

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Abstract

Access to clean water is essential to ensure good health and is considered a basic human right. As the largest sector and social group, households have very high-water consumption needs. Understanding household water-saving behavior can provide important foresight to predict future population water-saving characteristics. This work aims to identify the factors that may influence households' water-saving behavior. This study proposed an extended use of the Theory of Reasoned Action, consisting of three variables: attitudes, social norms, and awareness. Household income and household numbers were also measured in this model. Using data collected from 200 valid questionnaires from sub-urban areas in Seberang Prai Utara, Penang, this study found awareness ($b=0.372$; $p<0.05$) as the factor that influences household water-saving behavior. Attitudes and social norms were shown to have a positive but insignificant relationship. Based on what emerges from the analysis, the work can be understood as a useful tool for scholars and practitioners, suggesting theoretical and managerial implications. This study contributes to the enrichment of scientific literature related to the factors involving individual choices. It also helps maximize the success of the water management sector by highlighting the levers to be actioned to improve demand-side water management performances.

Keywords: Water-saving behavior; Attitudes; Social norms; Awareness Households

Abstrak

Akses kepada air bersih adalah penting untuk memastikan kesihatan yang baik dan dianggap sebagai hak asasi manusia. Sebagai sektor dan kumpulan sosial terbesar, isi rumah mempunyai keperluan penggunaan air yang sangat tinggi. Memahami

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tingkah laku penjimatan air isi rumah dapat memberikan pandangan dalam meramalkan ciri penjimatan air penduduk pada masa depan. Kerja ini bertujuan untuk mengenal pasti faktor-faktor yang boleh mempengaruhi tingkah laku penjimatan air isi rumah. Kajian ini mencadangkan Teori Tindakan Beralasan yang diperluaskan penggunaannya, yang terdiri daripada tiga pembolehubah: sikap, norma sosial, dan kesedaran. Pendapatan isi rumah dan bilangan isi rumah juga diukur dalam model ini. Menggunakan data yang dikumpul daripada 200 soal selidik yang sah dari kawasan pinggir bandar di Seberang Prai Utara, Pulau Pinang, kajian ini mendapati kesedaran ($b=0.372$; $p<0.05$) sebagai faktor yang mempengaruhi tingkah laku penjimatan air isi rumah. Sikap dan norma sosial ditunjukkan mempunyai hubungan yang positif tetapi tidak signifikan. Berdasarkan hasil analisis, kajian itu boleh difahami sebagai alat yang berguna untuk sarjana dan pengamal, mencadangkan implikasi kepada teori dan pengurusan. Kajian ini menyumbang kepada pengayaan literatur saintifik yang berkaitan dengan faktor-faktor yang melibatkan pilihan individu, dan dalam sisi lain, ia juga membantu memaksimumkan kejayaan sektor pengurusan air dengan menonjolkan perkara utama yang perlu diambil tindakan untuk meningkatkan prestasi pengurusan air dari aspek permintaan.

Kata kunci: *Tingkah laku penjimatan air; Sikap; Norma sosial; Kesedaran; Isi rumah*

Introduction

Economic development, rapid urbanization, high population rate, change in land use, and global climate change have adverse effects on the earth's potential potable water (Chang, 2013; De la Cruz et al., 2017). Ramsey et al., (2017) note that, in developing countries, more than 2 billion people currently lack sufficient water to meet basic human needs. Although water is virtually abundant, study shows that two-thirds of the world's population could be living in regions with limited access to freshwater resources by 2050, as the world population is forecast to grow to 11.2 billion by 2100 (UNESCO, 2022). Throughout the years, the world is constantly faced water problems and increasing depletion of our fresh-water supplies. Billions of people are suffering from water scarcity either regularly or permanently (Bari et al., 2015). Muller (2020) reported that approximately 6.65 billion liters of metered water per day for domestic use were consumed in Malaysia in the year 2018 (Figure 1). The increasing trend of water consumption seems to need to put an immediate effort into reducing water consumption for the future. The increasing trend of high per capita domestic consumption is one of the demand-side management issues that need to be addressed immediately.

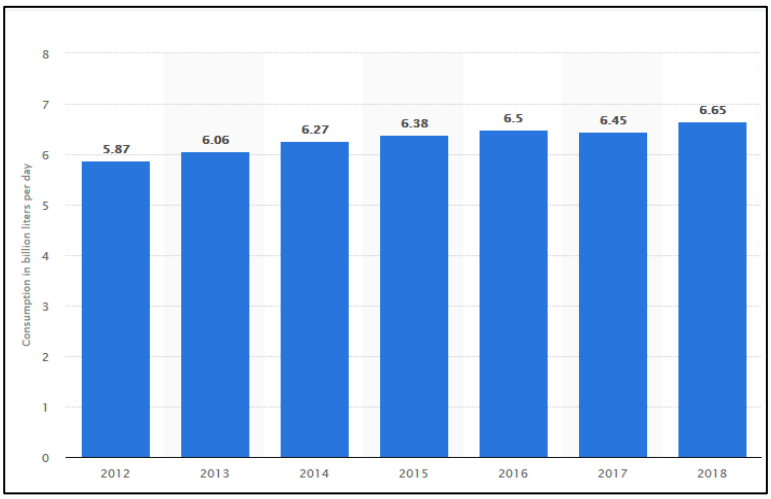

Figure 1: Domestic metered water consumption in Malaysia from 2012 to 2018 (in billion liters per day).
Source: Muller, J. (2020)

Based on the PBA Holdings Bhd report, the Corporation Penang Water Supply Sdn Bhd (PBAPP) provides continuous water service for the benefit of 1.77 million people and thousands of businesses in Penang. From this report, the data shows that the household water utilization per capita in Penang expanded from 276 LCD (liters/capita/day) in 2017 to 278 LCD in 2018. This is a minimum 2 LCD increment in residential per capita utilization in Penang which is excessively high as compared to the national average used which was just 201 LCD in 2017. At the same time, the Federal Government was now focusing to arrive at a national average of 180 LCD by 2025 (PBA, 2019). Historical data shows that per capita domestic consumption had increased by 19.6% from 255 LCD to 305 LCD in 2021 (PBAPP, 2022). Projected forward, Penang's per capita domestic water consumption may reach 333 LCD by 2030. This scenario may need to be closely monitored in future water-saving measures.

Referring to the above pattern of water consumption, there is rising pressure on household water use in Penang which is also an issue in many other countries (Jakubczak, 2020; Lowe et al, 2015; Seelen et al., 2019). Therefore, people are gradually pushing to move towards more sustainable water consumption concerning natural and water resources, which are limited in their availability. Sustainable water conservation now has become a cornerstone of society and public concern (Chen et al., 2015, Bari et al., 2015).

Recently, more and more scholars recognize the importance of reducing water consumption in terms of people’s water-saving awareness and behavioral perspective

(Chang, 2013; Harland, 2009; Jacubczak, 2020; Mahlasela et al., 2020). Water consumption of households is determined by water-saving awareness and other factors, which are more difficult to regulate than other water consumption sectors. To reduce household water consumption, understanding the correlation between water-saving awareness and other factors is the basis of exploring the formation of individual water-saving behaviors. Existing studies have used the survey data in specific cities and regions to reveal the impact of internal influence factors (such as demographic variables, attitude, and awareness) and external influences factors (such as social norms and government policy) on water-saving behavior. For example, Willis et al. (2011) investigated the influence of attitudes, Syme et al. (2000) on government campaigns, Tong et al. (2017) and Randolph & Troy (2008) focused on social norms and awareness.

At present, Malaysia's water-saving policies are mainly focused on advanced water-saving technologies (such as water-saving devices or appliances). However, this technical approach is widely believed to require a lot of time and money, and in fact, changing behavior can be more effective without additional investment. For the sub-urban households' characteristics, it still needs to be clarified whether these factors bring any influences, in what ways, and whether there are spatial differences among other households' characteristics. This study aims to investigate suburban households' water-saving behavior, attitude, subjective norms, and awareness, as well as identify their possible influence factors, and further put forward effective suggestions for improving households' water-saving behaviors.

Therefore, this study is conducted to examine factors that may potentially motivate or impede households to save water based on the Theory of Reasoned Action in suburban Penang, Malaysia. A suburban area is primarily a residential area that is not overcrowded but very near to an urban area. Although it is not urban, it has many characteristics that do not fall into the features of rural areas. Living costs in these areas are lower than in city areas but higher than in rural areas. Suburban areas are facilitated with roads, electricity, hospitals, educational institutions, and many other facilities like urban areas. A better understanding of the drivers of water-saving behaviors especially in specific characteristics can influence policymaker's program design and maximize the impact of water conservation policies. To the best of the author's knowledge, there is no such investigation into the specific suburban characteristics of households in water-saving behavior. Therefore, this study aims to answer these questions;

a) Is there a significant difference between household characteristics (household size and income) on household water-saving behavior?
b) Do attitudes, social norms, and awareness affect household water-saving behavior?

LITERATURE REVIEW

Sustainable water consumption in the household sector

Households are one of the sectors that consume more water. Beaman & Dillon (2012) stated that a household is a group of individuals inside the household who usually live and eat their meals together. Members must accept one person's authority as head of household and that person simply has to deal with the rest of the members of the household. Furthermore, the household is an administrative entity in which the members have some economic relations. They could engage in the same productive activity and earn revenue together. Home activities and households' management of water consumption is an essential element in designing water policy in the future.

The domestic sector or household water use is water used for indoor and outdoor home purposes. Water needs for household drinking, washing, bathing, preparing food, brushing teeth, watering the garden, and many other reasons (Amin et.al., 2011). Studies in developed nations showed that about half of all domestic water was used indoors and the other half was used for outdoor purposes, although outdoor use may account for as much as two-thirds of total use in warmer climates (Mayer & DeOreo, 1999). Syme et al. (2000) explicitly identified the use of outdoor water and discovered several lifestyles, for instance, the value of a large garden lifestyle, a large lawn, a green home environment, and garden leisure and enjoyment are all interconnected and lead to increased water usage.

The basic concept of sustainability refers to the use of related services and products that meet basic needs which leads to a better quality of life. At the same time, it should minimize the use of natural resources, toxic substances, waste release, and pollution throughout the product's service life. Current consumption actions should also not harm the needs of future generations (United Nations, 1994). Therefore, sustainable use is characterized as a pattern of more scientific use, fair use of the process, and more conducive use. Gleick (1996) and Hassell & Cary, (2007) define sustainable water use as the ability to preserve the quantity of water for the present and future population, without sacrificing its quality.

Households' characteristics and water consumption

The effect of socio-demographic factors on household water consumption has been studied by many previous research studies (Chen et al, 2015; Garcia et al., 2013; Shan et al., 2015; Willies et.al, 2011). Household size, level of education, employment, age, and gender may cause different levels of water consumption (Jorgensen, Graymore, and O'Toole, 2009). ARCWIS (2002) indicated that owners occupied properties, higher-earning families, and swimming pool households consumed more water for irrigation purposes. Besides, there is a close association

between the level of income and use of the outdoor water (Loh & Coghlan, 2003). Before that, a study by Mayer and DeOreo (1999) found the occupancy and make-up of dwellings, lot size, and age of water-using devices influence water consumption with larger lot sizes probably consuming more water. Studies from different developed nations indicated that higher-income families use more water and save less on preservation (Jakubczak, 2020; Jorgensen et al., 2009; Loh, 2003). According to Chen (2015), larger household sizes tend to be more water-intensive than smaller households and wealthier people are more likely to use water due to assets such as swimming pools. Besides, there is a close association between the level of income and use of the outdoor water (Loh & Coghlan, 2003; Romano et al., 2016). Besides, previous studies (Gilg & Barr, 2006; Willis et al., 2013) found that higher-income households are more likely to install water-efficient technology. It also indicates that these higher-income homes are not inherently lower consumers of water, particularly per household. For instance, Fan et al. (2014) postulate that water savings can be balanced by technology-induced behavioral improvements to benefit from water-efficient appliances. Mayer et al. (1998) stated that people may take longer showers for example if they have a low-flow shower head installed.

Attitude, Subjective Norms, and Awareness

Hassel and Cary (2007) stated that consumer attitudes and beliefs will have a direct impact on water consumption behavior. Randolph and Troy (2008) defined attitudes refers to people's reactions when invited to assess the efficacy or expectations of others' actions or when invited to share their opinions on their behavior. Stern et al. (1999) explore that people gain their attitudes from their general beliefs and internalized norms on particular environmental concerns. Researchers found that attitudes concerning the importance of gardening as a house investment and a source of leisure, spending on gardening, and attitude toward water prices were all important predictors of household water usage (Syme et al., 2000). Attitudes and subjective norms are two important variables in the Theory of Reasoned Action (TRA) by Ajzen and Fishbein in 1980. Attitudes are defined as positive or negative feelings concerning the achievement of an objective. If people evaluate the suggested behavior as positive (attitude), this results in a higher intention or motivation for them to perform the behavior. Several studies found a significant relationship between attitudes and water-saving behavior (Randolph & Troy, 2017; Willis et al., 2011). These studies confirm that a higher attitude towards water conservation then leads to a higher level of water conservation.

Another variable in the TRA is social norms. Referring to this theory, social norms are characteristics that have a social orientation and represent a person's belief in the social acceptance of behavior concerning a comparison group of peers. Social norms are what people in any group think are common within the group, i.e. standard actions, appropriate behavior, or both (Mackie et al., 2015). People's beliefs about

what most other people do or agree to do are very important, and research has shown that social norms can have a strong influence on behavior (Stern et al., 1999). The social norm seems to be very important in previous water-saving behavior (Tong, 2017; Torres & Carlsson, 2016). Accepted practices are standard guidelines of conduct that facilitate our cooperation with others (Stern et al., 1999). Jorgensen et al. (2009) asserted that if the general public sees that water experts and others are generally deceiving, they will not follow their guidelines to conserve water, along these lines showing the close relationship between beliefs and accepted practices. Therefore, the social standard of water-saving practices and what their friends, family, and others do is very important in influencing other behavior among households. Thus, many studies conclude that social norms strongly influence people's water conservation and other green behaviors (Ramli, 2021; Stern et al., 1999; Torress & Carlsson, 2016; Tong, 2017).

Water awareness is characterized as being aware of how much water is used daily by direct use, such as drinking and washing, and indirect use, such as how much water is used to produce food or clothing products. In addition, water understanding requires the realization of risks to water quality such as agricultural run-off, and the recognition that a minimal solution is freshwater (Seelan, Flaim, Jennings & Domis, 2019). Many studies have found the importance of people's awareness concerning water-saving practices. Jakubczak (2020) confirmed awareness of individuals as vital to water-saving practices among European households. Augustine & Mohd Hanafiah (2019) found a high level of students' awareness of water conservation but a lower level of water-saving practice. Tong et al., (2017) and Seelan et al. (2019) confirmed that awareness and water conservation practice is highly correlated.

Based on the variables discussed above, the framework of the study is therefore depicted in Figure 2

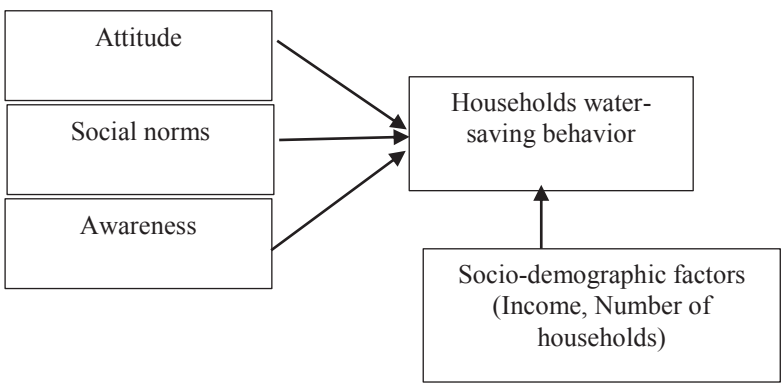

Figure 2: A proposed model based on the Theory of Reasoned Action (Ajzen, 1991)

Based on the aforementioned literature, we hypothesize that:

a. Income level (H1a) and household number (H1b) will result in a significantly different level of households' water-saving behavior.
b. Households' water-saving behavior would be influenced by attitudes (H2a), social norms (H2b), and awareness (H2c).

Methodology

Convenience sampling was used in this study with a target of suburban households in Seberang Prai Utara (SPU). SPU is one of five districts in Penang which is the largest area with 26588.04 hectares (262.53 sq km). According to Majlis Bandaraya Seberang Perai (MBSP) (2020), the population of SPU in 2019 totaled 396,160 and increased by 2.2% every year to 405,100 residents in 2020. Respondents are selected from three areas which are Penaga, Bertam, and Pinang Tunggal (Figure 3). Participation in the study was voluntary and anonymous. In meeting the objectives of this study, a survey was conducted using a structured questionnaire, and 200 households took part in the face-to-face survey. The questionnaire used is divided into three parts the first part includes general questions to measure households' water-saving behavior. The second section includes questions designed to reveal water-saving attitudes, subjective norms, and awareness. The third part of the questionnaire collects some basic information about the respondents (including gender, age, race, education level, occupation, income, number of households, and monthly water bill).

For this questionnaire design, a pretest survey (n=30) was conducted to assess the validity of the questionnaire. The content of the questionnaire was modified based on feedback from this pretest. The questionnaire consisted of a total of 27 items which were defined on an interval scale from 1 (never) to 5 (always) for water-saving behavior and a scale from 1 (strongly disagree) to 5 (strongly agree) for attitudes, subjective norms, and awareness. The items developed for each construct are listed in Table 1. The results and data for each household were then processed according to the planned statistical analysis that was performed using SPSS version 25.0. Descriptive analysis was used to describe patterns in demographic profiles. A one-way ANOVA was used to assess whether income and the number of households were related to water-saving behavior. Regression analysis was used to test the effects of attitudes, subjective norms, and awareness on household water-saving behavior. Table 1 shows the mean scores for each of the items.

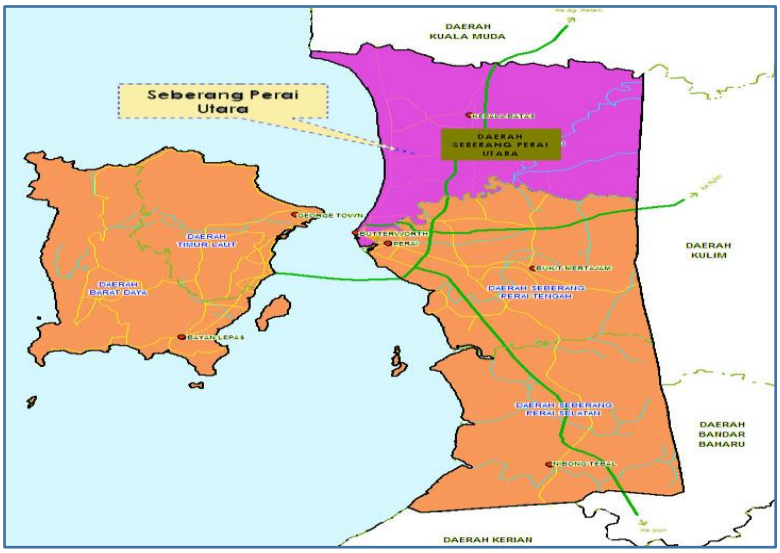

Figure 3 : The area of Seberang Perai Utara.
Source : Majlis Bandaraya Seberang Perai (MBSP), (2020).

Table 1: Measurement scores

Items	Mean	SD
Water-saving behavior		
I make sure the water pipes are tightly closed to prevent water from dripping.	4.59	0.717
If I find that the water pipe is not closed, I immediately act to close it.	4.56	0.685
I use an adjustable sprayer to water the plants.	3.10	1.418
I use the water collected during the rain to water the plants and wash the car.	2.89	1.436
I use a little water during cleaning	3.81	0.970
My family and I collect rainwater for daily use	2.83	1.474
I have been trying to take a shower for a short time.	3.87	0.910
I try to limit the use of water while doing housework.	3.56	1.231
I take a shower using boiled water as opposed to shower water.	3.93	0.879
Attitudes		
Everyone must be able to use as much water as they like.	3.57	1.304
I feel a moral obligation to use water carefully.	4.38	0.676
I will make sure the leaking pipes are always repaired.	4.51	0.601
I am ready to do water-saving activities.	4.42	0.636
I feel guilty for wasting water at home.	4.47	0.694
I always think and feel responsible for saving water consumption in my daily behavior.	4.43	0.676
I am willing to engage in water-saving activities.	4.44	0.706

Table 1 (continues)

Items	Mean	SD
Subjective norms		
Ensuring adequate water is everyone's responsibility.	4.67	0.594
The government should impose fines on people who waste water.	4.24	0.810
The more people use water, the more they have to pay for water use.	4.50	0.610
I save water consumption like everyone else.	4.43	0.676
I do not waste water use even if others do.	4.39	0.671
I save on water consumption even if others do not	4.41	0.628
Awareness on water-saving		
I am conscious of the amount of water I consume.	4.51	0.657
I encourage awareness and water-saving activities near my home.	4.24	0.778
I do not water the flowers excessively and reduce watering during the rainy season.	4.31	0.753
I try to advise friends or neighbors about the importance of water.	4.01	0.980
I believe that water saving is the best water solution.	4.47	0.609

Results and Discussion

Table 2 shows the socioeconomic profile of the respondents. The data shows that more than half of the participants (63%) are female and 92.5% are Malay. About 50.5% of respondents are between 20-29 years old. The level of education of the respondents shows that 48% of them have a bachelor's degree or higher and 26% have obtained a high school education. About 27% of respondents are from the private sector, while 33.5% are categorized as students and unemployed. Income below MYR2500 (72%) is the dominant group with 51.5% of them having a small household size of fewer than 5 people.

Table 2: Demographic Profile of Respondents (n=200)

Characteristics	%	Characteristics	%
Gender		Race	
Men	37.0	Malay	92.5
Female	63.0	Chinese	4.0
		Indian	3.0
		Others	0.5
Income		Educational level	
Below RM 2500	72.0	Primary school	2.5
RM 2501 - RM 4849	19.5	SPM	26.0
RM 4849 - RM 10 595	8.5	Diploma/STPM/Certificate	23.5
RM 10 960 and above	0	Degree/ Master and above	48.0

Table 2 (continues)

Characteristics	%	Characteristics	%
Occupation		Age	
Civil servant	17.5	Under 20 years old	4.0
Private sector	27.0	20 - 29 years old	50.5
Self- employed	9.0	30 - 39 years old	27.5
Housewife	13.0	40 - 49 years old	9.0
Student	13.5	50 - 59 years old	6.5
		Above 60 years old	2.5
Household size		Monthly water bill	
5 people and less	51.5	RM 50 - RM 100	37.5
6 to 9 people	45.5	RM 101 - RM 150	55.5
10 people and more	3.0	RM 151 - RM 200	3.5
		RM 201 and above	2.0

Income and household size differences with households' water-saving behavior

Table 3: ANOVA Table of Income

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.392	2	.696	1.390	.252
Within Groups	98.696	197	.501		
Total	100.088	199			

Table 4: Multiple comparisons

(I) Income	(J) Income	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Less than RM 2500	RM 2501 - RM 4849	-.20346	.13118	.270	-.5132	.1063
	RM 4850 - RM 10 959	-.17744	.18636	.608	-.6176	.2627
RM 2501 - RM 4849	Less than RM 2500	.20346	.13118	.270	-.1063	.5132
	RM 4850 - RM 10 959	.02602	.21120	.992	-.4727	.5248
RM 4850 - RM 10 959	Less than RM 2500	.17744	.18636	.608	-.2627	.6176
	RM 2501 - RM 4849	-.02602	.21120	.992	-.5248	.4727

The results of One Way ANOVA for hypothesis 1a are given in Table 3. Based on the p-value of 0.005, it is clear that H1a is not supported. Income differences do not significantly influence water-saving behavior. The strength of the relationship between income level and water-saving behavior as measured by Eta Squared is 0.001, indicating a low influence of income on water-saving behavior. Tukey's HSD test (Table 4) for multiple comparisons found that the mean value of water-saving behavior was not significantly different between income levels.

There were also no statistically significant differences in water-saving behavior between household sizes (p=0.270; p=0.608; p=0.992). Table 6 summarized the results of multiple comparisons of household size. The result in Table 5 confirms that there was no significant difference in the mean value of water-saving behavior in at least two groups (F(2,197)=[0.678], p=0.509). Hence, *H1b* is also not supported which concluded that no significant difference in household size regarding household water-saving behavior. Based on these results, we can conclude that these two variables (income and household size) do not show a significant influence which contradicts previous studies (Loh & Coghlan, 2003; Willies et.al, 2013).

Table 5: ANOVA Table of Household size

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.684	2	.342	.678	.509
Within Groups	99.404	197	.505		
Total	100.088	199			

Table 6: Multiple Comparisons

(I) Household size	(J) Household size	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
5 people and less	6 - 9 people	-.09286	.10505	.651	-.3409	.1552
	More than 10 people	.11044	.30665	.931	-.6137	.8346
6 - 9 people	5 people and less	.09286	.10505	.651	-.1552	.3409
	More than 10 people	.20330	.30776	.787	-.5235	.9301
More than 10 people	5 people and less	-.11044	.30665	.931	-.8346	.6137
	6 - 9 people	-.20330	.30776	.787	-.9301	.5235

Analysis of predictive factors that influence household water-saving behavior

The second objective of this research is to analyze the predictor factor among the three independent variables toward the dependent variable. Based on Uyanik and Guler (2013), states that regression analysis is conducted to assess the relationship between two or more variables with cause-and-effect relationships and draw conclusions for the subject by using those relationships. Therefore, to analyze this objective, multiple linear regression is used as a statistical method in this research.

Table 7: Regression analysis

Variables	B	Std. Error	Beta	t	Sig.
(Constant)	1.151	.527		2.183	.030
Attitude	.019	.149	.011	.127	.899
Social Norm	.191	.135	.129	1.412	.160
Awareness	.372	.118	.262	3.160	.002

The results of multiple regression (Table 7) indicate a positive and significant relationship between awareness and water-saving behavior (t=3.160, p=0.002, b=0372). With the support of H2c, we have established that as the level of awareness increases, water-saving behavior also increases. However, the study shows that attitude (t=0.127, p=0.899, b=0.019) and subjective norm (t=1.412, p=0.160, b-0.191) are not significantly but positively related to water-saving behavior. Based on the summary output of the regression model, the value of R and R^2 shows a weak correlation value of 0.357 and 0.127 respectively. The coefficient of determination (R-square) explains only 12.7% of the variation in the dependent variable. Based on this analysis, awareness is the only predictor factor that affects household water-saving behavior concerning this household characteristic. This finding is in line with the previous findings of Tong et al., (2017), Seelan et al. (2019), and Jakubczak (2020) which found a strong relationship between awareness and water-saving behavior. Thus H2c is accepted. For attitudes and social norms, analysis shows a positive relationship but not significance. Then hypotheses H2a and H2b are not supported which found different results from previous studies (Tong, 2017; Torres & Carlsson, 2016; Ramli, 2021).

Conclusion

In this research, an extended model of the TRA has been developed to predict behavior in the area of water-saving. Different studies have confirmed the importance of reducing water use as far as protecting natural resources and environmental

sustainability. According to the results obtained, water-saving behavior is mainly explained by people's awareness. The demographic characteristics, attitudes, and social norms are not significant but have a positive influence on water-saving behavior. This study has therefore developed and corroborated an explanatory model which, taking the TRA as a starting point, has increased its explanatory power, added the awareness and characteristics of households, and improved the theoretical framework used to explain consumption behavior relating to the water resource.

The findings of this study will be beneficial to households as the main water consumers, service providers, and policymakers who have an interest in this area. Awareness could have a positive impact on households by having an action plan and thereby reducing water consumption. Save water by spreading awareness should be an important slogan for water conservation efforts in the future. There are many ways to make the public aware of how to save water and make people understand the current situation of water on earth. Nowadays, social media is a big medium to discuss and spread information to people all over the world. The use of social media like Facebook, Instagram, TikTok, and many more can be the best platform to spread awareness to save water in public. Future research can examine how this social media impacts the spread of awareness about these green efforts in the public.

In this respect, increasing awareness and knowing about the information can help households with their water management. The results of this study will benefit water service providers or companies when debating or deciding strategies to market their water-saving devices. The Malaysian government is always encouraging households' awareness to go green through its various initiatives and campaigns. Therefore, this study will also come to the assistance of the Malaysian government and NGOs in implementing policies that are better focused on water-saving and going green. The findings of the study can be used as a guide and a way out that can help to improve and strengthen this water-saving development program. Determining the motivation to save water is important when implementing an educational approach to save water in the household sector, therefore, an understanding of water-saving behavior, attitudes, social norms, and awareness is important for the design of future household policies.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes* 50(2): 179-211.

Ajzen, I., & Fishbein, M. (1980). Understanding attitudes and predicting social behavior. Englewood Cliffs, New Jersey: Prentice-Hall.

Amin, M.A., Mahmud, K., Hosen, S. and M.A. Islam (2011). Domestic water consumption patterns in a village in Bangladesh. 4th Annual Paper Meet and 1st Civil Engineering Congress, Dhaka, Bangladesh. ISBN: 978-984-33-4363-5.

Augustine, E. E. & Mohd Hanafiah, M. (2019). Awareness level of water resource conservation of university students. *Water Conservation and Management.* 3(2) 18-21.

ARCWIS. (2002). Perth Domestic Water-Use Study Household Ownership and Community Attitudinal Analysis. NWS. Australian Research Centre for Water in Society (ARCWIS) CSIRO Land and Water.

Bari, M., Begum, R. A., Nesadurai, N., & Pereira, J. J. (2015). Water consumption patterns in greater Kuala Lumpur: Potential for reduction. *Asian Journal of Water, Environment and Pollution*, *12*(3), 1-7.

Beaman, L. & Dillon, A. (2012). Do household definitions matter in survey design? Results from a randomized survey experiment in Mali. *Journal of Development Economics*, *98*(1), 124-135.

Chang, G. (2013). Factors influencing water conservation behavior among urban residents in China's arid areas. *Water Policy*, *15*(5), 691-704.

Chen, X., Yang, S. H., Yang, L., & Chen, X. (2015). A benchmarking model for household water consumption based on adaptive logic networks. *Procedia Engineering*, *119*, 1391-1398.

De la Cruz, A. O., Alvarez-Chavez, C. R., Ramos-Corella, M. A., & Soto-Hernandez, F. (2017). Determinants of domestic water consumption in Hermosillo, Sonora, Mexico. *Journal of Cleaner Production*, *142*, 1901-1910.

Fan, L., Wang, F., Liu, G., Yang, X., & Qin, W. (2014). Public perception of water consumption and its effects on water conservation behavior. *Water*, *6*(6), 1771-1784.

Garcia, X., Ribas, A., Llausàs, A., & Saurí, D. (2013). Socio-demographic profiles in suburban developments: Implications for water-related attitudes and behaviors along the Mediterranean coast. *Applied Geography*, *41*, 46-54.

Gilg, A. & Barr, S. (2006). Behavioral attitudes towards water saving? Evidence from a study of environmental actions. *Ecological Economics,* 57, pp. 400-414.

Gleick, P.H. (1996) Basic water requirements for human activities: meeting basic needs. *Water International 21*, 21:2, pp. 83-92.

Harlan, S. L., Yabiku, S. T., Larsen, L., & Brazel, A. J. (2009). Household water consumption in an arid city: Affluence, affordance, and attitudes. *Society and Natural Resources*, *22*(8), 691-709.

Hassell, T. & Cary, J. (2007) Promoting Behavioral Change in Household Water Consumption: Literature Review. Victoria, Smart Water.

Jakubczak, A. (2020). Water conservation Behaviour as a sustainable action of young consumers from selected European Countries. *European Research Studies Journal*. XXIII(2), pp 763-780.

Jorgensen, B., Graymore, M., & O'Toole, K. (2009). Household water use behavior: An integrated model. *Journal of Environmental Management*, *91*(1), 227-236.

Loh, M., Coghlan, P., 2003. Domestic Water Use Study. Water Corporation, Perth.

Lowe, Ben and Lynch, David and Lowe, Julian (2015) Reducing Household Water Consumption: A Social Marketing Approach. *Journal of Marketing Management*, 31(3-4). pp. 378-408. ISSN 0267-257X.

Mackie, G., Moneti, F., Shakya, H., & Denny, E. (2015). What are social norms? How are they measured. *University of California at San Diego-UNICEF Working Paper, San Diego*.

Mahlasela, P., Oke, A., & Madonsela, N. S. (2020). Household's Satisfaction with Water Supply in Johannesburg Metropolitan Municipality, South Africa. *Procedia Manufacturing*, *43*, 183-192.

Majlis Bandaraya Seberang Perai (MBSP). (2020). Kependudukan. https://www.mbsp.gov.my/index.php/ms/mengenai-mpsp/maklumat-am/kependudukan

Mayer, P.W., DeOreo, W. B. (1999). Residential End Uses of Water. Aquacraft, Inc. Water Engineering and Management, Boulder, CO.

Muller, J. (2020, January 14). Malaysia: Domestic metered water consumption 2018. https://www.statista.com/statistics/796354/domestic-metered-water-consumption-malaysia/

PBA (2019). Penang has to tackle 3 key water supply issues. Media release. 30.5.2019. www.pba.com.my PBA (2022). Penang water alert: Air Itam dam capacity is low and water demand is high. Media release. 2.4.2022. www.pba.com.my

PBAPP (2022). 305 LCD: Per capita Domestic Water Consumption in Penang Reached an all-time high in 2021. www.pocketnews.com.my

Ramli, U. (2021). Social norms based eco-feedback for household water consumption. *Sustainability*. 13. 2796. https://doi.org/10.3390/ su13052796

Ramsey, E., Berglund, E. Z., & Goyal, R. (2017). The impact of demographic factors, beliefs, and social influences on residential water consumption and implications for non-price policies in Urban India. *Water*, *9*(11), 844.

Randolph, B., & Troy, P. (2008). Attitudes to conservation and water consumption. E*nvironmental Science & Policy*, *11*(5), 441-455.

Romano, G., Salvati, N., & Guerrini, A. (2016). An empirical analysis of the determinants of water demand in Italy. *Journal of Cleaner Production*, *130*, 74-81.

Seelen, L. M., Flaim, G., Jennings, E., & Domis, L. N. D. S. (2019). Saving water for the future: Public awareness of water usage and water quality. *Journal of environmental management*, *242*, 246-257.

Shan, Y., Yang, L., Perren, K., & Zhang, Y. (2015). Household water consumption: insight from a survey in Greece and Poland. *Procedia Engineering*, *119*, 1409-1418.

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A. & Kalof, L. (1999). A Value-Belief-Norm Theory of support for social movements : The case of environmentalism. *Human Ecology* 6(2), 81–97. doi:10.2307/2083693

Syme, G. J., Nancarro, B. E. & Seligman, C. (2000) The Evaluation of Information Campaigns to Promote Voluntary Household Water Conservation. *Evaluation Review,* Vol 24:6, pp. 539-578. Sage Publications.

Tong, Y., Fan, L., & Niu, H. (2017). Water conservation awareness and practices in households receiving improved water supply: A gender-based analysis. *Journal of Cleaner Production*, *141*, 947-955.

Torres, M. M. J. & Carlsson, F. (2016). Social Norms and information Diffusion in water-saving programs: Evidence from a randomized field experiment in

Colombia. Environment for development Initiative. http://www.jstor.org/stable/resrep15042

UNESCO. (2022). Groundwater making the invisible visible. The United Nations world water development report 2022. Paris France.

United Nations. (1994). Protocol to the 1979 convention on long-range trans-boundary air pollution on further reduction of sulfur emissions.

Uyanık, G. K., & Güler, N. (2013). A study on multiple linear regression analysis. *Procedia-Social and Behavioral Sciences*, *106*, 234-240.

Willis, R.M. Stewart, R.A. Giurco, D.P. Talebpour, M.R. and Mousavinejad, A. (2011). End use water consumption in households: impact of socio-demographic factors and efficient devices. *Journal of Cleaner Production.* doi:10.1016/ j.jclepro.2011.08.006.

Willis, R.M., Stewart, R.A., Panuwatwanich, K., Williams, P.R., Hollingsworth, A.L., (2011). Quantifying the influence of environmental and water conservation attitudes on household end use water consumption. *Journal of Environmental Management*, 92, pp. 1996-2009, doi:10.1016/j.jenvman.2011.03.023.