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IDENTIFYING THE DRIVERS OF HOUSEHOLD WATER USAGE EFFICIENCY IN TERENGGANU: THEORY OF PLANNED BEHAVIOR (TPB) APPROACH

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Abstract

In the contemporary era, the issue of water scarcity has emerged as a critical concern on a global scale. Factors such as rapid population expansion, urbanization, and the uncertainties associated with climate change have exerted significant influence on water availability, particularly in the context of domestic consumption. Regions including Klang Valley, Selangor, Johor, Perlis, Melaka, and Negeri Sembilan are currently grappling with water shortages. Despite Malaysia's reputation for substantial rainfall, the nation is increasingly confronted with freshwater scarcity concerns. Consequently, the primary objectives encompass an examination of water consumption patterns and the identification of determinants driving water conservation within households. The study sample encompasses 271 households. Results indicate that both attitude and subjective norms are significantly correlated with water use efficiency, with corresponding p-values of 0.076 and 0.86, respectively. The insights gleaned from water usage patterns can serve as valuable tools for water operators in the management and educational efforts targeted at households, including campaigns promoting sustainable water usage and conservation practices.

Keywords: Water Scarcity, Pattern, Water Usage, Consumer Behaviour

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INTRODUCTION

In the 21st century, water scarcity has become a crucial issue worldwide. Rapid population growth, urbanization, and uncertainties related to climate change are some of the factors influencing water availability, particularly for domestic consumption. Additionally, domestic water consumption in Malaysia is high and increasing annually. It is vital to understand water use behavior to effectively manage and promote water use efficiency in daily activities such as toilet use, laundering, showering, car washing, gardening, and both interior and exterior cleaning. Currently, Malaysians consume 220 to 250 liters of water per person per day, exceeding the 165 liters recommended by the World Health Organization. This is higher than the daily per person consumption in Thailand (160 to 170 liters), Singapore (130 to 150 liters), and Indonesia (140 to 160 liters), indicating that consumers' behavior and attitudes toward water consumption in Malaysia are inefficient (Kamarudin, K. 2020). In general, water use patterns can be divided into indoor and outdoor activities such as bathing, showering, toilet, household cleaning, car washing, gardening and many more.

Household behaviors can be measured using the Theory of Planned Behavior, which can determine water use efficiency (Ajzen, I.,1991). Intention toward efficient water use can be influenced by attitudes, subjective norms, and perceived behavioral control. Therefore, this study examined water use patterns and explored the relationship between the Theory of Planned Behavior (TPB) and water use efficiency. The questionnaire includes items related to water use patterns and TPB elements on water use efficiency, and it was administered to 300 residential customers. This research gap needs to be addressed to comprehend consumer behavior toward water use, provide insight into domestic use patterns, and identify TPB elements influencing water use efficiency.

This paper commences with an introduction, followed by a literature review on household water usage and consumer behavior based on the Theory of Planned Behavior (TPB). Section three discusses the study's methodologies and materials, while section four focuses on the results, findings and conclusions.

LITERATURE REVIEW

Drivers of Household Water Use Behavior

There are various factors that influence water conservation behavior, such as psychological aspects including values, beliefs, trust, emotional reactions, and attitudes. While previous behavioral studies have examined the relationship between psycho-social factors and household water use behavior, there has been a lack of a profiling approach to understand the barriers and drivers of household water conservation within behavior-change theory (Corral-Verdugo et al., 2002; Syme et al., 2004).

Earlier studies have linked attitudes toward gardening to overall household water consumption rather than just outdoor water use, but the findings of this research have been inconclusive. For instance, in a study conducted in Perth, Syme et al. (1990/1991) found significant relationships between spouses' opinions regarding their gardens and their household's total annual water consumption. Families who perceived their gardens as adding more value to their homes used more water throughout the year, as did families who valued their garden's recreational amenities.

Aitken et al. (1994) discovered in a study in Melbourne that attitudes toward water consumption were not reliable predictors of household water use when tested twice a week for 2.5 months during the winter. Many psychological and social factors can encourage positive behavior in households when implementing water-saving solutions (Fielding et al., 2012). Water conservation intervention solutions are typically delivered through communication and understanding and directing the psychological and social predictors of home water use behavior adds further depth to this area of study. Additionally, the understanding of the capability, opportunity, and motivation (COM) dimensions can be beneficial for identifying behaviors that affect water usage (Addo & Thoms, 2018). These factors, their impact on household water consumption, and their interaction with other potential factors that may hinder behavioral change are currently under investigation.

Behavioral Drivers

Behavioral factors encompass perceptions, thoughts, feelings, and beliefs that influence behavior. One popular theory for examining environmental behaviors is the Theory of Planned Behavior (TPB) developed by Ajzen in 1991, and it encompasses various aspects such as water use (Fu and Wu, 2014; Harland et al., 2006; Mosler, 2012; Steg and Vlek, 2009; Stern, 2000; Yuriev et al., 2020). According to the theory, beliefs have the power to influence norms, and in turn, norms will influence behavior among individuals (Roobavannan et al., 2018). Values can also influence beliefs, norms, and conduct.

Several studies have investigated the impact of individual behavior on water efficiency, including studies on water use efficiency (WUE) and regulations. These studies have involved various groups such as farmers and rural residents, and they have considered contextual elements including an individual's background and physical environment (Dreibelbis et al., 2013).

Behavioral aspects are influenced by a variety of factors, some of which may encourage or inhibit behavior (Contzen and Mosler, 2012). Contextual elements including environmental, technological, economic, social, institutional, and individual factors are significant in predicting water consumption (Russell et al., 2020). Environmental factors relate to geographical experiences associated

with sustainable learning (Dean et al., 2016), while institutional factors encompass linkages between water users and water delivery systems and relevant regulations (Khair et al., 2019).

Consumer Behavior Toward Water Usage Efficiency

The Theory of Planned Behavior (TPB) is an advancement of the Theory of Justified Action. TPB includes decision elements such as attitudes and subjective norms (Ajzen, 1991; 2006; Botetzagias et al., 2015). According to this theory, when consumers feel positive about buying a product or adopting a certain consumer habit, receive encouraging feedback from their environment (subjective norm), and have the means to purchase the product (perceived behavioral control), they are more likely to buy the product or engage in the promoted practices (Klockner, 2013; Lopez-Mosquera, and Sanchez, 2012). Figure 2 illustrates the three elements contributing to water usage efficiency intention in this study.

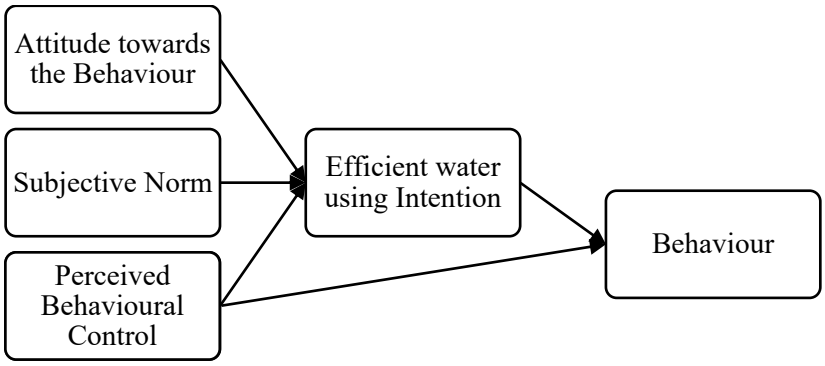

Figure 1: Adopted Theory of Planned Behaviour (Ajzen, 1985)

To create more accurate forecasts of behavioral intentions than previous models, the theory of planned behavior has been expanded to include attitudes, subjective norms, and perceived behavioral control as variables. An individual's attitude toward action is the extent to which the behavior is positively or negatively evaluated. Attitudes are determined by two factors: the instrumental factor (if the behavior can achieve something) and the experiential factor (how the individual feels while performing the behavior). The perceived positive or negative outcomes of engaging in a behavior, as well as people's evaluations of these outcomes, are referred to as behavioral beliefs.

These factors come together to form a person's attitude toward the behavior, reflecting the individual's positive or negative evaluations of a specific behavior (Abrahamse, 2019). Attitudes are determined as a set of probabilities

regarding the likelihood that the behavior will lead to desired consequences. These probabilities are based on personal experiences, opinions, information sources, and deductions. Subjective norms are perceived social pressures to engage in a particular behavior based on the opinions of a significant individual or a group of individuals (Ham, 2015).

Two types of clauses can be used to evaluate subjective norms: imperative clauses and descriptive clauses. Imperative statements refer to people's beliefs that others think "it should be done," and descriptive statements refer to what most people do. This also involves considering what is likely to be common in the social environment. Normative beliefs are the set of beliefs that other people (such as family, neighbors, or friends) may have about the behavior the person wishes to perform. Compliance motivation is an individual's awareness of complying with behavior based on what those around them think about performing that behavior.

Normative beliefs and motivation to comply are two factors, along with statements, that should be used to determine a person's subjective norms for behavior (Midden & Ritsema, 1983). Perceived behavioral control, the third element after attitudes and subjective norms, refers to a person's perception of their ability to perform a certain behavior. If a person's behavior is completely under control, intentions alone are sufficient to predict behavior. However, if a person's behavior is not fully within their control, perceived behavioral control (PBC) can provide additional information to help predict behavior beyond the TPB model's capability (Madden et al., 1992). PBC consists of two parts: self-efficacy and controllability. Self-efficacy refers to an individual's belief in their ability to perform behaviors that affect their lives (Bandura, 2010). Controllability is the ability of individuals to control behavior, their thoughts on the behavior's importance to the people around them, and their ability to perform the behavior when factors are beyond their control. These items identify PBC as Control Beliefs, which refer to beliefs about the factors or circumstances that make the performance of the behavior difficult or better (Ajzen, 2002).

RESEARCH METHODOLOGY

Study Area

Kuala Terengganu is located on the East Coast of Peninsular Malaysia, about 440 kilometers northeast of Kuala Lumpur. The city is situated at the estuary of the Terengganu River, which borders the South China Sea. The population of Terengganu is around 1.2 million people, with 90% being Malays, and the remainder being Chinese and Indians.

Kuala Terengganu, the state capital, as well as other towns and villages in Terengganu, have a relaxed pace of life that is untouched by the noise and hustle of a big city. Over the last 30 years, Terengganu has experienced

significant development due to rapid industrialization and increased commercial activity following the discovery of valuable assets. Prior to this, farming and fishing were the primary economic activities in the state.

Data Collection and Profile of Participants

The study was carried out from December 2021 to February 2022 in two districts in Terengganu: Kuala Terengganu and Kuala Nerus. A total of 300 responses were collected through face-to-face surveys, and after data cleaning, 271 cases were used for sample analysis. The Theory of Planned Behavior (TPB) model, based on Ajzen (2006) and Moura (2017), was used to understand household behavior related to water usage.

The study explored how beliefs and attitudes influence people's behavior and their perceived control over that behavior. A structured questionnaire was developed to assess water usage patterns, household water use efficiency behavior, and the Theory of Planned Behavior (TBP) toward water use efficiency. The results were measured on a five-point Likert scale, indicating respondents' subjective norms on water use efficiency (1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree). Participants in indoor and outdoor activities were asked to indicate their level of agreement or disagreement.

The study focused on understanding the impact of TPB on water use efficiency. A survey instrument and measurement scales were designed to test the conceptual model using items representing TPB components, such as intention and attitude, behavioral beliefs, subjective norms, perceived behavioral control, and control beliefs, towards water usage efficiency as presented in Figure 2.

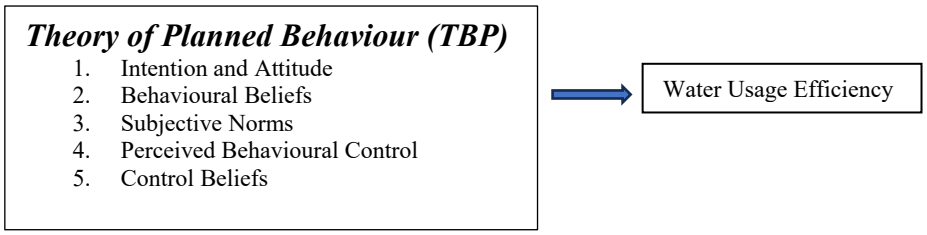

Figure 2: Conceptual model

Furthermore, descriptive analysis was used to evaluate domestic water consumption data. The factors influencing domestic water usage were determined using the following model:

$$\text{Water Usage } i = \beta_0 + \beta_1 \text{intention } i + \beta_2 \text{belief } i + \beta_3 \text{norms } i + \beta_4 \text{perceived behavioral } i + \beta_5 \text{control } i + \varepsilon\, i \quad (1)$$

Here, "i" represents the individuals (with i ranging from 1 to N). The variable "water usage i" denotes water consumption, $\beta_1$intention represents intention and attitude, $\beta_2$belief represents behavioral beliefs, $\beta_3$norms represents subjective norms, $\beta_4$perceived behavioral represents perceived behavioral control, $\beta_5$control represents control beliefs, and ε i represents the error term.

ANALYSIS AND DISCUSSION

Demographic Profile

The use of descriptive statistics helps to simplify and organize large amounts of data into a few numbers or graphs. This assists researchers in understanding the main features and patterns of the demographic profile of the data and identifying the important demographic characteristics of the study. the total sample for this study consisted of 300 residential customers. After data cleaning, 271 residential customers were used for further analysis, which represents 90.33% of the total sample. The main reason for this was that respondents needed to complete the TBP and water usage efficiency section in the questionnaire.

The majority of respondents were male (60.5%) and female (39.5%). The most common age group was 31 to 40 years (32.5%), followed by 20 to 30 years old (29.9%). Most respondents had 3 to 5 people in their households (49.8%) and lived in terrace houses (47.2%), followed by semi-detached and bungalow homes. The majority, approximately 77.9%, were married. In terms of education levels, most respondents had completed secondary school (19.4%) or college/university (38.7%).

Descriptive Analysis

Tables 1-5 present Cronbach's Alpha means, standard deviations, skew, and kurtosis for attitudes, behavioral beliefs, subjective norms, motivation to comply, perceived behavioral control, and control beliefs related to efficient water use. To ensure normal and univariate distribution, the values of skewness and kurtosis should fall within the range of -2 to +2 (George & Mallery, 2010). Other researchers such as Hair et al. (2010) and Byrne (2010) argue that data is considered normal if skewness is between -2 to +2 and kurtosis is between -7 and +7. Cronbach's alpha assesses the reliability and internal consistency of test items. Reliability refers to how consistently an item can measure a concept. Cronbach’s alpha value of .70 is considered good, .80 is better, and .90 is the best value for consistency in Cronbach’s alpha.

Table 1: Descriptive statistics for attitudes towards residential water use efficiently

	Mean	**SD**	**Skew**	**Kurtosis**	**Cronbach's Alpha**
I intend to manage and practice efficient water use at home in the future.	4.1439	.46103	.511	.993	.727
I am determined to manage and practice efficient water use at home.	4.1218	.44298	.565	1.473	
I plan to manage and practice efficient water use at home in the future.	4.2251	.56197	.007	-.297	
I recommend efficient water use practices to my family and friends.	4.2583	.53720	.119	-.374	
I have a positive view of this efficient water use practice.	4.2546	.50710	.329	-.334	
I think an efficient use of water at home would be good practice.	4.2804	.56005	-.026	-.503	
Overall Mean	4.2140				

Table 2; Descriptive statistics for behavioural beliefs toward residential water use efficiently

	Mean	**SD**	**Skew**	**Kurtosis**	**Cronbach's Alpha**
Efficiency in water use would lower my expenses on water bills.	4.2841	.48351	.560	-.722	.749
Efficiency in water use can reduce my water consumption.	4.3542	.52349	.138	-.992	
Efficiency in water use could improve the availability of water resources for other uses.	4.3247	.54916	-.014	-.691	
Efficiency in water use can reduce water wastage by using water efficiency equipment and changing water use habits.	4.4059	.53524	-.202	-.095	
Efficiency in water use can increase awareness and self-motivation to practice efficient water use in daily life.	4.2694	.50675	.335	-.460	
Efficiency in water use could make my daily routine at home easier.	4.2583	.51611	.098	.611	
More efficient water use practices can improve water conservation and the environment.	4.1661	.48506	.396	.540	
Efficiency in water use could raise awareness and motivation for myself to apply water use efficiency practices.	4.2362	.53363	-.001	.584	
Overall Mean	4.2874				

Table 3: Descriptive statistics for subjective norms towards residential water use efficiently

	Mean	SD	Skew	Kurtosis	Cronbach's Alpha
Most people think I should manage, and practice water use efficiency.	4.1365	.62048	-.192	-.070	.749
I expected to manage and practice water use efficiency at any time.	4.1661	.59482	-.068	-.325	
The people in my life whose opinions are that I would manage, and practice water use efficiency.	4.1365	.51621	.186	.439	
Most people around my neighborhood have started to practice or always practice water use efficiency in their households.	4.0812	.53129	.082	.479	
Overall Mean	4.1301				

Table 4: Descriptive statistics for perceived behavioural control towards residential water use efficiently

	Mean	SD	Skew	Kurtosis	Cronbach's Alpha
I am confident in managing and practicing water use efficiency.	4.2288	.49372	.421	-.092	.811
If I wanted to, I could manage, and practice water use efficiency at any time.	4.2841	.45183	.963	-1.081	
I can have full control over managing and practicing efficient water use.	4.2731	.51566	.263	-.473	
I have complete control over the decision to manage and practice efficient water.	4.2251	.50651	.320	-.087	
Overall Mean	4.2528				

Table 5: Descriptive statistics for control beliefs towards residential water use efficiently

	Mean	SD	Skew	Kurtosis	Cronbach's Alpha
I expect the government or non-government would offer water efficiency incentive programs (such as rebates and unit exchange programs).	4.2915	.48675	.529	-.782	.806
I expect the government or non-government would offer a water efficiency incentive program that would make it much more to manage and practice water use efficiency in the household.	4.2768	.55191	.022	-.481	
I expect the government or non-government would provide water management services related to water efficiency to help me manage water use efficiency in the household.	4.3542	.51637	.202	-1.064	
I expect the government or non-government would offer an educational program or awareness campaign to gain knowledge about the importance of water use efficiency.	4.2620	.59752	-.588	2.352	
Overall Mean	4.2961				

Data Analysis Behavior of Water Usage in Indoor and Outdoor Activities

Table 6 illustrates the breakdown of water usage for various indoor and outdoor activities such as bathing, laundry, dishwashing, cooking, drinking, aquarium care, pet bathing, toilet flushing, and general cleaning (indoor activities). It also includes outdoor activities like car washing, watering plants, maintaining landscapes, and swimming pool care. Most of these activities collectively contribute to over 60% of water usage both indoors and outdoors. The highest average water usage (4.11) is for bathing, followed by drinking (approximately 4.09) and laundry (about 4.03).

Table 6: Indoor and outdoor water usage

Indoor Water Usage								
No.	**Activities**	***Never use***	***Almost Never***	***Sometimes***	***Almost Every time***	***Frequently Use***	***Mean***	***Std. Deviation***
1	Bathing	-	-	14.0	60.5	25.5	4.11	0.61
2	Washing clothes	-	1.1	16.2	60.9	21.8	4.03	0.65
3	Washing dishes or kitchen appliances	-	0.4	27.3	47.2	25.1	3.97	0.73
4	Cooking	-	1.1	29.2	42.1	27.7	3.96	0.73
5	Drinking	-	0.7	19.9	47.6	31.7	4.09	0.75

Indoor Water Usage								
No.	**Activities**	***Never use***	***Almost Never***	***Sometimes***	***Almost Every time***	***Frequently Use***	***Mean***	***Std. Deviation***
6	Rearing fish in the aquarium	11.1	6.3	18.1	41.0	23.6	3.59	1.22
7	Bathing pets	11.8	7.0	15.1	47.6	18.5	3.53	1.21
8	Toilet flushing	3.0	7.4	22.1	46.5	21.0	3.75	0.96
9	Cleaning toilet and bathroom	1.8	8.9	22.1	42.8	24.4	3.78	0.97
Outdoor Water Usage								
No.	**Activities**	**Never use**	**Almost Never**	**Sometimes**	**Almost Every time**	**Frequently Use**	***Mean***	***Std. Deviation***
1	Cleaning the floor, windows, porch, and drain outside the house	1.5	15.5	13.3	50.2	19.6	3.70	0.99
2	Watering flowers, fruit, or vegetable plants	2.2	11.4	16.2	52.0	18.1	3.72	0.96
3	Washing the cars, motor vehicles, and bicycle	1.5	10.7	21.8	47.2	18.8	3.71	0.94
4	Business	15.9	4.4	19.9	43.5	16.2	3.39	1.26
5	Maintaining house landscape	14.4	5.2	18.8	43.9	17.7	3.45	1.25
6	Rearing fish at backyard fish pond	14.4	7.4	10.7	49.4	18.1	3.49	1.27
7	Swimming pool or portable swimming pool	18.5	4.1	12.9	46.1	18.5	3.42	1.34

Table 7: Water use efficiency and elements of TPB coefficients

Model		**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	30.496	18.935		1.611	.108
	Attitude	-5.771	3.241	-.117	-1.781	**.076***
	Beliefs	-2.316	3.695	-.044	-.627	.531
	Subjective	4.073	2.365	.106	1.722	**.086***
	Behavioural	2.333	3.005	.056	.776	.438
	Control	1.856	2.748	.048	.675	.500

a. Dependent variable: Water bill

Note: * Significant at 0.10%

Table 7 displays water usage and its relation to elements of the Theory of Planned Behavior (TPB) including attitude, behavioral beliefs, subjective norms, and perceived behavioral control. The elements of attitude and subjective norms in TPB are statistically significant at 0.1%, indicating that a 1% increase in attitude and subjective norms leads to households intending to manage and practice water use efficiency.

In summary, this study utilized the Theory of Planned Behavior (TPB) to investigate how attitudes, behavioral beliefs, subjective norms, and perceived behavioral control influence residential water use efficiency through multiple regression analysis. The results indicated that both attitude and subjective norms significantly correlate with water use efficiency, with p-values of 0.076 and 0.86, respectively.

Households are inclined to manage and practice efficient water use at home, and they also encourage such practices among their family and friends, viewing it as beneficial for future water management. The study found that attitude strongly influences intentions for pro-environmental behavior and water-saving, consistent with the findings of Si et al. (2022), Okumah et al. M. et al. (2019), Daxiniet al. (2018), and .(Bamberg & Möser, 2007) (, 2019)

Concerning subjective norms, households believe it is important to manage and practice water use efficiency. They also observe that their communities are adopting similar practices, as highlighted in a study by Perren and Yang (2015). Both attitudes and subjective norms have a significant direct impact on the intention to use water efficiently, aligning with the findings of Si et al. (2022) and Gibson et al. (2021), who demonstrated that attitudes, subjective norms, and perceived behavioral control influence water use efficiency intention.

CONCLUSION

Understanding water usage behavior is crucial for developing efficient water usage strategies to align with SDG6 (Clean Water and Sanitation). Managing water resources, water recycling, exploring freshwater resources, controlling water pollution, ensuring water affordability, maintaining water quality, and promoting sustainability are all essential aspects. SDG-6 highlights several effective ways to address the water crisis. Insights into water consumption patterns can help water operators manage and educate households about sustainable water use and conservation. From a policy perspective, these findings suggest that policymakers and regulators should consider TPB variables when aiming to promote efficient water use behaviors. Therefore, water company operators and policymakers can propose suitable policies to ensure effective domestic water consumption in a sustainable manner and preserve water resources for future generations.

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