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Socioeconomic Factors Affecting Water Conservation in Household Consumption in Johor Bahru and Kuala Terengganu Districts of Malaysia

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ABSTRACT

Water conservation plays a crucial role in addressing water scarcity and upholding water purity as well as safeguarding the environment. Responsible water management and prudent usage are pivotal aspects of water conservation. This study aims to assess the awareness of water conservation practices among households in the Johor Bahru and Kuala Terengganu Districts of Malaysia. Additionally, it seeks to gauge the attitudes towards water-efficient appliances and water-saving behaviors in domestic water consumption and to identify the socioeconomic factors influencing water conservation. The study involved a field survey of 571 heads of households in February and March 2020. Through descriptive analysis and multiple linear regression, it was determined that the sampled households exhibited awareness regarding their water usage to promote water conservation. Most respondents, 74% in Johor and 72.7% in Terengganu, demonstrated familiarity with water conservation and expressed the intention to adopt water-efficient appliances for conservation purposes. A multiple linear regression research of water conservation and appliance installation found that income, number of children, education, age, and gender are major socioeconomic factors impacting water conservation attitudes, with income serving as the primary driver. Civil society organizations should seek to hold governments accountable, invest in water research and development, and advocate for the participation of women, youth, and indigenous peoples in water resource management. Raising knowledge of these roles and implementing them will result in win-win scenarios, as well as enhanced sustainability and integrity for both human and ecological systems. These findings hold significant value for Malaysian policymakers in designing pertinent policies and programs aimed at educating the community to integrate water conservation practices into their daily routines to achieve the goal of SDG 6 to guarantee that everyone has access to sustainable water and sanitation services, which is a vital climate change mitigation strategy for the years ahead.

1. INTRODUCTION

The goal of Sustainable Development Goal (SDG) 6 by 2030 is to ensure that water supply and sanitation are available to all people in a sustainable and timely manner. A study by [1] highlights the importance of water in economic growth, using the environment Kuznets hypothesis to examine the relationship between development and freshwater in Iran [2]. Global employment heavily relies on sufficient water availability, with over 1.3 billion jobs, approximately 42% of the total global workforce, dependent on water in sectors such as agriculture, mining, paper production, and pharmaceuticals [3]. An additional 1.2 billion jobs in industries like construction, recreation, and transportation also depend on water to a lesser degree, making water a crucial element in around 78% of jobs worldwide [4]. In the 21st century, water scarcity has become a critical issue worldwide. According to [5], water scarcity is divided into two aspects: physical scarcity, where there is a failure to meet water demand, and economic scarcity, where the socioeconomic system fails to manage resources [6, 7]. Scarcity and droughts have severe impacts, as highlighted by Hohenthal and Minoia [7].

Additionally, Zisopoulou and Panagoulia [8] ranked water crises as the top societal risk impact in the Impact-Likelihood presented in Figure 1.

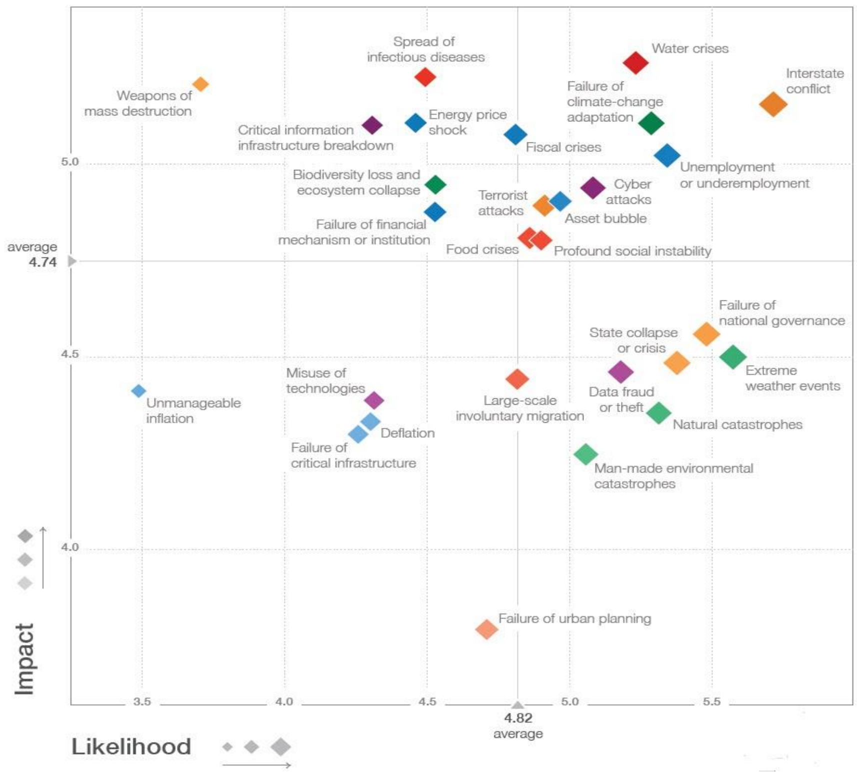

Figure 1. Impact-Likelihood Diagram World Economic Forum, 2015

Freshwater demand currently accounts for about 15% of worldwide domestic water demand. For instance, in India, the demand is 7%, while South Africa has recorded a 35% demand, and it is expected to rise in developing countries. This demand surge occurs in both the industrial [9] and agricultural sectors [10, 11], creating the potential for inter-sectoral competition for water in cases of scarcity [10]. Additionally, the imbalance between the supply and demand of freshwater availability is threatened by climate change impacts [11]. Malaysia has abundant water resources, with an annual average rainfall of around 3,000 mm, contributing to surface runoff of 556 billion m^3 and 120 billion m^3 of renewable water resources per year, totaling 5,400 m^3 per capita [12]. Additionally, rivers supply over 80% of freshwater abstraction [13]. However, there are occurrences of droughts [14, 15], while floods are noted as the major natural hazard, accounting for 90% of hazards, with the worst being the one in Kelantan State in 2014 [14]. In 2021, Malaysians consumed 251 liters of water per person per day, exceeding the WHO recommendation of 165 liters per person. Greater Kuala Lumpur's consumption was even higher at 288 liters of water per person [16], with a population of 6,851,000 at that time [17], representing 22% of the total population in 2015. This consumption rate is high compared to Thailand's approximately 193 liters per person per day, around 151 liters per person per day in Singapore [18], roughly 155 liters per person per day in Australia, and 140 to 160 liters per person per day in Indonesia. This indicates a need for households to change their water conservation behaviors and attitudes. The increasing population and rapid industrial development have exacerbated domestic demand, creating an unbalanced situation in the water market. Malaysia's population has substantially increased from 2009 to 2020 [19], as illustrated in Figure 2.

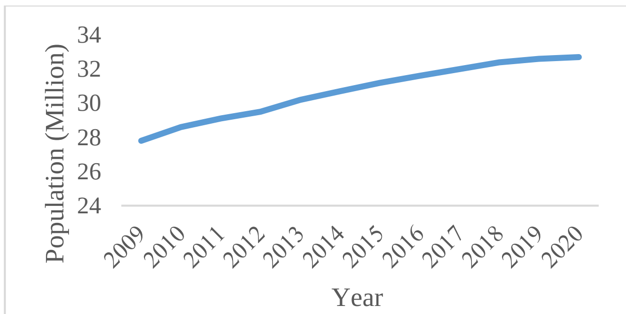

Figure 2. Population growth in Malaysia 2009-2020
Source: Department of Statistic Malaysia (19)

There are numerous publications about household water consumption in Malaysia utilizing different approaches. Moreover, Khalid et al. [20] identified household consumption patterns using household routine parameters. Daily water consumption for drinking and cleaning for households using direct means [21]. According to Shafie [22], domestic household consumption was identified using the Hoekstra footprint, and research considered rainwater harvesting as an alternative solution [23].

Another study by Raja et al. [24] aims to examine the impact of attitude on water conservation intentions, emphasizing its importance as a significant predictor of pro-environmental behavior applied Smart PLS 4.0.9.3. The results showed that the scales have strong convergent validity, with all items scoring above 0.5 and 0.7 for Average Variance Extracted (AVE) and composite reliability. Notably, the results show a favorable and significant link between attitude and intention to conserve water. In a study by Aini et al. [25] household water drinking practices are assessed. Water usage behavior is examined in Southern State in Peninsular Malaysia [26]. Water conservation awareness in school children [27]. Water usage audit and conservation awareness among university students at University Sains Malaysia [28]. The public's perception of non-revenue water (NRW) management was analyzed to support urban water policy [29]. Water-saving behavior among suburban households [30]. The factors influencing willingness to participate in water management [31]. A study by Kong et al. [32] employed socioeconomics to gather data from a nationwide survey of communities on drinking water sources and sanitation in Malaysia. Individuals require consistent and adequate water and sanitation facilities for personal and domestic use. Common uses include drinking, personal sanitation, washing clothes, food preparation, and personal and household hygiene. The World Health Organization (WHO) recommends 50-100 liters of water per person per day to meet basic needs and minimize health risks [33].

This paper addresses household water conservation in the Johor Bahru and Kuala Terengganu Districts of Malaysia using socioeconomic factors with the target of measuring household members' attitudes, which shape intents and purposes, towards household water conservation by employing an interviewer-supervised Likert questionnaire. A Likert scale is a psychometric response scale that is commonly used in questionnaires to assess participants' preferences or level of agreement with a statement or series of assertions. Respondents use five or seven levels to rank quality from high to low, or from best to worst [34]. In effect, it touches upon the basic question of multiple causations "Where do the 'preferences' that neoclassical economics treats as the root of behavior come from?" From the point of view of socioeconomics in the case of household water consumption. Extensive internal reliability and validity tests are employed, and the main calculation is carried out using linear multiple regression where the dependent variable is water consumption and the independent socioeconomic variables are gender, age, number of children, size of household, education, and income. The results obtained may be part of the basis upon which Water Demand Management (WDM) will determine optimum methods for its conservation [35].

This study aims to understand households' awareness of water conservation, examine attitudes towards the use of water-efficient appliances and water-saving practices, and identify the factors influencing water conservation. The article is structured with an introduction, literature review, methodology, results, empirical analysis and discussion, as well as conclusions and policy implications.

2. LITERATURE REVIEW

2.1. Determinants of household water conservation

2.1.1 Factors affecting household water conservation

Numerous studies have been conducted on the factors influencing water conservation, with a focus on socioeconomic factors, as indicated [36] in Southeast Queensland, Australia. The results revealed that demographic, psychological, behavioral, and infrastructure characteristics impact household water usage. Overall, residential water demand is influenced by income, socio-demographic factors, and weather conditions [37-39]. Pricing and income elasticities vary in different case studies, but this could be attributed, at least in part, to the absence of block-rate pricing considerations, which effectively creates a "piecewise linear" budget constraint [40]. According to Cominola et al. [41] water consumption factors are classified into three types: observable, latent, and external. Observable determinants are those that can be physically observed or measured. They are easily and/or directly measured and include objective characteristics about the household members and their homes. Latent determinants are the thoughts, feelings, and behaviors of the household's occupants. External determinants are elements that exist outside of the home and may affect a suburb or a group of houses on a regional scale. Weather variables such as rainfall and/or temperature could be utilized as examples.

A study by Jakubczak [42] indicated that knowledgeable and responsible water consumption is uncommon. It has been determined what characteristics influence water consumer behavior. It means that even if consumers exercise some water-saving activities, their actions are motivated by personal motivations rather than the need for global water conservation, namely a sense of social responsibility. The study examined specific measures used to preserve water in homes or during direct drinking water consumption. The study focused on the respondents' demographics, as well as their economic and lifestyle aspects.

Moreover, Russell and Fielding [36] demonstrated the influence of socio-demographic [43] and environmental variables [35], as well as psychosocial factors [35, 43-45]. The study adopted an interdisciplinary approach and considered socio-demographic and contextual aspects, which became the predictors of households' water usage behavior to provide a clearer understanding.

A significant amount of research has focused on the relationship between socio-demographic factors and household water usage, with findings indicating that households with more members tend to consume more water [46, 47]. It was found that the intention to conserve water and install water-efficient appliances is influenced by education and income [48, 49]. Additionally, Lam [50] discovered that education and income affect the intention to conserve water and install water-efficient appliances. According to Vieira et al. [51], consumer behavior was compared with that of their socio-demographic cluster, alongside an efficiency assessment of peer comparison, efficient patterns, and the performance of water use devices, leading to the conclusion that both socio-cultural and socio-demographic characteristics influence water consumption.

In Gold Coast, Australia [52] found a strong correlation between income and outdoor water use. In Jordan, a study [53] showed a significant dependence on household income, while the results on education were inconclusive. A positive correlation between income and water consumption indicates that low-income households are not very price responsive as they tend to prioritize covering basic needs [54]. On the other hand, high-income households are also not responsive, as water expenses rarely reach a point where they are forced to conserve. There are conflicting views on the water consumption habits of the elderly, with some studies indicating lower consumption while others suggest otherwise.

Additionally, studies [55, 56] revealed that households with lower education tend to practice better water-saving habits and consume minimal water compared to higher-educated and higher-income households. However, there are opposing views on this as well, with some researchers stating that higher-educated households desire to save more water. There's also evidence suggesting that higher levels of education may result in more water consumption. Furthermore, there is an association between education, income, and stronger intentions to use water-efficient appliances, although these appliances may use less water overall. Using district metering areas (DMA), it was shown that the monthly peak factor of water consumption is positively correlated with the number of university graduates.

A study found that people who stay at home, especially teenagers, use more water compared to working households [57]. Additionally, habits are positively correlated with intentions to conserve water, according to studies [55, 56, 58]. Another research [59] used cross-sectional data from a 1,300 household survey to predict drivers of residential water use using a multiple linear regression model. Access to water, household size, trip frequency, monthly income, water payment, educational qualification, journey duration, and home style are some of the variables that influence outcomes. Moreover, Rahayu and Rini [60] applied multiple regression to discover socioeconomic characteristics that determine water use levels in an urbanised medium-sized metropolitan area, specifically Surakarta. The findings show that, at a 95% significance level, the age of the head of household, total monthly income, housing type, the number of water sources used by each household, total number of people in each household, and total number of people working in each household have all become factors influencing water consumption in Surakarta. A study by Alvarado Espejo et al. [61] purpose to establish which socioeconomic characteristics have a greater influence on water-saving habits in Ecuadorian families, allowing them to propose policy formulations that help to save water. The findings indicate that gender, marital status, and homeownership are the most important drivers of water-saving behaviors for Ecuadorian families, with the main conclusion being the variable of perception of environmental concerns, which is significant in most of the presented models. Another study by Balata et al. [62] intends to examine the relationship between water use and socioeconomic development. The purpose of this essay is to discuss three important themes: socioeconomic development, water usage, and the circular economy. Moreover, study examines potential patterns in home water use among Saudi households. The statistics suggest that education, household size, wealth, housing type, age, and nationality, in that order, are the most important factors influencing household water consumption and conservation tendencies [63]. Lamprom et al. [64] investigate socioeconomic, cognition, opinions, and perception of information elements to conduct deeper analysis of the factors influencing the wastewater management (WWM) of people in Thailand's urban areas. This study used multiple regression analysis using a questionnaire survey of nine towns in Krathum Baen municipality, Samut Sakhon Province. The findings indicate that people in the studied areas have a modest level of cognition and opinion about WWM activity. Perception of information was the best variable for describing people's WWM behaviours in cities. Additionally, this research looks at the distribution of water consumption across Bruneian families. The report also looks at measures to cut household water consumption. Increasing water prices is one approach to minimize home water consumption [65].

A study [66] noted that women are responsible for managing water both at home and in the office, playing a critical role in sustainable water management. Additionally, studies conducted in India and Africa revealed that only a third of rural people and two-thirds of urban people have access to piped water. Women have sensibly regulated water usage, as they are considered accurate estimators of their water consumption [58, 67]. The Women for Water Partnership [68] established and recognized at the UN Commission on Sustainable Development's 12th session in April 2004, emphasizes several significant roles that women play in water use. According to Wolters [69], women are perceived to have stronger environmental attitudes [66, 70-72] although doubts have been expressed by Tindall et al. [72] regarding the extent to which this translates into action. However, a study by Stern [35] claims the opposite. On the other hand, a study by Nkiaka [73] suggests that in developing countries such as Malaysia, the limitations of education for women may constrain gender-inclusive water governance. Removing this constraint may result in increased participation [74], leading to female support for sustainable water resource management [75].

Another studies [57, 76] found that attitude, culture, and behavior play a significant role in water consumption in Fukuoka, Japan. Households with a stronger water-saving culture and positive attitude consume less water, ameliorating the existing potential inconsistency which separates attitude from actual behavior [77]. This position is supported [78-81]. Additionally, ethnic differences play a role in perceptions, attitudes, and behaviors [82]. Water conservation strategies involve lowering water consumption, home water consumers' behaviours and attitudes play an important role in achieving significant reductions in home water consumption [83]. Additionally, a study consolidated environmental and behavioral elements that influence water usage, investigate gaps in our understanding of human water behavior that underpins water use efficiency (WUE), and emphasized the importance of comprehensively assessing and consistently measuring such aspects and their interactions [84]. Sanchez et al. [85] conducted a bibliometric and systematic literature evaluation to identify factors influencing household water-saving behaviors. The 155 papers considered in this study were published between 1984 and early 2023. The findings emphasize two aspects of earlier research that had been overlooked: the use of guiding ideas and an overreliance on self-reported metrics. Attitude, perceived efficacy, emotions, and habits are all important aspects to consider while understanding water conservation. According to Guo et al. [86] the research design employed an exploratory empirical analysis using a non-linear curve function to investigate the development of water consumption efficiency when economic growth happened. The data confirmed the existence of an inverted-S link between water use efficiency and regional economic growth. In a field experiment with Singaporean households, regular feedback was offered, with different groups receiving informational, normative, and monetary incentives [87]. The authors confirm a negative association between water pricing and consumption while finding a positive relationship between economic growth and water use in most Thailand's regions. Furthermore, the authors find a definite link between climate conditions and water use, as well as an inverse relationship between income and water consumption in the metropolitan area [88, 89].

2.1.2 Infrastructure factors

The design of buildings and the residency status of occupants are contextual factors that have been identified as significant in water conservation practices [36]. Previous research has shown that households in detached homes are more likely to conserve water [50, 81], and homeowners generally use less water than renters [90]. Furthermore, Olmstead and Stavins [91] found that households with water meters tend to practice higher water conservation. It is also assumed that larger households consume more water in total, but water consumption per capita decreases [92] and younger households use less water than older households.

According to Grey and Sadoff [93], water infrastructure services play a crucial role in providing access to water resources. Examples of these services include multipurpose dams for regulating and storing water, interbasin transfer systems, and facilities for drinking water and wastewater treatment [94]. Therefore, efficient water infrastructure is another important factor in determining domestic water usage. A study showing that installing water-saving products, such as low-flow showerheads, can reduce water use by 9% to 50% [95]. Furthermore, studies have indicated a link between education, income, and a stronger intention to use water-efficient appliances, which generally consume less water [50, 56]. However, some studies have suggested that the use of water-efficient equipment can lead to "rebound" water consumption, where changes in water use behavior negate potential savings [72, 73]. The willingness to invest in these technologies is of paramount importance [74, 75].

According to Fielding et al. [96], previous studies have presented conflicting findings regarding the relationship between water-efficient appliances (such as dishwashers and low-flow showerheads), water systems (like rainwater tanks), and other methods that increase water conservation (such as efficient washing machines, pool covers, and water-efficient irrigation). Furthermore, technology that significantly reduces water usage in showers can be installed [77, 90].

2.1.3 Use of efficient appliances to conserve water

Several studies have been conducted in Australia on the adoption of efficient appliances for water conservation. Water demand in Melbourne was influenced by factors such as the effectiveness of demand management campaigns, climate, consumer willingness to change behavior, current levels of water waste, and the structure and intensity of the campaign [97]. The study reported a 32% decrease in domestic water consumption initially, followed by subsequent annual increases.

A study found the factors driving water conservation in Melbourne [98]. They discovered that approximately 6% of respondents had installed rainwater tanks, 52% used water-efficient showerheads, and 5% recycled greywater. Behavioral changes in water usage depend on individuals' ability to adopt and implement water-saving measures. The study also found that obstacles like cost and renter status hinder water conservation efforts. In a telephone survey [99], about 21% of respondents in Melbourne reported using water-efficient showerheads.

According to a study involving the U.S., Australia, and the UK, the installation of devices such as cisterns, faucet aerators, and low-flow shower heads as part of retrofit programs resulted in a 9% to 12% reduction in water use. Extensive plans to replace current appliances with water-efficient ones can save between 35% and 50% of water usage [95]. For example, a study of 30 homes in Tampa, Florida, showed a 49.7% reduction in per capita water use after the installation of water-saving toilets, clothes washers, showerheads, and faucets. Most of the savings came from fixing tap leaks at home [100]. In Australia's largest household demand management research, a 12% decrease in water usage was achieved through a visit by a licensed plumber, replacement of inefficient fixtures, and monitoring and fixing leaks [3]. A study reported savings ranging from 29% to 75% by replacing old devices with efficient ones and found that the money saved from this replacement amounted to 11.4% of augmentation costs mainly through deferring network augmentations [101, 102]. Potable water savings from greywater recycling range from 25% to 50% [103, 104]. Additionally, research reported annual savings per household ranging from 40-50 kL through rainwater tank installation [105].

In the research conducted by Gurung et al. [101] and others, the cumulative water-saving benefits of alternative water supplies and water-efficient appliances have been analyzed [57, 98, 100, 105-107]. An examination of data from the Metropolitan Water Authority in 1985 revealed that only 1% of households in Perth used dual flush toilet cisterns, and rainwater tank ownership was not considered in the study. Moreover, the study found that 3% of families lacked access to a water bore, while 24.1% utilized them. It was reported that digging and owning a water bore had become increasingly popular due to stricter restrictions on the use of piped water supplies and rising water prices.

According to an investigation by the Australian Bureau of Statistics for the Melbourne Metropolitan Board of Works, 9.8% of Victorian homes had installed a rainwater tank, 10.1% used one or more dual flush toilets, and 23.8% had dishwashers [108]. These studies provide valuable insights for examining attitudes and behavior related to water conservation in Australia and its impact on domestic water use. This study examines how biographic factors influence water usage and uptake of water-saving equipment in Durban, South Africa. Probit regression models are built with survey data from 300 household heads from across the city. Among other findings, the study found that income is the most consistent predictor of water use behaviors and the adoption of water-saving technology. Furthermore, education level was found to be a consistent predictor of the adoption and deployment of water-saving technologies [109].

3. METHODOLOGY

The research methodology is outlined in Figure 3. It encompasses the research objectives, identification of household groups, selection of various characteristics for survey development, creation and testing of the questionnaire, data collection and analysis covering socioeconomic characteristics and installation of appliances, and finally, the interpretation of the analysis. The study's contribution to water conservation policy development is emphasized. The income notation is as follows: B40 refers to households with an income below RM 4850, M40 refers to households with an income between RM 4851 and RM 10,970, and T20 refers to households with an income of RM 10,971 and above.

Face-to-face interviews with a Likert-type questionnaire were conducted in Johor Bharu, Johor, and Kuala Terengganu, Terengganu (depicted in Figure 4). The structured questionnaire covers experience towards the water company, water consumption patterns, awareness of water conservation, attitude towards water conservation, water conservation practices, installation of water-efficient appliances, and socioeconomic demographics.

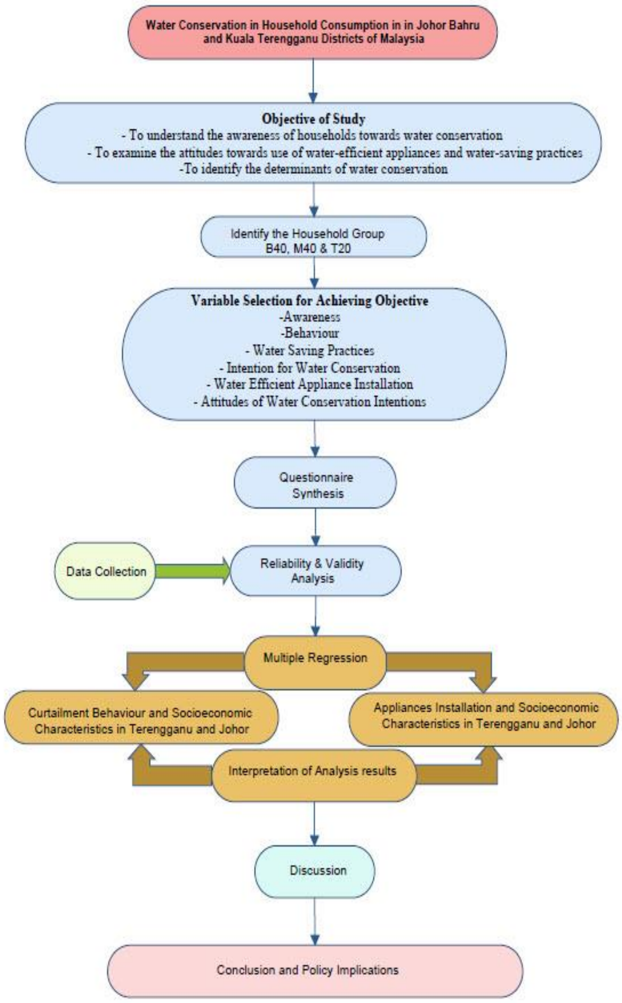

Figure 3. Research framework

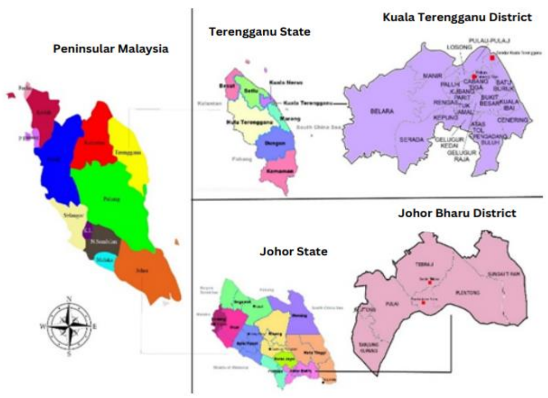

Figure 4. Study area

A random sampling of heads of households was conducted among households aged 18 to 65 years old in the study area, categorized based on three income groups: B40, M40, and T20. The number of respondents is determined by the Krejcie and Morgan [110] sampling method, which was chosen for its ability to provide a representative sample while reducing selection bias, as stated in the paper on sampling processes. This survey took place from February to March 2020, and the total number of respondents was 571 for all states.

4. RESULTS AND EMPIRICAL ANALYSIS

4.1 Descriptive analysis

4.1.1 Socioeconomic profile

Table 1. Socioeconomic characteristics profile (N= 571)

	Johor		**Terengganu**	
Respondents' Profile	Frequency	Percentage (%)	Frequency	Percentage (%)
Gender				
Male	119	59.2	173	46.8
Female	82	40.8	197	53.2
Race				
Malay	133	66.2	289	78.1
Chinese	31	15.4	35	9.5
Indian	36	17.9	25	6.8
Others	1	0.5	21	5.7
Age				
20 - 30 years	52	25.9	84	22.7
31 - 40 years	72	35.8	102	27.6
41 - 50 years	73	38.3	175	47.2
More than 51 years	0	0	9	2.4
Education				
Primary School	5	2.5	19	5.1
Secondary School	33	16.4	188	50.8
College	46	22.9	51	13.8
University	117	58.2	112	30.3
Economic Sector				
Support Staff	53	26.4	73	19.7
Professional Staff	84	41.8	82	22.2
Others	64	31.8	215	58.1
Household Size No				
Less than 2 people	26	12.9	44	11.9
3 - 5 people	101	50.2	148	40
6 - 8 people	62	30.8	105	28.4
More than 9 people	12	6	73	19.7
Type of House				
Terrace	124	61.7	109	29.5
Semi D	46	22.9	70	18.9
Bungalow	20	10	69	18.6
Others	11	5.5	122	33
Gross Income				
Less than RM4360	63	31.3	272	73.5
RM4361-RM9619	99	49.3	74	20
More than RM962	39	19.4	24	6.5

Descriptive analysis is crucial for providing fundamental information about variables in a dataset and allows for data visualization. The sample included 571 respondents from Terengganu and Johor. Face-to-face interviews were conducted at residential houses based on income groups of B40, M40, and T20. The socioeconomic information is helpful in determining the water consumption patterns that influence water security. In this study, the socioeconomic characteristics, including gender, race, age, education, economic sector, household size, type of house, and income were considered and are presented in Table 1.

In Johor, the majority of respondents were male (59.2%), and the remaining (40.8%) were female. In Terengganu, 46.8% of the sample comprised male respondents and 53.2% were female. Most respondents were Malay (78.1%). In Terengganu, most respondents were aged between 41 and 50 (47.2%), followed by those in the 31-40 age group (27.6%). A similar trend was observed in Johor where 66.2% of the respondents were Malay. The age distribution was as follows: 35.8% (31 to 40 years old), 25.9% (25 to 30 years old), and 38.3% (41 to 50 years old and 20 to 30 years). The majority of respondents lived in households comprising three to five people (50.2%). Terrace homes accounted for the majority of respondents' residences (61.7%). A terrace house is a row of comparable homes connected by their side walls and typically has two or three bedrooms. Similar patterns were observed in Johor. Therefore, lifestyle may influence water usage patterns and attitudes towards conservation.

4.1.2 Awareness of water conservation

In Table 2, the results for awareness of water conservation are presented. It shows that 74.1% of respondents in Johor and 77% in Terengganu had heard about water conservation. The main source of information about water conservation was the internet, which was cited by 82.1% of respondents in Johor and 59.2% in Terengganu. Most of the respondents had not experienced a leakage at home from the water utilities supply. Additionally, they felt that there was no wastage of water in their household, and most respondents did not recycle or reuse water at home.

Table 2. Awareness of water conservation

Items	Johor		Terengganu	
	F	P (%)	F	P (%)
Have you heard about water conservation?				
Yes	149	74.1	285	77
No	52	25.9	85	23
What are your sources of information about water conservation?				
Newspaper	165	82.1	219	59.2
Talk	23	11.4	81	21.9
Friend	6	3	36	9.7
Others	7	3.5	34	9.2
Do you encounter pipe break/leaks in your supply?				
Yes	17	8.5	97	26.2
No	184	91.5	273	73.8
Do you feel that there is water wastage in the household?				
Yes	51	25.4	102	27.6
No	150	74.6	268	72.4
Do the household recycle/reuse water?				
Yes	31	15.4	68	18.4
No	170	84.6	302	81.6

Note: F - Frequency; P- Percentage

4.1.3 Level of attitudes toward water conservation

Table 3. Attitudes of water conservation

Items	Johor			Terengganu		
	P(%)	M	SD	P(%)	M	SD
How well informed do you consider yourself to be about water conservation and the risk of water shortage?						
Strongly Disagree	0.5			2.2		
Disagree	8			3.2		
Neither Agree or Disagree	20.1			29.2		
Agree	64.2	3.52		51.4	3.72	
Strongly Agree	7.5		0.81	14.1		0.82
How motivated are you to learn more about the connection between water conservation and preventing water shortage?						
Strongly Disagree	0.5			0.8		
Disagree	6.5			2.2		
Neither Agree or Disagree	24.9			23		
Agree	56.2	3.56		57.3	3.87	
Strongly Agree	11.9		0.75	16.8		0.74
How vulnerable do you feel about the possibility of water shortage affecting you or your family?						
Strongly Disagree	0.5			0.8		
Disagree	5.5			1.6		
Neither Agree or Disagree	14.9			14.9		
Agree	70.2			57.6		
Strongly Agree	9	3.53	0.76	25.1	4.05	0.73
How is water crisis affecting your land and property?						
Strongly Disagree	-			0.5		
Disagree	7			5.1		
Neither Agree or Disagree	20			18.6		
Agree	64.2			54.3		
Strongly Agree	9	3.37	0.78	20.8	4.12	3.05
You are confident of being able to carry out water conservation.						
Strongly Disagree	1			0.3		
Disagree	7.5			1.6		
Neither Agree or Disagree	27.4			25.1		
Agree	56.2			54.1		
Strongly Agree	8	3.37	0.78	18.9	3.9	0.72

Notes: P - Percentage; M -Mean; SD - Standard Deviation

The attitudes toward water conservation in Terengganu and Johor are presented in Table 3. These attitudes include knowledge of water conservation and water shortage, motivation to learn about the link between water conservation and preventing shortages, feeling vulnerable to shortages, the impact of the water crisis on land and families, and confidence in carrying out using a 5-point Likert scale. Respondents were questioned about their attitudes toward water conservation, and the scale ranged from strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), to strongly agree (5).

Most respondents expressed concerns about water scarcity and conservation, with 71.7% of respondents in Terengganu and 65.5% in Johor acknowledging the danger of water scarcity. Between 68.1% and 74.1% of respondents in Johor expressed a genuine interest in learning more about the link between water conservation and avoiding water shortages. Additionally, 79.2% of households felt insecure about the prospect of a water deficit affecting them and their family, while 73.2% were concerned about how water scarcity would impact their land and personal belongings. Many respondents also expressed confidence in conserving water, with estimated rates of 64.2% in Terengganu and 73% in Johor. This finding is consistent with research from the UK [97] and Australia [98]. However, the study in Australia had a higher response rate compared to the study conducted in the UK, with estimated rates of 94-98% and 83%, respectively.

In Johor, the average scores for motivation and vulnerability in the face of a water crisis were high, estimated at 3.56 and 3.53, respectively. In Terengganu, the level of attitude toward water conservation was 4.05 for vulnerability to water scarcity affecting households, and 3.9 for the impact of a water crisis on land and property.

4.1.4 Water conservation

In Table 4, the water-saving practices in domestic activities, such as bathing, toothbrushing, laundry, using dishwater, and cooking are presented. In Johor, households consistently checked and fixed leaking taps and collected rainwater for garden use at rates of 62.2% and 59.2% respectively. Other activities also had high rates of more than 50% participation, including taking shorter showers, using less water to wash cars, running the washing machine only when full, using minimal water in the kitchen, collecting and using grey water in the garden, turning off taps when brushing teeth, and being water-wise in the garden.

Similarly, in Terengganu, most households reported consistently checking and fixing leaking taps, collecting rainwater for garden use, running the dishwasher when full, taking shorter showers, using less water to wash cars, and collecting and using grey water in the garden, with participation rates exceeding 50%. However, 46.5% of respondents reported never using a half flush or not flushing the toilet every time. The study also revealed that most respondents ensured to run the washing machine when it was full (52.7%) and used minimal water for cooking, washing up, and rinsing in the kitchen (51.1%). Additionally, they turned off taps when brushing teeth (61.6%) and were efficient in watering the garden, practicing techniques such as watering at night, using less water, and using a bucket (about 52.2%).

The mean score of water-saving practice in Johor was estimated at an average level of 3.33 among respondents. The most common practices included turning off taps when brushing teeth, using half flush or not flushing the toilet every time, and using minimal water in the kitchen during cooking, washing up, and rinsing. Similarly, in Terengganu, water-saving practices were focused on turning off taps when brushing teeth and using minimal water in the kitchen, with mean scores of 3.79 and 3.49 respectively as presented in Table 4. These findings contrast with various studies in the UK [97] and Australia [98]. Both studies indicated that households made sure taps did not drip, with participation rates at about 87% and 98% respectively. Whereas in ASEAN countries, for instance in Brunei, study [65] proposes that changing the consumption slab can assist reduce home water consumption. Brunei's water authority may reduce the top limit to 45 cubic metres from its existing figure of 54.54 cubic metres per month instead of increasing the water price. Evidence suggests that all households saved an average of 4 litres of water per person per day, with no difference in treatment impact seen between groups. Perhaps unsurprisingly, the water-saving effect is greater among high baseline users, who saved up to 5.9 litres per person per day. Non-monetary incentives are also more effective for households with a higher baseline in Singapore [87].

Table 4. Water conservation

Item	Johor			Terengganu		
	P (%)	**M**	**SD**	**P (%)**	**M**	**SD**
Check and fix leakage taps						
Never	4.5			2.4		
Rarely	24.9			20.8		
Sometime	8.5	3.01	0.97	41.9	3.2	0.97
Almost Always	17.9			24.3		
Always	44.3			10.5		
Collect rainwater to use in garden						
Never	12.4			15.1		
Rarely	19.4			26.2		
Sometime	9	2.9	1.1	31.9	2.78	1.15
Almost Always	16.4			7.8		
Always	42.8			18.9		
Only run dishwater if it is full						
Never	8.5			21.9		
Rarely	18.9			21.1		
Sometime	8.5	3.01	1.04	26.8	2.75	1.27
Almost Always	20.4			9.2		
Always	43.8			21.1		
Have shorter showers (3 minutes or less)						
Never	7			21.1		
Rarely	19.9	3.04	1.03	28.6	2.73	2.96
Sometime	10			24.9		
Almost Always	18.4			20.5		
Always	44.8			4.6		
Use half flush or do not flush the toilet every time						
Never	40.3			46.5		
Rarely	20.9			17.6		
Sometime	4	3.16	1	12.2	2.22	1.39
Almost Always	24.4			14.9		
Always	10.4			8.9		
Wash cars with less water (e.g., with bucket or at an efficient carwash)						
Never	4.5			11.6		
Rarely	20.4			17		
Sometime	10	3.08	0.98	30.8	3.14	1.2
Almost Always	17.4			26.8		
Always	47.8			13.8		

Only run the washing machine if it is full.						
Never	3.5			11.6		
Rarely	24.4			10.3		
Sometime	12.4	3.13	1.03	25.4	3.42	1.27
Almost Always	19.9			29.7		
Always	39.8			23		
Use minimal water in kitchen (e.g., for cooking, washing up, rinsing)						
Never	2.5			2.7		
Rarely	22.9	3.14	0.99	13	3.49	1
Sometime	12.4			33.2		
Almost Always	16.9			34.9		
Always	45.3			16.2		
Collect and use grey water on garden (e.g., from washing machine, sink, shower/bath)						
Never	10			21.9		
Rarely	22.4			15.7		
Sometime	6.5	2.86	1.01	31.4	2.82	1.87
Almost Always	14.9			21.1		
Always	46.3			10		
Turn off taps when brushing teeth						
Never	1.5			4.6		
Rarely	14.9			9.7		
Sometime	11.9	3.33	0.92	23.8	3.79	1.48
Almost Always	27.4			30		
Always	44.3			31.6		
Be water-wise in the garden (only water at night, less watering, use a bucket, plant drought-tolerant plants)						
Never	4			7		
Rarely	18.9			11.6		
Sometime	8	3.08	0.93	29.2	3.46	1.14
Almost Always	19.4			33		
Always	49.8			19.2		

Notes: P - Percentage; M -Mean; SD - Standard Deviation

4.1.5 Water-efficient appliance installation

Table 5 presents the findings on the installation of water-efficient appliances for water conservation. In Johor, about 57.2% of households opted to install water-efficient appliances, and 64.2% of households felt societal pressure to do so.

Approximately 58.7% of respondents believed that installing water-saving equipment in the home and garden is essential. Around 55.2% agreed that there is a significant moral obligation to install water-saving appliances. The survey also revealed that 64.2% of people were willing to make extra efforts to install water-saving appliances, and about 70.1% would feel guilty if they did not.

In Terengganu, the survey showed that 48.6% of families agreed to install water-efficient appliances in their home and garden and were willing to make additional efforts (44.1%). They also reported feeling a high sense of personal obligation (27%) and social pressure (25.4%) to install water-saving appliances. Additionally, 44.1% were willing to make extra efforts, and 35.7% would feel guilty if they did not install water-saving appliances.

Table 5. Water efficient appliances installation

Items	Johor			Terengganu		
	P (%)	M	SD	P (%)	M	SD
I should install water efficient appliances in house and garden.						
Strongly Disagree	1.5			2.7		
Disagree	8			5.7		
Neither Agree nor Disagree	21.4	3.83	0.72	28.1	3.9	3.42
Agree	57.2			48.6		
Strongly Agree	11.9			14.3		
I feel under social pressure to install water efficient appliances in the house and garden.						
Strongly Disagree	0.5			2.2		
Disagree	4			15.9		
Neither Agree nor Disagree	22.4	3.78	0.67	44.6	3.28	0.94
Agree	64.2			25.4		
Strongly Agree	9			11.9		
People who are important to me want me to install water efficient appliances in the house and garden.						
Strongly Disagree	1			1.9		
Disagree	9			15.7		
Neither Agree nor Disagree	24.9	3.72	0.75	40.5	3.4	2.29
Agree	55.2			34.6		
Strongly Agree	10			7		
I feel a strong personal obligation to install water efficient appliance in the house and garden.						
Strongly Disagree	-			2.7		
Disagree	5		0.76	17.3		
Neither Agree nor Disagree	27.4	3.8		43	3.28	1.35
Agree	58.7			27		
Strongly Agree	9			9.7		
I am willing to put extra into installing water efficient appliance in the house and garden.						
Strongly Disagree	0.5			1.6		
Disagree	5.5		0.78	11.1		
Neither Agree nor Disagree	22.4	3.74		31.6	3.52	0.89
Agree	64.2			44.1		
Strongly Agree	7.5			11.6		
I would feel guilty if I did not install water efficient appliances in the house and garden.						
Strongly Disagree	0.5			2.4		
Disagree	7.5			13		
Neither Agree nor Disagree	14.9	3.66	0.83	36.5	3.5	1.8
Agree	70.1			35.7		
Strongly Agree	7			12.2		

Notes: P - Percentage; M -Mean; SD - Standard Deviation

The average mean score for the items related to installing water-efficient appliances in homes and gardens was 3.83 in Johor and 4.07 in Terengganu. The items for personal responsibility, social pressure, willingness to make extra efforts, and feeling guilty if not installing water-saving appliances also scored high. The overall mean score was 3.74 in Johor and 3.52 in Terengganu.

4.2 Empirical analysis

The researchers used multiple linear regression analysis to examine the connection between water conservation and specific socioeconomic factors such as gender, age, number of children, household size, education, and income. Although the impact seems apparent, formal hypothesis testing was conducted separately for the Johor and Terengganu regions.

Hypothesis 1 (Eq. (1))

H1: Socioeconomics has a positive impact on water conservation.

H0: Socioeconomics has a negative impact on water conservation.

Hypothesis 2 (Eq. (2))

H1: Socioeconomics has a positive impact on efficient appliance installation.

H0: Socioeconomics has a negative impact on efficient appliance installation.

There are two equations as follows: -

Eq. (1) was developed for estimating the determination of water conservation.

$$WC_i = \beta_0 + b_1 Gen_i + b_2 Age_i + b_3 Child_i + b_4 Family_i + b_5 Education_i + b_6 Inc_i + e \quad (1)$$

where, *WC* is water-saving (for using water efficiently/ water conservation), *Gen* is respondent's gender, *Age* is respondent's age, *Child* is number of children, *Family* is number of Family members, *Education* is level of education, *Inc* is income and *e* is the error term.

Eq. (2) was developed for estimating the determination of efficient appliance installation.

$$AI_i = \beta_0 + b_1 Gen_i + b_2 Age_i + b_3 Child_i + b_4 Family_i + b_5 Education_i + b_6 Inc_i + e \quad (2)$$

where, *AI* is appliance installation (reasons for using efficient appliance at home and garden), *Gen* is respondent's gender, *Age is respondent's age, Child* is number of children, *Family* is number of family members, $Education$ is level of education, *Inc* is income and *e* is the error term.

The results of multiple linear regression on water-saving practices by income group (B40, M40, and T20) and selected socioeconomic variables in Johor and Terengganu are presented in Table 6. In Johor, significant socioeconomic variables influencing water-saving practices in the B40 and M40 groups include number of children, education, and income, while in the T20 group, significant variables include gender, number of children, education, and income.

Furthermore, in Terengganu, significant variables for the B40 and M40 groups are number of children, education, and income, while for the T20 group, the variables are gender, number of children, education, and income. It is worth noting that income has a significant impact ($p<0.001$), indicating that it plays a crucial role in driving water-saving practices. The null hypothesis (H0) is rejected, suggesting that socioeconomic characteristics have a positive impact on water conservation and the installation of efficient appliances.

Table 6. Water conservation and socioeconomics characteristics by income group in Johor and Terengganu

Income Groups	Johor State			Terengganu State		
Income Group B40	**Coefficients**	**Standard Error**	**P-Value**	**Coefficients**	**Standard Error**	**P-Value**
Constant	3.988	.282	.000	1.919	.221	.000
Gender	-.041	.089	.643	.038	.070	.582
Age	-.028	.048	.558	.034	.038	.367
Number of Children	.166	.078	**.036****	.195	.061	**.002*****
Number of Households	-.059	.075	.435	-.074	.059	.208
Education	.105	.053	**.050****	.135	.042	**.001*****
Income	-2.428	.102	**.000*****	-1.244	.080	**.000*****
Income Group M40	**Coefficients**	**Standard Error**	**P-Value**	**Coefficients**	**Standard Error**	**P-Value**
Constant	.949	.479	.049	.517	.312	.099
Gender	-.229	.159	.151	-.114	.103	.272
Age	.086	.086	.316	.091	.056	.106
Number of Children	.597	.136	**.000*****	.434	.088	**.000*****
Number of Households	-.133	.134	.323	-.118	.087	.177
Education	.456	.091	**.000*****	.329	.059	**.000*****
Income	.521	.077	**.000*****	.120	.050	**.017****
Income Group T20	**Coefficients**	**Standard Error**	**P-Value**	**Coefficients**	**Standard Error**	**P-Value**
Constant	2.418	.497	.000	1.451	.250	.000
Gender	-.460	.159	**.004*****	-.194	.080	**.016****
Age	-0.18	.088	.841	.004	.045	.937
Number of Children	.457	.142	**.001*****	.240	.072	**.001*****
Number of Households	-.110	.137	.424	-.062	.069	.370
Education	.329	.096	**.001*****	.174	.048	**.000*****
Income	.421	.071	**.000*****	.406	.036	**.000*****

a. Dependent Variable: Water Conservation. * Significant level at 0.10 *** Significant level at 0.01.

Table 7. Appliances installation and socioeconomics characteristics by income group in Johor and Terengganu

Income Groups	**Johor State**			**Terengganu State**		
Income Group B40	**Coefficients**	**Standard Error**	**P-Value**	**Coefficients**	**Standard Error**	**P-Value**
Constant	3.785	.186	.000	3.765	.183	.000
Gender	-.015	.058	.795	.026	.058	.649
Age	.031	.032	.327	.040	.031	.200
Number of Children	.090	.052	**.083***	.093	.051	**.068***
Type of Households	-.024	.049	.626	-.033	.049	.498
Education	.047	.035	.179	.053	.035	.126
Income	-1.212	.067	**.000*****	-1.198	0.66	**.000*****
Income Group M40	**Coefficients**	**Standard Error**	**P-Value**	**Coefficients**	**Standard Error**	**P-Value**
Constant	2.297	.271	.000	2.256	.266	.000
Gender	-.119	.090	.185	-.126	.088	.153
Age	.087	.048	**.075***	.101	.048	**.035****
Number of Children	.308	.077	**.000*****	.315	.075	**.000*****
Number of Households	-.061	.076	.423	-.878	.074	.295
Education	.224	.051	**.000*****	.233	.050	**.000*****
Income	.231	.043	**.000*****	.240	.043	**.000*****
Income Group T20	**Coefficients**	**Standard Error**	**P-Value**	**Coefficients**	**Standard Error**	**P-Value**
Constant	3.120	.258	.000	3.011	.268	.000
Gender	-.235	.082	**.005*****	-.237	.086	**.006*****
Age	.030	.046	.504	.042	.048	.378
Number of Children	.220	.073	**.003*****	.215	.077	**.005*****
Number of Households	-.061	.071	.394	-.042	.074	.570
Education	.142	.050	**.005*****	.153	.052	**.004*****
Income	.245	.037	**.000*****	.234	.039	**.000*****

Dependent Variable: Appliances Installation.
* Significant level at 0.10
*** Significant level at 0.00

Table 7 displays the results of multiple linear regression on appliance installation by income group (B40, M40, and T20) and selected socioeconomic variables in Johor and Terengganu. In Johor, the significant variables for the B40 group are number of children and income, while for the M40 group, age, education, and income are influential. In the T20 group, gender, number of children, education, and income are significant factors. In Terengganu, the significant variables for the B40 group are number of children and income, with significant levels of 0.1 and 0.001, respectively. Once again, H0 is rejected, indicating that socioeconomic characteristics have a positive impact on water conservation and the installation of efficient appliances.

The results of multiple linear regression analysis on water conservation and appliance installation indicates that income, number of children, education, age, and gender are significant socioeconomic factors affecting water conservation attitudes, with income being the primary driver. Income emerged as the most significant determinant of behavior towards water conservation. There is a positive relationship because higher-income groups comprise more educated households. They are more aware of water conservation behaviors in indoor and outdoor activities. Higher-income groups have a budget to install appliances at home and in the garden. They are also more educated and exposed to water conservation activities conducted by water operators, NGOs, and the government. As a result, they practice water-saving tips in daily activities such as bathing, cooking, watering the garden, washing a car, and more. Increasing their income leads households to increase their water conservation behavior.

However, it should be noted that there exists a gap between knowledge (94.4%) and actual behavior (74.1%) regarding water-saving techniques, as seen in a study of low-income bands in South Africa [111]. Also, caution should be applied to the belief that water consumption will be influenced by income at the same rate in rapidly urbanizing areas in Asia as seen in developed countries [112].

The findings in this text are consistent with several other studies. For example, Lyman [76] found that variables such as household income, property value, property features, and age distribution all play a significant role in water conservation. Similarly, Gregory and Di Leo [56] observed that households that practice water conservation tend to develop water conservation habits, leading to a tendency of perpetuation. Gilg and Barr [113] identified four types of water savers, while Gil-Olcina et al. [114] recommended replacing turf grass with pavement to reduce water overconsumption in Alicante, Spain.

Furthermore, Arbués et al. [115] found that income level influences how households behave in terms of water conservation. The study discovered that income is the most constant predictor of water-use behaviors and the adoption of water-saving devices. Furthermore, Ngcobo et al. [109] discovered that education level is a reliable predictor of the adoption and implementation of water-saving devices. Bradley [116] discovered that the two highest socioeconomic groups in the UK consume 1.47 times more water than the two lowest groups. In the Philippines, Abansi et al. [117] noted that price, through its impact on income, is a useful tool for manipulating water consumption, especially when employing a tariff structure that favors the low-income group.

In contrast, Renwick and Green [118] found that the low-income band, where water is consumed for basic needs, either does not respond to price increases or responds at a higher rate than the higher-income band, which raises concerns about equity and distribution of environmental cost.

Dinar and Subramanian [119] studied both developed and developing countries, while Olmstead and Stavins [91] examined market-based and prescriptive approaches to water conservation. They found that pricing is the most cost-effective tool for conservation promotion, which aligns with the OECD's position on water service provision and pricing [120].

Vivek et al. [121] reported a 15-25% reduction in household consumption after the absence of volumetric pricing for 5 weeks, and this behavior persisted even after 18 months when marginal pricing was reinstated. Ratnasiri et al. [122] found that an increasing block tariff scheme (IBT) leads to water conservation compared to a uniform pricing scheme. Additionally, Ali et al. [123] observed that an increase in water-saving devices leads to a decrease in water consumption levels.

Finally, Howe [124] found that a 100% increase in income would lead to a 30% increase in water consumption in the U.S. and Canada, and Suarez-Varela [125] suggested that the dependence on income may not be linear and should be considered in the context of a WEF Nexus approach [126].

In various studies, it has been observed that the percentage of income spent on water tends to decrease as income increases [47, 122, 123]. However, a study by Patterson and Doyle [127] indicates that in the U.S., as income decreases, the percentage of income spent on water consumption increases, especially in working days, and falls below the utility expenses median. Another study conducted in the city of Campina Grande, Brazil, found that water consumption is influenced by water price and income [128]. Similarly, in Joinville, Southern Brazil, the number of residents and area per capita were identified as determinants of water consumption [129]. In the Offa community in Nigeria, income plays a primary role in determining water consumption, with education also exerting a secondary influence [130]. Contrary to these findings, a study in Hong Kong revealed that household area was the main determinant of water consumption, with household income being a secondary factor [131]. Additionally, households with higher incomes were found to use more water than lower-income households [132]. An inverse relationship between income and water consumption in the metropolitan area, Thailand [88] as well as income (either GDP per capita or income per capita) influences water consumption [89, 130].

Moreover, education has been identified as a driver for water conservation and appliance installation, with lower-educated households generally exhibiting more water conservation behaviors and using less water than higher-educated households [55, 56, 130].

The impact of age on water consumption is not entirely clear. While some studies suggest that older households use less water [56], it's possible that life stage, rather than age, has a more significant impact on water use. For example, retiring or having adolescent children could potentially increase water consumption. The former is because people spend more time at home during retirement, and the latter is because teenagers tend to use a lot of water [107]. In summary, households with lower water usage tend to have fewer members with lower education and income levels. Additionally, findings [60] show that, at a 95% significance level, the age of the head of household, total monthly income, housing type, the number of water sources used by each household, total number of people in each household, and total number of people working in each household have all become factors influencing water consumption in Surakarta, Indonesia. A study used cross-sectional data from a survey of 1,300 households to predict determinants of domestic water use using a multiple linear regression model. Access to water, household size, trip frequency, monthly income, water payment, educational qualification, route time, and home style are some of the factors that influence outcomes [59].

In a future scenario-based study, it is projected that household water demand will be highest in the Fortress Scenario (Barbarization) due to a higher increase in population and built-up area, and lowest in the Policy Reform Scenario [133]. In the context of underdeveloped countries, a study in Nicaragua found that reducing the walking distance to the well by 1000 to 10 meters could increase water consumption by 20%, and having educated mothers could lead to a 17% increase in water consumption over uneducated mothers [134]. Another study by Rahayu and Rini [60] found that only 16% of water consumption in Surakarta City, Indonesia could be attributed to socioeconomic determinants. In a study of a growing urban center in Osun State, Nigeria, it was found that 76% of water consumption is influenced by factors such as household size, water supply preferences, age range, religious beliefs, and gender composition [135].

Additionally, characteristics such as age, gender, and income are socioeconomic factors that affect water conservation, as indicated by the results of multiple regression analyses on curtailment behavior and appliance installation. These findings align with previous studies [56, 76, 113, 114, 136, 137]. Younger individuals appear to find it easier to conserve water, while older individuals have a greater awareness of environmental issues and use less water at home [138]. Income level also influences how households behave in terms of water conservation [115].

The usage of water in households can be influenced by various factors. According to research by Gregory and Di Leo [56], older households tend to consume less water. Ngcobo et al. [109] found that people who stay at home, especially teenagers, use more water compared to households where individuals work. Additionally, Gregory and Di Leo [56] and Aitken et al. [70] discovered that habits have a positive relationship with intentions for water conservation. Other factors such as age and occupancy also play a role in water conservation.

Moreover, gender also impacts water usage behavior, with females showing more awareness compared to males. Furthermore, age has a negative relationship with water conservation behavior. Older households tend to use water more efficiently, likely due to their heightened awareness of water as a scarce resource. A study by Chan and Nitivattananon [138] mentioned that women, as water managers at home and in offices, play a crucial role in sustainable water management. Additionally, studies in India and Africa indicate that women have effectively managed water consumption where access to piped water is limited [139]. The Women for Water Partnership (WWP) was launched and registered at the 12th session of the UN Commission on Sustainable Development in April 2004 to underscore the significant roles of women in water use.

5. CONCLUSION AND POLICY IMPLICATIONS

The study used multiple linear regression to analyze the relationship between socioeconomic variables and water conservation behaviors, specifically water consumption curtailment and efficient appliance installation. The research focused on domestic water usage in Johor and Terengganu, and found that factors such as gender, age, number of children, education, and income influenced these behaviors in both states. The results support previous findings that higher income is associated with greater willingness to install water-efficient appliances.

The study suggests that policymakers should emphasize water demand management and promote conservation programs starting from early education to households, in order to raise awareness about the importance of water conservation. The government could incentivize the installation of rainwater collection systems in homes through measures like tax breaks and subsidies, which could also be applied to other states in Malaysia.

In this study, new evidence of household awareness and attitudes towards water conservation in Johor and Terengganu was presented. This information is valuable for understanding water-saving attitudes and behaviors in these regions. Policy makers can use this information to develop new strategies and policies. The National Water Services Commission (SPAN), a government organization in Malaysia, should propose legislation to label water-efficient products and enforce their usage. To incentivize manufacturers to create efficient products, efficiency labeling programs should be established. Collaboration between the government, policymakers, and public authorities can help households learn about water conservation and its effects. This, in turn, can encourage people to be more mindful of their water usage and reduce water resource pollution. All parties involved should be aware of the key challenges and potential responses of neighborhood communities and individuals regarding the sustainable development goal 6, ensuring that everyone has access to sustainable water and sanitation services, is an important climate change mitigation plan and manage of water resources in the future.

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