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RESEARCH ARTICLE

UNDERSTANDING CONSUMER BEHAVIOUR TOWARDS WATER USAGE EFFICIENCY IN TERENGGANU

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ABSTRACT

Climate change, population increase, and industrial activity are all putting a strain on water resources, emphasizing the importance of good demand management. These solutions necessitate a thorough understanding of household water consumption patterns and behavioral inclinations, especially in water-scarce countries. This study looks into household water consumption habits and identifies the primary drivers of water demand in Terengganu, Malaysia's east coast. The study's goal is to look at home water use trends in Terengganu and discover socioeconomic factors that influence water demand in the region. Correlation and multiple regression models were used to examine survey data obtained from 271 households from December 2021 to February 2022. The correlation study indicated strong links between daily household water use and socioeconomic characteristics such as gender, education level, income, dwelling type, number of children, and marital status. The multiple regression analysis revealed that characteristics such as education level, number of children, and family size all had a significant impact on water quality, odor, and taste. These findings have important implications for water utilities and policymakers. Understanding the underlying elements influencing water consumption behavior allows for the development of successful water demand management strategies that promote conservation and optimize water use. The study leads to a better knowledge of household water use patterns and serves as a platform for future policy formulation targeted at ensuring Terengganu's water resources are sustainable.

KEYWORDS

Consumer behaviour, water service, water pattern, water shortage

1. INTRODUCTION

Water scarcity constitutes one of the most pressing challenges on a global scale. Public authorities consistently encounter the challenge of ensuring the availability of sufficient water resources to meet the escalating demand for water. Factors such as population growth, increased commercial activities, and urbanisation all contribute to the mounting need for freshwater resources. Conversely, the adverse effects of climate change, droughts, and pollution further exacerbate the availability of water resources. The scarcity of water is particularly acute in semi-arid regions, making it significantly more challenging to secure water supplies, especially in densely populated urban areas with substantial industrial activities (Fielding et al., 2012; Priyan, 2021).

Households represent one of the largest consumer segments of water resources. Therefore, strategies focused on managing water demand to reduce residential water consumption are likely to yield positive results. While there is currently no consensus in the literature regarding the optimal methods to regulate household water consumption, other studies concur that the assessment of household water-usage behaviours enables a proactive approach to water demand management (Matikinca et al., 2020). This assessment can serve as a basis for effective interventions and strategies that can lead to substantial and enduring reductions in household water usage (Jorgensen et al., 2009; Shan et al., 2015).

Despite Malaysia's abundant rainfall, which contributes to ample water resources, the escalating population, industrialisation, and urbanisation are projected to drive an annual 12% increase in water demand across the country. The current water demand of 12 billion m3/year is anticipated to rise to 20 billion m3/year by 2020. The water usage per capita per day (LCD) is detailed in Table 1.

Table 1: Water Usage Per Capita Per Day (LCD) in Peninsular Malaysia

Unit LCD	2018	2019	2020	2021	2022
Johor	216	222	229	232	216
Kedah	251	253	263	269	258
Kelantan	89	86	89	89	89
F.T. Labuan	179	179	168	202	196
Melaka	226	225	231	246	226
N. Sembilan	259	260	282	290	254
Pulau Pinang	278	281	301	308	307
Pahang	200	203	219	232	238
Perak	265	270	281	280	277

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Table 1 (Cont.): Water Usage Per Capita Per Day (LCD) in Peninsular Malaysia					
Perlis	313	315	306	313	276
Selangor	229	239	260	272	245
Terengganu	208	213	227	237	241
Pen. Malaysia & F.T. Labuan	225	230	244	251	237

Source: Water and Sewerage Fact Book, 2022

Referring to Table 1, Penang exhibits the highest water usage per capita per day (LCD) estimated at 307 in 2022, followed by Perak and Perlis. Kelantan demonstrates the lowest water usage, approximately 89 LCD. Terengganu represents moderate water usage among states, approximately 241 LCD, indicating a consistent increase in water usage from 2018 to 2022. This domestic water usage surpasses the World Health Organisation's (WHO) recommended 165 litres, while the water tariff is estimated at 42 cents for the first 20m3, representing a moderate rate compared to other states in Malaysia. This scenario suggests that households consume water for indoor and outdoor activities beyond the standard usage, reflecting ineffective water usage behaviours and attitudes. Consequently, this situation may lead to freshwater scarcity in the long run, presenting a critical issue in both developed and developing countries.

Terengganu is seeing a gradual increase in consumption despite relatively low water tariffs and plentiful rainfall. Terengganu's Water Supply Department (2022) reported that the average daily water consumption per capita in the state is approximately 220 liters, which is higher than the national average of 180 liters per person. This increase in per capita water use raises concerns about future water availability, especially given the state's reliance on surface water from rivers and reservoirs, which are vulnerable to seasonal droughts and changing rainfall patterns.

Despite attempts to enhance water conservation and infrastructure, many regions in Terengganu continue to confront water supply issues, especially during the dry season. This has led to the need for thorough research that not only investigate how water is used in families, but also uncover the socioeconomic, demographic, and behavioral aspects that influence water demand. However, this increase in water use, particularly for both indoor and outdoor activities, suggests a possible inefficiency in how water is used, implying a lack of awareness or inadequate water conservation practices. These trends indicate a major concern that may increase freshwater scarcity in the long run, not only in Malaysia but also in other regions under similar pressures.

As a result, this study focuses on two key goals: first, to investigate household water consumption patterns in Terengganu, and second, to determine the factors that influence water demand in the region. The study's goal in researching these characteristics is to identify the individual habits, preferences, and attitudes that affect water use among inhabitants, as well as the wider socioeconomic, cultural, and environmental factors that influence demand.

The aim for this study originates from a desire to better understand household water consumption patterns in Terengganu and to uncover socioeconomic characteristics that influence water demand. This study intends to provide significant insights into the relationship between socioeconomic characteristics such as income, education, household size, and water usage behaviors in order to develop targeted and successful water conservation initiatives. Despite a growing body of literature on household water use, there is still no consensus on the most effective strategies for regulating water use at the household level, especially in Malaysia's diverse socioeconomic landscape (Matikinca et al., 2020).

This study is unique in that it focuses on socioeconomic determinants of water demand and uses regression models to provide quantitative insights into the relationship between these factors and household water usage. This study uses correlation analysis and multiple regression models to examine how variables such as gender, education level, income, and household size affect water usage, providing a nuanced understanding of the drivers of domestic water consumption in Terengganu.
This research not only adds to the current literature on water demand management, but it also has important practical implications for water utilities and regulators. Understanding the socioeconomic elements that influence household water usage can help build more targeted and effective water demand management measures, eventually ensuring the region's water resources are used sustainably. The study is organized as follows: a literature review to examine the current state of research on household water consumption, a methodology section that details data collection and analytical methods, results and discussion, and policy implications and recommendations. Consequently, an investigation should be conducted to analyse the pattern of water usage, households' behaviour and perception towards water usage, and to identify the determinants of water usage, particularly from a socioeconomic perspective. This article will be structured with an introduction, literature review, methodology, results and discussions, and finally, a conclusion and policy implications.

2. Literature Review

2.1 Consumer Behaviour In Water Usage Efficiency

The foundation for quantitative research into current trends in consumer behaviour and existing ideas is established by fundamental studies of consumer behaviour. This research primarily focuses on the decision-making process that consumers employ when choosing what to purchase for personal use. The study aims to understand how consumers make purchase decisions. Additionally, it examines foundational studies on consumer purchasing behaviour, models of consumer purchasing behaviour, variables influencing consumer purchasing behaviour, types of consumers purchasing behaviour, and consumer decision-making processes (Roy et al., 2022a;2022b).

Rational consumer behaviour models presume that behaviours result from "rational choices made to maximise personal benefits" (Bamberg, 2013). Economic theories assume that consumer behaviour is influenced by incentives or penalties affecting an individual's utility level (Saphores et al., 2012; Nnorom et al., 2009). Moral concepts encompass the value-belief-norms (VBN), which is one of the most widely applied moral theories to investigate environmentally friendly behaviours (Bronfman et al., 2015). Callejas Moncaleano D. C. et al. (2021) conducted a study that combined environmental and behavioral elements impacting water use efficiency. It highlights the impact of psychological processing and institutional elements in developing water-related behaviors.

Several studies have found that demographic variables such as income, education, and household size influence water usage behaviour. A study aimed to identify water conservation consumer behaviour among young Europeans by (Jakubczak, 2020). The findings indicated that educated and responsible water consumption is limited. The study identified characteristics that influence water consumption habits and suggested that even when consumers use water-saving measures, their actions are motivated by personal reasons rather than the need for global water conservation, particularly a sense of social responsibility. Another study conducted a bibliometric and systematic review of literature to pinpoint the factors influencing household water-saving practices by (Sanchez et al., 2023). The review included 155 publications released between 1984 and early 2023. According to the research, there has been a noticeable increase in research focus on this field since 2010, especially in water-stressed countries. The study highlighted two neglected areas of previous research: the incorporation of guiding theories and the over-reliance on self-reported measures. Factors such as attitude, perceived efficacy, emotions, and habits emerged as crucial in understanding water conservation.

Additionally, investigated the impact of demographic variables on water consumption behaviour and the adoption of water-saving technology in Durban, South Africa (Mbuso et al., 2023). Probit regression models were constructed using survey data from 300 household heads across the city. The study identified income as the most consistent predictor of water usage habits and the adoption of water-saving technologies. Additionally, education level was found to be a consistent predictor of the adoption and implementation of water-efficient devices. The researcher developed a stochastic model to estimate the energy, greenhouse gas (GHG), and water consumption footprints of bathing in four different countries (Australia, Switzerland, the United Kingdom, and the United States of America) (Sadegh Shahmohammadi et al., 2019). The study aimed to measure the variation in life cycle energy use, GHG emissions, and home showering water consumption associated with two types of consumer behaviour. The study utilised one shower event as the functional unit and focused on four nations with distinct meteorological conditions, energy and water infrastructures, and adequate data for analysis: Australia, Switzerland, the United Kingdom, and the United States. Monte Carlo simulation was used to capture the variability in consumer behaviour, such as showering. Furthermore, examined the economic relationship between water use efficiency and scarcity, focusing on how agricultural dependency affects water use efficiency in various economies (Barbier and Burgess, 2024). Examined factors impacting urban water use, such as the efficacy of water efficiency programs (Dias and Ghisi, 2024). For example, such programs

helped participating families lower their water consumption by 15%.

In a 2012 study, Suraiya Ishak and Nur Faridah M. Zabil explored the relationship between consumer awareness, knowledge, and behaviour. The research utilised a survey technique to measure these variables and found that awareness precedes effective consumer behaviour. However, ignorance results in a decrease in a person's ability to defend their rights against sellers. Notably, there were differences in consumer knowledge between metropolitan and less-urban areas. A study examined Punjab's urban consumer behaviour and perceptions on water use efficiency (Singh Brar, 2015). It revealed that the size and season of a home influenced water consumption. The research also highlighted respondents' willingness to impose restrictions on water usage and their readiness to pay more for water, with variations based on wealth and educational attainment.

Analysed consumer behaviour in the water utility industry business model and identified obstacles to reducing home water use in the UK (Probert et al., 2013). Understanding the elements that could lead to long-term reduced consumption is crucial to overcoming water-intensive lifestyles. In a 2017 study, AA Boylu observed water consumption habits in Safranbolu, Turkey, and found strong positive links between attitudes towards water use, sustainable consumption behaviour, and saving behaviour at home. The investigation revealed that beliefs about water conservation and sustainable consumption patterns influence household water conservation behaviour.

The studied barriers and drivers towards household water conservation behaviour, identifying time restrictions, the acuity of water-efficient devices, lack of skills to adopt conservation behaviours, and incentives or disincentives for water-saving devices as key factors influencing conservation behaviour and sociodemographic status (Addo et al., 2018). Overall, the study of consumer behaviour sheds light on decision-making processes, social persuasion, perception, attitude, and motivation that affect consumers' purchase and usage of goods. It underscores the significant influence of institutions and the community on people's intentions to preserve and save water. identified drivers and constraints to water use efficiency in construction, emphasizing the significance of water cost and availability as significant drivers (Waidyasekara Anuradha et al., 2016).

2.2 Household Water Conservation

Household water conservation has emerged as a critical concern due to the impact of climate change, population growth, and industrialisation. Extensive literature has focused on analysing household water consumption patterns to provide insights into how households interact with water resources (Sing and Turkiya, 2013; Viljoen, 2015; Chen et al., 2019; Virk et al., 2020). Additionally, numerous studies have explored the determinants of household water usage (Fielding et al., 2012; Newton and Meyer, 2013; Fan et al., 2017; Russell and Knoeri, 2020; Oh et al., 2021).

Furthermore, attention in the literature has been directed towards attitudes, perceptions, and water-efficient appliances, with a growing emphasis on their role in water conservation (Sonnenberg et al., 2011; Willis et al., 2011; Carragher et al., 2012). The literature also provides evidence on how water authorities can effectively manage household water consumption (Thwala and Edoun, 2018; Booysen et al., 2019; Matikinca et al., 2020). A study in four northern Chinese cities examined the effects of individual characteristics such as knowledge, attitude, and information source, selection criteria, and selling points on the purchase of cloth washers, distinguishing cloth washer buyers from those of conventional washing machines. Then, the data was examined using one-way ANOVA and binary logistic regression. A consumer's decision to buy cloth washers was positively related to education, income, and water conservation knowledge, the product's energy and water consumption efficiency, and the popularity of e-commerce and manufacturer websites (Fan, 2019).

Research on household water use trends is prevalent globally, particularly in semi-arid settings. For instance, scrutinised the domestic water consumption pattern in a semi-arid Indian community, while examined household water consumption trends in South Africa (Sing and Turkiya, 2013). Other recent studies include, which investigated water reliability, time spent collecting water, and total water consumption among urban households in Nepal, who assessed the state of water supply, consumption, and sufficiency in Pakistan (Chen et al., 2019; Viljoen, 2015; Meyer et al., 2021; Virk et al., 2020).

While determinants may vary across different locations, there is a consistent trend of similar factors influencing household water consumption behaviour in semi-arid regions. For instance, sociodemographic factors, property characteristics, and psychosocial constructs have been reported to impact household water consumption behaviour in Greece, Poland, and Chinese cities (Shan et al., 2015; Fan et al., 2017). Similar findings have been observed in studies conducted in Australia (Fielding et al., 2012; Newton and Meyer, 2013). Additionally, the literature suggests that water demand is generally price inelastic, with relatively less inelasticity observed in higher socioeconomic groups that can afford investments in water-efficient technologies to reduce consumption. Further research in the literature provides additional insights into the determinants of household water consumption (Wa'el et al., 2016; Russell and Knoeri, 2020; Adil et al., 2021; Oh et al., 2021).

A Malaysian study looked at households' awareness and attitudes about water conservation. It identified elements impacting water conservation measures, stressing the significance of socioeconomic determinants in shaping household behaviour (Anang Zuraini et al; 2024). A study investigated that environmental views and household water conservation habits have been investigated in research by (Prajapati, Mayurkumar et al., 2025). This study highlights the complex relationship between environmental awareness and actual conservation practices. According to study a systematic literature analysis revealed household preferences for residential water saving techniques (Nurshafiqah Abdul Malek et al., 2024). The study used the PRISMA 2020 technique to synthesis data on what families prefer in terms of water-saving solutions. Additionally, applied bibliometric to reveal factors of home water-conservation behaviors, highlighting both hurdles and motivators that influence these practices (Sanchez, et al., 2023). A study by Silvert, reported by 2030, worldwide water consumption is expected to skyrocket, underlining the importance of effective water conservation techniques (Colby et al., 2024). This necessitates research interventions based on household habits and preferences.

The literature highlights the significant influence of inter-personal and institutional trust on household water consumption. Inter-personal trust reflects water-saving behaviour stemming from the belief that others are also conserving water, while institutional trust involves saving water due to trust in the water authority (Jorgensen et al., 2009). Researcher emphasised the importance of household perception in water conservation, based on their analysis of data from 273 Texas households, and recommended prioritising educational programmes in water demand management efforts (Dascher et al., 2014).

Effective implementation of water demand management strategies targeting household water consumption can yield positive results. The anlysis observed a reduction of approximately 260 litres per family in daily water use among households in Cape Town within 36 months of government announcements and public engagement through social media (Booysen et al., 2019). Encouraging households to conserve water through nudging has proven to be an effective method (Matikinca et al., 2020). It is widely agreed that behavioural messages play a pivotal role in water conservation, thus advocating behavioural interventions as an effective strategy. Various techniques for reducing household water use by addressing behaviour have been outlined in the literature (Kanakoudis, 2002; Mini et al., 2015; Sorensen, 2017; Thwala and Edoun, 2018). Furthermore, a study with randomly selected participants demonstrated the influence of conservation campaigns on consumers planned and habitual water conservation behaviour, highlighting the beneficial role of social marketing communications in water conservation efforts, particularly in emerging nations by (Maduku, 2021).

2.3 Determinants Of Water Use Behaviour From Socioeconomic Variables Perspectives

According to, water consumption determinants can be categorised into three types: visible, latent, and external. Observable determinants are easily measurable and include objective characteristics such as occupant age, household size, income, and number of toilets (Cominola, et al., 2023). Latent determinants pertain to subjective factors like personal habits and attitudes towards water conservation, while external determinants encompass factors outside the home, such as weather conditions.

A study by examined behavioural tendencies in domestic water consumption among Saudi households, finding that education, household size, income, dwelling style, age, and nationality are the most influential factors (Abdulaziz et al., 2024). Another study aimed to explore the relationship between water usage and socioeconomic development, focusing on the urban water cycle and the circular economy to address water management challenges and identify ways to enhance water availability and access by (Edson Elídio Balata et al., 2022). Moreover,

research consolidates environmental and behavioral elements that influence water consumption, investigates gaps in our understanding of human water behavior that underpins water usage efficiency (WUE), and emphasizes the importance of comprehensively assessing and consistently measuring such aspects and their interactions (Callejas Moncaleano, 2021). According to this study, education, household size, wealth, dwelling style, age, and nationality all have a significant impact on household water usage and conservation. Income has been highlighted as a key factor of water conservation attitudes. The study underlines the role of socioeconomic factors in affecting water consumption behaviors in Malaysia (Anang, Zuraini et al., 2024). As study by Tehupeiory, explores the multiple sociodemographic factors influencing water conservation behavior, focusing on the function of demographic and socioeconomic characteristics (Aarce et al., 2023).

This study discussed the economic components of water use change, emphasising the input and output aspects (Lishuo Guo et al., 2022). They highlighted that increased water consumption can be viewed as an economic input, while water use efficiency represents the combined effect of various contributing components on the final output. A study identified ten drivers with diverse influences and impacts on water resources, including agriculture, climate change, demography, economy, ethics, society, governance, infrastructure, politics, and technology. They also emphasised the significance of socioeconomic factors in predicting future water demand and supply, highlighting the role of unrestricted economic growth by (Cosgrove and Cosgrove, 2012).

In the realm of water usage efficiency, have demonstrated a strong correlation between water consumption changes and water use efficiency (Doeffinger and Hall, 2020; Zhou et al., 2020). Enhancing water use efficiency plays a pivotal role in mitigating the surge in water demand (Molden et al., 2007). It is widely acknowledged that agricultural water constitutes a substantial proportion of total water usage in numerous regions across the globe (Borrelli et al., 2020). Molden et al., 2007) have projected that without improvements in water use efficiency, global agricultural water demand would escalate by 70-90% by 2050. Augmenting water usage efficiency stands as a potent strategy to combat water scarcity and serves as the principal approach for sustainable water resource management on a global scale, effectively reducing net water withdrawal (Zoebl, 2006; Alcamo et al., 2007; Shen et al., 2014; Doeffinger and Hall, 2020).

In China, despite a recent decline in human water consumption, primarily driven by improvements in water use efficiency the levels remain considerably lower than those of industrialised nations (Zhou et al., 2020). Water usage per CNY10,000 of industrial added value stands at 45.6 m3, which is twice the global average. On a broader scale, water consumption per US$10,000 of GDP is approximately 500 m3, compared to less than 300 m3 in developed countries, representing a 40% disparity. Water use efficiency is on the rise, while overall withdrawals remain stable or decrease in affluent nations (Alcamo et al., 2007). As previously highlighted, a fundamental challenge for human society is to elevate global water usage efficiency to effectively curtail net water extraction, a notion widely concurred (Shen et al., 2014).

In developed nations, common variables influencing water demand include water price, income, and income elasticity. In developing nations, the determinants of water demand are multifaceted, encompassing household income (wealth index), income elasticity, household size, plot size, population, water cost, asset score, distance to the water source, trip time and waiting time, quality and reliability of source, water pressure, daily water demand, water leakage and losses, source of water (level of access), and seasonality (Bradley, 2004; Jansen and Schulz, 2006; Nauges and van den Berg, 2006).

The utilisation of water is significantly influenced by sociodemographic and environmental factors, as they play a pivotal role in shaping human behaviour (Russell and Fielding, 2010). Research indicates that households with a greater number of residents tend to consume more water (Fielding et al., 2012; Gregory and DiLeo, 2003; Jeffrey and Gearey, 2006). Furthermore, higher levels of education are associated with a greater inclination to conserve water, although some studies have found that increased education levels may lead to higher water consumption (De Oliver, 1999; Gregory and Di Leo, 2003; Gilg and Barr, 2006; Lam, 1999). It is essential to consider education alongside other characteristics. Similarly, higher income levels have been linked to a stronger propensity to install water-efficient equipment but have also been associated with increased water usage (Fielding et al., 2012; Lam, 1999).

In general, households with elderly members tend to use less water, while those with younger members, particularly teenagers, have been found to consume more water than average (Mayer et al., 1999; Lyman, 1992; Clark and Finley, 2007; Gilg and Barr, 2006). The socio-biographical factors considered as explanatory variables in this study have been previously utilised in similar investigations (Jorgensen et al., 2009; Fielding et al., 2012; Fan et al., 2017; Shan et al., 2015).

There are several factors, including age, gender, and education level have been identified as substantial determinants of understanding regarding water use (Beal et al., 2013; Tang et al., 2013; Attari, 2014; Chang et al., 2016; Dean et al., 2016; Piedra-Muñoz et al., 2018; Khair et al., 2019). Moreover, age is considered an important variable in the adoption of water-saving practices at home. Younger individuals are more inclined to adopt behaviours resulting in lower water consumption, whereas older individuals exhibit a higher level of environmental awareness and consequently consume less water in their households (Gil Olcina et al., 2015; Gilg and Barr, 2006; Gregory and Leo, 2003; Lyman, 1992; Morote Seguido, 2016; Pato and Tamayo, 2006).

Research indicates that there are discernible differences in environmental awareness and risk perception between men and women (Piedra-Muñoz et al., 2018; Attari, 2014). Cultural factors, such as attitudes and traditions, also play a significant role in shaping water usage habits. For instance, Kadibadiba et al. (2018) discovered that in certain cultures, high levels of domestic water consumption are associated with a daily need for cleanliness, comfort, and convenience. Moreover, household size and composition are linked to the economic capacity to make investments, including in water-saving technologies, while population density impacts the functioning and efficiency of water utilities due to economies of scale stemming from utility size (Benito et al., 2019).

Furthermore, water pricing is a critical factor influencing the perceptions, willingness, awareness, and attitudes of water users, such as farmers and households. This, along with other variables, serves to promote efficient water usage (Tang et al., 2013; Bruneau et al., 2013; Nazari et al., 2018). The local economy also influences technical aspects such as training, infrastructure investment, and access to water-saving equipment (Bruneau et al., 2013). Various economic activities, including agriculture, rely on water for producing goods, and its productivity is often associated with the average producer income, as well as economic diversification (Graymore et al., 2010; Khair et al., 2019; Xiao et al., 2019).

Researcher seek to identify the socioeconomic determinants that carry the most significant influence on water-saving practices within Ecuadorian households, with the aim of formulating policies to promote water conservation (Johanna Magaly Alvarado Espejo et al., 2021). The study findings highlight gender, marital status, and homeownership as the most impactful determinants of water-saving behaviours among Ecuadorian households. Notably, the perception of environmental issues emerges as a significant variable across most of the models presented.

This paper endeavours to employ multiple regression analysis to pinpoint socioeconomic indicators that affect water usage levels in an urbanised medium-sized metropolis, specifically the Surakarta metropolis. The results demonstrate that, at a 95% significance level, the age of the household head, total monthly income, housing type, the number of water sources used by each household, the total number of individuals in each household, and the total number of individuals employed in each household have emerged as influential factors affecting water consumption in Surakarta (Paramita Rahayu and Erma Fitria Rini, 2019).

The adoption of water-saving behaviours among individuals is contingent upon various factors such as income level, urban population, educational attainment, and climatic conditions (Arbués et al., 2016). Additionally, the pricing structure for water consumption significantly influences the decision-making process related to the implementation of water conservation measures, with family size exerting a greater external influence (Dupont and Renzetti, 2013). Several scholarly works have addressed the escalating trend in water prices (Dalhuisen et al., 2003; Marzouk and Mahrous, 2020).

The architectural typology of a building determines its size, built-up area, and available household amenities. According to a study, a house consumes more water compared to an apartment, with a correlation coefficient of

0.052 and statistical significance at $P < 0.05$. It is suggested that future urban development could prioritise apartments over standalone buildings to potentially reduce water consumption. However, regardless of dwelling type, water usage per unit land area has been observed to remain relatively constant (Jacobs et al., 2013).

A study conducted underscored the significance of city stakeholders' focus on not only slum areas but also densely populated urban neighbourhoods by providing alternative on-site water sources. Similarly, a study utilised cross-sectional data from a survey of 1,300 households to predict domestic water usage patterns using a multiple linear regression model by (Oyerinde and Jacobs, 2022). Factors such as access to water, household size, trip frequency, monthly income, water payments, educational qualifications, commuting distance, and dwelling type were identified as influential determinants of water usage patterns.

With today's hectic lifestyles, many people are unaware of how much water they consume. With the pace of modern life, people frequently choose the solution that best suits their time and convenience, rather than optimizing for efficiency and environmental results, because they do not value water-related activities. Water, which is naturally viewed as an infinite source, is rapidly diminishing and disappearing day by day. As a result, the purpose of this study is to assess individuals' water consumption behavior at home in terms of effective and efficient water source use (Ayfer Aydiner Boylu and Gulay Gunay, 2017)

3. Methods

3.1 Study Area

Kuala Terengganu is situated on the east coast of Peninsular Malaysia, approximately 440 kilometres northeast of Kuala Lumpur. The city is positioned at the estuary of the Terengganu River, adjacent to the South China Sea. The population of Terengganu is approximately 1.2 million, predominantly comprising Malays (90%), with the remaining populace being of Chinese and Indian descent.

As the state capital, Kuala Terengganu, along with other towns and villages in Terengganu, embodies a serene lifestyle, largely unaffected by the commotion and vigour of a metropolis. Over the past three decades, Terengganu has experienced substantial growth due to rapid modernisation and heightened commercial activities subsequent to the discovery of valuable resources. Previously, the primary economic pursuits in the state were agriculture and fishing. Refer to Figure 1 for a geographical representation of Terengganu.

Figure 1: Map of Kuala Nerus and Kuala Terengganu

Moreover, the framework of the study encompasses the identification of gaps in the research, establishing the study's objective, which is to scrutinise the pattern of water usage, household behaviour, and perceptions of water usage, as well as identifying the determinants of water usage, particularly from socioeconomic variables. This study used both descriptive, correlation analysis and multiple regression analysis to investigate the association between household water consumption behavior, socioeconomic characteristics, and perceptions of water services. The methodology is divided into two major stages: an initial descriptive and correlation analysis and followed by a more in-depth multiple regression analysis. Subsequent sections include the findings and discourse, culminating in the conclusion and policy implications.

3.2 Data Collection And Analysis

Face to face with the head of households who aged between 18 to 65 years old have been conducted from December 2021 to February 2022 in two districts in Terengganu: Kuala Terengganu and Kuala Nerus. In total, only 271 respondents have chosen for further analysis to achieve the objectives of this study. In addition, descriptive analysis was used to examine the correlation with indoor and outdoor activities and socioeconomics as well as the water service perception. It followed with multiple regression to determine the significant of socioeconomics variable by using the following model:

$$WS\ i = \beta 0 + \beta 1 quality\ i + \beta 2 odour\ i + \beta 3 taste\ i + \beta 4 pressure\ i + \varepsilon\ i \quad (1)$$

Where, "i" represents the individuals (with i ranging from 1 to N). The variable "WS i" denotes water service, β1quality represents water quality, β2odour represents water odour, β3taste represents water taste, β4pressure represents water pressure, and ε i represents the error term.

$$WU\ i = \beta 0 + \beta 1 gen\ i + \beta 2 age\ i + \beta 3 edu\ i + \beta 4 house\ i + \beta 5\ size\ HH\ i + \beta 6\ child + \beta 7\ status + \varepsilon\ i \quad (2)$$

Here, "i" represents the individuals (with i ranging from 1 to N). The variable "WU i" denotes water usage, β1gen represents gender, β2age represents age of household, β3edu represents education level, β4work represents work of household, β5 house represents type of house, β6 size HH represents size of households, β7child represents number of children, β8 status represents status of households and ε i represents the error term.

4. Results And Discussion

4.1 Descriptive Analysis

The following text presents the results of a study on the water resources and patterns of water usage by households in Terengganu. Descriptive analysis, known for its comprehensive nature, offers a more in-depth understanding of events or phenomena compared to other quantitative methods. This type of analysis can encompass various variables, even a single one, and is considered a superior method for gathering information as it portrays relationships in a natural manner, reflecting the world as it is. Consequently, this form of analysis is deeply connected to humanity, as the trends it reveals are based on real-life behavioural data.

The study revealed that the primary water resource for most households in Terengganu is the water tap, accounting for approximately 83.4% of households. This is followed by a combination of water tap and well as sources for daily water activities at home. Additionally, it was found that most households partake in bathing three times daily, with shower being the main bathing appliance (75.6%) and the average bathing time ranging from 10-20 minutes (39.9%), with a secondary portion of households bathing for less than 10 minutes (31.7%).

Furthermore, the study found that households typically engage in daily laundry activities, with 31% doing laundry every day and 25.8% conducting it once a week. The average number of taps per household ranges from 1 to 4 units. Notably, the majority of households reported no experience with pipe bursts or leakages at home, while 82.6% and 57.6% of households reported poor water quality and lack of water tank maintenance, respectively.

Table 2: Water Resource and Pattern of Water Usage in Terengganu

Items	Total (n=271)	
	Frequency	%
Main water resource at home		
Water Tap	226	83.4
Sharing Water Tap	2	0.7
Water Tap and Well	37	13.7
Water Tap and Rainwater	4	1.5
Well and Rainwater	2	0.7
Others	-	-
I take bath daily		
One time	28	10.3
Two times	90	33.2
Three times	151	55.7
One time a week	2	0.7
Others	-	-
Main appliance for bathing		
Shower	205	75.6
Waterhead	42	15.5
Bucket	24	8.9
Others	-	-
Time for bathing		
Less than 10 minutes	86	31.7
10-20 minutes	108	39.9
20-30 minutes	66	24.4
40-60 minutes	6	2.2
More than 60 minutes	5	1.8
Time for laundry		
Everyday	84	31.0
One time a week	70	25.8
Two times a week	51	18.8
Three times a week	63	23.2
Others	3	1.1
Number of taps at home		
One tap	95	35.1
Two Taps	68	25.1
There Taps	50	18.5
More than four taps	58	21.4
Pipe burst or leakages at home		
Yes	47	17.3
No	224	82.6
Water taps in bad quality of color		
One time a month	62	22.9
Two times a month	53	19.6
No	156	57.6
Maintenance the taps, water tank if necessary		
Yes	86	31.7
No	185	68.2

The data presented in Table 3 illustrates the water usage patterns and perceptions of households. The majority of households employ buckets (49.4%) and water tanks (34.3%) to conserve water during disruptions, which typically last a few hours (54.6%). Notably, 88.1% of households do not actively practice water conservation at home. During normal seasons, 39.5% of households experience rain for 2 days, while 50.6% report a slight increase and 35.4% report a decrease in water usage. Interestingly, water usage differs between low temperature and rainy seasons, with a decrease of 43.9%, and hot and drought seasons, with an increase of 59.8%.

Furthermore, 88.2% of households are billed less than RM40 monthly for water usage, which is considered acceptable and competitive compared to other utilities. Most households are willing to pay the water operator less than RM1.20 for water service improvements (76%) and are aware of water conservation programmes, expressing willingness to participate in related activities. Additionally, 68.3% of households are open to joining subsidised programmes for water service upgrades with a willingness to pay less than RM1.20.

Table 3: Households Behavior and Perception of Water Usage in Terengganu

Items	Total (n=271)	
	Frequency	%
Water saving during water disruption		
Bucket	134	49.4
Water Tank	93	34.3
Jar	28	10.3
Urn	16	5.9
Time for water disruption		
A few minutes	37	13.7
A few hours	148	54.6
A few days	77	28.4
Others	9	3.3
Practices of water conservation at home		
Yes	32	11.8
No	239	88.1
Number of raining day		
One day	62	22.9
Two days	107	39.5
Three days	67	24.7
Four days	19	7.0
More than 4 days	16	5.9
Impact of water usage during raining day		
Increase	137	50.6
Decreased	96	35.4
Unchanged	38	14.0
Water usage if increasing number of raining days in a week		
Increased	101	37.3
Decreased	122	45.0
Unchanged	48	17.7
Water usage if low temperature particularly in night dan raining season		
Increased	108	39.9
Decreased	119	43.9
Unchanged	44	16.2
Water usage if high temperature particularly in hot season dan drought season		
Increased	162	59.8
Decreased	58	21.4
Unchanged	51	18.8
Knowing the water tariff charge for each m^3		
Yes	150	55.4
No	121	44.6
Monthly water bill		
Less than RM20	123	45.4
RM21-RM40	116	42.8
RM41-RM80	29	10.7
More than RM80	3	1.1
Opinion on current water tariff		
Expensive	66	24.4
Normal	204	75.3
Cheaper	1	0.4
Opinion on current water tariff compare other utilities such as electricity and telecommunication		
Expensive	45	16.6
Normal	224	82.7
Cheaper	2	0.7
Impact of water usage if water tariff increased than normal rate		
Expensive	92	33.9
Normal	135	49.8
Cheaper	44	16.2

Table 3(Cont.): Households Behavior and Perception of Water Usage in Terengganu		
Assist for paying water bill if water operator provides rebate or discount, for instance 20% of water bill		
Yes	237	87.5
No	32	11.8
	2	0.7
Willing to pay if water operator would like to improve water services such as improve the water quality and water pressure		
Yes	253	93.4
No	18	6.6
Maximum price willing to pay		
Less than RM1	123	45.4
RM1.20	83	30.6
RM1.60	42	15.5
RM2.00	21	7.7
RM2.20	1	0.4
RM2.60	1	0.4
More than RM3	-	-
Knowing on campaign or water conservation program		
Yes	227	83.8
No	44	16.20
Join the campaign or water conservation program		
Yes	235	86.7
No	36	13.2
Join the subsidize program for upgrading the water service		
Yes	261	96.3
No	10	3.7
Maximum willingness to pay for joining the program		
Less than RM1	108	39.9
RM1.20	77	28.4
RM1.60	41	15.1
RM2.00	37	13.7
RM2.20	5	1.8
RM2.60	3	1.1
More than RM3	-	-

The perceptions of households regarding water services, encompassing water quality, odour, taste, and pressure, are detailed in Table 4. This analysis employed a 5-point Likert scale, comprising "strongly poor," "poor," "not sure," "good," and "excellent." The findings indicate that a majority of households, on average, perceived water services favourably, with 72% rating water quality positively, 69.4% for water odour, 64.6% for water taste, and 69.4% for water pressure. The mean ratings for water services range from 4.04 to 4.08, reflecting a notably positive assessment.

Table 4: Perception on Water Service

	Strongly Poor	**Poor**	**Not Sure**	**Good**	**Excellent**	**Mean**	**Standard Deviation**
Water Quality	2 (0.7%)	2 (0.7%)	20 (7.4%)	195 (72%)	52 (19.2%)	4.08	0.59
Water Odour	2 (0.7%)	7 (2.6%)	21 (7.7%)	188 (69.4%)	53 (19.6%)	4.04	0.66
Water Taste	2 (0.7%)	2 (0.7%)	31 (11.4%)	175 (64.6%)	61 (22.5%)	4.07	0.65
Water Pressure	2 (0.7%)	5 (1.8%)	22 (8.1%)	188 (69.4%)	54 (19.9%)	4.05	0.64

4.2 Correlation Analysis

The study employed Pearson correlation analysis to assess the influence of demographic variables on water consumption behaviours, including showering, cooking, toilet flushing, laundry, and dishwasher usage. This method is valuable for determining the strength and direction of associations between two continuous or ordinal variables.

4.3 Correlation Between Indoor And Demographic Variables

Indoor activities encompass bathing, laundry, dishwasher usage, drinking, maintaining an aquarium, pet care, and bathroom cleaning. The relationship between indoor activities and socioeconomic factors is detailed in Table 5, revealing a positive correlation among the activities. Strong correlations were observed between laundry and bathing, dishwasher and laundry, cooking and dishwasher, drinking and cooking, flushing and laundry, and flushing and dishwasher, with approximate correlation coefficients of 0.743, 0.691, 0.706, 0.700, 0.704, 0.527, and 0.501, respectively. Additionally, pet care and drinking, as well as cleaning and flushing, exhibited estimated correlations of 0.835, 0.693, and 0.711, respectively. Other activities demonstrated moderate correlations, with estimates of 0.489 and 0.338

Conversely, indoor activities such as maintaining an aquarium, pet care, flushing, and bathroom cleaning displayed negative correlation coefficients. The Pearson correlation coefficients with the level of education were low, with estimates of 0.170 and 0.242. Similar studies have also been conducted (Beal et al., 2013; Chang et al., 2016; Dean et al., 2016; Arbués et al., 2016). It has been observed that households with higher levels of education are more inclined to conserve water (Gilg and Barr, 2006; Lam, 1999). However, knowledge does not always translate into action, as some studies have found that higher education levels are associated with increased water usage (De Oliver, 1999; Gregory and Di Leo, 2003; Oyerinde and Jacobs, 2022; Abdulaziz I. Almulhim and Ismaila Rimi Abubakar, 2024).

Furthermore, the type of house exhibited low correlation with cooking and drinking, while the status had a low correlation with dishwasher usage. The number of children showed a correlation with maintaining an aquarium, and the status had a correlation with dishwashers. This is consistent with the findings, who noted that unmarried individuals had a higher mean water usage in daily activities compared to married individuals of (Rachmat et al., 2024). Another study also found that gender has a significant influence on water-saving habits by (Johanna Magaly Alvarado Espejo et al., 2021).

4.4 Correlation Between Outdoor And Demographic Variables

The following activities are considered indoor activities: cleaning, watering the garden, washing the car or motorbike, engaging in business activities, maintaining the landscape, fishing, pet care, and pool maintenance. The relationship between outdoor activities and socioeconomics is detailed in Table 6.

Table 5: Correlation Between Indoor Activities and Socioeconomics

		Bathing	Laundry	Dishwasher	Cooking	Drinking	Aquarium	Pet	Flushing	Cleaning	Edu	House	Child	Status
Bathing	Pearson Correlation	1	**.743****	**.691****	**.482****	**.347****	**.377****	**.416****	**.481****	**.446****	-.032	.039	.057	-.069
	Sig. (2-tailed)		**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	.602	.520	.346	.258
Laundry	Pearson Correlation	.743**	1	**.706****	**.489****	**.338****	**.429****	**.469****	**.501****	**.450****	-.081	.043	.058	-.116
	Sig. (2-tailed)	<.001		**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	.186	.481	.339	.057
Dishwasher	Pearson Correlation	.691**	.706**	1	**.700****	**.430****	**.397****	**.458****	**.527****	**.453****	-.048	.015	.016	**-.126***
	Sig. (2-tailed)	<.001	<.001		**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	.433	.803	.788	**.038**
Cooking	Pearson Correlation	.482**	.489**	.700**	1	**.704****	**.462****	**.411****	**.438****	**.364****	-.020	**-.153***	.038	-.029
	Sig. (2-tailed)	<.001	<.001	<.001		**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	.745	**.011**	.532	.631
Drinking	Pearson Correlation	.347**	.338**	.430**	.704**	1	**.308****	**.153***	**.219****	.133*	.066	**-.206****	.014	.040
	Sig. (2-tailed)	<.001	<.001	<.001	<.001		**<.001**	**.012**	**<.001**	.029	.276	**<.001**	.824	.508
Aquarium	Pearson Correlation	.377**	.429**	.397**	.462**	.308**	1	**.835****	**.577****	**.556****	**-.188****	-.022	**.151***	.032
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001		**<.001**	**<.001**	**<.001**	**.002**	.721	**.013**	.598
Pet	Pearson Correlation	.416**	.469**	.458**	.411**	.153*	.835**	1	**.711****	**.693****	**-.242****	.040	.058	-.020
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	.012	<.001		**<.001**	**<.001**	**<.001**	.511	.343	.738
Flushing	Pearson Correlation	.481**	.501**	.527**	.438**	.219**	.577**	.711**	1	**.835****	**-.202****	.050	.011	-.020
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001		**<.001**	**<.001**	.410	.855	.746
Cleaning	Pearson Correlation	.446**	.450**	.453**	.364**	.133*	.556**	.693**	.835**	1	**-.170****	.008	-.047	-.038
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	.029	<.001	<.001	<.001		**.005**	.899	.439	.538

Table 5(Cont.): Correlation Between Indoor Activities and Socioeconomics													
Gen	Pearson Correlation	.022	.052	-.009	-.039	.027	-.043	-.054	-.036	-.082	.034	.089	-.047	-.037
	Sig. (2-tailed)	.725	.398	.887	.521	.655	.482	.377	.560	.180	.580	.145	.443	.542
Age	Pearson Correlation	-.011	-.047	-.112	.040	.103	.101	.070	.028	-.018	-.116	-.033	**.338****	**.443****
	Sig. (2-tailed)	.863	.439	.066	.507	.091	.097	.253	.644	.772	.056	.594	**<.001**	**<.001**
Edu	Pearson Correlation	-.032	-.081	-.048	-.020	.066	-.188**	-.242**	-.202**	-.170**	1	-.040	.024	-.031
	Sig. (2-tailed)	.602	.186	.433	.745	.276	.002	<.001	<.001	.005		.509	.694	.613
Work	Pearson Correlation	.017	.080	.037	-.050	-.036	-.054	-.006	-.029	-.038	-.136*	.021	.042	-.183**
	Sig. (2-tailed)	.785	.187	.546	.415	.558	.372	.927	.634	.531	.025	.728	.492	.003
Inc	Pearson Correlation	.054	-.028	-.064	-.035	.017	-.081	-.116	-.038	-.070	.350**	-.091	.024	.072
	Sig. (2-tailed)	.378	.642	.295	.567	.784	.185	.058	.528	.249	<.001	.137	.691	.240
House	Pearson Correlation	.039	.043	.015	-.153*	-.206**	-.022	.040	.050	.008	-.040	1	.002	-.048
	Sig. (2-tailed)	.520	.481	.803	.011	<.001	.721	.511	.410	.899	.509		.979	.435
Size HH	Pearson Correlation	.118	.102	.048	.028	.032	.119	.075	.085	.024	.175**	.109	**.518****	-.025
	Sig. (2-tailed)	.052	.094	.436	.650	.606	.050	.217	.165	.697	.004	.073	**<.001**	.681
Child	Pearson Correlation	.057	.058	.016	.038	.014	.151*	.058	.011	-.047	.024	.002	1	.103
	Sig. (2-tailed)	.346	.339	.788	.532	.824	.013	.343	.855	.439	.694	.979		.090
Status	Pearson Correlation	-.069	-.116	-.126*	-.029	.040	.032	-.020	-.020	-.038	-.031	-.048	.103	1
	Sig. (2-tailed)	.258	.057	.038	.631	.508	.598	.738	.746	.538	.613	.435	.090	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed)

Table 6: Correlation Between Outdoors Activities and Socioeconomics											
		Cleaning	Watering	Car wash	Business	Landscaping	Fishing	Pool	Gen	Edu	Inc
Cleaning	Pearson Correlation	1	**.793****	**.713****	**.711****	**.735****	**.729****	**.736****	-.074	**-.177****	**-.139***
	Sig. (2-tailed)		**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	.224	**.003**	**.022**
Watering	Pearson Correlation	.793**	1	**.733****	**.703****	**.678****	**.645****	**.628****	-.011	**-.129***	**-.131***
	Sig. (2-tailed)	<.001		**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	.858	**.034**	**.032**

Table 6(Cont.): Correlation Between Outdoors Activities and Socioeconomics											
Car Wash	Pearson Correlation	.713**	.733**	1	**.772****	**.706****	**.646****	**.628****	-.002	**-.176****	**-.150***
	Sig. (2-tailed)	<.001	<.001		**<.001**	**<.001**	**<.001**	**<.001**	.979	**.004**	**.014**
Business	Pearson Correlation	.711**	.703**	.772**	1	**.916****	**.831****	**.826****	-.057	**-.229****	-.109
	Sig. (2-tailed)	<.001	<.001	<.001		**<.001**	**<.001**	**<.001**	.346	**<.001**	.073
Landscape	Pearson Correlation	.735**	.678**	.706**	.916**	1	**.872****	**.848****	**-.046**	**-.213****	-.092
	Sig. (2-tailed)	<.001	<.001	<.001	<.001		**<.001**	**<.001**	**.455**	**<.001**	.131
Fishing	Pearson Correlation	.729**	.645**	.646**	.831**	.872**	1	**.934****	-.065	**-.238****	-.112
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001		**<.001**	.289	**<.001**	.067
Pool	Pearson Correlation	.736**	.628**	.628**	.826**	.848**	.934**	1	-.073	**-.265****	**-.138***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001		.230	**<.001**	**.023**
Gen	Pearson Correlation	-.074	-.011	-.002	-.057	-.046	-.065	-.073	1	.034	.004
	Sig. (2-tailed)	.224	.858	.979	.346	.455	.289	.230		.580	.946
Edu	Pearson Correlation	-.177**	-.129*	-.176**	-.229**	-.213**	-.238**	-.265**	.034	1	.350**
	Sig. (2-tailed)	.003	.034	.004	<.001	<.001	<.001	<.001	.580		<.001
Inc	Pearson Correlation	-.139*	-.131*	-.150*	-.109	-.092	-.112	-.138*	.004	.350**	1
	Sig. (2-tailed)	.022	.032	.014	.073	.131	.067	.023	.946	<.001	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed)

The analysis indicated a negative correlation between gender and landscape maintenance, consistent with the findings of (Johanna Magaly Alvarado Espejo et al., 2021). Research also suggests that men and women exhibit varying levels of environmental awareness and risk perception (Piedra-Muñoz et al., 2018; Attari, 2014; Beal et al., 2013).

Furthermore, the level of education showed a low correlation with cleaning, watering the garden, washing the car or motorbike, engaging in business activities, maintaining the landscape, fishing, and pool maintenance, in line with similar studies (Beal et al., 2013; Chang et al., 2016; Dean et al., 2016; Arbués et al., 2016; Oyerinde and Jacobs, 2022; Abdulaziz I. Almulhim and Ismaila Rimi Abubakar, 2024).

Income was found to have a negative correlation with cleaning, watering the garden, washing the car or motorbike, and pool maintenance. This suggests that households with higher levels of education and income are more likely to practice water usage efficiency in daily activities such as cleaning, gardening, car or motorbike washing, landscape maintenance, fishing, and pool maintenance. These findings align with previous studies that have linked higher income and education to a greater inclination to install water-efficient equipment and increased water use (Fielding et al., 2012; Gregory and Di Leo, 2003). Additionally, total monthly income influences water usage in daily household activities (Paramita Rahayu and Erma Fitria Rini, 2019), and households with higher levels of education are more likely to conserve water (Gilg and Barr, 2006; Lam, 1999). However, it is important to note that knowledge does not always translate into action, as some studies have found that higher education levels are associated with increased water usage (De Oliver, 1999; Gregory and Di Leo, 2003; Bradley 2004; Jansen and Schulz 2006; Nauges and van den Berg 2006; Oyerinde and Jacobs, 2022; Abdulaziz I. Almulhim and Ismaila Rimi Abubakar, 2024).

4.5 Multiple Regression Analysis

4.5.1 Drivers Of Households Perception Towards Water Service And Socioeconomic Variables

The water service element encompasses water quality, odour, taste, and water pressure, all of which are crucial for ensuring the safety and compliance of water in households with the standards set by the Ministry of Health (MOH). Table 7 outlines the perceptions of households regarding water service and its correlation with socioeconomic variables such as gender, age, education, employment, income, housing type, household size, number of children, and status.

Table 7: Perception Towards Water Service and Socioeconomic Variables					
Water Quality and Socioeconomics Variables					
	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta		
(Constant)	3.416	.286		11.948	<.001
Gen	-.066	.076	-.054	-.869	.386
Age	-.012	.038	-.024	-.322	.748
Edu	.170	.077	.149	**2.212**	**.028****
Work	.042	.032	.087	1.316	.189
Inc	.030	.030	.067	.992	.322
House	.024	.026	.056	.900	.369
Size HH	-.081	.055	-.109	-1.458	.146
Child	.049	.066	.056	.742	.459
Status	.130	.089	.100	1.460	.145
Water Odour and Socioeconomics Variables					
(Constant)	3.386	.320		10.567	<.001
Gen	-.056	.085	-.041	-.652	.515
Age	-.016	.043	-.028	-.378	.705
Edu	.152	.086	.119	1.764	**.079***
Work	.031	.036	.058	.865	.388
Inc	.016	.034	.032	.474	.636
House	.012	.029	.025	.406	.685
Size HH	-.063	.062	-.076	-1.010	.314
Child	.126	.073	.131	1.713	**.088***
Status	.104	.100	.072	1.041	.299
Water Taste and Socioeconomics Variables					
(Constant)	3.434	.315		10.917	<.001
Gen	.047	.084	.035	.557	.578
Age	-.019	.042	-.033	-.450	.653
Edu	.158	.084	.126	1.872	**.062***
Work	.033	.035	.063	.948	.344
Inc	-.001	.033	-.002	-.028	.978
House	-.035	.029	-.075	-1.209	.228
Size HH	-.106	.061	-.129	-1.731	**.085***
Child	.105	.072	.111	1.460	.146
Status	.154	.098	.108	1.570	.118|

a. Dependent Variable: Water Quality, Water Odour and Water Taste
Note: * Significant at 0.10%

The findings indicate that water quality is influenced by the level of education. This suggests that different educational groups have varying concerns and perceptions regarding the importance of water quality. Higher educated households exhibit greater concern for water quality due to its impact on their health (Beal et al., 2013; Chang et al., 2016; Dean et al., 2016; Arbués et al., 2016). Furthermore, households with higher levels of education are more inclined to conserve water (Gilg and Barr, 2006; Lam, 1999). However, knowledge does not always translate into action, as some research indicates that higher education is associated with increased water usage (De Oliver, 1999; Gregory and Di Leo, 2003). Additionally, odour is influenced by education level and number of children, while water taste is affected by education and household size (Benito et al., 2019; Oyerinde and Jacobs, 2022; Abdulaziz I. Almulhim, Ismaila Rimi Abubakar, 2024). Family size exerts an even greater external influence (Dupont and Renzetti, 2013; Abdulaziz I. Almulhim and Ismaila Rimi Abubakar, 2024). Surprisingly, there is no discernible relationship between water pressure and socioeconomic variables.

4.6 Determinants Of Water Usage And Socioeconomics Variables

In our analysis, a multiple linear regression was conducted to identify the factors influencing water usage in relation to selected socioeconomic variables, including gender, education, occupation, type of housing, household size, and number of children. The detailed results are presented in Table 8.

Table 8: Water Usage Efficiency and Socioeconomics Variables					
	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta		
(Constant)	41.398	7.757		5.337	<.001
Gen	-.838	2.066	-.025	-.406	.685
Edu	1.016	1.962	.032	.518	.605
Work	-.729	.836	-.056	-.872	.384
House	1.245	.714	.106	1.744	.082*
Size HH	-.362	1.507	-.018	-.240	.810
Child	1.794	1.694	.075	1.059	.290
Status	-8.127	2.215	-.226	-3.669	<.001**

a. Dependent Variable: Monthly Water Bill
Note: * Significant at 0.10%
** Significant at 0.01%

The findings revealed that both type of housing and marital status significantly impact water use efficiency, with p-values of 0.082 and 0.001, and significant levels at 0.01% and 0.1% respectively. This suggests that a 1% increase in type of housing and marital status leads to households displaying greater intent to manage and practice water use efficiency. Marital status has demonstrated notable differences in water-saving behaviours, potentially attributed to varying responsibilities and routines among different marital statuses. For instance, single individuals may exhibit distinct water usage patterns compared to married individuals or those with families, as similarly observed by (Rachmat et al., 2024).

Moreover, the type of housing emerged as a significant factor influencing water usage, consistent with the findings, who noted that size, built-up area, and availability of domestic facilities are all influenced by the housing structure (Jacobs et al., 2013). Additionally, study emphasised the importance of city stakeholders not only focusing on slum areas but also on densely populated urban neighbourhoods, by providing them with alternative on-site water sources (Dungumaro, 2007). Such on-site water alternatives can serve as reliable and cost-effective water sources for these communities (Rahayu, and Erma Fitria Rini, 2019).

Furthermore, marital status has been identified as significantly influencing water-saving behaviours, potentially due to the varying responsibilities associated with different marital statuses. For example, unmarried individuals may exhibit different water usage patterns compared to married individuals or those with families. Chinese respondents were more inclined than individuals of other ethnicities to engage in water conservation behaviours, such as using a washing machine only when it is full. Conversely, unmarried individuals exhibited a higher mean compared to married individuals (Rachmat M et al., 2024; Johanna Magaly Alvarado Espejo et al., 2021).

5. Conclusions And Policy Implication

This study sheds light on household water consumption trends in Terengganu, underlining the importance of socioeconomic factors in driving water use behavior. The descriptive study found that the majority of homes had positive opinions of water services, with high scores for water quality, taste, odor, and pressure. The average rating varied from 4.04 to 4.08, indicating a positive attitude toward water services.

Correlation study revealed that household daily activities were substantially associated with socioeconomic characteristics such as gender, education level, income, household size, number of children, and marital status. These factors influence water consumption patterns and must be considered when developing water demand management methods. Furthermore, multiple regression analysis revealed that education level, household size, and number of children all have a substantial impact on water service quality. These findings highlight the necessity of understanding the socioeconomic causes of water demand.

The findings of this study have important implications for water resource management. Understanding the elements that determine water use can assist water utilities and policymakers in creating focused, successful demand control strategies. Tailored interventions that address specific socioeconomic variables, such as income, education, and household size, will be critical to encouraging water conservation.

For policymakers, these findings highlight the importance of developing customized water-saving initiatives that address the specific demands of various community groups. This can involve instructional efforts, incentives for water-saving technologies, and new water price schemes. Addressing the socioeconomic factors of water demand can allow for more effective water management, a reduction in overall water usage, and long-term sustainability.

Finally, this study emphasizes the need of incorporating socioeconomic insights into water management measures. Policymakers can protect Terengganu's water resources, assure water security for future generations, and promote sustainable water consumption throughout the region.

The descriptive analysis revealed that the majority of households held positive perceptions of water services, with favourable ratings for water quality (72%), water odour (69.4%), water taste (64.6%), and water pressure (69.4%). The mean rating for water services ranged from 4.04 to 4.08, indicating a high level of satisfaction.

Correlation analysis indicated that the daily activities of households are correlated with gender, level of education, income, type of house, number of children, and marital status. Furthermore, the multiple regression analysis demonstrated that water services, including water quality, odour, taste, and pressure, are influenced by the level of education, number of children, and size of households.

Understanding household water consumption patterns is essential for the development of water-related policies, particularly those aimed at managing water demand and reducing household water usage. These findings are of great significance and should aid water utilities in the development of demand management water programmes. Additionally, policymakers in the water sector seek to comprehend the underlying factors that shape household water consumption behaviour. By understanding local residential water consumption patterns, policymakers and managers may be able to formulate more effective water-saving strategies. In essence, studying water usage trends equips policymakers and managers with a valuable tool for evaluating planning and environmental strategies. Likewise, water operators must grasp customer attitudes and perspectives on water usage and the sustainability of water for future generations.

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