# PENANG WATER USE BEHAVIOURAL SURVEY

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Abstract

The study aims to provide insight into treated water utilization among residents of Penang for their daily consumption. It also aims to study the behavioural usage of water in order to identify effective methods to reduce water consumption in households and engage Penangites to improve water usage behaviour and create a water resilient society, while providing the state government and related agencies with scientific findings to form a basis for making informed decisions. A total of 669 respondents were involved in the study, which covers all five districts of Penang. The study presents demographic information on age, gender, ethnicities, occupation, type of housing, education level, number of household members and families, and provides additional references for future use.

Respondents were assessed on the amount and types of water fittings installed in the house, including traditional fittings and water-friendly devices. The questionnaire also covers the current usage of automatic devices and fittings such as washing-machines, dishwashers, water flushes, automatic taps and pressure control valves in their house. In addition, respondents were asked about the availability of existing alternative water sources near them and current use by the respondents. This provides some insights on the potential of utilizing such sources in the future.

Quantity and quality are of utmost importance in water sources. This survey found that the majority of respondents rated it from average to good in terms of overall perception on the treated water supplied to them. The respondents were also asked on the frequency of experiencing water cuts and the result shows that one third of them have not experienced it in a year and another one third only experienced it once a year. These results indicate that PBAPP have provided a good service regardless of the notion that Penang is a water-stressed state.

This study also evaluates the respondent's knowledge and opinions regarding water management in Penang. Majority of respondents believed that the state government is the responsible body for the supply of treated water in Penang instead of the PBAPP and the same view is also extended in regards of solving problems that is related to supply of treated water in Penang. In terms of water tariffs, most respondents believe that government should subsidise not more than 60%. However, the average domestic user only pays RM0.32 per 1,000 litres of water they use in Penang (for the first 35,000 litres). As such, Penangites enjoy a water subsidy of RM1.99 per 1,000 litres of water. This is 86.1 % of the cost of treating water.

In assessing respondents' awareness of water related problems, results show that over-consumption was cited as the main issue followed by low water pressure and pipe burst among others. Meanwhile, education and awareness on water in Penang should be further expanded, as 44% of the respondents are still unaware of the main water source in Penang. On the other hand, half do acknowledge that Penang is likely to face water shortages in the future. The survey also assesses respondents' practices in using treated water in their daily life from duration and frequency of showering, water re-use practices, fixing leakages, gardening practices, car-washing and kitchen water usage.

Public willingness to pay for water tariffs was also assessed. The majority agreed that it would be affordable if it is below RM50 per payment for a family. In terms of installing water saving equipment, the majority are willing to spend RM500 and below in order to reduce water consumption. In a question assessing public willingness for a tariff review, 36.8% disagreed on reviewing the tariff. However, for those who agreed with revising the tariff, the majority chose a water tariff that is revised up to 50 % at cost, with government subsidising the other 50 %.

The study also aimed to determine whether there is any association between demographic profiles and practices of water usage among the respondents using Chi-square analysis. Unfortunately, no significant association was recorded between the demographic profiles and the water usage behaviour among Penangites.

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1   Introduction

The United Nations has warned the global community that there is nothing more essential to life on earth than water, and recognizes the importance of addressing the global water crisis. Without clean, potable, and affordable water, families and communities are locked in poverty for generations, as children drop out of school and parents struggle to make a living, severely hampering national development and progress. Many countries across the world are increasingly affected by the water crisis, as achieving water security becomes more and more difficult. Although many critics blame climate change and natural conditions for their poor water security situations, it is increasingly clear that humans are the main cause of water insecurity. Why else do countries that are well endowed with abundant water resources, with some of the best water technologies and expertise, still suffer from water problems? Increasingly, water security has been shown to be largely determined by human population as population size (quantity) puts a huge stress on the water system through excessive water demands, water wastage, water pollution and other anthropogenic activities. As consumers hold the key to water security, nations can no longer solely rely on a top-down government approach to water supply management. Water consumers at all levels, including businesses, must be engaged in water management, especially water demand management. In many countries such as Singapore, Denmark, Egypt and Australia, water consumers play a vital role in reducing per capita water use. There is no doubt that the quality of the population in terms of the level of education, environmental awareness and commitment can determine the water security of a country. Hence, this study/survey focuses on "Engaging water consumers towards enhancing water security focusing on perception of water consumers, the role of consumers, water practices, water demand management (water savings), and commitment towards water conservation in Penang State, Malaysia."

There are good reasons why Penang needs to engage the public, especially water consumers in ensuring the sustainability of water resources. Penang State is the second smallest state in Malaysia, but it is one of the country's most advanced industrialized states with a world class port, and is a world-renowned tourism destination. All these need sustainable water resources to support. So far, Penang has managed its water resources well with the Perbadanan Bekalan Air Pulau Pinang (PBA), one of the best water service providers in the country. However, Penang has very little water resources. In fact, it is often considered a "water-stressed" and even "water-poor" state. Most forested water catchments in the state have been developed, leaving Penang heavily dependent on one major source of water, the Muda River, which is shared with Kedah State. In recent decades, there have been various disputes between Kedah and Penang over the Muda River's water resources, which until today have remained unresolved. With competition over this river's water resources, Penang is looking towards alternative water sources, such as desalination and water from the Perak River. Complementing these alternative sources, there is the option of managing its water demands. This required the engagement of all water consumers in the state to come on board. Hence, this study and survey is aimed at finding out the perception of Penangites over water

resources, their awareness of water and its importance, and their commitment towards paying more for water. The survey also aims at finding out the water practices of Penangites in order to ascertain whether such practices are water saving or water wasting. The results of this survey can then be used as information to guide the Penang State government in making informed decisions on water tariffs, water projects, desalination, and other plans.

At this moment, issues such as public awareness and perception of water, water use practices, water saving devices, and public commitment towards paying more for water remain largely unclear. As there are many gaps in the area of understanding the human dimensions of water security, the fundamental questions of how human perceive water, value water, use water, save water and are willing to commit resources and collaborate with others need to be studied.

A study to understand current situation is important to gain detailed insights on how society in Penang utilized their treated water in daily consumption is thus deemed vital. The study will provide a baseline reference for future planning and decision-making process. It also aims to study the behavioural usage of water in order to identify effective method to reduce water consumption in household and engage Penangites to improve water usage behaviour and create a water resilient society while at the same time provide related State Government and related agencies with scientific finding to for better understanding in order to make informed decisions.

2 Methodology

The study will represent Penang residents. As such, 400 respondents are needed to reach a 95% confidence level with a margin of error of 5%. A total of 669 respondents throughout Penang State completed the questionnaire. The survey assesses the pattern and behaviour of respondents while also identifying significant factors that might contribute and affect their ways water consumption pattern.

The responses were collected both through the online platform Google Form and hard copy forms distributed to the public. Both forms we provided in English and Malay Languages.

3 Results and Discussion

3.1 General Characteristics of Respondents

All five districts in Penang State were sampled as shown in Table 1 and Figure 1, with the North-east District (Timur Laut) having the highest number of respondents. In terms of urban, sub-urban and rural representation, the ratio is roughly about 6:2:2, respectively (Table 2 and Figure 2). In terms of ethnicity, more than half were Malay, with 40 % Chinese and 7 % Indians, followed by other ethnicities and foreigners (Table 3 and Figure 3).
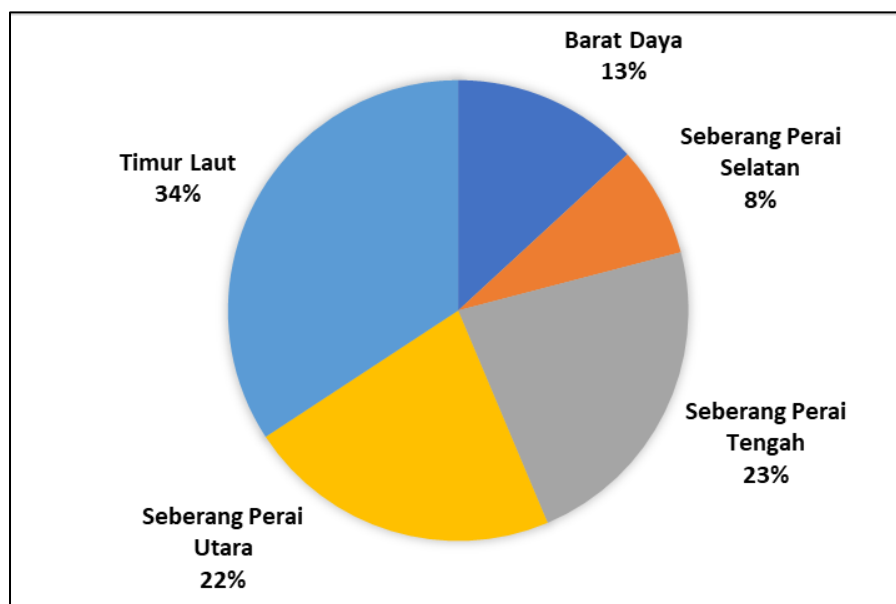
Figure 1 Percentage by District

Table 1 Respondents by District.

District	Frequency	Percent	Cumulative Percent
Barat Daya	88	13.2	13.2
Seberang Perai Selatan	52	7.8	20.9
Seberang Perai Tengah	152	22.7	43.6
Seberang Perai Utara	148	22.1	65.8
Timur Laut	229	34.2	100.0
Total	669	100.0	
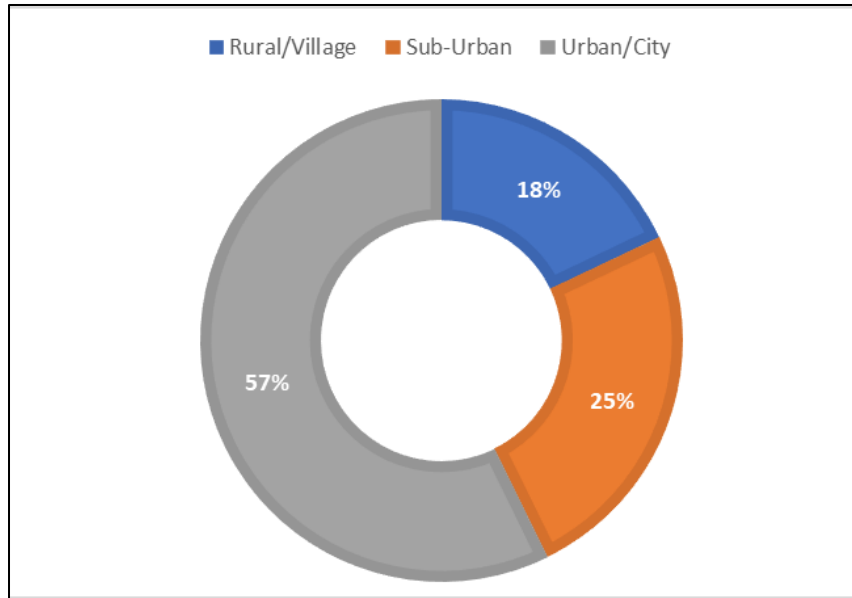
Figure 2 Percentage by Location

Table 2 Respondents by Location

Location	Frequency	Percent	Cumulative Percent
Rural/Village	120	17.9	20.4
Sub-Urban	166	24.8	42.8
Urban/City	383	57.2	100.0
Total	669	100.0	
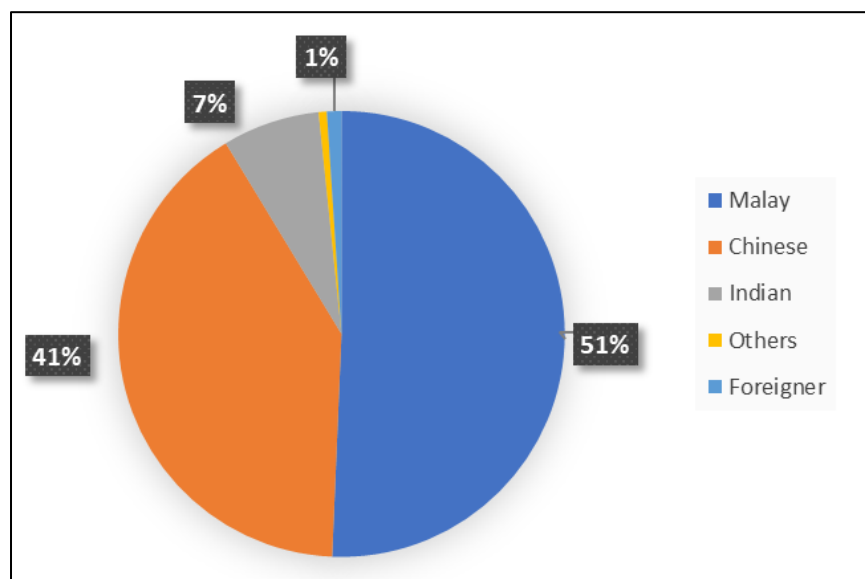
Figure 3 Percentage of Ethnicities/Races.

Table 3 Ethnicity/Race of Respondents.

	Frequency	Percent	Cumulative Percent
Malay	339	50.7	50.7
Chinese	272	40.7	91.4
Indian	47	7.0	98.4
Others	4	0.6	99.0
Foreigner	7	1.0	100.0
Total	669	100	

Table 4 shows that males slightly outnumbered females, with the respective percentages in Figure 4. In terms of age, Table 5 and Figure 5 show that more than half of respondents were aged between 21 to 40 years. Nevertheless, the various age groups were well represented. Married respondents were the majority, making up 62 % of all respondents, followed by single respondents and divorced respondents, respectively (Table 6 and Figure 6). Table 7 and Figure 7 indicate that more than half of respondents were Muslims, followed by Buddhists (a third of respondents), then by Christians and Hindus. In terms of educational level, more than half of the respondents had completed tertiary education (diploma/degree), followed by secondary education and post-graduates (Table 8 and Figure 8). Table 9 and Figure 9 show the various occupation groups of the respondents. Table 10 shows that the number of household members varied greatly, from 1 member to more than 10 members. Table 11 shows the number of families in each household. Most households have only 1 family. These were mostly single-family households. Interestingly, there were several households with 5 families or more, possible from extended families.

Table 4 Respondent by Gender

	Frequency	Percent	Cumulative Percent
Female	390	58.3	58.3
Male	279	41.7	100.0
Total	669	100.0	
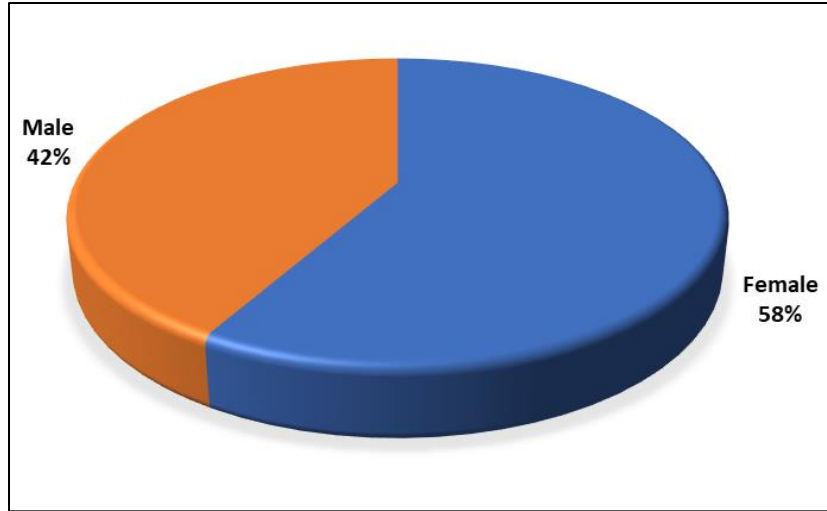
Figure 4 Percentage by Gender

Table 5 Age of Respondents

	Frequency	Percent	Cumulative Percent
20 & below	45	6.7	6.7
21 - 40	380	56.8	63.5
41 - 60	211	31.5	95.1
61 & above	33	4.9	100
Total	669	100	
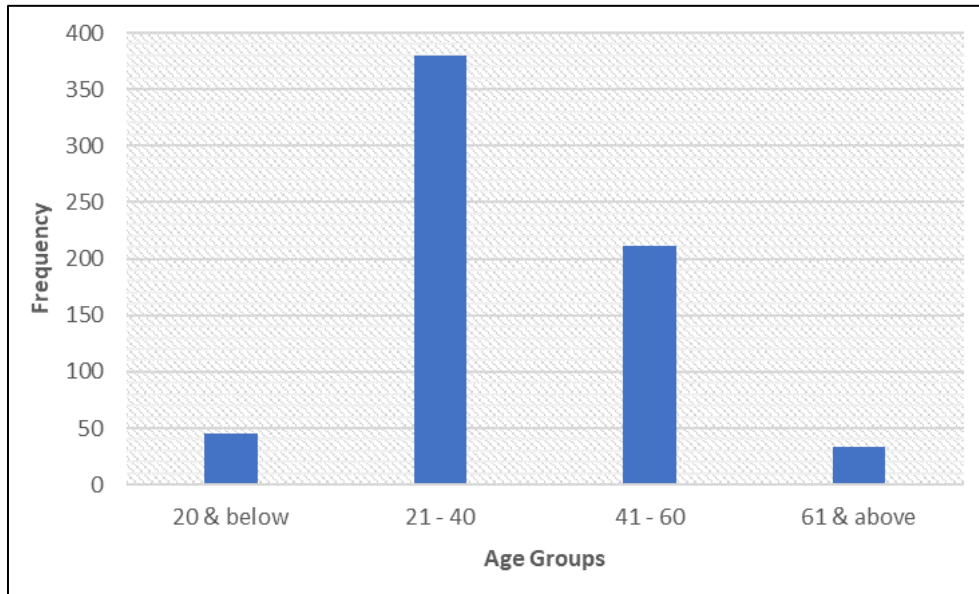
Figure 5 Percentage of Age Groups

Table 6 Respondents by Marital Status

	Frequency	Percent	Cumulative Percent
Divorced	25	3.7	3.7
Married	415	62.0	65.8
Single	229	34.2	100.0
Total	669	100.0	
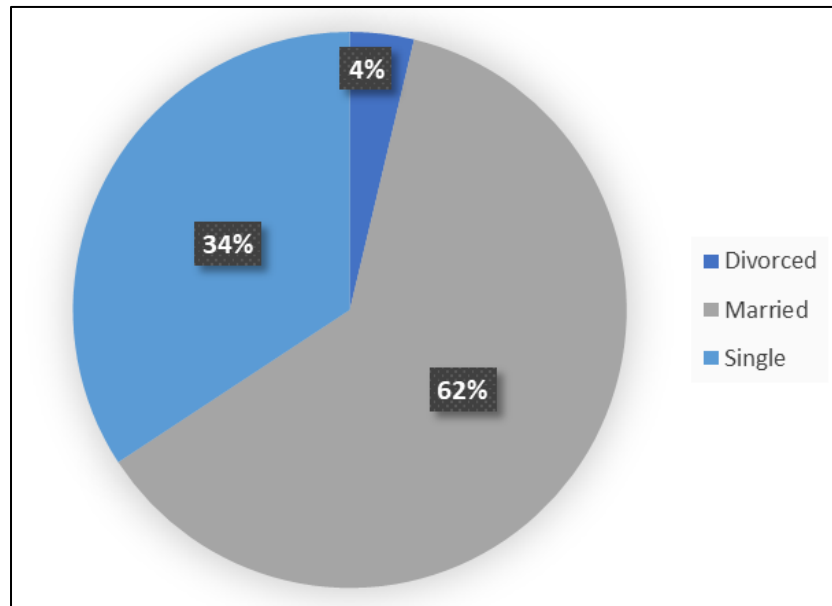
Figure 6 Percentage of Marital Status.

Table 7 Respondents by Religion

	Frequency	Percent	Cumulative Percent
Muslim	342	51.1	51.1
Buddhist	216	32.3	83.4
Christian	60	9.0	92.4
Hindu	42	6.3	98.7
Free Thinker	9	1.3	100.0
Total	669	100.0	
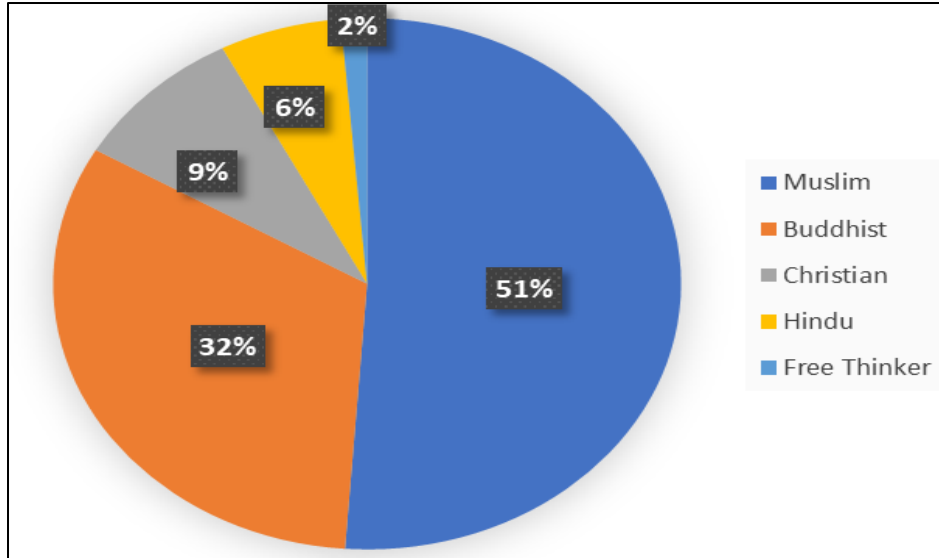
Figure 7 Percentage of Religions

Table 8 Respondents by Education Level

	Frequency	Percent	Cumulative Percent
Postgraduate (Msc/PHD)	81	12.1	12.1
Tertiary (Diploma/Degree)	383	57.2	69.3
Secondary	181	27.1	96.4
Primary	24	3.6	100.0
Total	669	100.0	
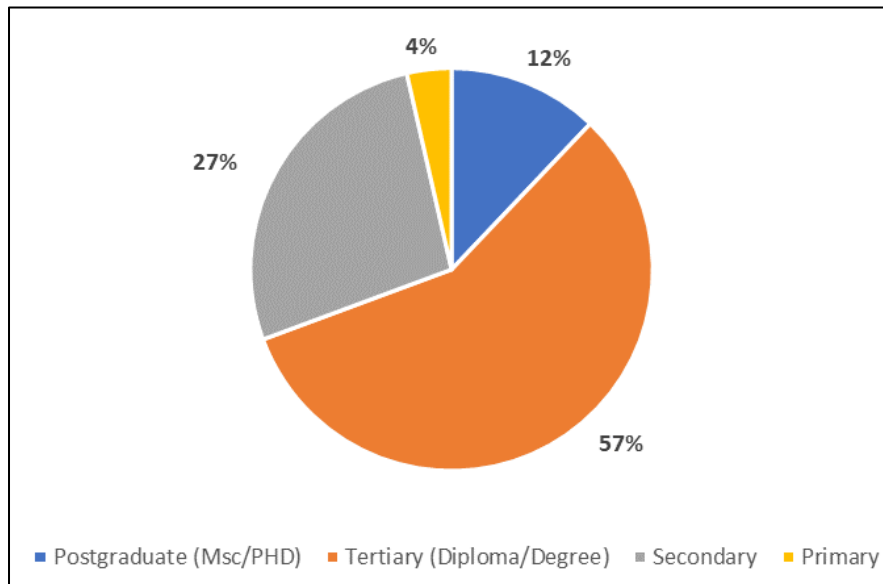
Figure 8 Percentage of Education Levels

Table 9 Respondents by Occupation Group

	Frequency	Percent	Cumulative Percent
Civil Worker	281	42.0	42.0
Professional	201	30.0	72.0
Unemployed	105	15.7	87.7
Others	82	12.3	100.0
Total	669	100.0	
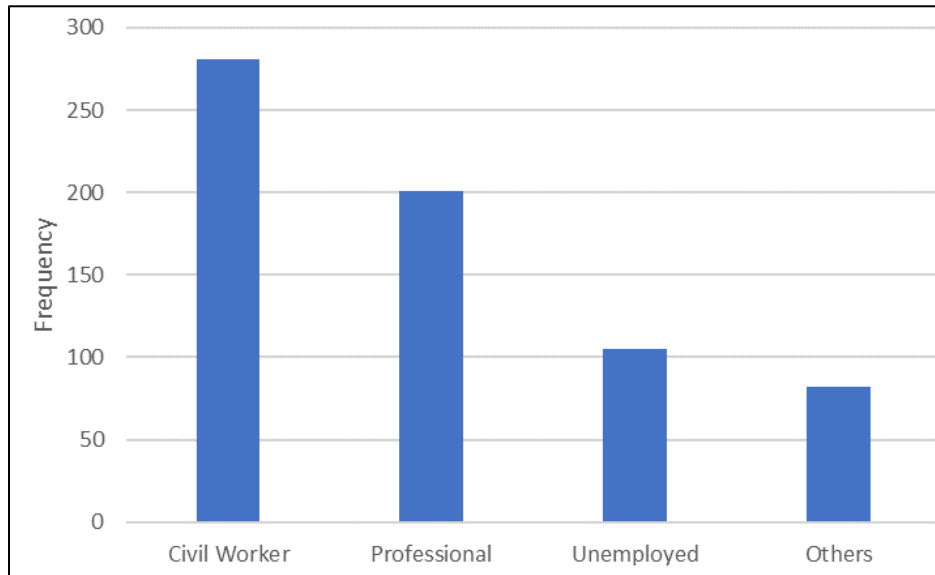
Figure 9 Percentage of Occupation Groups

Table 10 Number of Household Members

	Frequency	Percent	Cumulative Percent
1	37	5.5	5.5
2	86	12.9	18.4
3	144	21.5	39.9
4	148	22.1	62
5	120	17.9	80
6	66	9.9	89.8
7	24	3.6	93.4
8	19	2.8	96.3
10 or more	8	1.2	97.5
Missing Data	17	2.5	100.0
Total	669	100.0	

Table 11 Number of Families in Household

	Frequency	Percent	Cumulative Percent
1	363	54.3	54.3
2	73	10.9	65.2
3	76	11.4	76.5
4	68	10.2	86.7
5	40	6.0	92.7
6	20	3.0	95.7
7 or more	16	2.4	98.1
Missing Data	13	1.9	100.0
Total	669	100.0	

Table 12 and Figure 10 Percentage of Monthly Incomes show that most respondents were from the B40 groups, with monthly household incomes less than RM 4849, followed closely by M40 respondents with monthly incomes between RM 4850 and RM 10,959. Very few respondents were from the T20 group, earning household incomes of more than RM 10,960 per month. Table 13 and Figure 11 show the various house types occupied by the respondents.

Table 12 Monthly Household Income of Respondents.

	Frequency	Percent	Cumulative Percent
B40 (< RM 4849)	324	48.4	48.4
M40 (RM 4850 - RM 10,959)	285	42.6	91.0
T20 (> RM 10,960)	60	9.0	100.0
Total	669	100	
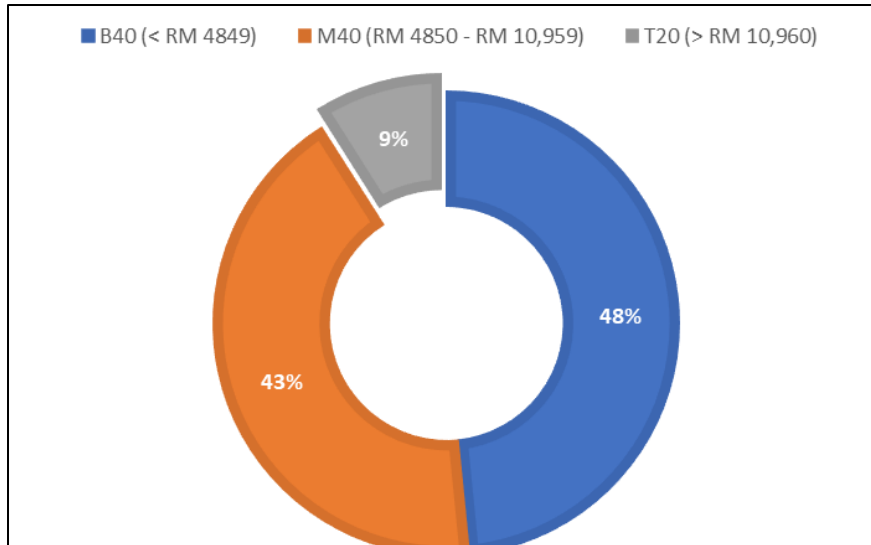
Figure 10 Percentage of Monthly Incomes

Table 13 Respondents by House Type Group

	Frequency	Percent	Cumulative Percent
Bungalow/Single Landed Property	356	53.2	53.2
High Rise	261	39.0	92.2
Village House	43	6.4	98.6
Others	9	1.4	100.0
Total	669	100.0	
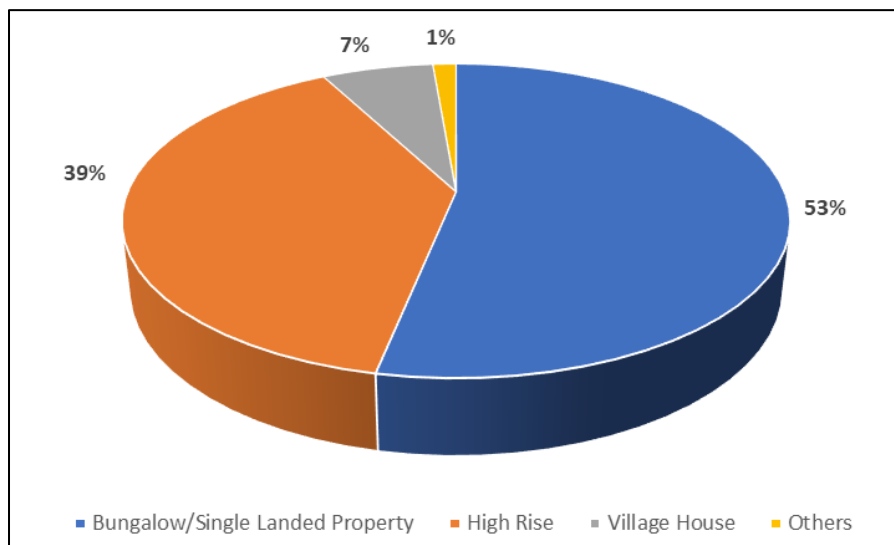
Figure 11 Percentage of House Type Groups

3.2   Water Fittings in Houses of Respondents

Water fittings, specifically the type of water fittings, can determine how water is used and saved. In many countries, the use of certain water saving fittings can save a great amount of water (Ali et al., 2020). In countries such as Singapore, Australia, and Japan, almost all water fittings are "water-friendly", or built to save water. For example, a water-friendly flush system uses only 3 to 4 litres per flush. A dual-flush system also saves a lot of water as a half-flush for urination uses only 2 to 3 litres, compared to the traditional 9 litre flush found in most developing countries. This survey endeavours to find out what sort of water fittings most Penangites use in their houses. The general characteristics of water fittings in the houses of respondents are given in Table 14 to Table 29. Table 14 shows that most respondents have less than 10 manual switches on taps in their houses. Few respondents have more than 10 manual taps. Manual switches on taps are a typical non-water saving fitting. In terms of automatic taps which are water-friendly, Table 15 and Figure 12 indicate that nearly two-thirds of respondents do not have this type of tap. Automatic taps are generally much more expensive than normal taps, and are not popular with private house owners. These automatic taps are usually installed in public toilets or toilets of government offices, factories, or hotels. Only a quarter of respondents reported that they have installed between 1 to 5 automatic taps in their houses. Table 16 shows that most respondents have installed between 1 to 5 normal shower heads in their houses, while Table 17 shows that only a small number of respondents have installed water-friendly shower heads that save water. This is not a good sign, as it indicates that most Penangites are either unaware of such shower heads, or have low awareness of their importance in saving water (Figure 13).

Table 14 Number of manually switch on/switch off water taps in the house

	Frequency	Percent	Cumulative Percent
< 6	368	55.0	55.0
6-10	217	32.4	87.4
11-15	30	4.5	91.9
16-20	10	1.5	93.4
21 & More	22	3.3	96.7
Don't Know	22	3.3	100.0
Total	669	100.0	

Table 15 Number of automatic water taps in the house

	Frequency	Percent	Cumulative Percent
0 (None)	415	62.0	62.0
1-5	175	26.2	88.2
6-10	8	1.2	89.4
11-15	2	0.3	89.7
16-20	1	0.1	89.8
21 & More	1	0.1	90
Don't Know	67	10	100
Total	669	100	
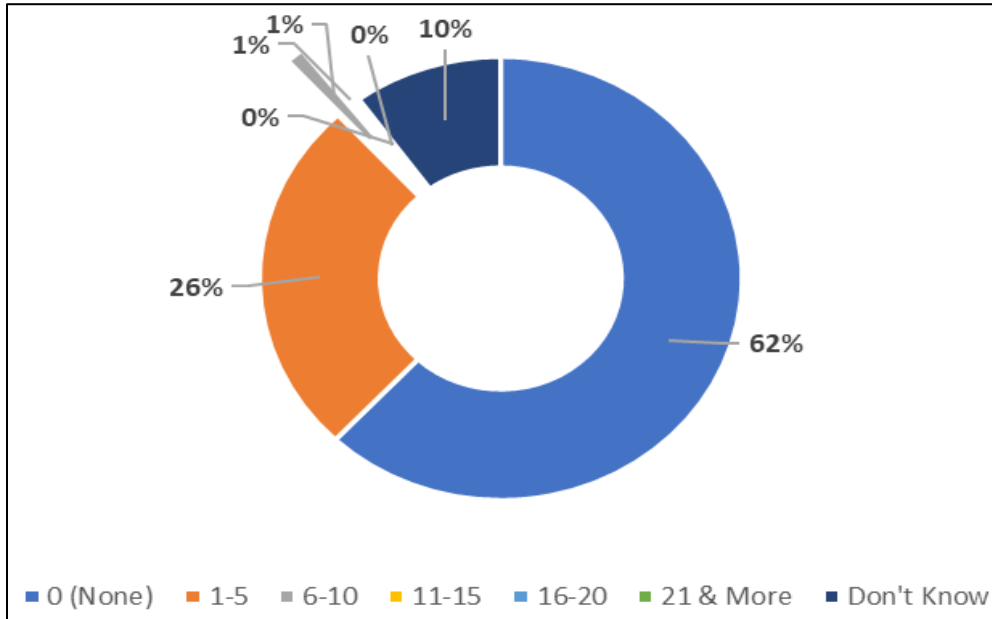
Figure 12 Percentage on numbers of automatic water taps in the house

Table 16 Number of normal shower heads in the house

	Frequency	Percent	Cumulative Percent
0 (None)	27	4	4
1-5 number	612	91.5	95.5
6-10 number	12	1.8	97.3
11-15 number	1	0.1	97.5
16-20 number	1	0.1	97.6
Do not Know	16	2.4	100
Total	669	100	

Table 17 Number of water saving shower heads in the house

	Frequency	Percent	Cumulative Percent
0 (None)	474	70.9	70.9
1-2 number	152	22.7	93.6
3-4 number	32	4.8	98.4
5-6 number	7	1.0	99.4
7-10 number	3	0.4	99.9
11 & More	1	0.1	100
Total	669	100	
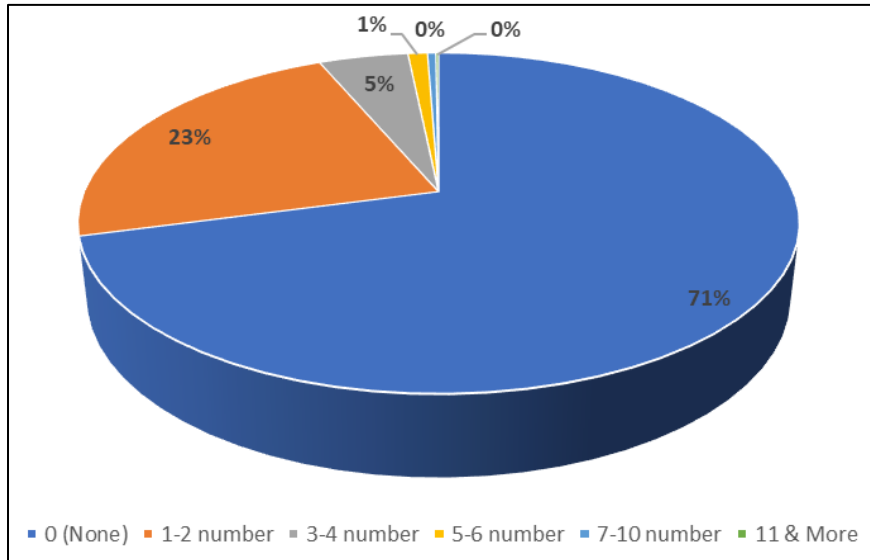
Figure 13 Percentage on numbers of water saving shower heads in the house

Table 18 shows respondents in terms of number of normal/traditional flush toilets (9 liters). Most respondents still have traditional flush systems in their houses. These flush systems are not water-friendly, as each flush uses 9 liters of water. Most developed countries have already done away or replaced such flush systems with water-friendly systems. In Penang, water-friendly flush systems have been made mandatory for new buildings. The Penang State Executive Council had approved Perbadanan Bekalan Air Pulau Pinang Sdn Bhd's (PBAPP's) proposal for the mandatory installation of WSDs on 28/11/2017. A variation of the traditional one button flush system is the dual flush system. The dual-flush cistern uses two buttons or to flush different amounts of water. The purpose of this mechanism is to reduce the volume of water used to flush liquid waste and solid waste. The design takes advantage of the fact that liquid wastes require a lesser amount of water (2 to 3 liters) to flush than solid wastes (5 to 6 liters). The dual-flush system also usually has a more stylish look, but is more expensive. Cost could be one of the reasons why the dual-flush system is not popular with house builders and owners (Table 19 and Figure 14).

Table 18 Total number of normal/traditional flush WC/toilet (9 liters)

	Frequency	Percent	Cumulative Percent
0	121	18.1	18.1
1	193	28.8	46.9
2	207	30.9	77.9
3	93	13.9	91.8
4	29	4.3	96.1
5	12	1.8	97.9
6 & More	14	2.1	100
Total	669	100	

Table 19 Total number of dual flush WC/toilet (9 liters)

	Frequency	Percent	Cumulative Percent
0	414	61.9	61.9
1	100	14.9	76.8
2	88	13.2	90
3	37	5.5	95.5
4	16	2.4	97.9
5 & More	14	2.1	100
Total	669	100	
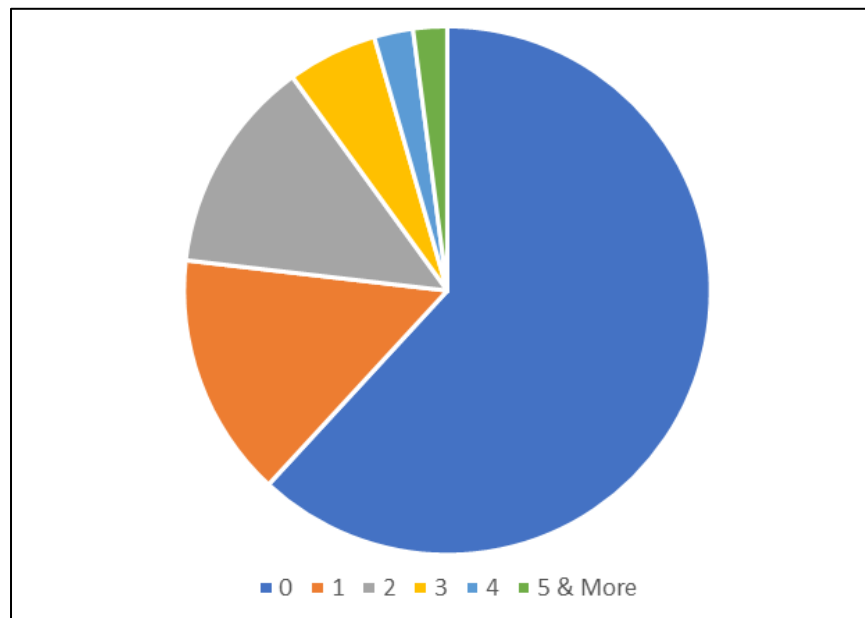
Figure 14 Percentage on number of dual flush WC/toilet (9 liters)

The long bathtub is popularly used in developed Western countries. It is a very wasteful bathing method, as each time a person takes a bath, it uses 200 litres of water. In this survey, nearly 80 % of respondents reported that they do not have a bathtub in their house (Table 20). However, the habit might be getting more popular, as 13.2 % reported that they already have at least one in their house. Table 21 shows results of the total number of normal/traditional washing machines; most respondents appear to have one. In contrast, Table 22 shows the total number of waters saving washing machines owned by respondents. Less than half of the respondents reported owning one or more water-saving washing machines (Figure 15). This is not encouraging as water-friendly washing machines can save a lot of water as well as electricity. It allows the user to adjust the water level to suit the size of the wash load with some new water efficient models being able to do this automatically. Every time a water-friendly washing machine is used with a full load, it can save up to 10 litres of water for each wash. As between 5 to 20 % of water used in the home is used for doing laundry, water-friendly washing machines can save a lot of water. Penangites should be made aware of all these advantages of a water-friendly washing machine.

Table 20 Total number of bathtubs

	Frequency	Percent	Cumulative Percent
0	532	79.5	79.5
1	88	13.2	92.7
2	27	4	96.7
3	8	1.2	97.9
4	8	1.2	99.1
5 & More	6	0.9	100
Total	669	100	

Table 21 Total number of normal/traditional washing machine

	Frequency	Percent	Cumulative Percent
0	190	28.4	28.4
1	444	66.4	94.8
2	25	3.7	98.5
3	4	0.6	99.1
4 & More	6	0.9	100
Total	669	100	

Table 22 Total number of water saving washing machine.

	Frequency	Percent	Cumulative Percent
0	349	52.2	52.2
1	293	43.8	96
2	12	1.8	97.8
3	6	0.9	98.7
4	5	0.7	99.4
5 & More	4	0.6	100
Total	669	100	
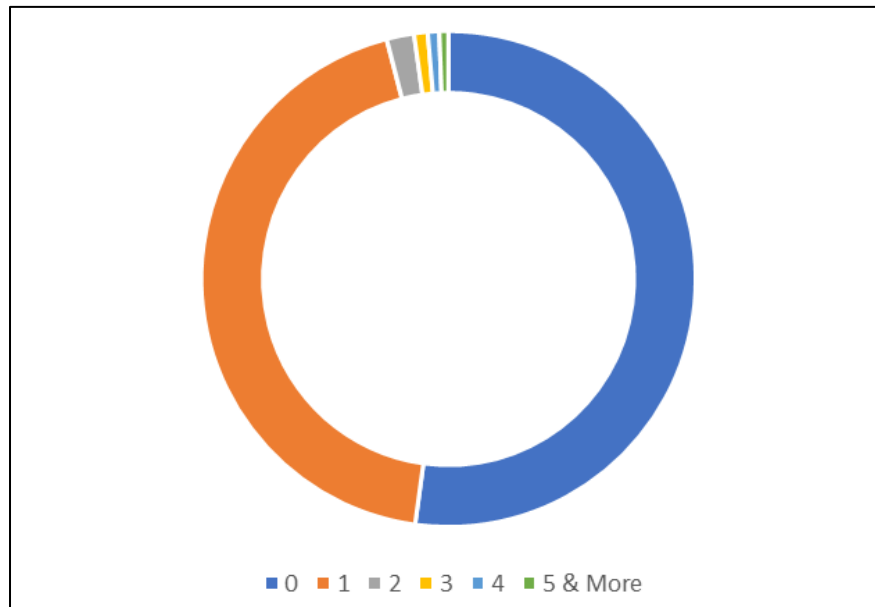
Figure 15 Percentage of respondents owning water saving washing machine

Table 23 shows the number of respondents owning various numbers of dishwashers. Dishwashers are not popular in Penang or Malaysia. They are expensive and generally uses a lot of water, despite claims from manufacturers that they save more water than hand washing. Only 1 in 4 respondents in Penang own a dishwasher.

The use of water filters has become popular in Penang in recent decades, as Penangites have become more affluent and better informed. Advertisements may also have contributed to the belief that piped water from the public supply is contaminated to various degrees. Many houses in Penang are old, some pre-war, and pipes within the house compounds may cause some contamination of the piped water. Hence, almost every house has some forms of water filter ranging from the simplest cork filters fixed on taps to highly advanced ultra-violet light filters. Table 24 shows that

only a small percentage of respondents have garden filters. In fact, 3 out of 4 respondents do not have garden filters. These are huge water filters fixed just after the water meter as the public water supply enters the house. Table 25, however, tells a different story, as 3 out of 4 respondents have some form of kitchen filters. Some house owners even have more than one water filter in their house. Some water filters use a lot of water, as dirty water is filtered out of the pipes. In general, for every 1 litre of filtered water, an average RO water filter/purifier wastes around 3 litres of water (World Economic Forum). This means that just 25% of the water gets cleansed and 75% of the water is wasted.

Table 23 Total number of dishwashers

	Frequency	Percent	Cumulative Percent
0	514	76.8	76.8
1	111	16.6	93.4
2	20	3	96.4
3	10	1.5	97.9
4	7	1.0	99
5 & More	7	1.0	100.0
Total	**669**	**100.0**	

Table 24 Total number of garden water filters

	Frequency	Percent	Cumulative Percent
0	515	77	77
1	127	19	96
2	13	1.9	97.9
3	7	1.0	99.0
4	3	0.4	99.4
5 & More	4	0.6	100.0
Total	**669**	**100.0**	

Table 25 Total number of kitchen water filters

	Frequency	Percent	Cumulative Percent
0	189	28.3	28.3
1	437	65.3	93.6
2	27	4.0	97.6
3	6	0.9	98.5
4	2	0.3	98.8
5 & More	7	1.1	99.9
No Comment	1	0.1	100.0
Total	**669**	**100.0**	

In terms of using alternatives sources of water, it was rather surprising to find that quite several respondents in the survey uses well water. Table 26 shows that 28.3 % of respondents uses well water for various purposes ranging from drinking to flushing, washing, gardening, and cooking. Table 27 again shows that quite several respondents have installed Rainwater Harvesting Systems in their houses and have used the harvested water for various purposes. Table 28 shows the number of respondents with an alternative river water source and have also used it for various purposes. Finally, the last alternative water source reported by respondents is that of spring water (Table 29). Only 4.0 % of respondents tap spring water and use it. These are probably people who are living near the hills. Soon, as water resources become scarce, people may take matters into their own hands and look for their own alternative water supply/source. Nobody likes to experience water cuts, water rationing or water contamination. An alternative water supply is therefore a logical alternative to the public water supply.

Table 26 Respondents with Well and Uses of Well Water

	Frequency	Percent	Cumulative Percent
Do not have/Not Applicable	480	71.7	71.7
Drinking, Washing, Gardening, Flushing Toilet & Car Washing	179	26.8	98.5
Gardening & Fishpond	10	1.5	100.0
Total	**669**	**100.0**	

Table 27 Respondents with Rainwater Harvesting System and Its Uses

	Frequency	Percent	Cumulative Percent
Do not have/Not Applicable	580	86.7	86.7
Drinking, Washing, Gardening & Flushing Toilet	65	9.7	96.4
Washing & Gardening	14	2.1	98.5
Washing, Gardening &Flushing Toilet	10	1.5	100.0
Total	669	100.0	

Table 28 Respondents with River Water Source and Its Uses

	Frequency	Percent	Cumulative Percent
Do not have/Not Applicable	644	96.3	96.3
Drinking & washing	2	0.1	96.6
Flushing Toilet	4	0.6	97.2
Gardening	10	1.5	98.7
Washing	4	0.6	99.3
Washing, Gardening & Flushing Toilet	5	0.7	100.0
Total	669	100.0	

Table 29 Respondents with Spring Water Source and Its Uses

	Frequency	Percent	Cumulative Percent
Do not have/Not Applicable	642	96.0	96.0
Drinking	9	1.3	97.3
Drinking, Washing, Gardening & Flushing Toilet	5	0.7	98.0
Washing & Gardening	13	2.0	100.0
Total	669	100.0	

3.3   Results on Water Consumers' Perception of Water

Consumers' perceptions determine whether they are likely to engage in a certain action, such as water-saving practices. Table 30 shows that the majority of Penangites only clean their water tanks when there is a problem. For those who regularly clean their water tanks, most of them do it once in one to five years. A third of respondents never clean their water tanks, and a sizeable percentage do not know or are unsure. These results indicate that most Penangites pay little attention to the water source in their house, even though it may affect them negatively. Respondents' apathy over the cleaning of their water tanks could also be due to their low awareness of the importance of cleaning and maintaining water tanks to ensure high water quality.

Table 30 Frequency in cleaning the water tank (tank under roof)

	Frequency	Percent	Cumulative Percent
Do not know/Not sure	96	14.3	14.3
Never	109	16.3	30.6
Once a year	49	7.3	37.9
Once in >5 years	9	1.3	39.2
Once in 2-3 years	22	3.3	42.5
Once in 4-5 years	6	0.9	43.4
Only when there is a problem	104	15.6	59.0
Not applicable (No tank)	274	41.0	100.0
Total	669	100.0	

In terms of their perceptions of and views on the piped water quality supplied to their house, Table 31 shows that the majority of Penangites rated it between average to good, with a sizeable percentage rating it very good. This is a good testimony of the good water quality provided by the water service provider Perbadanan Bekalan Air Pulau Pinang (PBA). However, there is room for improvement as nearly a fifth of respondents rated their water quality between poor and very poor. Table 32 shows the respondents' estimation of the colour of the piped water in their houses. The vast majority confirmed that their water was transparent, or colourless. Again, this is a good testimony of the good water quality provided by the water service provider PBA. Less than 10 percent of respondents estimated the colour of their piped water to be yellowish, blue, greenish, grey and others. Table 33 indicates the clarity of piped water as reported by respondents in their houses. The majority rated that their piped water was between clear and very clear. However, one in 5 respondents said their water was only moderately clear, while one in 10 respondents said their water was between turbid/unclear to very turbid/very unclear. Hence, there is much room for improvement in terms of the clarity of water supplied. Nevertheless, reasons for unclear water may

include old pipes within old houses, and not just problems in the main supply pipes, or both. They could also be due to poorly maintained water tanks.

Table 31 Overall quality of piped water

	Frequency	Percent	Cumulative Percent
1 Very Good	152	22.7	22.7
2 Good	206	30.8	53.5
3 Average	191	28.6	82.1
4 Poor	104	15.5	97.6
5 Very Poor	16	2.4	100.0
Total	669	100.0	

Table 32 Color of the piped water

	Frequency	Percent	Cumulative Percent
Blue	5	0.7	0.7
Greenish	5	0.7	1.5
Grey	3	0.4	1.9
Others	95	14.2	16.1
Transparent	498	74.4	90.6
Yellowish	63	9.4	100.0
Total	669	100.0	

Table 33 Turbidity level of piped water

	Frequency	Percent	Cumulative Percent
1 Very Clear	222	33.2	33.2
2 Clear	234	35	68.2
3 Moderate	145	21.7	89.8
4 Turbid/Unclear	56	8.4	98.2
5 Very Turbid/Very Unclear	12	1.8	100.0
Total	669	100.0	

Table 34 shows that more than half of all respondents reported that there were no sediments (mud, soil, rusts, etc) in the piped water in their houses. This is comforting news to the good water quality provided by the water service provider PBA. However, the worrying part is that slightly less than 50 % reported that their piped water contains a little to a lot of such impurities. Chlorine is a popular disinfectant commonly used in conventional water treatment. It is very effective in

preventing contamination of water by disease-causing germs such as Salmonella, Campylobacter, and norovirus. Table 35 reports on the smell of chlorine in respondents' piped water in their houses. The responses were rather mixed. Although nearly half the respondents reported no smell of Chlorine in their piped water, and a third said the smell was weak, a significant percentage indicated that the smell was between moderate to strong.

In many parts of the world, including neighbouring ASEAN countries, poor water pressure is a serious problem (McIntosh, 2014). Table 36 shows the normal water pressure in respondents' houses in this survey. Most of the respondents reported moderate to very strong water pressure indicating that this is not a problem on Penang. Only a small percentage at less than 4 % said that their house water pressure was weak or very weak.

Table 37 shows the respondents' responses on how often on average they experience water cuts in their houses. The results show that Penangites on average experience few water cuts as more than one-third did not experience water cuts, while most experience it only once in a few months. Another one-third said they experience water cuts only once a year.

Table 34 Sediments (mud, soil, rusts, etc.) in the piped water

	Frequency	Percent	Cumulative Percent
A little	220	32.9	32.9
A lot	8	1.2	34.1
Moderate	75	11.2	45.3
None	366	54.7	100
Total	669	100	

Table 35 Strength of chlorine smell in the piped water

	Frequency	Percent	Cumulative Percent
Moderate	129	19.3	19.3
No smell	318	47.5	66.8
Strong	20	3.0	69.8
Very strong	6	0.9	70.7
Weak	196	29.3	100
Total	669	100	

Table 36 Normal water pressure in respondent's houses

	Frequency	Percent	Cumulative Percent
1 Very Strong	121	18.1	18.1
2 Strong	224	33.5	51.6
3 Moderate	207	30.9	82.5
4 Weak	91	13.6	96.1
5 Very Weak	26	3.9	100
Total	669	100	

Table 37 Frequency of experiencing water cuts on average

	Frequency	Percent	Cumulative Percent
1/ few months	144	21.5	21.5
1/ year	214	32	53.5
1/day	25	3.7	57.2
1/month	38	5.7	62.9
1/week	12	1.8	64.7
None	236	35.3	100
Total	669	100	

Table 38 tests the respondents' perception and view as to who should be responsible to supply water to consumers in Penang State. The majority of Penangites believed that the State Government of Penang should be the responsible party. This was surprising as water supply has long been privatised in Penang to the PBA way back in 1999. A small minority believed that the federal or local municipal government should be responsible. In Table 39, respondents were asked who should take the responsibility if there was a water problem in Penang State. Again, the majority believed it was the Penang State Government (PSG). In Table 40, when Penangites were asked as to who should be responsible in ensuring long term water security in Penang, the majority pointed to the PSG, although the majority was smaller. About one-fifth of respondents indicated that all stakeholders should be responsible. This is a good sign that shows Penangites are aware that the public and other stakeholders should play a role in water management. Only a very small percentage of respondents were of the view that the water company (PBA) should be solely responsible.

Table 38 In your opinion, who should be responsible to supply water?

	Frequency	Percent	Cumulative Percent
Do not Know	2	0.3	0.3
Federal and State Government	3	0.4	0.7
Federal Government	87	13.0	13.8
Local Municipality	54	8.1	21.8
Myself	7	1.0	22.9
Private Water Company	79	11.8	34.7
State Government	437	65.3	100
Total	669	100	

Table 39 Responsible party in the event of water problem

	Frequency	Percent	Cumulative Percent
All Stakeholders	2	0.3	0.3
Apartment Maintenance Officer	1	0.1	0.4
Developers	1	0.1	0.6
Do not Know	3	0.4	1
Federal and State Government	3	0.4	1.5
Federal Government	83	12.4	13.9
Local Municipality	76	11.4	25.3
Myself	2	0.3	25.6
Private Water Company	85	12.7	38.3
State Government	413	61.7	100
Total	669	100	

Table 40 In ensuring long term water security in Penang, who should play an active part?

	Frequency	Percent	Cumulative Percent
All levels of government	115	17.2	17.2
All stakeholders	150	22.4	39.6
Do not Know	2	0.3	39.9
Federal Government	77	11.5	51.4
Local Municipality	22	3.3	54.7
Private Water Company	28	4.2	58.9
State Government	275	41.1	100
Total	669	100	

In Table 41, the vast majority of Penangites believed that government should subsidize the cost of water to citizens. Public believe that they pay taxes and hence government should be responsible to subsidize water tariffs. Table 42 indicates the level of subsidy of the cost of water that Penangites expect the government to provide. Most believe that government should subsidise not more than 60 %. SPAN's reports show that the cost of treating 1,000 litres of water is around RM2.31. However, the average domestic user only pays RM0.32 per 1,000 litres of water they use in Penang (for the first 35,000 litres). As such, Penangites are now enjoying a water subsidy of RM1.99 per 1,000 litres of water. This is 86.1 % of the cost of treating water. Penangites should be made aware of this subsidy in order to have a fairer perspective on the pricing of water tariffs.

To provide a better perspective regarding the issue of water in comparison to other issues in Penang, respondents were asked their opinion as to what the biggest problem in Penang was at the current moment. The results in Table 43 proves that most respondents do not consider water to be a top problem in the state. The top problem identified by most of the respondents was the high cost of living. This is hardly surprising, as making a living and earning a decent income is by large a top priority of the public. Water was hardly considered a problem. In fact, only 0.4 % of all respondents mentioned water as the biggest problem. Because of this, it is hardly surprising that water issues and water conservation are given a low priority amongst Penangites. When the respondents were asked as to whether they think water was a serious problem in Penang, more than half of them said "No" (Table 44). Only a third believed that water was a serious problem in the state. It can therefore be said that most Penangites have low awareness of water issues in Penang, and do not generally pay attention to water as an issue. This could again be due to the good quality and consistent water supply, cheap water tariffs, and an efficient water service provider.

Table 41 Does government should subsidize the cost of water to citizens?

	Frequency	Percent	Cumulative Percent
No	85	12.7	12.7
Yes	584	87.3	100.0
Total	669	100.0	

Table 42 How much of the cost of water should government subsidize?

	Frequency	Percent	Cumulative Percent
Don't Know/No Comments	49	7.3	7.3
1-20%	205	30.6	38.0
21-40%	182	27.2	65.2
41-60%	155	23.2	88.4
61-80%	34	5.0	93.4
81-100%	44	6.6	100.0
Total	669	100	

Table 43 Current concern of respondents in Penang

	Frequency	Percent	Cumulative Percent
Unsure	6	0.9	0.9
Covid-19	64	9.6	10.5
Crime	12	1.8	12.3
High cost of living	448	67.0	79.3
Others	52	7.8	87.1
Poor quality education	15	2.2	89.3
Poor quality environment	53	7.9	97.2
Unemployment	16	2.4	99.6
Water supply	3	0.4	100.0
Total	669	100.0	

Table 44 In your opinion, is water a serious problem in Penang?

	Frequency	Percent	Cumulative Percent
Do Not Know	83	12.4	12.4
No	348	52.0	64.4
Yes	238	35.6	100
Total	669	100	

When respondents were asked as to what the biggest water problem in Penang was, there was no obvious major reason (Table 45). Common problems mentioned were over-consumption, low water pressure and pipe burst. A very surprising result was that a significant number of respondents

identified high cost of water as a major water problem. Given the fact that water tariffs are cheapest in Penang State in the whole country, it was indeed surprising to see Penangites highlighting water tariffs as high. Table 46 indicates the respondents' low knowledge of the water situation in Penang. Although slightly more than half the respondents were correct when they mentioned Sg Muda as the major water source for Penang State, an alarming 44.8 % of respondents got this wrong.

Table 45 What is the biggest water problem in Penang?

	Frequency	Percent	Cumulative Percent
Do not Know/Unsure	12	1.8	1.8
Frequent Water Cuts	28	4.2	6.0
High Chlorine Content	15	2.2	8.2
High Cost	73	10.9	19.1
Low Water Pressure	128	19.1	38.2
Low Water Tariff	17	2.5	40.7
None	22	3.3	44.0
Not Enough Water	75	11.2	55.2
Others	10	1.5	56.7
Over-Consumption	139	20.8	77.5
Pipe Bursts	67	10.0	87.5
Poor Water Quality	50	7.5	95.0
Poor Water Service	33	5.0	100.0
Total	**669**	**100.0**	

Table 46 Source of raw water for Penang

	Frequency	Percent	Cumulative Percent
Desalination of Sea Water	17	2.5	2.5
Don't Know	5	0.7	3.3
Groundwater	12	1.8	5.1
Its 3 dams	234	35	40.1
Others	2	0.3	40.4
Rainwater	30	4.5	44.8
Sg Muda	369	55.2	100.0
Total	**669**	**100.0**	

A comforting result from this survey is that most respondents are of the opinion that Penang will likely experience water shortages in the future, as nearly half of them think so (Table 47). Only a very small minority think that Penang will not suffer water shortages in future. Table 48 asks

respondents to identify the state with the best water supply/service in Malaysia. Only one-third of the respondents identified Penang as the best state in terms of water supply. Table 49 shows respondents' attempts to identify the state with the worst water supply in the country. Admittedly, this is a very sensitive and debatable issue. The highest number of respondents picked Selangor, probably due to the many incidents of water rationing reported in the press in the last few years. Many picked Kelantan, which also has a poor record in water supply. A few even picked Penang. When respondents were asked to name the water service provider in Penang, 9 out of 10 respondents did so correctly by naming the PBA (Table 50). This is comforting, but 10% of respondents are still in the dark. When respondents were asked to rank their water service provider in terms of the water service provided to their houses, the answers were varied, but more on the negative side. More than half the respondents ranked the PBA's water supply/service between poor and very poor (Table 51). 10 % of the respondents ranked PBA as good or very good.

Table 47 Do you think Penang will experience water shortages in the future?

	Frequency	Percent	Cumulative Percent
Do not know	35	5.2	5.2
Maybe	285	42.6	47.8
No, unlikely	28	4.2	52.0
Yes, Very Likely	321	48.0	100.0
Total	**669**	**100.0**	

Table 48 Please state which state has the best water supply in Malaysia.

	Frequency	Percent	Cumulative Percent
Do not Know/ Not Sure	179	26.8	26.8
Johor	22	3.3	30
Kedah	88	13.2	43.2
KL	9	1.3	44.5
Melaka	2	0.3	44.8
Pahang	59	8.8	53.7
Penang	229	34.2	87.9
Perak	55	8.2	96.1
Perlis	9	1.3	97.5
Sabah	4	0.6	98.1
Sarawak	3	0.4	98.5
Selangor	4	0.6	99.1
Terengganu	6	0.9	100
Total	**669**	**100**	

Table 49 Please state which state has the worst water supply in Malaysia.

	Frequency	Percent	Cumulative Percent
Do not Know/ Not Sure	175	26.2	26.2
Johor	3	0.4	26.6
Kedah	46	6.9	33.5
Kelantan	86	12.9	46.3
KL	22	3.3	49.6
Melaka	3	0.4	50.1
Negeri Sembilan	1	0.1	50.2
Pahang	3	0.4	50.7
Penang	40	6.0	56.7
Perak	3	0.4	57.1
Perlis	5	0.7	57.8
Sabah	11	1.6	59.5
Sarawak	3	0.4	59.9
Selangor	267	39.9	99.9
Terengganu	1	0.1	100.0
Total	669	100.0	

Table 50 Name the water service provider in Penang.

	Frequency	Percent	Cumulative Percent
Department of Environment (DOE)	4	0.6	0.6
Department of Irrigation and Drainage (DID)	5	0.7	1.3
Jabatan Bekalan Air (JBA)	42	6.3	7.6
Kementerian Air & Sumber Asli (KASA)	1	0.1	7.8
Penang State Government	10	1.5	9.3
Perbadanan Bekalan Air PP (PBAPP)	607	90.7	100.0
Total	669	100.0	

Table 51 Please rank the water service provider for water provided to your house.

	Frequency	Percent	Cumulative Percent
Very Poor	168	25.1	25.1
Poor	253	37.8	62.9
Moderate	177	26.5	89.4
Good	56	8.4	97.8
Very Good	15	2.2	100
Total	669	100	

3.4 Water Practices Amongst Water Consumers in Penang

Water consumers can make or break a water system. If they over-use and wastewater excessively, the water supply system can be stressed beyond its limits, leading to an insufficient water supply. Hence, water consumers hold the key towards achieving water sustainability. Highly sensitized water consumers such as Singaporeans and Australians practice water conservation and are very careful with their water usage. However, Penangites are known to be excessive users, largely due to cheap water tariffs and public apathy, amongst other reasons (Chan, 2015; Chan et al., 2021). Generating greater public awareness through water education to engage Penangites to adopt a water saving lifestyle is vital for Penang's water sustainability.

Table 52 shows that most Penangites have developed a good water practice of turning off the tap while brushing their teeth. Nearly 3 out of 4 Penangites reported that they are very likely to turn off the tap while brushing their teeth. Table 53 again shows that most respondents are very likely to turn off the shower while they are shampooing and soaping. This is again a good water-saving practice. It is also a good water conservation practice that more than two-thirds of respondents say they are likely to take showers within 5 minutes or less. Less shower time would reduce water use. However, Malaysians in general, and Penangites in particular, are used to taking two showers a day. Although the vast majority of respondents take two showers or less a day, a significant percentage of 21.8 % take three showers or more a day. Another more alarming behaviour is that the majority said they would not consciously cut down on the number of baths/showers per day (Table 56). This implies that Penangites are unlikely to compromise on the number of showers taken daily.

Table 52 Do you turn off the water while brushing your teeth?

	Frequency	Percent	Cumulative Percent
Very Likely	480	71.7	71.7
Somewhat Likely	147	22	93.7
Not Likely	42	6.3	100
Total	669	100	

Table 53 Do you switch off the shower while shampooing and soaping?

	Frequency	Percent	Cumulative Percent
Very Likely	389	58.1	58.1
Somewhat Likely	186	27.8	85.9
Not Likely	94	14.1	100
Total	669	100	

Table 54 Do you normally take a short (5 minutes or less) bath/shower?

	Frequency	Percent	Cumulative Percent
Very Likely	252	37.7	37.7
Somewhat Likely	240	35.9	73.5
Not Likely	177	26.5	100
Total	669	100	

Table 55 How often do you shower/bath on average?

	Frequency	Percent	Cumulative Percent
Once in few days	16	2.4	2.4
Once a day	68	10.2	12.6
Twice a day	439	65.6	78.2
3 Times a day	116	17.3	95.5
More than 3 times a day	30	4.5	100.0
Total	669	100.0	

Table 56 Do you consciously cut down on the number of baths/showers?

	Frequency	Percent	Cumulative Percent
Very Likely	104	15.5	15.5
Somewhat Likely	252	37.7	53.2
Not Likely	313	46.8	100.0
Total	669	100.0	

Most respondents also indicate that they are practicing water recycling and water re-use, such as re-using water used for washing vegetables to water plants or flush the toilet, etc. (Table 57). However, there is still a significant percentage of respondents (more than a third) who indicated that they do not recycle water. Table 58 tests the respondents' response to water leakages in their houses. Fortunately, 3 out of 4 respondents are sensitized about the need to prioritise the repairing of water leakages immediately. Table 59 indicates that roughly 4 out of 5 respondents are likely to wash fruits and vegetables with a running tap. This is a convenient water using habit amongst Penangites, and Malaysians in general. However, it is not a good water practice, as it wastes a lot of water. Another bad water practice amongst Malaysians and Penangites is that of letting the tap run continuously while hand washing dishes. Most respondents reported that they are likely to do so (Table 60).

Table 57 Water Recycling, Water Re-Use practices

	Frequency	Percent	Cumulative Percent
Very Likely	180	26.9	26.9
Somewhat Likely	248	37.1	64.0
Not Likely	241	36.0	100.0
Total	669	100.0	

Table 58 Ensure all leaks in the house are repaired immediately

	Frequency	Percent	Cumulative Percent
Very Likely	469	70.1	70.1
Somewhat Likely	177	26.5	96.6
Not Likely	23	3.4	100.0
Total	669	100.0	

Table 59 Do you wash fruits and vegetables with a running tap?

	Frequency	Percent	Cumulative Percent
Very Likely	258	38.6	38.6
Somewhat Likely	266	39.8	78.3
Not Likely	145	21.7	100.0
Total	669	100.0	

Table 60 Do you let the tap run continuously while hand washing dishes?

	Frequency	Percent	Cumulative Percent
Very Likely	152	22.7	22.7
Somewhat Likely	271	40.5	63.2
Not Likely	246	36.8	100.0
Total	669	100.0	

Table 61 shows that nearly two-thirds of respondents are likely to fix a nozzle in their water hoses for gardening and washing, which is a good water behaviour. However, a significant percentage of more than one-third are unlikely to do so. The results in Table 62 are more encouraging, as 3 out of 4 respondents are likely to turn off all taps tightly after using them. However, the results in Table 63 are quite alarming, as nearly half of respondents reported that they are likely to flush the toilet before using. There has been some suspicion that females may practise this habit more than males. However, the Crosstab and Chi-Square test results in Table 64 yielded a Pearson Chi-square value of 0.157 which is not significant. Hence, contrary to popular belief, there is no significant difference between males and females in flushing toilets before use. Men do it just as often as women. Table 65 indicates that almost all the respondents are likely to flush the toilet after use. This is a good hygienic practice.

Table 61 Do you fix a nozzle in your water hose (for gardening & washing)?

	Frequency	Percent	Cumulative Percent
Very Likely	264	39.5	39.5
Somewhat Likely	244	36.5	75.9
Not Likely	161	24.1	100.0
Total	669	100.0	

Table 62 Do you always turn off all taps tightly so they don't drip?

	Frequency	Percent	Cumulative Percent
Very Likely	522	78.0	78.0
Somewhat Likely	129	19.3	97.3
Not Likely	18	2.7	100.0
Total	669	100.0	

Table 63 Do you always flush the toilet before using it?

	Frequency	Percent	Cumulative Percent
Very Likely	83	12.4	12.4
Somewhat Likely	200	29.9	42.3
Not Likely	386	57.7	100.0
Total	669	100.0	

Table 64 Habit of flushing the toilet before using by Gender.

Gender	Do you always flush the toilet before using?			Total
	Very Likely	Somewhat Likely	Not Likely	
Female	46	107	237	390
Male	37	93	149	279
Total	83	200	386	669

Table 65 Do you always flush the toilet after using?

	Frequency	Percent	Cumulative Percent
Not Likely	556	83.1	83.1
Somewhat Likely	98	14.6	97.8
Very Likely	15	2.2	100.0
Total	669	100.0	

In terms of gardening, it is comforting to note that two-thirds of respondents are likely to use a watering can instead of the hose to water their plants (Table 66). This is a good water-saving practice. A hose can waste 23 litres per minute if left running, but using a watering can only uses a few litres. Another good water saving habit is the using of a pail and mop to clean floors instead of a water hose (Table 67). Almost all respondents (93.4 %) are likely to use the pail and mop. In terms of washing cars, it is noted that half the respondents take their cars to the car wash for washing (Table 68). Those who wash their cars themselves largely use a hose, and 1 in 5 respondents use hoses fixed with nozzles. The nozzle is a water-saving device that saves a lot of water. The user does not need to switch the tap off even if he/she is not using the water, as water only flows out when the nozzle is squeezed. However, a significant number of respondents (1 in 10) use the hose without nozzles, and this is a water wasting habit. The most water-saving car washing practice is the use of a few pails of water. This is the recommended method of car washing in many countries where water is scarce, such as in Australia and Singapore. During drought periods in many parts of Australia, using the hose to wash cars is prohibited. However, this method is considered strenuous and slow. Only a small percentage of respondents use this method.

Table 66 Do you use a Watering Can instead of the hose to water your plants?

	Frequency	Percent	Cumulative Percent
Very Likely	231	34.5	34.5
Somewhat Likely	235	35.1	69.7
Not Likely	203	30.3	100.0
Total	669	100.0	

Table 67 Do you use a Pail and Mop instead of Water Hose to wash floors?

	Frequency	Percent	Cumulative Percent
Very Likely	440	65.8	65.8
Somewhat Likely	185	27.7	93.4
Not Likely	44	6.6	100.0
Total	669	100.0	

The amount of water used to wash cars not only depends on the method of car washing, but also on the frequency of car washing. Table 69 shows that more than half the respondents only wash their cars when it is necessary. It is interesting to note that a small group of respondents wash their cars in the rain. Thus, it can be seen from this that most of the respondents are practical people. A significant number of respondents wash their cars once a week to once a fortnight. Very few respondents wash their car every day. However, the average time respondents take to wash their cars is quite long. More than two-thirds of respondents take more than 15 minutes to wash their cars (Table 70).

Table 68 How do you wash your car?

	Frequency	Percent	Cumulative Percent
I wash it at the car wash	339	50.7	50.7
I wash it in the rain	28	4.2	54.9
Not Applicable (not car owner)	53	7.9	62.8
With 2 Pails of water	48	7.2	70.0
With a hose fixed with nozzle	128	19.1	89.1
With a hose without nozzle	73	10.9	10.00
Total	669	100.0	

Table 69 How often do you wash your car?

	Frequency	Percent	Cumulative Percent
Not Applicable (Not car owner)	55	8.2	8.2
Once a day	6	0.9	9.1
Once in a few days	8	1.2	10.3
Once a week	60	9.0	19.3
Once in 2 weeks	80	12.0	31.3
Once a month	103	15.4	46.7
Once a year	2	0.3	47.0
Only when it's needed	355	53.0	100.0
Total	669	100.0	

Table 70 What is the average time you take to wash your car?

	Frequency	Percent	Cumulative Percent
>30 minutes	55	8.2	8.2
10-15 minutes	188	28.1	36.3
16-30 minutes	185	27.7	64
Between 5-10 minutes	125	18.7	82.7
Less than 5 minutes	34	5.1	87.7
Not Applicable (Not car owner)	82	12.3	100.0
Total	**669**	**100.0**	

Many Penangites also use water in relation to their religious activities. Table 71 shows most respondents use water very often in activities related to their religion. A fifth of respondents use water for religious purposes all the time. However, another one-fifth does not use water at all for religious purposes.

Table 71 How often do you use water in relation to your religious activities?

	Frequency	Percent	Cumulative Percent
All the time	146	21.8	21.8
Never	146	21.8	43.6
Seldom	129	19.3	62.9
Sometimes	129	19.3	82.2
Very often	119	17.8	100.0
Total	**669**	**100.0**	

Water consumers' perception of the fairness of water tariffs is extremely important in the context of tariff revision or restructuring, which takes place once in every few years in most countries. If consumers think that the tariffs are fair, they would be willing to pay for reasonable increase in tariffs. However, if they feel that current tariffs are already expensive, any tariff review would be rejected by consumers. In Penang, the Water Conservation Tax (WCT) was implemented in 2010. Strictly speaking, this is not a tariff review but the introduction of the WCT to discourage water wastage. The last tariff review was done in 2015. In 2019, PBA applied for a tariff review, but the ministry Environment and Water Minister issued public statements in 2020 and 2021 stating that the Federal government had postponed all water tariff reviews because of the Covid-19 pandemic.

The results in Table 72 indicate that most respondents consider water tariffs in Penang State to be low to moderate. Only a small minority think that current water tariffs are high which in contra with the fact that Penang's tariff is the cheapest in the whole country. A third of respondents do not know which state has the most expensive water tariffs (Table 73). Only 1 in 5 respondents answered correctly when they identified Johor to be the state with the most expensive water tariffs. Alarmingly, there were even a small number of respondents picking Penang as the state with the highest tariffs. When respondents were asked as to which state has the cheapest water tariffs, one in five admitted that they did not know (Table 74). The good news is that more than half identified Penang correctly. The results clearly confirm that at least half of Penangites are either unaware about water tariffs, or do not pay too much attention to them, since domestic tariffs are low.

Table 72 Do you consider your water bill High, Moderate or Low?

	Frequency	Percent	Cumulative Percent
High	96	14.3	14.3
Low	216	32.3	46.6
Moderate	357	53.4	100.0
Total	669	100.0	

Table 73 Name the state in Malaysia with the most expensive water tariff.

	Frequency	Percent	Cumulative Percent
Don't Know/ Not Sure	239	35.7	35.7
Johor	138	20.6	56.4
Kedah	39	5.8	62.2
Kelantan	4	0.6	62.8
KL	53	7.9	70.7
Melaka	4	0.6	71.3
Negeri Sembilan	1	0.1	71.4
Pahang	4	0.6	72
Penang	30	4.5	76.5
Perak	12	1.8	78.3
Perlis	1	0.1	78.5
Sabah	6	0.9	79.4
Sarawak	3	0.4	79.8
Selangor	135	20.2	100.0
Total	669	100.0	

Table 74 Name the state in Malaysia with the cheapest water tariff.

	Frequency	Percent	Cumulative Percent
Do not Know/ Not Sure	176	26.3	26.3
Johor	3	0.4	26.8
Kedah	51	7.6	34.4
Kelantan	11	1.6	36
KL	2	0.3	36.3
Melaka	1	0.1	36.5
Pahang	7	1	37.5
Penang	367	54.9	92.4
Perak	10	1.5	93.9
Perlis	22	3.3	97.2
Sabah	1	0.1	97.3
Sarawak	2	0.3	97.6
Selangor	13	1.9	99.6
Terengganu	3	0.4	100.0
Total	669	100.0	

Table 75 shows respondents' opinions on what is a fair and affordable monthly water bill (RM) for an average family normally. The results show that the answers varied from less than RM10 to RM300. The majority, however, feels that it should be less than RM50 with the highest percentage picking between RM11-20. This implies that Penangites are very careful about their water tariffs, and will not over-commit to pay too high a tariff. However, most respondents are likely and willing to spend money to install water saving equipment in their houses to save water (Table 76). This is indeed a good sign. However, most respondents are unsure whether they want to invest in installing water saving devices in their houses. Of those who are willing to do so, most are only willing to spend a small amount (less than RM500) to install water saving equipment in their houses for saving water (Table 77).

Table 78 is an important question as it tests whether water consumers are willing to accept an increase water tariffs to encourage water saving. Unfortunately, only a small minority are willing to do so. Most respondents are unsure, non-committal or are unwilling. Table 79 indicates that respondents are only willing to pay a small increase of water tariffs of between 1 to 30 %. Very few are willing to pay more than that, and no respondent wants to pay more than 100 % of the existing rate.

Table 75 What is a fair and affordable monthly water bill (RM) for an average family?

	Frequency	Percent	Cumulative Percent
Don't Know/ Not Sure	6	0.9	0.9
RM 1- RM 10	192	28.7	29.6
RM 11 - RM 20	220	32.9	62.5
RM 21 - RM 50	190	28.4	90.9
RM 51 - RM100	50	7.5	98.4
RM 100 - RM 300	11	1.6	100.0
Total	669	100.0	

Table 76 Willingness to spend money to install water saving equipment in saving water

	Frequency	Percent	Cumulative Percent
No	255	38.1	38.1
Yes	414	61.9	100.0
Total	669	100.0	

Table 77 How much are you willing to spend to install water saving equipment?

Ringgit	Frequency	Percent	Cumulative Percent
Unsure	356	53.2	53.2
1-100	181	27.1	80.3
101-200	43	6.4	86.7
201-300	18	2.7	89.4
301-500	42	6.3	95.7
501-1000	26	3.9	99.6
1001 or more	3	0.4	100.0
Total	669	100.0	

Table 78 Do you agree that water tariffs should be increased to encourage water saving?

	Frequency	Percent	Cumulative Percent
Maybe	267	39.9	39.9
No	247	36.9	76.8
Yes	155	23.2	100.0
Total	669	100.0	

Table 79 How much of an increase of water tariffs would you be willing to pay?

	Frequency	Percent	Cumulative Percent
1 - 10%	324	48.4	48.4
11 - 21%	83	12.4	60.8
21 - 30%	37	5.5	66.4
31 - 40%	18	2.7	69.1
41 - 50%	20	3.0	72.0
51 - 100%	14	2.1	74.1
No	173	25.9	100.0
Total	669	100.0	

Table 80 shows various scenarios related to water tariffs. A third of respondents did not agree to tariff review, and said that tariffs should stay the same. What is encouraging is that two-thirds of respondents, or the majority, agreed to some form of tariff review. Of those who agreed to tariff review, the majority chose a water tariff that is revised up to 50 % at cost, with government subsidising the other 50 %. Hence, respondents still want the government to be partly responsible for subsidising water tariffs. This is a kind of compromise meeting the government halfway in terms of tariff review. Finally, Table 81 shows that most respondents (4 out of 5) would be likely to install water saving devices in their houses to save water and reduce their water bill.

Table 80 Select one scenario of tariff review that you are most likely to agree to

	Frequency	Percent	Cumulative Percent
I do not agree to tariff review. Tariff should stay the same	246	36.8	36.8
Tariff to stay the same for the first 20 m3 of water, but charged 20% at cost from 21 m^3	73	10.9	47.7
Tariff to stay the same for the first 20 m^3 of water, but charged at cost from 21 m^3 upwards	78	11.7	59.3
Tariff to stay the same for the first 20 m^3 of water, but charged at cost from 21 m^3 upwards	18	2.7	62
Tariff to stay the same for the first 20 m^3, but charged 50% at cost from 21 m^3 upwards	44	6.6	68.6
Water tariff to be charged at Cost based on the Cost of Production RM1.30 per cubic metre	64	9.6	78.2
Water tariff to be revised to 50% at cost, with government subsidizing 50%	146	21.8	100.0
Total	669	100.0	

Table 81 Would you consider installing water saving devices?

	Frequency	Percent	Cumulative Percent
Very Likely	304	45.4	45.4
Somewhat Likely	266	39.8	85.2
Not Likely	99	14.8	100.0
Total	669	100.0	

4 Gender, Ethnicity, Age, Income, Location and Water Practices

It was envisaged in the beginning of the survey that difference in gender, ethnicity, age, income and location may have an influence on water practices. For example, there is a public perception that females tend to use more water than males. On the other hand, females are more sensitised towards water conservation and may tend to save water compared to males who may tend to waste water. The lines between ethnicity, however, may not be so clear-cut. Income was also thought to have a bearing on water use and practices as poor people may tend to save water in order to save money. A city dweller was thought to use more water than rural folks because of more water fittings in the house. All of these assumptions needed to be tested before anything can be confirmed. Hence, further statistical testing was necessary.

Further analysis using Chi-square test was performed on gender and water practices. The tests all turned up to be not significant, indicating that there were no significant differences in water practices between males and females in this survey. Similarly, further analysis using Chi-square test was also performed on Ethnicity and water practices. The tests again all turned up to be not significant, indicating that there was no significant difference in water practices between respondents from various ethnicities. Whether it was brushing teeth, installing water saving devices, switching off shower while shampooing, taking 5-minute showers, or recycling water, different ethnicities showed similar patterns of practices.

In terms of age, further analysis using Chi-square test was also performed on age and water practices. The tests again all turned up to be not significant, indicating that there was no association between age of respondents and water practices. In terms of income, further analysis using Chi-square test was also performed on monthly household income and water practices. The tests again all turned up to be not significant, indicating that there was no association between monthly household income of respondents and water practices, and no significant differences in water practices related to the monthly household income of respondents. Whether the respondent was from the B40, M40 or T20 group, they all appeared to practise similar water practices.

In terms of location (rural, suburban and urban), further analysis using Chi-square test was also performed on location and water practices. The Chi-square tests again all turned up to be not significant, indicating that there was no association between location of respondents and water practices, or there was no significant difference in water practices based on the location (address) of respondents. Whether the respondent is from an urban area, suburban area or rural area, they all appear to have similar water practices.

It may seem strange that despite all the statistical testing, there were no significant differences or associations between demographic parameters and water practices. This could be due to several reasons. Firstly, it is likely because water tariffs in Penang State are extremely cheap, less attention is given to save or conserve water. There seems to be no reason to save water when all one can save is a few ringgits per month. Secondly, water is readily available in Penang State 24/7. Water flows with good pressure in the entire state 24 hours a day, and 365 days a year. There is no water rationing, and even if one does not have piped water in the house, one can easily get piped water in public places such as public taps, public toilets, and government buildings. Hence, water is not an issue in Penang, and Penangites know this. Thirdly, Penangites share similar habits and culture, even if religion may be different. Hence, whether one is a Malay, Chinese or Indian, and whether one is rich or poor, male, or female, urban or rural, all practice similar water habits and behaviour.

5 Conclusions and Recommendations

The results and findings of this study are summarised into the following major points:

Most water consumers in Penang State are still using traditional water fittings that are not water-friendly. Most respondents have traditional manual switch on taps in their houses, and these do not have water-saving features. In contrast, only few respondents have automatic taps which are water-friendly. Hence, in order to encourage the use of these automatic taps, tax incentives should be given by the government to lower the prices of these automatic taps. Likewise, the same observation was made with water-friendly shower heads. Similarly, most respondents have normal/traditional flush WC/toilet, whereby each flush dispenses 9 litres of water. These flush systems are therefore not water-friendly. Few respondents have installed a dual flush system in which 2 to 6 litres are dispensed for each flush. There is a need to mobilise water consumers to adopt all these water saving devices to reduce their water usage. For this to take effect, the cost of water saving devices must be lowered to make them attractive to both developers and homeowners.

Water Security is often misunderstood as something that is determined by how rich a country or state is in terms of water resources availability. This could not be further from the truth, as even countries and states that are richly endowed with lots of water can have poor water security. Water quantity cannot be equated with water security. This is because water quality may be a problem,

and mismanagement of water resources can result in imbalances in water supply. Water security in Penang is not solely determined by nature (e.g., rich, or poor in water resources), technology (e.g., possessing high-tech desalination plants) or financial capacity (e.g., adequate funds to finance water projects). Rather, it is a combination of nature, technical, finance and human inputs in managing water resources. In terms of nature, it affects water security as rainfall and water resources availability varies over space (e.g., Pahang is rich in water resources while Penang is poor) and time (e.g. Penang experiences a short dry period between January to February although in most parts of Malaysia the northeast monsoon period brings with it heavy rains and an abundance of water resources while the southwest monsoon months are is not as abundant).

In terms of technology, Penang can move towards desalination, but this is much more expensive. This brings us to the question of financing. A rich state may not necessarily have better water security. For example, the advanced state of Selangor has poor water security compared to the less advanced state of Pahang. This study has focussed on human behaviour in terms of water practices, human perception on water resources, and willingness to pay for tariff review. Penang State Government should scrutinize the factors mentioned and its applicability to Penang. Human actions can affect water security either positively or negatively. Water saving behaviour can create a "Water Saving Society" while water wasteful behaviour can exert pressures on the water system and cause water crises. Hence, understanding human perception, beliefs, practices, politics, willingness to pay, apathy or commitment, lifestyles, and most of all human behaviour in relation to water is crucial in planning strategies towards achieving water security and water sustainability.

Water security is not easy to achieve. This is because it depends on many factors, all of which act holistically. The aim of this survey is to help understand water consumer perceptions and behaviour in Penang State. Results show that Penangites are still very much reliant on water subsidies from the state government (via PBA). Nevertheless, although most feel that some sort of subsidies should be supported by the government, the encouraging news is that a significant percentage of respondents in this survey feel that water consumers should share the cost of water supply. Most feel that a 50:50 sharing of cost between government and water consumers is a fair deal. With greater responsibility and greater role to play, water consumers can be engaged to create a more inclusive water management model involving all relevant stakeholders. The water supply management model should also be incorporated together with the water demand management model to produce a more holistic model.

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