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Assessment of Water Demand From Urban and Rural Area in Kota Bharu, Kelantan

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Abstract: Population growth and inefficient water supply management are the main factors that cause treated water supply to not function properly. This problem has been faced in the state of Kelantan for many years and until now this problem is still faced by the local community, especially in the district of Kota Bharu. Therefore, this study was conducted to identify the rate of water demand from urban and rural areas and the cost-effective of water distributed in Kota Bharu, Kelantan. A total of 50 respondents provided feedback through this survey questionnaire. The results showed that a large number of residents from urban areas use treated water (100 %) provided by Air Kelantan Sendiri Berhad (AKSB) while rural areas still use treated water (62 %) and also other alternative sources such as groundwater (38 %). Statistical tests found 0.05 were analyzed to determine the relationship between per capita demand for urban and rural areas and costs paid. With the study done, it can be proved that the use of groundwater is high because the bills charged are very cheap and affordable. The implications of this work on water demand could contribute to AKSB providing adequate water and gradually meet better water standards.

Keywords: Water Demand, Cost-Effective , Groundwater

1. Introduction

Water is such basic essentials required of human life that human cannot continue living and becomes important element to animals and plants life too. The rapid urbanization and adding of the population have led to increasing demand for water in Malaysia. Water becomes the vital component because it is used for a different function which is 76 percent for agriculture activity, 11 percent for municipal water supply, 13 percent for industries and less than 1 percent of available water resources are used for drinking water supply. For the state of Kelantan, where groundwater is being significantly utilized for potable water supply, is the leading state and largest groundwater operator in Malaysia. Traditionally people in Kelantan have used groundwater resource as the potable use since early civilization, before fully developed into industrial potable use in 1935 (W Ismail 2009), taking the advantage of the rich groundwater alluvial basin especially in the north region of Kelantan.

Air Kelantan Sendirian Berhad (AKSB) is the sole water provider in Kelantan since 1995 and responsible for operating the existing water supply, water treatment and supply system including bills issues and collecting revenue as well as advancing the needs of the people of Kelantan. Nowadays, Kelantan states having an experiencing of water shortage from their own water sources. This is due to the several problems occur and need for sustainable and cost-saving system in order to get clean water supply.

The aim of this study is to identify water demand from urban and rural area in Kota Bharu district. Mostly, the residents from urban areas used water that provided from operator water, AKSB or used both sources which is private water meter and also alternative source of water supply such as groundwater. The wastage of water done is close to the cost and the water consumption payment rate also being measured to identify how many liters used and the bills in a month.

This study uses method of data collection that is through questionnaire form instruments for obtaining data from respondents. Besides, to analyze the data, a quantitative method was used in conjunction with relevant statistical approaches. The data was analyzed using the Statistical Package for the Social Sciences (SPSS) software version 26.

2. Assessment of water demand

Domestic sector water demand and consumption is so high and experiencing an increasing trend will threaten water sustainability. Although Malaysia is a country rich in water resources, but clean water safe to use is declining. Thus, water management measures are able to control domestic water demand needs to be implemented. According to Chan (2008), a water demand management approach is key towards water resources management sustainable and effective in reducing domestic water consumption. This approach requires consumer commitment whether in terms of energy, time or money to managing water demand and in turn reducing total water consumption. According to DID (2011), water demand management involves the receipt and implementation of strategies by consumers to influence water demand and water usage. Thus, the practices and attitudes of consumers as well as water equipment are aspects of control by the users themselves to reduce the use of deep water daily activities.

In recent years, the demand for water in Kelantan has grown because of the population, industries and agriculture growth. In Kelantan, more than 90% of domestic water supplies come from groundwater (Wan Mohd Zamri W. Ismail, Ismail Yusoff, 2013). The projected demand for water from local governments shows that the demand for water by the state will continue to grow significantly in the coming years. Figure 1 shows projections for water demand in Kota Bharu, from 2000 to 2050, by local authorities for water supply design (SMHB, Ranhill, and Perunding Zaaba., 2000).

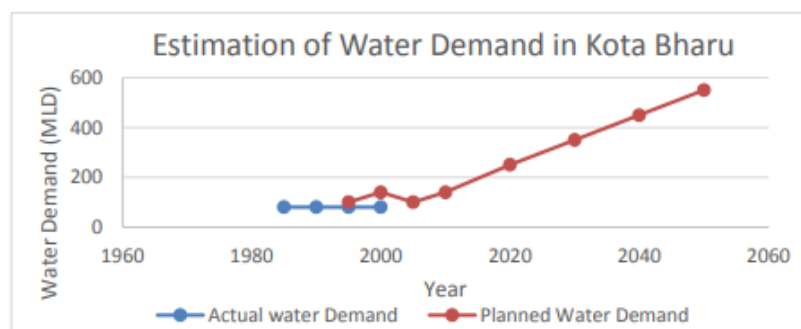


Figure 1: Estimation of Water Supply Demand in Kota Bharu (2000- 2050) (SMHB, Ranhill, and Perunding Zaaba, 2000)

2.1 Factor affecting water demand

Size of the town or cities are related to the factor of water demand. In general bigger is the town or cities, the water demand also higher in rate for domestic purposes. This is because large cities or towns

are always supplied with the sewerage system which requires large amounts of water. The huge amount of water is required to maintain a clean and healthy environment in major cities or towns for various other civic and public purposes. Next, higher population growth is another factor of water demand. Figure 2 shows population of Kota Bharu from 2015 (323,000) until 2021 (352,000). These population estimates and projections come from the latest revision of the UN World Urbanization Prospects. These estimates represent the urban agglomeration of Kota Bharu, which typically includes Kota Bharu's population in addition to adjacent suburban areas.

Kota Bharu - Historical Population Data		
Year	Population	Growth Rate
2021	352,000	1.15%
2020	348,000	1.46%
2019	343,000	1.18%
2018	339,000	1.80%
2017	333,000	1.52%
2016	328,000	1.55%
2015	323,000	1.89%

Figure 2: Population of Kota Bharu district

Besides that, climatic conditions also become the factor of water demand due to the places having hot and dry climate need for bathing, washing of clothes and air coolers in domestic used. Usually for public use will be affected by much street sprinkling, watering a supplying fountains.

The rate at which water is supplied to the consumer may also affect the rate of water demand. If the rates at which water is supplied are high, lesser quantity of water may be consumed by the people. For example, the consumers used water with minimum wastage compared to unmetered supply the consumers are charged at a fixed monthly flat rate irrespective of the quantity of water consumed by them.

2.2 Payment rate for water consumption

A water tariff is a cost to water supplied by a public utility through a piped network to its customers. Water tariffs vary widely in their structure and level between countries, cities and sometimes between user categories (residential, commercial, industrial or public buildings). The lower of water tariff experience, the higher usage of water use for users, may lead to decreased liability and waste. Nearly 20 years of unchanged water tariffs, the government proposes increasing water tariffs to restructure the water supply services industry. The higher tariff goes hand in hand with an improvement in the quality of water services, then consumers will accord the same importance to the water services industry as they do to the energy sector.

3. Methodology

The methodology part describes all the necessary information that is required to obtain the results of the study.

3.1 Data collection

A total of 50 respondents provided feedback through this survey questionnaire. This respondents of this study consists of residents who has ever lived or settled in Kelantan. The questionnaire was distributed through Google Form which is used as instrument. Then, data was analyse using SPSS

software. The process of this study ends with an interpretation based on the analysis of the findings of the study are equivalent to some useful suggestions that can be used in the future.

3.2 Descriptive analysis

Descriptive statistics was applied for respondents' demographic data such as gender, age, and residential area. Section A was collected the basic personal data to understand the background of each respondent, while in Section B was determine the water demand from both urban and rural area in terms of frequency. The measurement scales of Section A and Section B was adopted in nominal and ordinal scales. Frequency and percentage has been analysed for both part of the questionnaire.

3.3 Chi-square test

A chi-square test, also written as χ^2 is any statistical hypothesis test where in the sampling distribution of the test statistic is a chi-square distribution when the null hypothesis is true. This test measures whether there is a relationship between two categorical variable and also can be used to attempt rejection of the null hypothesis that the data are independent.

Therefore, a chi-square test was determined between residential area and water demand used. There is a relationship between the two variables which is the p-value is less than 0.05. The total groundwater consumption for one month is also compared with the water billed imposed on the community and the value of asymptotic significance (2-sided) showed a value of 0.001 which is very low compared to the p-value (0.05). This showed that the amount of monthly payment charged to the community depends on the amount of groundwater used. Based on the findings, it can be concluded that the use of groundwater is indeed high in the community although there is some problems with the water supply because of groundwater represent an alternative fresh water compared to the surface water.

4 Results and Discussion

This section presented the results using descriptive analysis and Chi-square test mentioned in the previous section. The demographic data of the respondents also known and was analysed by using descriptive statistics.

4.1 Respondent's Demographic Analysis

According to the demographic data of the respondents, 58 % of those who responded were female, with the remaining 42% of those who responded being male. Based on data compiled, the number of female respondents who participated in this questionnaire was significantly higher than the number of male respondents. Majority of this respondent that response to the questionnaire is in the age group 18-25 years, followed by 30% in the age group 26-35 years. 12 % in the 36-45 age group and 8 % in the 46- 55 years can be categorized in the middle age while 2 % in the age group 56-65 years can be categorized as elderly. Therefore, majority from young adult who answered the questionnaire and sometimes the age factor may also make it difficult for the elderly category to answer this questionnaire compared by using an interview method. Mostly, the respondents that have responded to the questionnaire are from the urban area with frequency 29, another 21 respondents live in rural area and focus from Kota Bharu district only.

4.2 Water demand in Kota Bharu district

Based on Figure 3, there are different of water demand from urban and rural areas in Kota Bharu district. Mostly water consumption used from the respondent in urban area is private water meter from AKSB's water treatment plants. In rural area, it used two water supply from AKSB and other alternative source such as groundwater. Therefore, certain household used extract groundwater or known as 'Boring water' (61.90 %) It is actually water that is pumped through a process of drilling (boring) from the groundwater to the surface through a pipeline. Another residents used groundwater and private water meter (38.10 %) for domestic purposes.

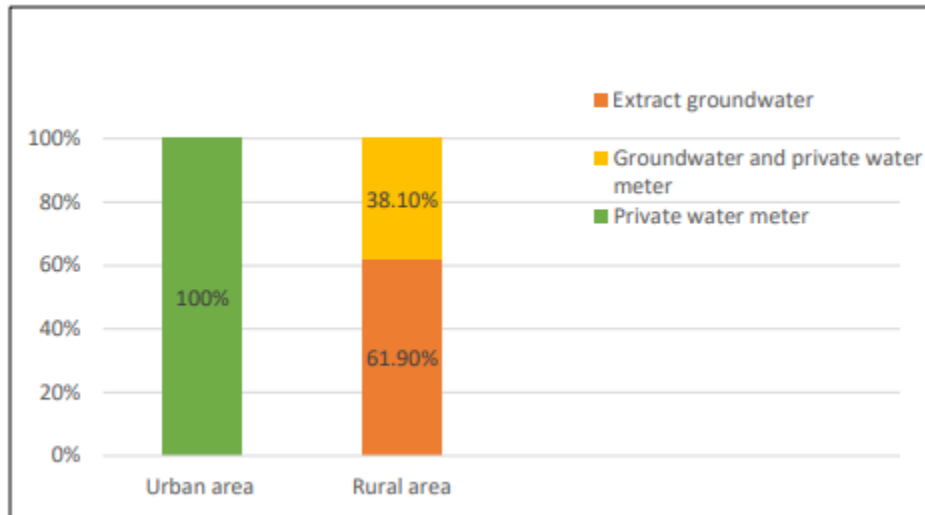


Figure 3: Water demand in urban and rural area

4.2.1 Chi square test for residential area and water demand used

The first variables studied is residential area which include of urban and rural area and the second variable is water demand used such as private water meter and groundwater. The p-value found is less than 0.05, therefore there is significant relationship between the two variables.

Table 1: Chi-square test between residential area and water demand used

	Value	df	Asymptotic Significance(2sided)
Pearson Chi-Square	50.000 ^a	2	.000
Likelihood Ratio	68.029	2	.000
Linear-by-Linear Association	42.420	1	
N of Valid Cases	50		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 3.36.

4.3 Water consumption payment rate

Table 2: Water consumption in a month

Gender	N	Below 30L (%)	30L-50L (%)	Above 50L (%)
Males	21	14.28	52.38	33.33
Female	29	3.45	34.48	62

Table 2 shows the water consumption and its classified based on their gender in a period of one month. Between the genders, the highest consumption water below 30 litre is from males (14.28 %) and females used 3.45 % of water. Water consumption of 30 litre until 50litre also being measured which is the highest usage between two gender is males but water consumption exceeding 50 litres is used by females (62 %). Therefore, the percent shows that the highest water consumption in a month is because of females used for domestic purposes. Usually Malaysians used 200 litres a day and that amount is much higher because the average water rate recommended by the World Health Organization (WHO) is 165 litres a day for each individual.

Table 3: Water consumption bills in a month

	Frequency	Percent (%)
No charge	13	26
Below RM5	1	2
RM6-RM10	13	26
Above RM10	23	43

Table 3 shows water consumption bills by respondents from urban and rural area in Kota Bharu, Kelantan in a period of one month. Usually, the respondents from rural area easy to extract the groundwater and does not have any charge. Water usage bill below RM5 is only 2 % because of using both supply from private water meter and groundwater and between RM6 to RM10 is about 26 %. Consumption of water above RM10 is 43 %. The wastage of water done is close to the cost. For example the water tariff rate in Kelantan is RM 0.45 per cubic meter and it has been divided according to categories such as domestic, commercial buildings, industrial and others. Therefore, lower tariffs experience higher usage of water among their consumers and can lead to less responsibility as well as lead to wastage.

4.3.1 Chi-square test between water consumption and water billed

The total of water consumption is also compared with the total billed imposed on the community for one month. In order to analyse the data, chi-square test has been used.

Table 4: Chi-square between water consumption and total water billed

	Value	df	Asymptotic Significance (2sided)
Pearson Chi-Square	29.061 ^a	6	.000
Likelihood Ratio	33.072	6	.000
Linear-by-Linear Association	5.159	1	
N of Valid Cases	50		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 3.36.

Table 4 shows that the value of asymptotic significance (2-sided) for these two variables is 0.001 which is very low compared to the p-value (0.05). Therefore, this amount of monthly payment charged to the community depends on the amount of groundwater used. If water consumption is high, then the billed charged is also high depending on the water tariff.

5 Conclusion

As a conclusion, groundwater use is a common occurrence among the community in Kelantan. This study aims to determine the water demand from urban and rural area in Kota Bharu district. This study focus on one district only due to the highest consumption of groundwater in the area. In addition, water demand used in urban area is a treated water provided by Air Kelantan Sendirian Berhad (AKSB) due to the locations are not suitable for excavation because in some other places, the smell of the water will

deterioration. In rural area, the community used private water meter and also other alternative source such as groundwater. Therefore, a chi-square test was determined between residential area and water demand used. There is a relationship between the two variables which is the p-value us less than 0.05. The total groundwater consumption for one month is also compared with the water billed imposed on the community and the value of asymptotic significance (2-sided) showed a value of 0.001 which is very low compared to the p-value (0.05). This showed that the amount of monthly payment charged to the community depends on the amount of groundwater used. Based on the findings, it can be concluded that the use of groundwater is indeed high in the community although there is some problems with the water supply because of groundwater represent an alternative fresh water compared to the surface water. Therefore, the proposal for future work is, the parties involved can ensure that the use of surface water is also one of the high demand for water supply.

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