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Study on Water Pollution Impacts on Human Health from Water Usage based on Household's Perception at Setiu River Basin

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ABSTRACT

Anthropogenic activity near the Setiu River basin can have a detrimental effect on people who use water in the area in terms of their body health. This study was important to assess the impact of river water degradation based on household perception so that the related parties can take intensive action to address this problem on the impact of river water degradation on human health. It involved 203 locals living along the Setiu River basin. Questionnaires were distributed and collected through face-to-face and "Google forms". The survey was conducted for four months from 1 January 2022 to 1 May 2022. All the respondents were locals who are Malaysian citizens. The data were obtained through questionnaires including questions based on a 5-point Likert scale and analysed by the Statistical Package for Social Science (SPSS) Software. Current water quality data was obtained through secondary data from the Department of Environment (DOE), Terengganu. The respondents' Income, Awareness, Knowledge, and Attitudes supported the hypothesis that demographic and socio-economic factors had significant differences in the risk perception for the impact of water pollution on human health. This study identified health issues related to the water pollution of Sungai Setiu among the residents from the questionnaire distributed by a regression analysis model.

Keywords: Setiu River, water pollution, questionnaire, regression analysis, human health

INTRODUCTION

Water is the most important resource for living things that are required for survival such as drinking, domestic, agriculture, industrial, recreational, wildlife, and other uses. It is very important to sustain clean water resources for living uses. However, there are many factors affecting water pollution to occur such as urbanization, industrialization, agriculture, and a human population that increasing over centuries which will led to aesthetic and detrimental effects on aquatic life and those who consumed the water.

Located in the Setiu district of Peninsular Malaysia, Setiu river basin is receiving runoff from three major tributaries that are the Guntung River, the Tarum River, and the Caluk River. Approximately it has 188 km² and

52 km in length of catchment area. Setiu River has an important role for local people living along the river basin especially for domestic usage and as resources of clean water in agricultural and freshwater aquaculture industry. According to the 9th Malaysia Plan had been drafted to develop Setiu as a gateway for economic development and outcomes on the east coast of Malaysia. However, this was leaded to massive land clearing and construction activities along the building process of the infrastructure that is being conducted at Setiu which can causes environmental stress along with rapid population growth in the Setiu district, especially for water bodies which resulted in water pollution (Suratman & Talib 2015; Suratman et al. 2014).

The effect in consuming polluted water was well known as dangerous for body health (Ashraf et al., 2013). Human heart and kidneys can be damages from regular consumption of polluted water. Poor blood circulation, vomiting skin lesions, and damage to the nervous system are parts of many diseases related to water pollution impact for human bodies (Ghafoor et al., 1994).

According to Williamson & Weyman (2005), the idea that risk perception is influenced by social relations and trust in risk management institutions has wide support and increasing concern over the limitation of approaches that do not account for social explanations. The government's water resources management program influenced people's attitudes towards and perceptions of water resources as people's intentions that were the necessary ingredients for political will and action (Miller, 2018; Dent, 2013). This study was carried out concerning the people's willingness by collecting their perceptions to participate in integrated water resources management based on regression analysis. Hence, this study explored people's behavioural intentions in the Setiu River Basin, Malaysia to identify their health regarding river water states and to determine demographic and socio-economic factors that could influence their risk perception by using regression analysis.

MATERIALS AND METHODS

Study area

Sungai Setiu is important to the communities as its use for irrigation and sources of water supply for domestic and agricultural use, fishing, and wastewater dilution. Setiu Wetland is associated with Sungai Setiu which the wetland receives freshwater inputs from the river that flows into the wetland from the southeast (Tahir et al., 2006) (Suratman et al., 2014). Table 1 shows the coordinates for the sampling checkpoint along the Setiu river basin.

Table 1. Coordinate data Collection Checkpoints along Setiu River basin (Koh et al., 2015).

Checkpoint	Location Name	Coordinate	
		Latitude	Longitude
C1	Kampung Mangkuk	5°37'59.49"N	102°47'14.23"E
C2	Kampung Penarik	5°35'40.80"N	102°49'9.84"E
C3	Kampung Che Selamah	5°35'23.60"N	102°46'57.29"E
C4	Kampung Guntung Dalam	5°35'43.50"N	102°49'3.09"E
C5	Kampung Guntung Luar	5°33'22.07"N	102°40'30.95"E
C6	Kampung Tasek	5°32'48.73"N	102°45'26.92"E
C7	Loji Air Ibu Bekalan Setiu	5°31'46.82"N	102°44'47.37"E
C8	Bandar Permaisuri	5°29'48.60"N	102°43'23.22"E

C9	Kampung Besut	5°28'57.94"N	102°41'9.90"E
C10	Kampung Hulu Seladang	5°28'59.32"N	102°40'37.59"E

Questionnaire development

The questionnaire was developed by considered many questions that concerned the problem regarding pollution of water. The questionnaire divided into three sections. First section contained information in demographic area of the participants included gender, age, race, education, occupation, and income. For second section questions developed was related to water pollution and health issues and the third section included contents to discover participant perception, awareness, knowledge, attitudes, and behaviour towards water pollution and its impact on human health. For third section, the respondents were asked to give their response based on a 5-point Likert scale by using the scale between "1-strongly disagrees" to "5-strongly agree". This gave the respondents flexibility when answering the questions. The questionnaire items were created in Malay language to make them easy to understand by all the respondents with different education backgrounds as Malay language acts as intermediate language for Malaysian (Afroz et al., 2016).

Data collection

The surveys were conducted for 4 months from 1 January 2022 until 1 Mei 2022. All the respondents were Malaysian citizens. The questionnaires were distributed and collected through face-to-face interviews and *Google form*. A random sampling method was used to select the respondents. Respondents for this survey were local people aged above 18 years old and residents along Setiu River basin. A total of 203 questionnaires were distributed to individual respondents. As stated by Hoe, (2008), a sample size of 200 offers enough statistical strength for data analysis. The sample size was 203 people. Secondary data for river water quality status from Department of Environmental, Malaysia was used for this study. DOE is the agency that helps to monitor river condition in Malaysia and form guideline for standard quality of river water from sources of pollution identification.

Specification of model

The effect of demographic and socio-economic variables on risk perception of water pollution was estimated using regression analysis model as shown in Equation 1 below:

RPOWP= $a + \beta_1 ¼ Gen_1 + \beta_2 Age_2 + \beta_3 Edu_3 + \beta_4 Inc_4 + \beta_5 Att_5 + \beta_6 Awn_6 + \beta_7 Knw_7 + \varepsilon$ Equation 1

As stated in an Equation 1 by Afroz et al., (2016) above, Table 2 below shown variables that are used in the regression analysis. Statistical Package for Social Sciences (SPSS) Version 26.0 software was used to analysis multiple regressions.

Table 2. Variables use in regression analysis and its' description (Afroz et al., 2016).

Variables	Description of the variable
Gender (Gen)	Male, Female
Age	Age of the respondents
Education (Edu)	Education level
Income (Inc)	Household monthly income level
RPOWP	Risk perception of water pollution

Awn	Awareness of water pollution
Knw	Knowledge of water pollution
Att	Attitudes towards water pollution

RESULTS AND DISCUSSION

Setiu River water status

From this study, Table 3 shown that WQI ranged from 71 to 82 and the low WQI values were recorded at Jambatan Kampung Penarik located at the downstream location while the highest WQI was recorded at US Water Intake Kampung Besut which was located at the upstream location. Jambatan Kampung Penarik was marked as polluted site and these probably due to the accumulation of waste from the upstream and unregulated discharges from surrounding area. However, Kampung Buloh which located at the middle section of the river also identified among polluted site and the degradation in quality at this site due to high populated area resulted in unregulated discharges into the river. Overall, the mean WQI value obtained was 77, and it indicated that the quality status of Sungai Setiu Basin was slightly polluted with minimum pollution effect. According to INWQS classification, WQI value of 77 falls in Class II (WQI 71-82). Differ from previous study that obtained mean WQI value at 84.0 that categorized Setiu River as clean condition. As INWQS classification, WQI value of 84.0 falls in Class II (WQI 76.6-92.7)(Zaideen et al., 2017). That was shown the water quality degradation at Setiu River. Based on the interviewed with local people, they stated that early this year the sand mining activities that started at upstream river at Kampung Hulu Seladang causes river water clarity reduces specially to middle stream and downstream river. The recreational activities at upstream river, Lata Cangkah also cause accumulation of waste and trash down the river. From local information, the aquaculture activities at middle stream river causes them to loss their source of income because of the decreasing in fishes and crustacean population and cause the degradation in water quality at downstream river.

Table 3. Setiu River Water Quality Index (WQI) status (DOE, Malaysia 2020)

Coordinate		Location	WQI	Class	River Status
Latitude	Longitude				
5.52225	102.745	Kampung Buloh	78	II	Slightly Polluted
5.6045	102.814	Jambatan Kampung Penarik	71	III	Slightly Polluted
5.48431	102.709	US Water Intake Kampung Besut	82	II	Clean

Demographic information of the respondents

A total of 203 residents were approached. The demographic information of the respondents was summarized in Table 4 below. Most of the respondents were male (52 %) and the highest age range of respondents was between 56 years old and above (37 %). The race that involved in the survey was only Malay because majority of the residents are Malay people while other races are hardly to find. Most the respondents' education levels were between primary school and below (43.35%) and had the lowest income between RM 1000 and below per month (63.55%). There were only 0.46% respondents with an income of RM 3000 and above per month. From previous study, majority income between RM 2,000 and below per month (36.7%) while minority 3.5%

respondents with an income of more than RM 8,000 per month (Afroz et al., 2016). There was a bigger different in range of income because the previous study was held at Gombak River that is the city area while this study was held at Setiu River that is small town in Setiu district that starting to develop.

Table 4. Demographic information of the respondents (N=203)

Basic information	Group	Frequency	Percentage (%)
Age	18-25	31	15.27
	26-35	31	15.27
	36-45	21	10.34
	46-55	44	21.67
	56 and above	76	37.44
Gender	Male	105	51.72
	Female	98	48.28
Race	Malay	203	100.00
	Chinese	0	0.00
	Indian	0	0.00
	Other	0	0.00
Educational level	Primary school and below	88	43.35
	Secondary school	57	28.08
	SPM	40	19.70
	Diploma and skills certificate	13	6.40
	Degree and above	5	2.46
Income (RM/ month)	1000 and below	129	63.55
	1500 and below	43	21.18
	2000 and below	18	8.87
	3000 and below	12	5.91
	3000 and above	1	0.49

Perception of local people in pollution of water

The questions were designed to identify the general perception of households regarding water pollution. As shown in Table 5 below, 98% of the respondents are aware about causes of water pollution, 100% believed water pollution harms health and 98% stated that polluted water transmits various diseases. Moreover, the findings showed that 99% interested to attend educational programs on the health impact of polluted water and

99% mentioned that there are needs for someone to come to them to explain the water situation in their areas. As concluded by Afroz et al., (2016), 72.2% stated that polluted water transmits various diseases that lower than this study. It was shown that local people at Setiu River had more awareness on the health issue related to water pollution.

Table 5. Household perception

Items	Percentage (%)	
	Yes	No
1. Polluted water can harm human health (RPOWP).	100	0
2. It is important to have awareness on water pollution impact (Awn).	98	2
3. Polluted water can transmit various diseases (Knw).	98	2
4. It is crucial to attend educational programs on the health impact of polluted water (Behaviour).	99	1
5. There is a need for someone to visit you to explain water situation in your area (Att).	99	1

Diseases causes by water pollution

The respondents were required to choose the three specific diseases caused by water pollution in Setiu River. As shown in Fig. 1, 43% of the respondents selected diarrhea as the most serious disease. Similar results were found for the Gombak River basin in Malaysia (Afroz et al., 2016). About 33% agreed that all stated diseases were caused by water pollution, and only 1% chose hepatitis and dengue as related diseases. Half (22%) of those who chose others were ignorant of the disease, and half of them stated they had cases of Leptospirosis from river water in their area. These can be demonstrated from a previous study by Halim et al. (2019), which found Leptospira sp. positive samples in water and soil samples collected from rice fields and oil palm plantations in Setiu. *Leptospira* sp. outbreak from samples of water and soil could cause by widespread of rat species or other host for *Leptospira* sp. in that area. Pathogen would be spread through direct contact with urine or body fluids from contaminated animals or host through direct and indirect contact to the soil and water with that bacterial species. It is well known that mammalian like rodents excrete *Leptospira* sp. in their urine and make as reservoirs for leptospirosis transmission. *Leptospira* sp. can appeared in the surface water on the rainy days.
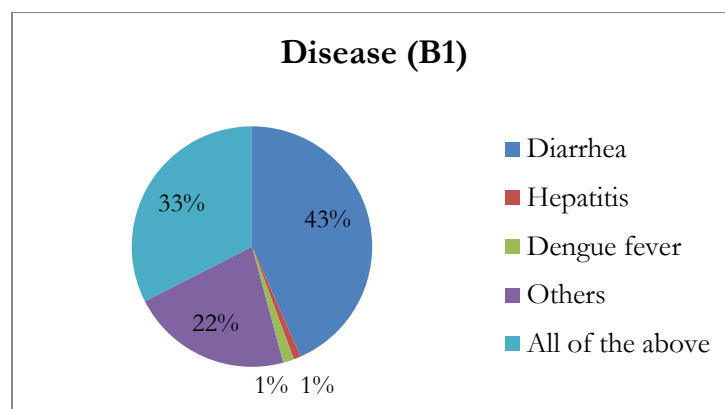

Fig. 1. Diseases caused by water pollution

Setiu River water usage

As a result in Fig. 2 shown 36.69% used Setiu river as irrigation and drainage for paddy, domestic, industrial, commercial, institutional demands and demand for animal husbandry as also marked by Department of Irrigation and Drainage (2021). There were 4.43% use river water as drinking water while 10.34% use as their food sources such as fishing and 10.34% use as their clean water resources especially when no water supply. 33.99% respondents expressed that they use river water for all the usage in their daily lives infrequently. The remained 4.93% never use river water in their daily life.
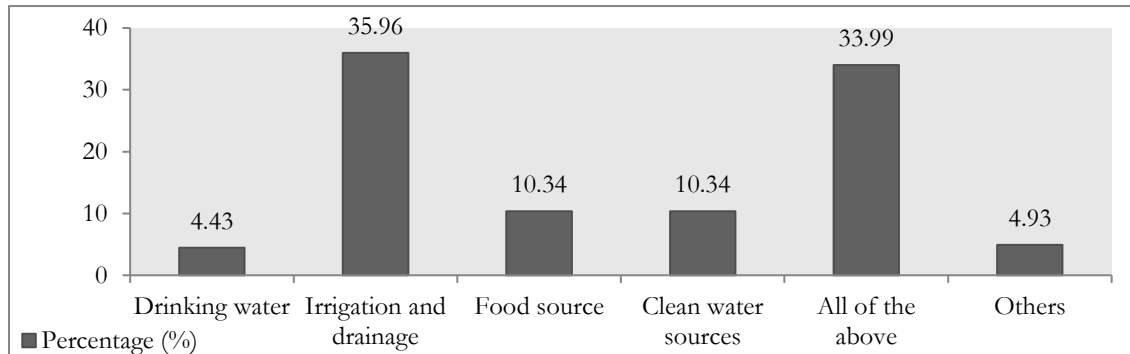
Fig. 2. Bar graph on Setiu River water usage.

Sources of Clean Water

Respondents were asked where they got drinking water. There were various sources for drinking water. Based on Fig. 3, 63% respondents only using pipe water while 16% of respondents uses river as the source of clean water and only 1% do not know the source of their drinking water. About 20% received water directly from water treatment plant. According to JPS (2021), 99% of Setiu district receives water from Syarikat Air Terengganu (SATU). From these findings, we can see that the most people do not know their sources of clean water and they don't receive the clear information about their clean water resources from the responsible agencies.
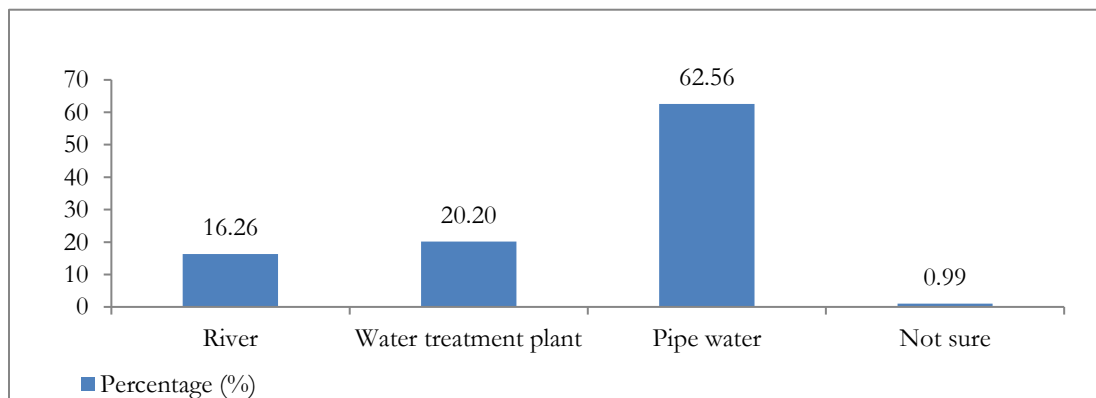

Fig. 3. Sources of household's clean water

Water pollution information sources

Respondents were asked how they knew about water pollution. The bar chart below shows that 46% of respondents obtained knowledge of water pollution from television, 35% from the internet, 12% from the community, 1.48% from friends, 0.49% from newspapers, and 4.93% from other sources, and some of them

never heard of water pollution. As a result from Afroz et al. (2016), 48% of respondents had obtained knowledge about water pollution from newspapers, 29.4% from television, 6.9% from internet, 6% from friends, 6.5% from the community and 3.2% from advertisements. As compared with previous study, it shown that nowadays people tend to use internet to gain knowledge and information than print media because it is more convenient, reasonable, and easy to get.
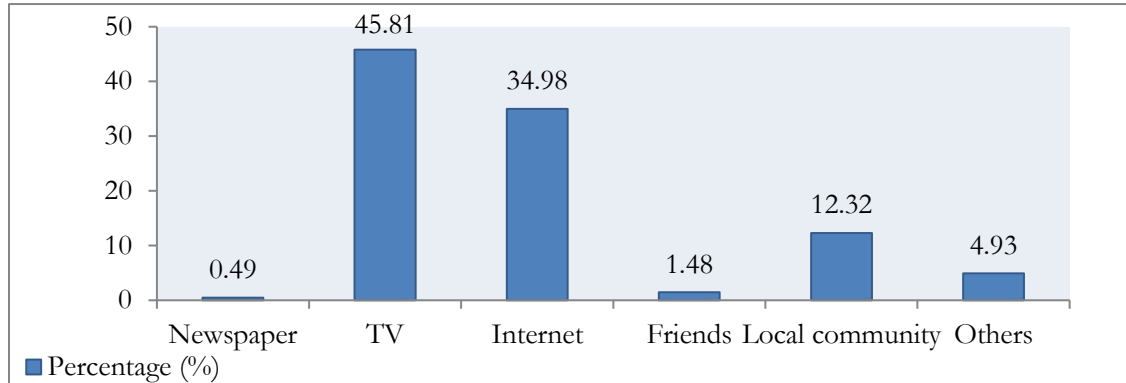

Fig. 4. Sources of information

Factor affecting risk perception on water pollution

Based on this study, demographic and socio-economic variables were hypothesised had different significant effects on risk perception of water pollution. Table 6 below shows that the value of adjusted R^2 was 0.65, suggesting that approximately 65% of the disparity in the risk perception of water pollution (RPOWP) can be clarified by estimated model. The F-statistic value (53.408) signifies that the general significance of the model was comparatively low at 0%. The coefficients of regression prove the sum has nature and greatness of the relationship among the variables, but some are not. The positive coefficients of Income (β= 0.016), AWN (β= 0.551), KNW (β= 0.095) and ATT (β= 0.248) indicate that the RPOWP has a positive relationship with the variables. Nonetheless, the coefficient communicates merely the greatness. To test the significance of the coefficients a t-test was employed. The result of the t-test displayed seven variables, namely gender, age, education, income, AWN, KWN and ATT were significant at 6% (p < 0.06) while gender was at 92%, ages was at 58%, education was at 18%, income was at 73% and KWN was at 23% significant level, respectively. From the statistics shown in Table 6 and the analysis presented below, it can be asserted that respondents that had high income, aware of water pollution, have knowledge of water pollution and favourable attitudes have greater influence on risk perception of water pollution. These results were shown that not all demographic and socio-economic factor influence risk perception on water pollution at Setiu River basin as shown in formula (2) below. Different from the result concluded in Afroz et al. (2016) study that all the demographic and socio-economic factors had significant different effects on risk perception. In this study, from all demographic and socio-economic factors listed, only income, AWN, KNW and ATT had supported the hypothesis with significant different effects on risk perception. From the result, it simplified the regression model by equation below:

$$\text{RPOWP} = a + \beta_1\,\text{INC}_1 + \beta_2\,\text{ATT}_2 + \beta_3\,\text{AWN}_3 + \beta_4\,\text{KNW}_4 + \varepsilon$$

Table 6. Factor influencing risk perception of water pollution along Setiu River basin

	Coefficient	Standard error	*t*-value	Significant
(Constant)	-	0.216	5.841	0.000
Gender	-0.027	0.014	-0.549	0.584
Age of respondent	-0.005	0.037	-0.107	0.915
Education	-0.071	0.021	-1.350	0.179
Income	0.016	0.022	0.346	0.730
AWN	0.551	0.063	7.409	0.000
KNW	0.095	0.067	1.198	0.232
ATT	0.248	0.049	4.425	0.000
R^2	0.657			
Adjusted R^2	0.645			
Durbin Watson	1.920			

CONCLUSION

Demographic and socio-economic factors that had impact in this study for local people along Setiu River basin were income, AWN, KNW and ATT that had been supported the hypothesis with significant different effects on risk perception. From this study, it was summarized that the respondents that had high income, aware of water pollution, have knowledge of water pollution and favourable attitudes have greater influence on risk perception of water pollution. Result from local people shown that not all demographic and socio-economic factors were influence risk perception on water pollution. The study was shared with responsible agencies that are Department of Irrigation and Drainage (JPS), Malaysia and Department of Environment (DOE), Malaysia that shown them on the local perspective in this issue related.

In order to minimize the impact of pollution in the study area, the responsible agency and people should work together on monitoring river water to ensure clean water resources to be preserve. The authority should provide adequate sewage and drainage systems as well as formulate stringent pollution control regulations and educate the people of this city to develop an ecological conscience. Then, conservation programme by the government should continue "International Day of Action for Rivers", programme that celebrate at 14 Mac every year to give consciousness to people especially on the important of river and bad impact on them from bad water quality. Finally, personal consciousness is one of the most important recommendations to protect water from pollution. Therefore, an individual should not use any products that are harmful to the environment by using biodegradable materials.

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