© 2015 IJSRST | Volume 1 | Issue 3 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science

Law Enforcement and Water Resources of the Malacca River A Case Study of Public Perception

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ABSTRACT

Malacca state is a historical tourism based economy, and has been recognized by UNESCO as a world heritage site. However, Malacca River pollution can be attributed to human activities such as agriculture, livestock, factories, commercial, and settlements. So, this research study has been conducted to determine the effectiveness of law enforcement of water resources in the Malacca River. The research involves a quantitative approach, which is a questionnaire divided into two parts. Part A is a demographic profile and part B concerns water pollution in the river and the effectiveness of law and regulation towards water resources in Malacca River. The sample size of 400 was decided with a sampling area of Alor Gajah and Melaka Tengah. Analyses involve chi-square (x^2) analysis and correlation analysis. A majority of respondents agree that the Malacca River is dirty due to industrial and excretory waste turning the water black, smelly, and contaminated. Polluted water cause disease and poisoning aquatic animals to death, and affect plant species through nutrients loss. At worst, polluted river leads to aquatic species becoming extinct and dirty the habitat of animals. Hence, the Water Act 1920, Environmental Quality Act 1974, Sewage and Industrial Effluent 1979, Sewage Service Act 1993, and River Act could stop pollution and protect the water resources of the Malacca River.

Keywords: Human Activities, Water Pollution, Law Enforcement, Wastes, Protect.

I. INTRODUCTION

Water is one of the important resources among the air, soil, solar energy, metals, minerals, and so on, which act to protect the Earth from overheating through the evaporation process, generate food sources, serve as transportation, and help the growth of animals and plants. According to a research entitled 'Water in Crisis: A Guide to the World's Fresh Water Resources', ice caps, glaciers and permanent snow have 68.7% of freshwater, followed by ground freshwater with 30.1%, lake freshwater with 0.26%, swamp freshwater with 0.003%, and river freshwater with 0.006% [5]. However, only 0.26% of freshwater is available as a source of water for drinking, bathing, washing, and others activities, and these water sources are lakes and rivers [5]. The situation becomes worst as 90% of wastewater produced in underdeveloped countries is discharged untreated into water bodies and cause water pollution to happen [16]. For example, 80% of China's major river is polluted and no longer able to support aquatic life while 90% of all groundwater systems under major cities in China are contaminated. 75% of India's rivers and lakes are polluted and cannot be used for drinking or bathing, while 60% of rural Russian drink water from contaminated wells [4]. So, increasing of river water pollution is not only happening worldwide, but these problems also affect a country like Malaysia.

According to Department of Environment Malaysia [2] stated that among 473 rivers monitored, only 278 (59%) are believed to be clean, but 161 (34%) are considered as slightly polluted and 34 (7%) are totally polluted. In other words, among 34 polluted rivers, 19 rivers are classified as Class III, 14 rivers as Class IV, and only one river is Class V [2]. The rivers that categories as polluted are Sungai Rajang, Sungai Selangor, Sungai Sarawak, and etc., which also include Sungai Melaka or

Malacca River in Malacca state [2]. As proved, water contamination in the Malacca River had affected local residents in carrying out daily activities such as fishing, bathing, washing, and so on [13] [9] [6]. Generally, Malacca is a state that based on historical tourism which been recognized by UNESCO as a world heritage site on July 07, 2008 [15] [1]. Tourism is an industry that generates economic value to the country through arrival of tourists from local and international [14]. Therefore, if water pollution is continuously happen in Malacca River, so this will not only affect the environment but also have a negative impact on the tourism industry. So, this issues and problems should be taken seriously in dealing with water pollution in Malacca River.

Malacca River pollution can be attributed to human activities such as agriculture, livestock, factories, commercial activities, and settlements [7]. According to a research done by Hua [8], stated that application of policy in controlling and managing the water resources in Malacca River can be successfully implement. However, the policy will take a long term to implement. So, there are suggestion to use law and regulation in preventing water pollution from continuously happen in Malacca River for this short term. The law can be categorized into several sections, namely Water Act 1920, Environmental Quality Act 1974, Sewage and Industrial Effluent 1979, Sewage Service Act 1993, and River Act [3]. Generally, the main purposed of Water Act 1920 is that any individual is prohibited from releasing or removed any material into the river that can change the original quality of the water; continued by Environmental Quality Act 1974, which states any individual release, remove, settling of waste in an area, segment, or any feature of environment without following the prescribed conditions; Sewage and Industrial Effluent 1979 states that individual is prohibited from removing or causing or permit the discharge of any material involve with liquid or solid form in upstream area which can cause river water quality to decrease. The Sewage Service Act 1993 states that any individual shall not discharge or allow any public sewer or public treatment of any industrial effluent except formal permission from Director General of Sewage Services into river water; and the last one is the River Act which imposes restrictions and sanctions for inland water pollution (only for those who have licensed and followed the conditions can release or discard wastes into inland water or inland waters) [3]. Therefore, research studies have been conducted to determine the effectiveness of law enforcement for the water resources in the Malacca River.

II. METHODS AND MATERIAL

The method used in this research study is a quantitative approach, which involves questionnaires for collecting the data. In other words, the data as collected and gathered will only involve primary data. In this questionnaire, will be divided into two main parts. Part A is respondent's demographic profile and part B is respondent's perception on water resource in Malacca River. There are another two parts in part B, while part B (I) contains respondent perception on water pollution in Malacca River and part B (II) contains respondent perception on the effectiveness of law and regulation on the environment, especially towards water resources in Malacca River. The questionnaire in part B (I) and part B (II) only has 5 questions for each part and is based on a Likert Scale (5 points: 1-Strongly Disagree, 2-Disagree, 3-Normal, 4-Agree, 5-Strongly Agree), which is referred to as a 'close-ended' approach. However, the part A is based on Thurstone scale of 'close-open ended', where respondent are given an answer to fill in the empty space (where applicable).

Since this research study is based on the Malacca River, the sampling area will be in Malacca state, especially respondents settled near the Malacca River. In general, the Malacca River spans two districts in Malacca State, namely Alor Gajah and Melaka Tengah (or Malacca Central) [11]. So, the questionnaire is concentrated on and distributed to respondents within Alor Gajah and Melaka Tengah, especially along and near the Malacca River. Once the sampling area is specified, the researcher determines the sample size needed. Since total population that lives in Malacca state is 830,900 [12], so the appropriate amount to collect data is 400 respondents [10]. The questionnaire was collected and gathered after the respondents successfully answered all parts. The analysis used in this research study is chi-square (x^2) analysis and correlation analysis. So, the value of reliability test (or Cronbach's Alpha) is 0.813; means items are satisfactory, suitable, and eligible for use in this analysis study.

III. RESULT AND DISCUSSION

The analysis for this research study can be seen in Table 1 for respondent's demographic profile, Table 2 for respondent's perception on water pollution in Malacca River, and Table 3 for respondent's perception on the effectiveness of law and regulation on the environment, especially regarding water resources in the Malacca River.

Table 1: Respondent's demographic profile

Category	Frequency	Percentage (%)	Total
Gender			
Man	200	50	
Women	200	50	400 (100%)
Age			
<20	1	0.25	
21-30	78	19.5	
31-40	183	45.75	
41-50	130	32.5	
51>	8	2	400 (100%)
Education Level			
Primary School	52	13	
Secondary School	166	41.5	
College	108	27	
University	74	18.5	400 (100%)
Occupation			
Government	30	7.5	
Private	86	21.5	
Self-Employment	131	32.75	
Retirees	78	19.5	
Student	75	18.75	400 (100%)
Number of Years Live in Malacca (years)	40	10	
1-10	70	17.5	
11-20	130	32.5	
21-30	119	29.75	
31-40	40	10	
41-50	1	0.25	400 (100%)
>51			

According to the Table 1, the total respondents involved in this research study were 200 males and 200 females with a majority at age 31-40 (45.75%) and working as a business owner or self-employment (131 respondents or 32.75%). Basically, minority respondents that run business will have higher education, but the respondents will only be studied until the secondary level (166 respondents or 41.5%) or even primary level (52 respondents or 13%) because they must continue the family business to prevent from closing, and most of respondents are in the age of 41-50 with 130 respondents (32.5%). There are also respondents that working in the private sectors with 86 respondents (21.5%) and government sector with 30 respondents (7.5%). In other words, a majority of respondents have a higher education level, with 74 respondents (18.5%) are graduate university and 108 respondents (27%) are graduate college. Only a small number of respondents at 8 respondents (2%) have an age of more than 51 and have chosen to retire and stay at home (78 respondents or 19.5%; with certain respondents are age 41-50). It is important to know the duration of respondents living in Malacca state especially near to the river (with a majority of respondents at 130 or 32.5% stay at Malacca for 21-30 years, 1 respondent or 0.25% resided more than 51 years in Malacca) because the exposure and experience of respondents with water resources in Malacca River will provide accurate and precise answers to the questions in the questionnaire provided.

Analysis of respondent's perception on water pollution in Malacca River may be seen in Table 2. This analysis involves a chi-square (x^2) test between education level and perception on water pollution in Malacca River.

Table 2: Respondent's perception on water pollution in Malacca River

Variable A

Education Level		Malacca River is dirty.					Total
		SD	D	N	A	SA	
University	EC	-	6.5	19.8	26.1	21.6	74
	SR	-	-2.2	-1.5	0.2	2.4	
College	EC	-	31.6	9.5	28.9	38.1	108
	SR	-	-1.4	0.5	0.8	0.3	
Secondary school	EC	-	14.5	44.4	58.5	48.6	166
	SR	-	-0.1	-1.1	0.1	1.1	
Primary school	EC	-	15.2	18.3	4.6	13.9	52
	SR	-	-2.9	-0.8	2.1	2.7	
						Total	400

*EC means Expected Count; SR means Standard Residual; SD means Strongly Disagree; D means Disagree; N means Normal; A means Agree; SA means Strongly Agree.

Chi-Square Test (x^2)

	Value	df	Asymp. Sig (2-sided)
Pearson Chi-Square	38.649[a]	9	0.000
Likelihood Ratio	42.094	9	0.000
Linear-by-Linear Association	17.298	1	0.000
N of Valid Cases	400		

a. 1 cells (6.3%) have expected count less than 5. The minimum expected count is 4.55.

Variable B

Education Level		Industrial waste and excretion waste will cause the water in the river to become black color, smelly, and contaminated.					Total
		SD	D	N	A	SA	
University	EC	-	5.9	25.7	30.3	12	74
	SR	-	-0.8	-1.5	-0.1	2.9	
College	EC	-	44.3	8.6	37.5	17.6	108
	SR	-	-0.6	1.5	0.9	-1.3	
Secondary school	EC	-	13.3	57.7	68.1	27.0	166
	SR	-	-0.9	0.3	0.2	-0.2	
Primary school	EC	-	8.5	4.2	21.3	18.1	52
	SR	-	-1.2	0.4	0.6	0.0	
						Total	400

*EC means Expected Count; SR means Standard Residual; SD means Strongly Disagree; D means Disagree; N means Normal; A means Agree; SA means Strongly Agree.

Chi-Square Test (x^2)

	Value	df	Asymp. Sig (2-sided)
Pearson Chi-Square	19.291[a]	9	0.023
Likelihood Ratio	18.197	9	0.033
Linear-by-Linear Association	3.211	1	0.073
N of Valid Cases	400		

a. 1 cells (6.3%) have expected count less than 5. The minimum expected count is 4.16.

Variable C

Education Level		Polluted water river can cause disease, cause aquatic animals to death and become habitat to dirty animals.					Total
		SD	D	N	A	SA	
University	EC	-	0.4	8.1	32.2	33.3	74
	SR	-	-0.6	-2.5	0.3	1.0	
College	EC	-	0.5	11.9	47.0	48.6	108
	SR	-	-0.7	0.0	-0.3	0.3	
Secondary school	EC	-	0.8	18.3	72.2	74.7	166
	SR	-	-0.9	0.4	-0.6	0.5	
Primary school	EC	-	23.4	0.3	22.6	5.7	52
	SR	-	-2.6	3.4	1.1	2.2	
						Total	400

*EC means Expected Count; SR means Standard Residual; SD means Strongly Disagree; D means Disagree; N means Normal; A means Agree; SA means Strongly Agree.

Chi-Square Test (x^2)

	Value	df	Asymp. Sig (2-sided)
Pearson Chi-Square	34.443[a]	9	0.000
Likelihood Ratio	33.472	9	0.000
Linear-by-Linear Association	16.068	1	0.000
N of Valid Cases	400		

a. 4 cells (25%) have expected count less than 5. The minimum expected count is 26.

Variable D

Education Level		Contaminated water can cause aquatic species to become extinct.					Total
		SD	D	N	A	SA	
University	EC	-	0.4	10.9	27.4	35.3	74
	SR	-	-0.6	-1.2	-0.8	1.5	
College	EC	-	40.0	0.5	15.9	51.6	108
	SR	-	-0.5	0.6	1.0	-0.2	
Secondary school	EC	-	0.8	24.5	61.4	79.3	166
	SR	-	-0.9	-0.7	-0.3	0.8	
Primary school	EC	-	24.8	0.3	19.2	7.7	52
	SR	-	-2.8	1.5	2.2	1.2	
						Total	400

*EC means Expected Count; SR means Standard Residual; SD means Strongly Disagree; D means Disagree; N means Normal; A means Agree; SA means Strongly Agree.

Chi-Square Test (x^2)

	Value	df	Asymp. Sig (2-sided)
Pearson Chi-Square	24.498[a]	9	0.004
Likelihood Ratio	25.956	9	0.002
Linear-by-Linear Association	7.831	1	0.005
N of Valid Cases	400		

a. 4 cells (25%) have expected count less than 5. The minimum expected count is 26.

Variable E

Education Level		Water pollution can cause the loss nutrients and will effect the plants species.					Total
		SD	D	N	A	SA	
University	EC	-	8.5	23.7	30.0	11.8	74
	SR	-	-1.9	-1.2	1.1	1.5	
College	EC	-	43.7	34.6	16	17.3	108
	SR	-	-0.3	0.4	12.4	-1.0	
Secondary school	EC	-	19.1	53.1	67.2	26.6	166
	SR	-	-0.2	-0.6	0.0	1.1	
Primary school	EC	-	21.1	16.6	6.0	8.3	52
	SR	-	-0.9	1.8	1.2	-2.2	
						Total	400

*EC means Expected Count; SR means Standard Residual; SD means Strongly Disagree; D means Disagree; N means Normal; A means Agree; SA means Strongly Agree.

Chi-Square Test (x^2)

	Value	df	Asymp. Sig (2-sided)
Pearson Chi-Square	22.586[a]	9	0.007
Likelihood Ratio	25.105	9	0.003
Linear-by-Linear Association	8.835	1	0.003
N of Valid Cases	400		

a. 0 cells (0%) have expected count less than 5. The minimum expected count is 5.98.

According to the Table 2, the analysis of respondent's perception on water pollution in Malacca River can be describe through x^2 test between education level with five variables, namely variable A, Malacca River is dirty; variable B, industrial waste and excretion waste will cause the water in the river to become black color, smelly and contaminated; and variable C, that polluted water river can cause disease, cause aquatic animals to die and become a dirty habitat to animals; variable D, contaminated water can cause aquatic species to become extinct; and variable E, water pollution can cause the loss of nutrients and affect plants. The results show that there is a significant correlation (x^2 = 38.649, df = 9, P < 0.05) in variable A between education level (university level: 26 agree, 21 strongly agree; college level: 9 normal, 28 agree, 38 strongly agree; secondary level: 58 agree, 48 strongly agree; primary level: 4 agree, 13 strongly agree) with Malacca River is dirty. Secondly, variable B showed significant correlation (x^2 = 19.291, df = 9, P < 0.05) between education level (university level: 12 strongly agree; college level: 8 normal, 37 agree, 17 strongly agree; secondary level: 57 normal, 68 agree; primary level: 4 normal, 21 agree, 18 strongly agree) with agreement that industrial waste and excretion waste will cause the water in the river to become black,, smelly, and contaminated.

Continuously, variable C indicates a significant correlation (x^2 = 34.443, df = 9, P < 0.05) between education level (university level: 32 agree, 33 strongly agree; college level: 11 normal, 48 strongly agree; secondary level: 18 normal, 74 strongly agree; primary level: 1 normal, 22 agree, 5 strongly agree) with polluted water river can cause disease, cause aquatic animals to death and become habitat to dirty animals. Fourthly, variable D provided the result of a significant correlation (x^2 = 24.498, df = 9, P < 0.05) exist between education level (university level: 35 strongly agree; college level: 1 normal, 15 agree, 51 strongly agree; secondary level: 79 strongly agree; primary level: 1 normal, 19 agree, 7 strongly agree) with contaminated water can cause aquatic species to become extinct. Lastly, variable E showed a result with a significant correlation (x^2 = 22.586, df = 9, P < 0.05) between education level (university level: 30 agree, 11 strongly agree; college level: 34 normal, 16 agree, 17 strongly agree; secondary level: 67 agree, 26 strongly agree; primary level 16 normal, 6 agree, 8 strongly agree) and the claim that water pollution can cause the loss nutrient and will affect the plants species.

Based on the results, education level has a significant correlation with all the variables. In other words, education is very important to all aspect because it helps people to think critically and advanced towards a particular issue or problem that may harm or cause dangerous to the society. For example, the Malacca River will never be polluted, except when human activities are carried out such as industries or factories which leading to the releasing of wastes and excretion either directly or indirectly into the river. This is the

main reason for the river to change and become black, smelly, and contaminated. A majority of respondents from university level to the primary level are agreed that when there is water pollution in the river, it will cause disease and poisoning the aquatic animals until death. If contamination in the river is elevated, this will cause aquatic species to become extinct. At the same time, the polluted water can become habitat to the dirty animals. Due to the length of time they have stayed near the Malacca River, some respondents strongly agree that water pollution not only can harm the ecosystem, but also affect plants through the loss of soil nutrients. This issue is affecting the respondents that carry out agricultural activities surrounding the house which cause 'death' to the plant. Therefore, most of respondents are agree that water pollution in Malacca River will cause death poisoning and extinction to aquatic animals, affect the plants through loss of soil nutrient, increase dirty animals through habitat, and destruct the environment if the water pollution in river is continuously happening.

After considering respondent perception on water pollution in Malacca River, these issues should be taken seriously and find a solution for the short term before successfully implementing water resource policies in Malacca River. Among the most suitable suggestions is to introduce and applies the law and regulation towards local residents to protect water resources in Malacca River. Hence, the analysis in this section is to determine the effectiveness of law against river pollution in Malacca through the perceptions of local residents, which can be seen in Table 3.

Table 3: Respondent's perception on the effectiveness of law and regulation towards water resources in Malacca River

	Variable A	Variable B	Variable C	Variable D	Variable E
Water Act 1920	r = 0.471** P < 0.01 N = 400 Significant	r = 0.484** P < 0.01 N = 400 Significant	r = 0.420** P < 0.01 N = 400 Significant	r = 0.333** P < 0.01 N = 400 Significant	r = 0.631** P < 0.01 N = 400 Significant
Environmental Quality Act 1974	r = 0.254** P < 0.01 N = 400 Significant	r = 0.258** P < 0.01 N = 400 Significant	r = 0.186** P < 0.01 N = 400 Significant	r = 0.137** P < 0.01 N = 400 Significant	r = 0.296** P < 0.01 N = 400 Significant
Sewage and Industrial Effluent 1979	r = 0.910** P < 0.01 N = 400 Significant	r = 0.726** P < 0.01 N = 400 Significant	r = 0.850** P < 0.01 N = 400 Significant	r = 0.791** P < 0.01 N = 400 Significant	r = 0.748** P < 0.01 N = 400 Significant
Sewage Service Act 1993	r = 0.764** P < 0.01 N = 400 Significant	r = 0.822** P < 0.01 N = 400 Significant	r = 0.839** P < 0.01 N = 400 Significant	r = 0.759** P < 0.01 N = 400 Significant	r = 0.822** P < 0.01 N = 400 Significant
River Act	r = 0.740** P < 0.01 N = 400 Significant	r = 0.749** P < 0.01 N = 400 Significant	r = 0.770** P < 0.01 N = 400 Significant	r = 0.799** P < 0.01 N = 400 Significant	r = 0.740** P < 0.01 N = 400 Significant

** Correlation is significant at the 0.01 level (2-tailed).
* r means Pearson Correlation, P means Significant (2-tailed), N means Total Number.

Referring to the Table 3, the law and regulation will be versus with water pollution in Malacca River to evaluate the significant between two variables through correlation analysis. Water Act 1920 showed weak-positive significant correlation with variable A (r = 0.471), variable B (r = 0.484), variable C (r = 0.420), and variable D (r = 0.333), but a normal-positive significant correlation with variable E (r = 0.631) at level P < 0.01. The Environmental Quality Act 1974 proved a very weak-positive significant correlation with variable A (r = 0.254), variable B (r = 0.258), variable C (r = 0.186), variable D (r = 0.137), and variable E (r = 0.296) at level P < 0.01. Next, the Sewage and Industrial Effluent 1979 indicates that it has strong-positive significant correlation with variable A (r = 0.910), variable B (r = 0.726), variable C (r = 0.850), variable D (r = 0.791), and variable E (r = 0.748) at level P < 0.01. Fourthly, Sewage Service Act 1993 also showed a strong-positive significant correlation with variable A (r = 0.764), variable B (r = 0.822), variable C (r = 0.839), variable D (r = 0.759), and variable E (r = 0.822) at level of P < 0.01. Lastly, the River Act has a strong-positive significant correlation with variable A (r = 0.740), variable B (r = 0.749), variable C (r = 0.770), variable D (r = 0.799), and variable E (r = 0.740) at level P < 0.01).

Overall, all of the variables show significant with all the law and regulation. In other words, majority of respondents are agreed to apply the law in their daily life with the aims to protect the water resources in Malacca River. Any individuals throwing garbage and wastes, chemicals and toxin, and any object that exist in solid or liquid form which can directly cause the changes to the quality of water resources in the river will be subjected to be punishment (either in the form of money, imprisonment, lashes, and so on, where applicable) according to the law of Water Act 1920, Environmental Quality Act 1974, and River Act. Secondly, if any individuals place tar material or other insoluble liquid, flammable solvents or garbage, sawdust, human or animal waste or solid materials, and any public sewer or public treatment or even any industrial effluent directly into the water and cause river to polluted will be punished (either in the form of money, imprisonment, lashes, and so on, where applicable) according to the Sewage and Industrial Effluent 1979, and Sewage Service Act 1993. However, if there are any individuals that remove, release, or place waste material which may fall, flow down, blown off or even wash away to cause

river water pollution will be punished according to the Environmental Quality Act 1974 and River Act. In the opinion of respondents, they agreed to choose law as a guide for the individual that making mistake which affect the environment, aquatic animals, and community or society, the sentence should be carried out to those offenders. At the same time, punishment in the form of money or jail may not dramatically impact them, so minority of respondents suggested that an offender should be punished through whipping and cleaning the river so that they aware on their actions that can bring negative impact. Therefore, education level (which is not only based on emotional but through critical thinking when giving the answer to questionnaire) is important to evaluate the condition of water resources in the river and helps to determine the laws and regulations that should apply towards the water resources in Malacca River.

IV. CONCLUSION

This research study has proven that law enforcement can help to protect the environment especially towards water resources in Malacca River. A majority of respondents agreed that human activities without control can cause Malacca River to become black, smelly, and polluted. Once the river is polluted, the water can bring disease and poison aquatic animals to death and affect the plant species through the loss of nutrients. At the same time, if the water quality conditions become worse, this will not only cause aquatic species to become extinct, but also become a dirty habitat for animals. So, respondents prefer to apply laws and regulations such as the Water Act 1920, Environmental Quality Act 1974, Sewage and Industrial Effluent 1979, Sewage Service Act 1993, and River Act [3] to the Malacca River. The main aim and reason to use laws and regulations is not to blame activities carried out daily (for example factory operators), but to create awareness that every action and attitude of individuals must be controlled to have a responsible attitude towards the environment. Hence, law enforcement should be used and applied in Malacca state especially for the river to protect water resources from continued pollution.

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