

Risk Assessment and Water Quality Analysis of Sungkai River, a Water Recreational Area Based On Water Quality Index(WQI)

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ABSTRACT : *This study was conducted to achieve several objectives that determine the value of the parameters that were studied based on Water Quality Index (WQI). The parameters include Dissolved Oxygen (DO), pH, Biochemical Oxygen Demand (BOD), Ammoniacal nitrogen, Chemical Oxygen Demand (COD) and Suspended Solids. In this study, Sungkai River, located in the state of Perak, Malaysia was selected as the sampling area. There are a few villages located near the river area. Sungkai river is a famous spot for water and family activities such as kayaking, rafting, camping, bathing and many others. Through the researcher's observations, several pollutions were found occurring along the research area such as the disposal of waste water directly from the villagers, widespread dumping of solid waste and the development of the surrounding areas that contributed to the pollution of the river. Results from the experiments showed that the Water Quality Index (WQI) result for Sungkai River is 72.5 and classified under class III which is safe, specifically for fishery and livestock drinking but it is slightly not so suitable to be used for recreational and bathing purposes. In addition, the water is not drinkable by human and extensive treatments are required. This category is based on the experiments results and referred to the Interim National Water Quality Standard for Malaysia (INWQS). As a recreational spot for the locals and tourists, the activities that could lead to the pollution of the Sungkai River need to be prevented and overcome. Therefore, there is a requirement to investigate and analyse the water quality of all rivers in Malaysia focusing especially on the area of water activities. This study can provide a good outcome on the water quality of the rivers, hence, actions can be taken to overcome any problems regarding river water quality for the safety of all.*

Keywords: *Risk Assessment, Water Quality, Recreation, Water Quality Index (WQI), Interim National Water Quality Standard for Malaysia (INWQS).*

1. INTRODUCTION

Water is one of the principal elements for all living organisms. Water is important in many aspects, from consumptions by living organisms, to other purposes such as agriculture, industrial, transportation, recreational and many others. There are various sources of water on

earth such as ground water, surface water and rain water. River is one of the most important water sources. The importance of water on daily basis is undisputable. Rivers are the most important natural resources for human consumption and development. On the recreational aspect, river is one important source for water activities such as rafting, kayaking, bathing as well as camping. Most recreational rivers are normally located within the primeval and natural ecosystem. Therefore, the rivers have appealing value and are complimentary with visitors to come and visit the area. Domestic pollutions, erosion and sedimentation are the causes of the deterioration of river water quality. These will cause the rivers to function unnaturally and will lead to limited uses of river water. Therefore, it is important to ensure the water quality (Mishra et al., 2009) and risk assessments of the rivers before it can be used for various purposes. Water quality is one of the important issues in water resources management. Water quality can be classified into three broad categories, physical, chemical and biological, and each category has a number of parameters (Swamee & Tyagee, 2007). The assessment of these three categories by field monitoring of rivers will provide basic data for detecting trends, for providing water quality information to water authorities, and for making recommendations for future actions. This assessment is usually conducted by referring to natural water quality, human health and intended uses (Pesce & Wunderlin 2000; Gazzaz et al., 2012). Water quality index is useful as a decision tool in environmental planning and decision-making activities related to water resource protection, improvement and utilization towards a sustainable water resource management (Kim and Cardone, 2005). In this research, the risk assessment of water quality at Sungkai River, a water recreation area, situated in the state of Perak, Malaysia will be assessed. The water quality parameters will be identified and determined based on Water Quality Index (WQI) and the suitability of water usage at the sampling area will be identified based on Interim National Water Quality Standard for Malaysia (INWQS).

2. METHODOLOGY

The sampling area is at Sungkai River, in the State of Perak, Malaysia. This river is famous among the locals as well as tourists who enjoy kayaking and rafting. Sungkai River is a common site for water recreation. Three sampling stations were identified, upstream, downstream and in between. Figure 1 shows the location of Sungkai River.

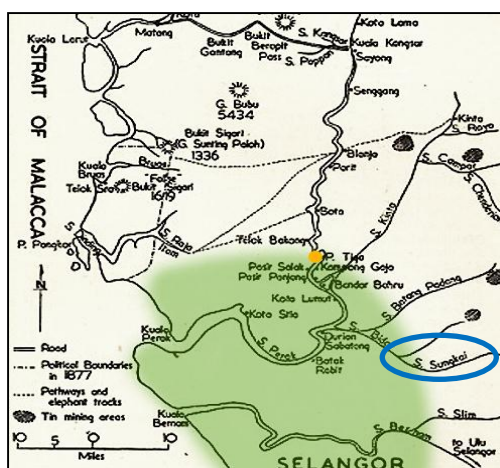


Figure 1: Location of Sungkai River, Perak, Malaysia

In situ measurement was conducted for dissolved oxygen (DO) and pH. For biological oxygen demand (BOD) measurement, water was collected using BOD bottles and

incubated for 5 days. Meanwhile, water for total suspended solid (SS), ammoniacal- nitrogen (NH₃-N) and chemical oxygen demand (COD) was collected using plastic bottle. All samples were stored under cooled temperature before being taken to the laboratory for further analysis. Each parameters were repeated thrice. The WQI produces indicative value and this value was compared to the standard given. As a result, the river quality can be estimated. All parameters data obtained were used to calculate subindex and WQI index. Water quality Index (WQI) was calculated based on the formula shown below:

$$\text{WQI} = 0.22(\text{siDO}) + 0.19(\text{siBOD}) + 0.16(\text{siCOD}) + 0.15(\text{siAN}) + 0.16(\text{siTSS}) + 0.12(\text{siPH})$$

Where by, siDO is the subindex for dissolved oxygen, siBOD is the subindex for biochemical oxygen demand, siCOD is the subindex for chemical oxygen demand, siAN is the subindex for ammoniacal-nitrogen, siTSS is the subindex for total suspended solid and siPH is the subindex for pH.

3. RESULTS AND DISCUSSION

Results of water quality of Sungkai River were obtained and recorded (Table 1). Dissolved oxygen provides information on the levels of pollution as well as determination of gross and net production (Ismail and Mohamad, 1992). From this study, it was found that the dissolved oxygen level in Sungkai River was above 4mg/L which is the minimum requirement for aquatic growth (Maun and Moulton, 1991). Meanwhile, chemical oxygen demand (COD) measures the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as ammonia and nitrite (Suki, 1993). The COD level in Sungkai River is quite low, indicating that the decomposition of matter in the water does not utilize a large amount of oxygen. This means that there would be enough oxygen to support other aquatic organisms. As for Biological Oxygen Demand (BOD), it is a measure of the oxygen used by microorganisms to decompose waste. If there is a large quantity of organic waste (dead plants, leaves, grass clippings, manure, sewage, or even food waste) in the water supply, there will also be a lot of bacteria present working to decompose this waste. In this case, the demand for oxygen will be high (due to all the bacteria) so the BOD level will be high.

The BOD levels in Sungkai River are considered average. When BOD levels are high, dissolved oxygen (DO) levels decrease because the oxygen that is available in the water is being consumed by the bacteria. When there are low levels of organic waste in the water, there are fewer bacteria present, the BOD will be lower and the dissolved oxygen levels will be higher. Ammonia is an inorganic form of nitrogen contained in fertilizers, sewage, and animal wastes. It is also a product of bacterial decomposition of organic matter. Ammonia becomes a concern if high levels are present.

Table 1: Water Quality Results of Sungkai River, Perak, Malaysia

PARAMETER	RESULTS		
	SITE 1 (LOWER)	SITE 2 (MIDDLE)	SITE 3 (UPPER)
DO (mg/L)	4.45	4.78	5.23
COD (mg/L)	22.0	20.4	18.2
BOD (mg/L)	4.82	4.46	4.22

NH ₃ -N (mg/L)	0.74	0.58	0.38
TSS (mg/L)	75.4	66.4	53.8
pH	6.62	6.75	6.88

In this study, the ammoniacal-nitrogen reading was low at upstream level and it increased slightly as the river flows downstream. However, overall Sungkai River ammoniacal-nitrogen reading is at low level and it showed that the river water is not toxic to aquatic organisms and safe. In the meantime, the total suspended solid recorded for Sungkai River was below 70mg/L which showed that the suspended solid in the river is still low. Total suspended solids (TSS) refer to small solid particles which remain in the water as a colloid or due to the motion of the water. High TSS can cause an increase in surface water temperature, because the suspended particles absorb heat from sunlight. Freshwater can vary in acidity and alkalinity which is mainly caused by natural factors and manmade input (Allan, 1995). pH is the measure of acidity or alkalinity of the water. pH 6.5 to 8.2 is optimal for most organisms. The pH at Sungkai River is within range and is considered good enough to support life.

From the results obtained subindex for all the six parameters were calculated based on Malaysian's Water Quality Index (WQI) (Table 2). Results showed that Sungkai River is classified under class III based on Water Quality Index (WQI). The WQI value for Sungkai River is 72.5 and the value is approaching class II. It is hoped that, further treatment and awareness from the society might increase the WQI value for Sungkai River in the near future. Based on Interim National Water Quality Standard for Malaysia (INWQS), the river is classified as safe, specifically for fishery and livestock drinking but it is slightly not so suitable to be used for recreational and bathing purposes. In addition, the water is not drinkable by human and extensive treatments are required. As a recreational spot for the locals and tourists, the activities that could lead to the pollution of the Sungkai River need to be prevented and overcome.

Table 2: Subindex (si) and Water Quality Index (WQI) of Sungkai River, Perak, Malaysia.

SUBINDEX/WQI/CLASS	VALUE
siDO	0
siCOD	72.5
siBOD	81.3
siNH ₃ -N	0
sits	42.9
sipH	317.5
WQI	72.5
CLASS	III

From the results obtained through this research, there a few concerns that need to be addressed based on the risk assessment of the Sungkai River water quality towards the recreational activities that usually take place at the river area. Some of the famous water recreation activities done are kayaking, rafting, water tubing, bathing and camping at the river side. These activities have contact with the river water. Therefore, it is very crucial to ensure that the river water is clean, unpolluted and safe to be used (O'Shea, 2002). Many parties need to play role in maintaining and preserving the river area as one of the popular spot for recreation activities. The government, local authorities and the public need to play their roles in ensuring the safety and cleanliness of the rivers area.

Based on the risk assessments results, Sungkai River is safe to be used as recreational area, however further intensive and continuous treatments need to be taken. The authorities need to do serious monitoring on the activities done near the river are such as dumping of wastes, illegal logging and many others. In addition, awareness programmes and campaigns need to be done actively to create consciousness among all on the importance to preserve and protect the rivers for the benefit of all. If serious actions are not taken, the deterioration of the river quality and the ecosystem will occur, hence it will be a great loss to the county's economic aspect as well such as a big loss to recreational activities operators, small community businesses for instance lodging and food services. Therefore, it is very important for all to realize the importance of water river quality.

4. CONCLUSION

It is very important to identify the rivers water quality based on Water Quality Index (WQI) and also the classification of rivers based on Interim National Water Quality Standard for Malaysia (INWQS). The analysis of water quality index of Sungkai River, Perak showed that the river is classified under class III. Sungkai River is safe but not notably suitable to be used for recreational activities. Therefore the cleanliness and monitoring of the river water needs to be conducted regularly in order to control and reduce river water pollution.

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