第 VII 部門

WATER QUALITY OF AN URBAN MALAYSIAN RIVER

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1. INTRODUCTION

Peninsular Malaysia and East Malaysia are drained by 189 river systems spread over a total landmass of 329,760 sq. km and 35,000 km of rivers [1]. 30 of these river systems are reservoirs and supply 97% of the water supply throughout the country. Rapid pace of development over the last three decades has overstressed Malaysian river systems thus aggravating massive water demand in urban areas. Malaysian river water quality appraisal is based on the Water Quality Index (WQI) consisting of six parameters, namely, Ammoniacal Nitrogen (NH_3-N), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Suspended Solids (SS) and pH. WQI serves as the basis for environment assessment of a watercourse in relation to pollution load categorization and designation of classes of beneficial uses as provided for under the National Water Quality Standards for Malaysia (INWQS). The objective of this study was to classify the river water quality of an urban Malaysian river according to the WQI and INWQS and recommend mitigation measures.

2. STUDY SITE and METHODOLOGY

2.1 Study area

Pencala River is the tenth tributary of Klang River (the longest river flowing through Klang Valley), is 15 km long; 12 km flowing though the Petaling District and 3 km more in the Damansara District[2]. The river flows through highly developed areas Petaling Jaya and Sg. Way, where population densities have been increasing along with a high degree of industrialization. The Klang River basin supports a population of approximately 5.2 million people, nearly 18 % of the nation's total population.

2.2 Methodology

Eleven sampling stations had been selected and placed along Pencala River from January 2005 until February 2006, which included wet and dry seasons. 5L of river water samples were collected by grab sampling for further laboratory analysis, in accordance to APHA 1998. The river water pH and DO analysis were performed on site.

The water quality status for Pencala River was determined by using the DOE-WQI (WQI) [3]. The WQI formula is as follows, where WQI is the Water Quality Index and SI indicates the sub index for each listed parameter obtained from the 90 percentile of these six parameters. **Table 1** shows in depth the value range of each WQI parameter with its defined classes.

$$WQI = 0.22 \times SI_{DO} + 0.19 \times SI_{BOD} + 0.16 \times SI_{COD} + 0.15 \times SI_{AN} + 0.16 \times SI_{SS} + 0.12 \times SI_{pH}$$

Table 1 WQI parameters according to classes

Parameter	*I*	*II*	*III*	*IV*	*V*
BOD	< 1	1–3	3-6	6-12	>12
COD	<10	10-25	25-50	50-100	>100
NH_3-N	<0.1	0.1-0.3	0.3-0.9	0.9-2.7	>2.7
DO	>7	5-7	3-5	1-3	<1
pH	>7	6-7	5-6	<5	>5
SS	<25	25-50	50-150	150-300	>300
WQI	>92.7	76.5-92.7	51.9-76.5	31.0-51.9	<31.0

Based on the WQI values, the river water is then defined as Class *I* to *V* and each class is then designated with the appropriate water usage as shown in **Table 2**. The most pristine water quality is therefore that of Class I with the highest WQI.

Table 2 INWQS for Malaysian Rivers

Class	WQI	Water use
I	92.6-100	• Environmental conservation & protection • Water supply • Aquaculture of highly sensitive species
II	76.4-92.6	• Water supply • Aquaculture of sensitive species • Recreation with water-body contact
III	51.9-76.4	• Water supply with extensive water treatment • Aquaculture of tolerant species • Livestock drinking
IV	30.5-51.9	• Irrigation
V	0.0 - 30.5	• Others uses not mentioned in the above

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3. RESULTS AND DISCUSSION

From the 11 sampling stations (**Fig. 1**), the head water source of Pencala River (Station 1) is the only station which appeared in Class *II* of the INWQS which verifies the unpolluted stage at this level. For a watershed, the river should belong to Class *I* or *II* thus classifying this river to be in the appropriate class.

However, the lower stations (Stations 8 to 11) have been classified in the Class *IV*. It is estimated that WQI decreased 62.42% from Station 1 at the Headwater source to Station 11 at the Log boom giving about 6.42% increase in pollution rate at every sampling station.

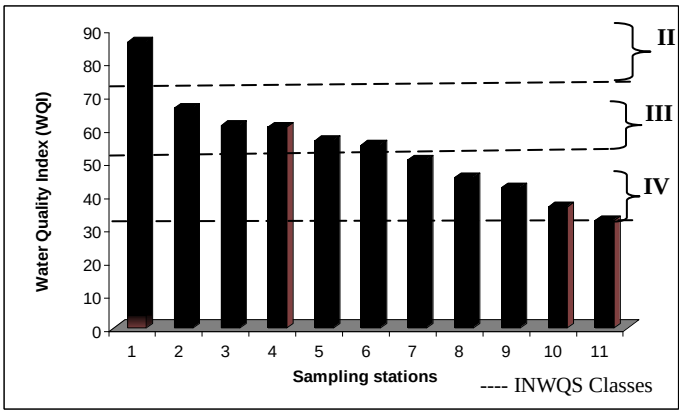

Fig. 1 Average WQI values with the INWQS classification for all sampling points at Pencala River

All the physico-chemical parameters, in general, exceeded the general WQI and INWQS standard levels. The pollution at Pencala River was caused mainly by domestic and industrial solid and liquefied wastes. The condition raises fears of flash floods and outbreak of diseases such as dengue and diarrhea. The absence of garbage collection in these illegal settlements has turned the river into a dumping ground. Several mitigation techniques had been implemented by the local municipality to curb the indiscriminate solid waste disposal and control the river pollution.

4. RECOMMENDATIONS

Based on the pollution sources mentioned, several recommendation options have been recommended to curb the pollution sources.

1. Gross Pollutant Traps (GPT)
   - Pencala River is currently facing major solid wastes problem which can be rectified by installing GPT.
   - The traps are used to remove gross solids (include coarse sediment) and litter from storm water.
2. Screen traps, net traps and Log Booms
   - More log booms and garbage traps should be installed across Pencala River at relevant areas to trap and collect floating and partially submerged trash and debris.
   - Approximately 14 metric tonnes are excavated daily from the last log boom before the river links to the Klang River. Thus by having more of these log booms, floating debris and garbage would help eradicate the solid waste issue at Pencala River.
3. Structure and Silt Fence
   - Technical appropriateness in the rehabilitation is the measure to reduce runoff and erosion along the river banks.
   - Structure and silt fence is able to reduce runoff velocity to prevent excessive erosion along the embankments.

5. CONCLUSION

This study classifies the water quality of Pencala River, an urban river in Kuala Lumpur. Only the headwater station which is the start of the river is categorized in Class *II*. The middle section is in the Class *III* while as the river flows through heavily dense populated urbanization, the lower reaches are in Class *IV*. This is due to the heavy industrialization with improper disposal of domestic and industrial waste is the main contributor to the degradation of the water quality in Pencala River. The recommended measures and active participation from networking among NGO's, the local government and individuals are only some actions in helping to restore the river.

6. REFERENCES

[1] Ministry of Environment and Water Resources (2005) State of the environment 2005 report. pp 99

[2] DOE – UM (1986). Water Quality Criteria & Standards for Malaysia, Vol. **1-12**. Kuala Lumpur : DOE Malaysia