WATER QUALITY ASSESSMENT BASED ON DIATOMS COMMUNITIES IN THE SARAWAK RIVER BASIN, MALAYSIA

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6.2 Enhanced Executive Summary

Many countries use water quality indexing (WQI) method to assess the overall status of the rivers. Unfortunately, the monitoring of physical-chemical parameters will not reflect the overall biota criteria of water quality. The algal species that grow in an area depend on the variability of abiotic factors such as salinity, temperature, pH, water velocity, shading, depth, availability of substrata, water chemistry, etc. Thus, the species that was captured in a water body will reflects some characteristics of the water. Diatoms have been used extensively for bio monitoring programmes due to certain shortcomings in standard physical and chemical methods. However, many of the widely used diatom indices which have been developed from studies of European rivers is unclear as to whether they are as effective to evaluate water conditions in other geographic regions such as tropical river. There were two objectives of studies conducted in this research. Data collected on water quality were used to formulate the WQI. The indication of WQI was to determine the status of river water quality at the time of sampling from September to December 2015 (Refer Figure 6.3, Section 6.6.1). Analysis of collected diatom is used to correlate the physical-chemical analysis of water samples as a biological indicator of river quality in the Sarawak River Basin. From the findings, eight abundant diatom species were found in the Sarawak River Basin as further discussed in section 6.6.2. *Skeletonema sp.* was found to have outnumbered other species and this population was less sensitive to polluted river as it is highly abundance in SW1 and SW2, which was located at downstream of Sg. Sarawak. The population of *Synedra sp.* was the highest at the upstream of Sg. Sarawak Kanan near Batu Kitang Water Intake which was totally absent at highly polluted river. On the other hand, in relation to WQI, it was difficult to figure out the relationship between the diatom population and water quality at all sampling points due too short term of water sampling. It is recommended that monitoring on diatom sampling to be implemented at least for one year continuously to get a better result.

6.3 INTRODUCTION

6.3.1 Research Background

Sarawak is a state in Malaysia with the largest water resources and reserves due to huge land area and high annual rainfall. The Sarawak River Basin is part of the river basin system where it's valuable water resources is available to sustain life of residents in Kuching City and its surrounding areas. It has two main tributaries that flow through a catchment area which has been experiencing rapid social and economic development, which contributes to changes in land use for the past two decades. Dominant types of land use in this catchment area include the agricultural sector (oil palm, rubber, rice, pepper, horticulture and aquaculture), mining (gold, and quarry), industries (Samajaya, Bintawa and Sejingkat), commercial area (Kuching, Satok Market, Padawan, Bau) (Lau, 2011),settlements (Kuching, Padawan, 7^{th} miles town, 12^{th} miles town) (Kuok et al.,2011) recreational (golf courses, parks, sports fields and stadium and reserved forest (national parks, forest reserves and conservation areas) (Lau, 2011). Kuching city is inclusive of Kuching North and Kuching South located at the downstream of Sarawak River while three major towns of Bau, Batu Kawa and Siniawan are located at upstream of Sarawak River.

The exponential growth of economic development surrounding the catchment area of Sarawak River is affecting the quantity and quality of water supply. The impact of water uses and waste discharge within the Sarawak River catchment is huge and the consequences are detrimental and will affect our quality of life (Lau, 2011). In addition, population growth increases the demand for water, while freshwater resources are limited. Therefore, the effort to protect and conserve our water resources is very crucial. In accordance with that, water quality monitoring is vital to safeguard our water resources. In this research, we are using one of the biological components in ecosystem, which is the diatom, as a bio indicator to reflect the water quality in the Sarawak River.

6.3.2 Problem Statement

Water quality can be evaluated either by individual parameter for specific interest or by elected important parameter to judge the overall quality of water (Abdullah and Azni, 2008). Many countries use water quality indexing (WQI) method to assess the overall status of the rivers. Unfortunately, the monitoring of physical-chemical parameters will not reflect the overall biota criteria of water quality. The use of macro benthic invertebrates as a biological indicator is very unpopular in the Asian region. Currently, Malaysia has not included macro benthic studies in determining river pollution mainly due to lack of expertise and information (Azrina et al., 2005).

6.4 LITERATURE REVIEW

6.4.1 Water Resources in Malaysia

Water is the most abundant form of resource on earth and Malaysia is a country prosperous with water resources. Water resources in Malaysia mainly come from its annual rainfall, followed by surface runoff which amounts to 566 billion m^3 and 64 billion m^3 recharges from groundwater. While 360 billion m^3 returns to atmosphere through evaporation and transpiration. The river systems in Malaysia consist of more than 100 river systems in Peninsular and 50 river systems in Sabah and Sarawak (Keizrul and Juhaimi, 1996). River systems as a whole with or without impounding reservoirs are estimated to contribute about 97% of the raw water supply source. In support of Vision 2020, Malaysia will conserve and manage its water resources to ensure adequate and safe water for all.

6.4.2 Water Quality Index (WQI)

Water is described as the binding force for development. Competition amongst different water users such as domestic, agriculture, industries, commercial activities and municipalities has intensified the demand for quantity and quality of water resources. Climate is the principal factor in determining water quantity and its temporal distribution whilst population and economic growth are the main influences on water quality (Keizrul and Juhaimi, 1996). Increasing pressure on water resources is also contributed by water pollution. Water is considered polluted if it contains high level of pathogenic agents, physical changes in terms of colour and odour and chemical substances loadings. As a result, the contaminated water if consumed by human will bring diseases to consumers. According to statistics, water borne diseases accounted for 250 million cases each year around the world (Ahuja, 2009). Water quality is intensively monitored by various agencies in Malaysia. Department of Environment (DOE) is the principal agency that is responsible for evaluating water quality. The Water Quality Index (WQI) method is employed in Malaysia in determining the status of river water. It is used as a communication tool to convey information with regards to status of water quality status to the public. The water quality data is transformed into a single index value which is comprehensible and useful for decision making (Bharti and Katyal, 2011). The index value represents the degree of water pollution and acts as a tool for water quality classification based on their intended uses. The existing WQI is developed based on opinion pool and questionnaire based survey (Khuan et al., 2002). However, WQI does not represent the ultimate status of water quality because it is based on only six significant parameters from physical and chemical variables. In relation to this, many studies were conducted to relate the WQI with biological indicator.