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Research Article

Application of Multivariate Statistical Analysis in Evaluation of Surface River Water Quality of a Tropical River

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The present study evaluated the spatial variations of surface water quality in a tropical river using multivariate statistical techniques, including cluster analysis (CA) and principal component analysis (PCA). Twenty physicochemical parameters were measured at 30 stations along the Batang Baram and its tributaries. The water quality of the Batang Baram was categorized as "slightly polluted" where the chemical oxygen demand and total suspended solids were the most deteriorated parameters. The CA grouped the 30 stations into four clusters which shared similar characteristics within the same cluster, representing the upstream, middle, and downstream regions of the main river and the tributaries from the middle to downstream regions of the river. The PCA has determined a reduced number of six principal components that explained 83.6% of the data set variance. The first PC indicated that the total suspended solids, turbidity, and hydrogen sulphide were the dominant polluting factors which is attributed to the logging activities, followed by the five-day biochemical oxygen demand, total phosphorus, organic nitrogen, and nitrate-nitrogen in the second PC which are related to the discharges from domestic wastewater. The components also imply that logging activities are the major anthropogenic activities responsible for water quality variations in the Batang Baram when compared to the domestic wastewater discharge.

1. Introduction

The Batang Baram ("batang" denotes big river) (coordinates: 4°35′5.28″N and 113°58′44.256″E) is located on the northern part of Sarawak where it flows 400 km westwards, mostly through primary and secondary forest to the South China Sea. The river is the second longest river in Sarawak and the third longest river in Malaysia. The Baram area was once a pristine area but it has undergone profound changes associated with the population growth and development. Increasing residential area, numerous longhouses, and swidden agriculture are found along the river. Commercial logging has also been carried out actively in the area for decades where the logged forest was then converted to commercial oil palm and acacia plantations [1].

Although development continues to grow in this area, the study on the water quality of the river is relatively scarce despite the river serving as an important source for drinking water for the rural community. The discharges of domestic sewage and agricultural runoff can lead to eutrophication [2–4] while deforestation can cause sedimentation and nutrient enrichment in the river [5–8]. In the year 1995, sampling was conducted in the uppermost catchment of the Baram River basin. The study revealed that the overall water quality of the river was relatively good at that time but was subjected to high suspended solids which came from soil erosions due to land