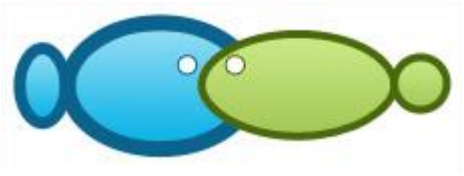

Relationships between water quality and dissolved metal concentrations in a tropical river under the impacts of land use, incorporating multiple linear regression (MLR)

You S. Liew, Siong F. Sim, Teck Y. Ling, Lee Nyanti, Jongkar Grinang

Faculty of Resource Science & Technology, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia. Corresponding author: S. F. Sim, sfsim@unimas.my

Abstract. The water quality and dissolved metal concentrations of the Baleh River were measured at 22 stations over four samplings, in March, June, September and December 2017. It is a tropical river under the influence of numerous land use activities including logging, constructions, plantations and settlements. The selected *in-situ* measured water quality parameters were temperature (Temp), pH, dissolved oxygen (DO), electrical conductivity (EC) and turbidity. The dissolved metals analyzed were aluminum (Al), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn) and mercury (Hg). Multiple linear regression (MLR) was used to model the relationships between water quality and dissolved Al, Fe and Mn. Prominent Fe and Mn were detected with increasing turbidity, implying accelerated surface runoff. Elevated Cu was registered during dry season and a negative correlation was established with Zn. The loadings of Cu and Zn were potentially associated with the brake wear and tire wear, respectively. Temporal variability was identified with consistent correlations established between water quality and metal concentrations. The quadratic model is best fitted with the lowest root mean squares error (RMSE). It was found that the relationships between water quality and dissolved Al and Fe were not well represented with this dataset, because the elements were not detected in most of the samplings, except in September. The considerable zero-clustered data may bias the true correlation. It was found that the pH had a significant effect on the dissolution of Al, Fe and Mn, where Mn^{2+} was ascertained to dissolve in a greater range of pH than Fe^{2+}.
Key Words: inter-metallic relationship, logging, regression model, surface runoff.

Introduction. Tropical rivers in this part of Borneo (Sarawak) form a combined network of 5000 km length. The rivers represent means of transportation for accessing interior areas of Sarawak, supporting the livelihood of locals. The river catchment has been subjected to physical disturbances by continuous land use development. Massive peatlands were cleared for oil palm plantations and riverbank erosion is constantly reported because of degraded vegetation and fluctuant water levels (Hooijer et al 2015; Yuhora et al 2009). The condition of surface runoff is further aggravated by dredging activities and heavy shipping traffic. Staub et al (2000) observes a total sediment input of 24 million MT per year from the drainage basin into the delta of Rajang River.

The Baleh River is a tributary of the Rajang River, with most of its part covered by dense primary forests, the vicinity being sparsely populated. O'Hanlon ventured this part of Borneo in 1984 and he compared his journey with travelling backwards in evolutionary time (Sugnet 1991). In recent years, the vicinity of Baleh has experienced escalated growth and development. Roads, bridges and dam constructions are taking place, along with numerous settlements, plantations and logging activities (RECODA 2017; Sapis et al 2017). Ling et al (2016) revealed that the value of total suspended solids in the river was 5-6 times higher at stations nearby logging. This observation corroborates the elevated iron (Fe), aluminum (Al) and manganese (Mn) concentration values reported by Chai et al (2018) and Sim et al (2016). In light of rapid development, this spurs the need to continuously assess and monitor the environmental conditions of the Baleh River.