

Impact of Land Use (Oil Palm) on the Fish Fauna, Macrobenthos and Water Quality of Kayan River and its Tributaries, Lundu, Sarawak

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ABSTRACT

This study was conducted to document the fish fauna composition and macrobenthos community structure as well as to determine the impact of land use changes on water quality and to apply QUAL2K model to Kayan River. Six stations were selected for fish fauna and macrobenthos and ten stations for water quality at Kayan River and its tributaries. Sampling method used for fish was gill net of various mesh sizes and three layer gill net. Grab sampler and kick net were used for macrobenthos. Measurements of physico-chemical and biological parameters were carried out between June 2010 and September 2011. Six months data were used for calibration and five months data for validation. QUAL2K model simulation was used to predict pollution concentrations reduction in Kayan River. A total of 456 fish individuals were caught comprising of 28 species, 19 genera and 10 families while 2,125 individuals of macrobenthos were sampled, comprising of 3 phyla, 4 classes and 12 families. The highest fish species diversity was at station 1 and highest species richness was at station 2 with a value of 1.096 and 8.274, respectively. All stations have similar community structure of macrobenthos which is dominated by Naididae family. Higher $\text{NH}_3\text{-N}$ (1.62 mg/L), TKN (2.46 mg/L), TP (0.64 mg/L) and BOD_5 (6.20 mg/L) at stations downstream of effluent input indicated the impact from effluent discharges. The average value of WQI in Kayan River was 80 which correspond to good water quality. However, average subindex for $\text{NH}_3\text{-N}$ (63) and TSS (66) were classified as polluted. Higher TSS and turbidity along the river were due to deforestation for oil palm plantation. Prediction results of TSS, $\text{NH}_3\text{-N}$ and BOD_5 in Kayan River exceeded Class II NWQS limits of $\text{TSS} \leq 50$ mg/L, $\text{NH}_3\text{-N} \leq 0.3$ mg/L and $\text{BOD}_5 \leq 3$ mg/L if raw effluent and discharge limit of effluent is discharged into the effluent discharge tributary. QUAL2K model application shows that inflow concentrations for Class II compliance at the palm oil mill effluent receiving tributary for TSS, $\text{NH}_3\text{-N}$ and BOD_5 were ≤ 1.0 mg/L, ≤ 0.002 mg/L and ≤ 0.8 mg/L, respectively while from headwater concentrations are TSS (50.00 mg/L), $\text{NH}_3\text{-N}$ (0.20 mg/L) and BOD_5 (3.00 mg/L). Fish fauna composition and macrobenthos community structures were affected by landuse and habitat characteristics while mill effluent and oil palm plantations are the main factors differentiating physical, chemical and biological variables of Kayan River.

Keywords: fish, macrobenthos, water quality, QUAL2K, oil palm plantation

Impak Penggunaan Tanah (Kelapa Sawit) terhadap Fauna Ikan, Makrobentos dan Kualiti Air Batang Kayan dan Anak-Anak Sungainya, Lundu, Sarawak

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ABSTRAK

Kajian ini dijalankan untuk mendokumentasikan komposisi fauna ikan dan struktur komuniti makrobentos serta menentukan impak perubahan penggunaan tanah terhadap kualiti air dan mengaplikasikan model QUAL2K di Batang Kayan. Enam stesen telah dipilih untuk fauna ikan dan makrobentos. Sepuluh stesen untuk kualiti air yang terletak di sungai Batang Kayan dan anak-anak sungainya. Kaedah persampelan yang digunakan bagi ikan ialah pukat insang pelbagai saiz mata jaring dan pukat tiga lapis. "Grab sampler" dan "kick net" digunakan untuk makrobentos. Pengukuran parameter fizikal-kimia dan biologiikal telah dijalankan antara Jun 2010 dan September 2011. Enam bulan data digunakan untuk kalibrasi dan lima bulan data untuk validasi. Simulasi model QUAL2K telah digunakan untuk menilai pengurangan konsentrasi pencemaran di Batang Kayan. Sejumlah 456 individu ikan telah ditangkap yang terdiri daripada 28 spesis, 19 genera dan 10 famili manakala 2,125 individu makrobentos telah disampel, terdiri daripada 3 filum, 4 kelas and 12 famili. Nilai kepelbagaian ikan tertinggi adalah di stesen 1 manakala nilai kekayaan ikan tertinggi adalah di stesen 2 dengan nilai sebanyak 1.096 dan 8.274, masing-masing. Semua stesen mencatatkan struktur komuniti makrobentos yang sama yang didominasi oleh famili Naididae. Nilai tertinggi nitrogen-ammonia ($\text{NH}_3\text{-N}$), 1.62 mg/L, jumlah nitrogen-Kjeldahl (TKN), 2.46 mg/L, jumlah fosforus (TP), 0.64 mg/L dan jumlah permintaan oksigen biokimia (BOD_5), 6.20 mg/L di stesen terletak hilir kemasukan efluen menunjukkan impak daripada pembuangan efluen. Nilai purata WQI di semua stesen untuk Batang Kayan adalah 80 dan dikategorikan sebagai kualiti air yang baik. Tetapi, nilai purata subindeks bagi $\text{NH}_3\text{-N}$ (63) dan TSS (66) diklasifikasikan sebagai tercemar. Nilai tertinggi jumlah pepejal terlarut (TSS) dan kekeruhan sepanjang sungai adalah disebabkan oleh penebangan hutan untuk ladang kelapa sawit. Keputusan penilaian bagi TSS, $\text{NH}_3\text{-N}$ dan BOD_5 di Batang Kayan adalah melebihi had NWQS Kelas II iaitu $\text{TSS} \leq 50$ mg/L, $\text{NH}_3\text{-N} \leq 0.3$ mg/L dan $\text{BOD}_5 \leq 3$ mg/L apabila efluen mentah dan had pembuangan efluen dilepaskan ke anak sungai pembuangan efluen. Pengurangan konsentrasi bagi pematuhan Kelas II di anak sungai pembuangan efluen untuk TSS, $\text{NH}_3\text{-N}$ dan BOD_5 adalah ≤ 1.0 mg/L, ≤ 0.002 mg/L dan ≤ 0.8 mg/L, masing-masing serta daripada kemasukan pencemaran di hulu sebanyak TSS (50.00 mg/L), $\text{NH}_3\text{-N}$ (0.20 mg/L) dan BOD_5 (3.00 mg/L). Komposisi fauna ikan dan struktur komuniti makrobentos telah dipengaruhi oleh perubahan penggunaan tanah dan ciri-ciri habitat sungai manakala efluen daripada kilang dan ladang kelapa sawit adalah faktor utama menyebabkan perbezaan parameter fizikal-kimia dan biologiikal di Batang Kayan.

Kata kunci: ikan, makrobentos, kualiti air, QUAL2K, ladang kelapa sawit