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Research Article

Physicochemical Characteristics of River Water Downstream of a Large Tropical Hydroelectric Dam

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Water quality in the downstream river of a hydroelectric dam may be affected by the structural design and operation. To date, little is known about the water quality downstream of the largest dam in Malaysia, the Bakun hydroelectric dam. Therefore, the objective of the study was to determine the water quality downstream of the dam when the spillway was closed and when it was opened. Results of the study indicate that the dam plays a significant role in regulating the water quality downstream of it. When the spillway was closed, pH and oxygen were lower in the river where DO was below 5 mg/L. When the spillway was opened, the water quality improved in terms of oxygen content (>8.0 mg/L), total sulphide (TS), and chemical oxygen demand (COD) but deteriorated in terms of five-day biochemical oxygen demand (BOD_5), total ammonia nitrogen (TAN), and total phosphorus (TP). Additionally, the intensity of the impacts, particularly BOD_5, COD, and TAN, shows a declining trend as distance from the dam increases. This study shows that impacts on the water quality extend to a distance of 32 km from the dam particularly turbidity and DO and opening the spillway changes the water quality significantly.

1. Introduction

Dam and reservoir construction in river courses are booming all over the world for hydropower generation, flood control, irrigation, and water supply. In Malaysia, there are about 80 dams that have been built where majority of the dams are for water supply in most of the states of Peninsular Malaysia including Sabah while hydropower dams are the most common in the states of Sarawak and Perak [1]. Among them, Sarawak owns the largest hydropower project in Malaysia with an installed capacity of 2,400MW of electricity and the second tallest concrete rock filled dams (205 m) in the world which is the Bakun hydroelectric dam. The dam is situated on the Balui River, a tributary of the longest river in Malaysia, the Rajang River. It is impounded in 2010 and reached its full supply level in 2012 where the flooded area is over 695 km^2 [2, 3].

The physicochemical parameters of the Bakun dam reservoir have been studied in pre- and postimpoundment condition [2, 3]. However, studies on the tropical regulated downstream river of the dam are limited though it is also subjected to major environmental impacts ranging from downstream morphology to biodiversity of the ecosystem [4–10]. Downstream impacts of the dam can sometimes extend up to a distance of hundred kilometers from the dam site [11], although the intensity of the impacts tends to decline with increasing distance from the dam site [12, 13]. Dams can change downstream hydrology by altering the flow pattern which subsequently change the water quality of the downstream river [14–19]. Thus, it is of scientific importance to investigate and evaluate the water quality changes induced by dam construction and operation.

Despite the substantial size of the Bakun hydroelectric dam and its potential impact on the downstream river, the