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Impacts of Cage Aquaculture on the Water Quality of Batang Ai Hydroelectric Reservoir

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Abstract

Batang Ai Reservoir was constructed for hydroelectric generation and cage culture was introduced in the reservoir to assist the displaced population. The objective of this study was to determine the impact of cage aquaculture on the water quality of the Batang Ai Reservoir due to the rapid development of aquaculture activity in the reservoir. The study was conducted at 4 selected stations; ST1 (inflow to the reservoir), ST2, ST3, ST4 (areas with cage aquaculture) at different depth (surface, middle, bottom). Water quality parameters studied include dissolved oxygen (DO), pH, total suspended solid (TSS), chlorophyll-a, temperature, orthophosphate, ammonia-N, nitrate-N, nitrite-N. Results show that the highest orthophosphate mean concentration was recorded at the surface of ST4 (0.46 mg/L) while the lowest was recorded at surface of ST3 (0.08 mg/L). Both surface water of ST1 and ST4 has the lowest ammonia-N concentration of 0.003 mg/L. On the other hand, bottom of ST3 has the highest ammonia-N (1.170 mg/L). Nitrate-N shows high mean value at the mid depth of ST1 whereas nitrite-N shows the highest value at the bottom of ST3 (0.013 mg/L). The results also show that the cage culture sites have higher mean values of orthophosphate, ammonia-N and nitrate-N compared to the site without cage culture. However, the site without cage culture has the highest nitrite-N mean concentration compared to those of aquaculture sites. This could be due to contribution from the longhouse communities upstream. Mean concentration of chlorophyll-a ranged from 2.9 – 20.0 mg/L with the highest recorded at the mid depth of ST3 which is more likely due to sinking of phytoplankton from surface to the mid depth of the reservoir. TSS was found to be highest at ST1 in all water columns compared to ST2, ST3 and ST4 which might be influenced by the water flow from the river. The lowest dissolved oxygen was recorded at mid depth of ST4 (3.94 mg/L) while the highest was recorded at surface of ST1 (9.07 mg/L). By referring to the DO measured at each station, the mid and bottom of ST1 and surface water quality of all stations falls in class I of the Interim National Water Quality Standard (INWQS) while the mid and bottom of cage culture sites falls in class III of the INWQS. Therefore, the presence of cage aquaculture brings about negative impacts to the water quality of the reservoir as the activity leads to an increase in the amount of nitrogen and phosphorus in the cultured stations being investigated.

Keywords: Cage culture; water quality; reservoir, Batang Ai

Introduction

Asian reservoirs are rarely, if ever, constructed for fisheries purposes alone, being usually designed as multifunctional structures for irrigation to enable a second annual rice crop, the generation of hydroelectric power and the provision of water for domestic and industrial use [1]. Batang Ai Hydroelectric Reservoir is one of the reservoirs constructed in Malaysia with the main purpose of generating hydroelectric power for Sarawak. Floating cage culture has successfully been introduced into the reservoir and ever since then, it has been a source of freshwater fish to the local people. The development of cage culture was strongly supported by Sarawak Government as a means to generate income of the displaced population [2]. Previous research found out that fish cage cultures cultivation in reservoir often leads to deterioration of water quality such as excessive increased organic loading to the water body and will greatly accelerate the natural process of eutrophication in an aquatic system [3]; [4]; [5]. The increase of organic loading due to excessive inputs of fish feeds enriched the water system with nutrients mainly phosphorus and nitrogen. Eutrophic waters consequently favor the proliferation of algae causing algal bloom and the onset of hypoxic and anoxic conditions [5]. Furthermore, leftover fish feed which enter the water system eventually will stimulate biomass in all tropic levels and significantly increase