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Simulation of water temperature and dissolved oxygen distribution of Kotmale reservoir in Sri Lanka

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Kotmale reservoir is the uppermost reservoir in the Mahaweli water resource development scheme in Sri Lanka. Though hydro-energy generation is its prime purpose, it acts as a storage reservoir in the satisfaction of downstream irrigation water requirements, too. Its total storage capacity is about 172×10^6 m^3 while the height of the dam is about 87 m. The Kotmale reservoir faced several water quality related problems in the recent past. This paper presents modeling of water temperature & dissolved oxygen distribution in the Kotmale reservoir to predict water quality in it, which enables taking precautionary measures in such situations.

A coupled hydrodynamic-water quality model, DYRESM-CAEDYM, was calibrated and validated for the Kotmale reservoir. The component, DYRESM (DYnamic REservoir Simulation Model) is a one-dimensional hydrodynamics model for predicting the vertical distribution of temperature, salinity and density in lakes and reservoirs. The other component, CAEDYM (Computational Aquatic Ecosystem DYnamics Model) is a complex ecological model containing process descriptions of primary production, secondary production, nutrient and metal cycling, oxygen dynamics and the movement of sediment. DYRESM-CAEDYM couples these two models, resulting in a powerful tool to investigate the interactions between physics, chemistry and biology in aquatic ecosystems. The data required for the calibration of the model includes daily values of air temperature, relative humidity, wind velocity, solar radiation, rainfall, evaporation, inflow quantity, inflow quality and outflow quantity. The model is able to predict water quality in the reservoir and released from the reservoir. The model was configured to simulate water level, water temperature and dissolved oxygen. The model results showed that there was good agreement between the simulated and the measured values at different depths in the reservoir and on different days of the year.

The collection of water quality data within the reservoir is very expensive and therefore, the ability to predict water quality, by the model would be very valuable. To predict reservoir water quality, the model needs only the inflow water quality, which can be measured easily and inexpensively. Further, if any adverse effects are predicted taking precautionary measures by the manipulation of outflows could be studied with the help of the model.

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