Modeling the effects of weather and climate on thermal stratification and the risks of low dissolved oxygen episodes in aquaculture ponds

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ABSTRACT

Dissolved oxygen (DO) plays a crucial role in aquaculture ponds. The specific objective of this study was to investigate the impacts of climate change on the risks of low dissolved oxygen concentration episodes in aquaculture ponds managed with different levels of nutrient inputs. A dynamic ecological simulation model developed was developed in VENSIM by adapting models for aquaculture ponds and estuaries. The new model was used to assess the effects of weather and climate on temperature stratification and consequent DO dynamics. Data for calibration came from ponds in 5 provinces in northern Thailand. Downscaled climate change projections were used to construct a set of alternative possible future climates. The model could accurately predict trends of thermal and oxygen dynamics in fish ponds with different culture systems over a 24-hour cycle under most conditions. Sensitivity analyses show that the factors with the most effect on risk of low DO levels were concentrations of chlorophyll-a and wind speed which influences degree of water mixing and thus extent of thermal stratification. The mixtures of conditions under which low-DO risks are elevated were then identified using multiple model runs.

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