

## Modeling the Impact of Aquaculture in Wetland Ecosystems Using an Integrated Ecosystem Approach: Case Study of Setiu Wetlands, Malaysia

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**Abstract :** This research is a new approach as it integrates information from both environmental and social sciences to inform effective management of the wetlands. A three-stage research framework was developed for modelling the drivers and pressures imposed on the wetlands and their impacts to the ecosystem and the local communities. Firstly, a Bayesian Belief Network (BBN) was used to predict the probability of anthropogenic activities affecting the delivery of different key wetland ecosystem services under different management scenarios. Secondly, Choice Experiments (CEs) were used to quantify the relative preferences which key wetland stakeholder group (aquaculturists) held for delivery of different levels of these key ecosystem services. Thirdly, a Multi-Criteria Decision Analysis (MCDA) was applied to produce an ordinal ranking of the alternative management scenarios accounting for their impacts upon ecosystem service delivery as perceived through the preferences of the aquaculturists. This integrated ecosystem management approach was applied to a wetland ecosystem in Setiu, Terengganu, Malaysia which currently supports a significant level of aquaculture activities. This research has produced clear guidelines to inform policy makers considering alternative wetland management scenarios: Intensive Aquaculture, Conservation or Ecotourism, in addition to the Status Quo. The findings of this research are as follows: The BBN revealed that current aquaculture activity is likely to have significant impacts on water column nutrient enrichment, but trivial impacts on caged fish biomass, especially under the Intensive Aquaculture scenario. Secondly, the best fitting CE models identified several stakeholder sub-groups for aquaculturists, each with distinct sets of preferences for the delivery of key ecosystem services. Thirdly, the MCDA identified Conservation as the most desirable scenario overall based on ordinal ranking in the eyes of most of the stakeholder sub-groups. Ecotourism and Status Quo scenarios were the next most preferred and Intensive Aquaculture was the least desirable scenario. The methodologies developed through this research provide an opportunity for improving planning and decision making processes that aim to deliver sustainable management of wetland ecosystems in Malaysia.

**Keywords :** Bayesian belief network (BBN), choice experiments (CE), multi-criteria decision analysis (MCDA), aquaculture

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