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Sustainable Marine Aquaculture in Tropical Waters with New Concepts and Technologies? — Lessons Learnt from a Mass Fish Kill

Wolfgang Reichardt, Gil S. Jacinto, Ma. Lourdes S. McGlone

University of the Philippines at Diliman (UPD), Marine Science Institute, The Philippines

Abstract

Extreme ups and downs of marine fish and shellfish aquaculture in SE Asia have led many scientists to question its principal sustainability. Impacts of new technologies about organic waste recycling processes in marine environments have yet to be analyzed and exploited. Monitoring of both internal and external effects of intensified marine aquaculture will require conceptual and technical adjustments, as current routines of ecotoxicological risk assessment tend to prove insufficient. In 2002 a massive fish kill affected net cages and pens with milkfish at Bolinao (Philippines). A retrospective analysis suggests that mass mortality of cultivated and wild fish had been caused by the same factors. This analysis illustrates fundamental differences in predictability and sustainability between land-based and marine production systems. Due to considerable tidal water exchange, the widespread net cages are essentially open systems. As these are closely linked with the sediments underneath, also benthic environments become integral parts of the net cage production systems. Criteria currently monitored in the assessment of ecotoxicological risks, nevertheless refer mainly to water quality. Proper consideration of benthic processes would eliminate such conceptual shortcomings. Coastal marine sediments not only offer the advantage of a fixed spatial reference base, they also harbor most ecological risk factors. These emanate from their role as recycling "hot spots" for organic waste when mineralization via sulfate reduction produces ecotoxic hydrogen sulfide. Furthermore, potentially harmful microorganisms tend to be conserved in sediments as repository sites of most dormant or resting cell stages including the cysts of harmful bloom-forming algae (toxin-producing "red tide algae"). New technologies such as multiple culture systems representing almost complete food chains, may reduce the accumulation of organic waste, but are most likely to become less intensive, though not less vulnerable, than conventional mariculture. There is considerable scope for bioremediation to improve the recycling capacities for organic waste within a net cage or fish pen Sustainability may further be enhanced by integrating "external" natural resources such as seagrass meadows or mangrove vegetation. By means of their rhizosphere microflora these aquatic plants have the potential to become instrumental in favoring biogeochemical pathways other than sulfate reduction in organic matter recycling.

Keywords: Mariculture, hypoxia, red tides, organic waste recycling

Contact Address: Wolfgang Reichardt, University of the Philippines at Diliman (UPD), Marine Science Institute, c/o Bolinao Marine Laboratory (BML) - UP, Guiguiwanen Rd, Bolinao, The Philippines, e-mail: wtreichardt@yahoo.com