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Effluent and disease management in traditional practices of shrimp farming: A case study on the west coast of Sabah, Malaysia

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Introduction

Similar to other aquaculture activities, the production process of shrimp farming is not without environmental implications. To a global context, the adverse environmental impact of unplanned and uncontrolled expansion of shrimp farming has prompted widespread criticisms (Naylor et al. 1998). Disease problems and environmental issues in shrimp farming have caused worries about the sustainability of traditional farming practices (Otoshi et al., 2005). Persistent disease and environmental threats originating from traditional practices have also caused concern in Sabah. A thorough assessment of the farming practices will provide a basis for recommendations for the most viable way of producing shrimp consistent with sustainability criteria. This has been attempted in the present study.

Materials and methods

In the process of data collection, this case study used method based on social science approach - technical site observations and interviews. Social science research offered a way of better understanding people who were engaged in the fisheries activities and the social dimensions needed for inclusion in the management process (Kaplan and McCay, 2004).

The farms were located on the west coast of Sabah, in Tuaran, Kota Belud, Kudat, Kuala Penyu and Beaufort. Three field visits were made to each of the shrimp farms during August-December 2005. This was followed by two more visits in August 2006 for reliability checks and to validate observations made earlier. These farms were chosen because of their willingness to cooperate unconditionally. The samples in this study were farm managers and farm technicians, working directly at the farms. Semi-structured interviews were performed on site, face to face, using a printed form as guidance. Questions were asked about farm management practices for disease and effluent management.

The observations were obtrusive; the farm managers were informed in advanced that site observation and interview would take place. Observation focused on obtaining direct and generally indisputable verification of obvious behaviour which can also be used to measure subjective experiences such as attitudes (Singleton and Straits, 2005). The Department of Fisheries, Sabah record showed as of August 2005 that there were 21 active shrimp farms on the west coast of Sabah. Ten shrimp farms were included and taken as purposive and convenient samples, representing about 50% of the total shrimp farms in that area.

The aim in a qualitative research is to describe the process and events involved rather than their distribution and therefore, sampling is purposive and does not attempt to be statistically representative (Rice and Ezzy, 2001). Questions and observations were designed so as to elicit this information. In such studies it is a general distribution of processes that is considered necessary.

Even though the shrimp farms are accessible by road, most of them are scattered and it took between two to three hours to reach some of the farms. In such a situation, this convenience or purposive sampling could be appropriate (Singleton and Straits, 2005). Due to limited time and resources, the number of shrimp farms included in this study was considered sufficient to achieve the objective of the study. The decision to select study sites was based on: 1) availability of funding, 2) allocation of time, 3) willingness of participants, and 4) accessibility.

Results and discussion

Results of this study are presented in a qualitative manner. The observed variables and questions asked are discussed to explore the qualitative dimension of traditional practices. This case study revealed that the nature of its operation is purely for commercial purposes. The size of shrimp farms varied from 7 acres to 100 aces.

Results showed that generally most farm managers are aware of the importance of environmental issues and disease prevention. All farms claimed to have stocked with post-larvae that have tested negative for White Spot Syndrome Virus (WSSV). In terms of disease experience, four farms reported to have been affected by WSSV, one farm experienced *Vibrio* disease in the ponds and six farms are free of any shrimp disease (Table 1). The results of this case study are synthesized and grouped into two components.

Disease management

Questions and observations regarding disease management were focused on how farm managers treated the waste water, sludge, and dead shrimp from ponds that have been affected with disease and post-harvest processes. Regardless of their experience with disease, all farm managers reported that dead shrimp of commercial value were sold and smaller shrimps were disposed off. Direct disposal of dead or diseased shrimp is not a good practice because it can spread disease to other crustaceans and neighbouring farms. Technical site observations revealed that such practices were common among shrimp farmers. Horizontal transmission of WSSV through water and feeding of infected shrimps and movement of infected live animals have been known to be a probable route for the spread of the disease (Mohan et al., 1997; Bondad-Reantaso et al. 2005). Farmers should be made aware that disposing dead or infected shrimp without treatment is not environment-friendly and of the environmental implications of their practices and their impact on shrimp aquaculture itself.

Different procedures were applied for treatment of waste water and effluent. Some farmers released waste water without treatment, others discharging it into nearby mangrove and estuary. One farm had tilapias and milkfish in the settlement pond as biological filter and two farms kept discharge water in settlement ponds for some time before releasing it to the open water. Farm managers related the importance of water quality, the use of certified disease-free post-larvae, seed selection techniques, use of vitamins and probiotics, and good nutritional management as steps in health management and specifically in reducing the chances of disease outbreak. It was encouraging to note that even with certified disease free post larvae, half of the farms observed still go through post-larvae selection technique.

This case study indicated that farms with disease experience exhibited some peculiarities. Since some of the farms are situated in the same area, it is likely that untreated water could have been pumped into culture pond or reservoir ponds. Disease outbreaks could very much be associated with the lack of responsible farm operations, especially waste disposal.

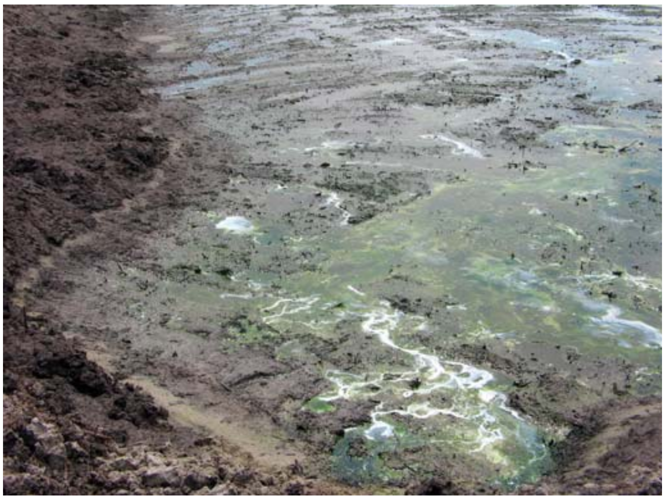
Six out of ten of the shrimp farms surveyed were neighbours and shared the water source but results of interviews indicated that not all managers informed their neighbours when faced with disease problems. This practice could have negative impacts on the ecosystem and the water source they are sharing. WSSV could affect pond rapidly with mass mortalities and readily transmitted disease from diseased shrimp to healthy susceptible shrimp via contaminated water (Rajan et al. 2000). Not informing the authorities and nearby shrimp farms could give shrimp farming an irresponsible and generally bad reputation, and contribute to self-pollution that escalates disease problems.

It was observed that the use of pet dogs for security and preventing intruders is very common in all shrimp farms. One shrimp farm employed contract security guard on contract basis but only at the entrance gate. Pet dogs were observed wondering freely around the shrimp ponds and workers quarters. This should not happen because dogs could also be a disease carrier, particularly when they wonder from one shrimp farm to another. Investing resources to employ more contract security personnel could add to the operation cost but will be a worthy investment. Visitors and vehicles that enter the farms are not subjected to any sanitary measures, which showed a lack of biosecurity and poor health management standard.

Managers reported that the use of probiotic base products and vitamins are helpful for health management and to reducing disease risk by fortifying natural defences of the stock. There is are growing evidence that show the effectiveness of probiotics in inhibiting a wide range of fish pathogens and disease problems in shrimp farming (Moriarty, 1999; Rengpipat et al., 2000; Irianto and Austin, 2002). This is a good indication that shows some farm managers are accepting new approaches to health management.

Certified disease free post-larvae and pond preparation were recognized as two of the most important steps in disease prevention. All the farms indicated that ponds were properly dried and green water was prepared before stocking the post-larvae. Several measures had been applied in health management to reduce disease which included post-larvae selection, specific pathogen free brooders,

Sludge area.



Black thick soil formed as sludge.

Outflow water canal.

closed systems, recirculation systems, probiotic application and some form of biosecurity (Donovan, 1997; Kongkeo, 1997; Moriarty, 1999; Kautsky et al., 2000; Irianto and Austin, 2002; Mustafa, 2004).

Training needs in health management were assessed to find out their technical capabilities in disease and effluent management. Only four farm managers were reported to have obtained formal training in disease management. Two of them attended training conducted by the Department of Fisheries Malaysia and the other two attended training organized By Charoen Pokphand (CP) group in Thailand. Other farm managers reported that they gained knowledge through their own experience working in different farms without attending any formal training at all. It was reported that there is shortage of local experts and qualified personnel to assist them with shrimp disease. Farm managers are very concerned about disease threats and voiced their interest in attending courses for health management if

Farm technician explaining feeding schedule.

Site observation.

Table 1: Farm Size, Disease Experience and Effluent Treatment

Farm size	Disease experience	Effluent treatment
7 acres	None	Closed system, solid waste recycled into fertilizer.
7 acres	None	No treatment of waste water, sludge is left to dry at pond bottom.
19 acres	White spot disease	Water is treated and kept in treatment pond before discharge. Sludge is recycled, used as fertilizer.
11 acres	None	No treatment of waste water, sludge is left to dry at pond bottom.
30 acres	White spot disease	Discharge of water to nearby mangrove, drying of pond sludge.
30 acres	None	No treatment of waste water, sludge is left to dry at pond bottom.
40 acres	White spot disease	Discharge of water to nearby estuary, sludge is kept in specific area in the farm.
50 acres	None	No treatment of waste water, sludge is flushed, ploughed and left to dry at pond bottom.
60 acres	None	Use of settlement pond, treatment of water before discharge, sludge is kept in specified area, used as fertilizer after two years.
100 acres	White spot disease	Water is treated, kept in settlement pond with tilapias and milkfish as bio-filters, sludge is kept in specified area.

arranged locally and free of cost. It is worth mentioning that training for shrimp health management is available locally but participation is generally subsidized, not entirely free.

This case study showed that technical consultation and professional services for effluent and health management are needed. Lack of widespread use of new techniques is due to hesitation of the farm enterprise to invest resources in acquisition of higher technology. Economic loses due to disease and environmental problems can be mitigated by investing in new technology, fine tuning traditional practices, and embracing new concepts (Mustafa, 2004).

Some farm managers reiterated that disease outbreaks could be reduced by proper water management throughout the farming period, regular monitoring of feeding, and the external appearance of the shrimp in the ponds. This shows that some farmers are receptive to change the traditional practices to contemporary disease management. However, concerns are high for those shrimp farms that lack biosecurity measures and choose to release untreated water from infected ponds, sale or dispose diseased or dead shrimp, and not willing to invest in training and consultation of professionals in shrimp health management.

Feeding tray.

Effluent management

To reduce negative impacts of effluents and enhance nutrients in the ponds, some farm managers indicated the used of effective microorganism product. As summarized in Table 1, it was noted that three out of the ten farms in this survey were recycling the sludge and using it as fertilizer. Three farms had allocated specific areas to contain the sludge. Farm managers dry the pond for a period of one to two months. One farm used tractors to plough and turnover the sludge at the pond bottom while the rest carry out disinfecting, drying and flushing methods to ensure the dark smelly pond bottom is cleaned and made suitable for aquaculture.

In spite of portraying some level of environmental awareness, some managers still discharged waste water directly without proper treatment. Not all farms have settling or reservoir pond for sedimentation and treatment. For those who treated effluents, they managed it by constructing settlement ponds, drying and reapplying of sludge, and discharging in mangrove areas. Recycling of sludge and providing settlement ponds are some of the approaches recommended to mitigate shrimp pond effluents (Donovan, 1997; Boyd and Tucker, 1998; Teichert-Coddington et al., 1999; Paez-Osuna, 2001). Some of the practices of effluent management observed in this study are not totally environment-friendly.

The variety of responses to effluent treatment and weather or not the farmers have disease experience showed a lack the conviction with farming commitments to adhere to better management practices and lacking willingness to invest in biosecurity measures. Although there is no one effluent treatment is suitable for all conditions, some level of awareness and basic concept of effluent management is necessary for a farm to reduce risks of diseases and maintain equilibrium with environment-friendly systems. This case study revealed that there is no significant relationship between disease experience and sludge

Monitoring feeding efficiency.

Pumping water to reservoir pond.

management. Disease experience has not made farm managers to be more cautious in effluent treatment. Some are learning from past experience while others continued their unsustainable practices, the latter category of farm managers often react to disease when it breaks out.

Conclusion

The findings of this study showed that not all traditional practices in effluent treatment and disease management conform to modern requirements. Disease management in traditional practices does not include the prescription in favour of prevention of infection and stress reduction; it shows their continued dependence on methods that have betrayed their expectations in the past. Currently, technical management and farm design are inadequate for comprehensive effluent and infectious disease exclusion. Shifting of paradigms and investments are needed to benefit from the current techniques. In the absence of such reforms the traditional practices of shrimp farming will remain unsustainable. Despite growing awareness of new methods, the reluctance of farm enterprise to invest more capital makes knowledge-based modernization difficult.

Drawing on these findings, some procedures can be suggested for introducing contemporary measures in disease and effluent management: i) working with farmers based on an institutional approach to implement a biosecurity model shrimp farm that envisages environmental and health management criteria, ii) offering technical services and resources formulated as Standard Operation Procedures for sustainable shrimp farming, iii) dissemination and communication of the benefits of good management practices in shrimp farming by doing it right the first time, iv) introducing stringent effluent management guidelines, and v) mandatory shrimp-pathogen free testing by accredited laboratories.

Organic fertiliser.

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