5. Implementation of risk analysis in aquaculture

The effective implementation of risk analysis methods in the aquaculture sector is contingent upon actions by government at the national policy level, by the private sector at the farm operational level and by international collaboration to build capacity for its wider application.

5.1 NATIONAL POLICY LEVEL

Actions required at the national policy level include:

- *Adoption of risk analysis in national policy* – The case for adoption of the risk analysis approach in aquaculture can be strengthened by including the method in national policies for aquaculture development. In doing so, the approach applied to aquaculture should be consistent with policies for other sectors and should be applied to the aquaculture industry in a balanced manner, *vis-a-vis* other natural resources activities and environmental policies and legislation.
- *Identification of a responsible agency* – In most national systems, the aquaculture industry is not represented by a single champion to promote multisectoral coordination of aquaculture's challenges into overall national development policy. Indeed, aquaculture is frequently managed under a variety of environmental, resource allocation and economic systems, some with primary relationships in the fisheries sector. The relationship between aquaculture and wild capture fisheries may provide some benefits, such as in development of international agreements; however, the benefits can be outweighed by the negatives. In many countries, the economic importance of the aquaculture sector is such that improved and higher profile institutional arrangements are necessary for its management. Aquaculture stakeholders desire a single and clear point of contact with government, and centralized communication benefits the industry (e.g. via reduced transactional costs and increased transparency and information exchange). This may, however, not be feasible in many countries under present institutional arrangements. Although development of a strong national strategy that provides risk-based decision-making and which also meets the needs for regional harmonization of aquaculture regulation will ideally require a single responsible agency responsible for coordinating all aspects of aquaculture policy, one should not be discouraged by not having such an arrangement to implement risk analysis and establish national strategies. Efforts must be made to streamline institutional arrangements, reduce transaction costs to farmers and harmonize administrative procedures within national policy and legal frameworks.

- *Formation of stakeholder groupings* – Identification and formalization of regional, national and subnational stakeholder groupings would aid the consultation and risk management process. The aquaculture industry is comprised of many disparate subsectors with differing operations resulting in different hazards. Yet these subsectors are often the least coordinated due to significant communication and competitive constraints. The establishment of "peak" bodies, such as democratically organized farmer associations, could provide a better basis for coordinated engagement at the national policy level and for better stakeholder communication. Harmonization or even joint development within similar biogeographic regions could also provide an improved investment climate and a mechanism for increased harmonization through development of industry-based voluntary guidelines, Codes of Practice and best management practices (BMPs). Risk analysis processes can be used to develop such guidelines and management practices.
- *Information acquisition and management* – At the national level, access to the information necessary to undertake comprehensive risk planning for the aquaculture sector (or even for other sectors) is problematic. Information may be gathered under national or international statutory obligations, but due to the multi-agency management of aquaculture, it is rarely available. Harmonization of information needs at the national and regional levels could greatly enhance information acquisition and management. This is likely to require regional agreements with clearly specified use agreements in place, such as through regional aquatic animal disease reporting.
- *Capacity building* – Many nations face significant capacity issues (both in terms of number of people and skill availability) at the national policy development and regulatory implementation levels. Conducting a risk analysis, while not a difficult skill to acquire, can be relegated to a lesser status unless it has a clear relationship with outcomes. Capacity-building needs at the national and sectoral levels must be assessed relative to risk analysis skills across the seven risk categories. FAO and regional bodies and programmes (e.g. the Network of Aquaculture Centres in Asia and the Pacific [NACA], the Southeast Asian Fisheries Development Center [SEAFDEC]), the Asia Pacific Economic Cooperation [APEC], the Association of Southeast Asian Nations [ASEAN] and South-South Cooperation arrangements provide significant opportunities for training and capacity building. The multidisciplinary knowledge base, access to information and on-going risk management skills should be identified in-house, and cross-linkages made with like-minded nations or regional partnerships to facilitate both capacity and capability enhancement. In support of this process, there should be ongoing efforts to share experiences and risk analysis tools and to develop simple manuals. There are presently limited experiences and case studies associated with some applications, such as complex ecological risk analyses and genetic risk analyses as applied to aquaculture. Case studies and sharing of experiences are needed. The understanding of some key issues (e.g. risks

associated with aquaculture and ecosystem functions, use of trash fish) is still limited, and research is required to develop understanding and practical tools. The need to develop and demonstrate cost-effective systems for small aquaculture operations is also apparent.

5.1.2 Farm operational level

Actions required at the farm operational level include:

- *Initial business planning* – The most fundamental and effective approach to risk management at the farm level is to integrate risk analysis into business planning when first establishing up an aquaculture farm. The proposed development plan should generally require analysis of the environmental impacts and will provide the opportunity to assess a number of risk categories at the outset. This will in turn give information on the implications of siting (e.g. environmental impacts), including the influence of prevailing weather and should include pathogen and pest information from the region. A business plan should incorporate analysis of possible financial risks and social risks associated with staffing strategies (e.g. social impacts) and the economic performance of the farm. In order to address the importance of application of risk analysis at the farm level, particularly during the planning stage, appropriate simple planning tools are required. Such tools are currently scarce; it is important that their development clearly addresses the requirements of small-scale farmers.
- *Ongoing management planning* – Once a farm is operational, the business plan should be updated to incorporate up-to-date risk analyses as new challenges emerge or the farm changes in terms of business strategy (e.g. new species and sites) or operation (i.e. staffing and resource management). For larger farms, this should be integrated into an annual risk audit for ongoing insurance purposes (see below). Any changes to farm operations, including those due to significant regulatory shifts, should trigger a reassessment of the risks. It is also important to address the issue within the context of small-scale farmers and farming systems. At the small-scale level, annual audits may not be feasible; however, organizing farmers into societies or farm/farmer clusters may assist in meeting such requirements. Organizing farmers into clusters for better management of the sector must be given due consideration during the planning process.
- *Insurance* – Insurance can be seen as a way of identifying and managing risk (see Secretan, 2008). It has traditionally been limited to larger farming operations with a formal, more stable production and management structure. However with the development of farming clusters adhering to common best practice guidelines and sharing common resources (e.g. feeds, markets, etc.), it may be possible to extend insurance coverage to small-scale operations within the cluster. For small-scale farmers, one necessary step is the establishment of mutual insurance groups that understand aquaculture and are able to spread risk appropriately in order to make insurance coverage feasible (see Box 7).

BOX 7

Case study: example of the application of risk analysis to small-scale rural aquaculture in Indian shrimp farming

This case study, summarized from Umesh *et al.* (2008), provides an example of how risk analysis can be informally applied to assist the development of sustainable small-scale rural aquaculture. The project, which was implemented by NACA in association with the Marine Products Export Development Authority (MPEDA) of India, was formulated to develop strategies for reducing the risk of shrimp disease outbreaks and improve farm productivity through formation of "aquaclubs" (cluster, farmer self-help groups) to tackle shrimp disease problems more effectively. Although the initial work was not formally planned to follow a risk analysis approach, the experiences provide valuable lessons in the application of risk analysis in small-scale aquaculture.

The project's demonstration programmes successfully organized small-scale farmers into self-help groups for adoption of best management practices (BMPs). The demonstration of risk management practices in cluster farms gave promising results, with improvements in both profits and productivity. In farms adopting better shrimp health management recommendations, returns shifted from a loss in 80 percent of the ponds to a profit in 80 percent of the ponds, a good indication of the viability of the management measures resulting from the study.

Hazard identification and risk assessment

The project began with a longitudinal epidemiological study to identify hazards (disease: horizontal and vertical transmission of diseases in selected shrimp farming areas, including investigation of hatcheries and broodstock, food safety, social, environmental and financial aspects) and assess risks of key hazards in small-scale shrimp farms during 2000–2001. The epidemiological study, which covered a total of 385 ponds in two districts of Andhra Pradesh, identified the farm-level hazards as (a) shrimp disease outbreaks and (b) low pond productivity, for further analysis. The risk associated with these hazards was then analysed using an epidemiological approach, and a range of risk factors were identified (e.g. presence of whitespot syndrome virus (WSSV) in shrimp seed, shrimp pond depth, soil conditions, etc.) that were significantly associated with these outcomes. Using epidemiological analysis, these "risk factors" provided an understanding of white spot disease (WSD) causation and possible risk management options for reducing the likelihood of disease outbreaks and low pond productivity.

In aquaculture systems, a risk factor is a crop-related factor that simply increases or decreases the probability of occurrence of an adverse event happening during a specified time period. For example, WSD is an adverse event during the shrimp-cropping period. If a high prevalence of WSSV in seed batches stocked in ponds increases the probability of occurrence of WSD, then the high prevalence of WSSV in seed batches is called a risk factor to WSD. Epidemiology investigates the statistical and biological significance of the relationship between the adverse event and the hypothesized risk factor to determine whether the hypothesized risk factor is a risk factor or not. The risk factor study of the project considered shrimp disease outbreak and poor production as adverse crop events for the epidemiological analyses.

In total, the study covered 365 ponds in the state of Andhra Pradesh. The ponds were selected randomly. WSSV has been established as the "necessary cause" of WSD. However, presence of the necessary cause alone will not lead to a WSD outbreak in a pond. In a farm situation, a number of "component causes" (risk factors) along with the "necessary cause"

BOX 7 (cont.)

might become "sufficient cause" to produce WSD outbreaks. The study clearly showed that WSD is not caused by any one factor. Rather a number of risk factors influence the occurrence of WSD in the farm. These risk factors occur throughout the shrimp cropping cycle and in general terms, fall into the following categories during the different stages of the crop cycle: season of stocking; pond preparation; pond filling and water preparation; seed quality and screening; water management; pond bottom management; feed management; and disease treatments.

It was concluded that:

- A WSD outbreak is the end result of a series of actions or changes from healthy shrimp through to disease outbreak.
- At each stage of the cropping cycle, a number of factors influence the development of the disease in individual animals and also in the population of shrimp in each pond.
- WSSV can enter the shrimp and pond through different routes, including shrimp seed, water, carrier animals and transfer of infected animals and farm equipment from one farm to another.
- Adverse environmental factors combined with a high prevalence of infected shrimp among the pond population are necessary for a mass disease outbreak to occur.

Management factors can be used to control environmental factors and reduce risks of WSD occurring in the pond. To be successful in controlling shrimp disease, one has to manage all potential risks at different stages of the cropping cycle.

The results from the shrimp disease risk factor study clearly showed a number of significant factors that influence shrimp disease outbreaks and shrimp yields at the pond level, many of which can be managed at the farm level. The risk factor study clearly demonstrated that WSD is not caused by any one factor but by a number of factors that interact and influence the occurrence of the disease. Thus, an integrated management and extension approach is necessary to deal with the key factors that contribute to disease occurrence.

The findings provided a strong foundation for reducing shrimp disease losses to farmers, improving farm-level capacities and skills in shrimp health management, minimizing the risks of spread of shrimp diseases to other areas and improving shrimp farm productivity and profitability.

Risk management

The risk management objective was to develop practical measures for containing/preventing shrimp disease outbreaks that should include identification of shrimp disease risk factors, diagnosis of problems and management strategies to control disease in farms. The results of the epidemiological study provided the basis for the project team to work closely with farmers and scientists to identify practical farm-level risk management interventions. Eventually two key areas were identified:

- BMPs that are practical farm-level interventions to address the key "risk factors". These were subsequently expanded to include all relevant shrimp disease risk factors, plus food safety and environmental risks.
- Farmer organization/self-help groups/clusters to address social and financial risks associated with farming and allow effective dissemination of the BMPs among group members.

The BMPs used were good pond preparation, good quality seed selection, water quality management, feed management, health monitoring, pond bottom monitoring, disease

BOX 7 (cont.)

management, emergency harvest, harvest and post-harvest, food safety and environmental awareness. The BMPs were disseminated through communication channels involving farmer meetings, regular pond visits, training of extension workers and publication of ten brochures on steps of BMP adoption and booklets on shrimp health management and extension.

The BMPs were implemented through farmer groups and clusters, a cluster being a group of interdependent shrimp ponds situated in a specified geographical locality and typically being comprised of the farmers whose ponds are dependent on the same water source. The cluster concept makes it practical to communicate risks and risk management to farmers more effectively to reduce risks and maximize returns.

Risk communication

Risk communication involved conducting training and demonstration of appropriate disease control measures, which especially included demonstration of efficient farm management practices for containing diseases in selected farms through cooperation and self-help among shrimp farmers in affected areas.

A village demonstration programme for effective communication of risks, promoting adoption of BMPs and capacity building of farmers was started in Mogalthur Village of Andhra Pradesh in 2002 and has been very successful in forming a participatory movement of farmers across the country. The demonstration programmes were successful in organizing small-scale farmers into self-help groups for adoption of BMPs. The success of this programme generated considerable enthusiasm among the aquaculture farming community, and there are now requests for conducting such programmes in the different regions of India. As a result, aquaclubs/aquaculture societies have been established in the maritime states for community management with a participatory approach. In order to continue the work initiated by the MPEDA-NACA project and to provide the much needed thrust through institutional and policy changes to the extension work in coastal aquaculture development, MPEDA has established a separate agency, the National Centre for Sustainable Aquaculture (NaCSA), with the approval of the Government of India.