

Review of environmental impact assessment and monitoring in aquaculture in Asia-Pacific¹

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ABSTRACT

This review is prepared as part of the FAO Project “Environmental Impact Assessment (EIA) and monitoring in aquaculture”. The review provides a compilation, review and synthesis of existing EIA and environmental monitoring procedures and practices in aquaculture in the Asia-Pacific region, the largest aquaculture-producing region in the world. This review, as in other regions, gives special consideration to four areas related to EIA and monitoring in aquaculture including: (1) the requirements (2) the practice (3) the effectiveness and (4) suggestions for improvements. Australia, China, India, Indonesia, Japan, Malaysia, the Philippines, Thailand and Viet Nam are covered in some depth, and a brief overview is provided of EIA and monitoring in several other countries in the region that are in various stages of adoption and implementation of environmental impact assessment, monitoring and other environmental management measures for aquaculture.

¹ This regional review is a contribution by the Network of Aquaculture Centres in Asia-Pacific (NACA)

The review synthesis provides an overview of the current status of EIA and monitoring in the countries around the Asia-Pacific region and provides a number of recommendations for future improvements in the environmental management of aquaculture.

CONTENTS

Abstract	153
Acronyms and abbreviations	156
Summary	159
Background	159
EIA and aquaculture	159
Practices	160
Effectiveness	161
Improvements	162
Background and scope	165
Synthesis of findings	167
Requirements	167
Practices	170
Effectiveness	173
Improvements	174
Country analyses	177
Australia	177
China	189
India	202
Indonesia	211
Japan	218
Malaysia	227
The Philippines	233
Thailand	246
Viet Nam	259
Other countries	270
Bibliography	274
Annex A: Example of EIA reporting format from China, Hong Kong SAR	282

Acronyms and abbreviations

ADB	Asian Development Bank
AGIP	Aquaculture Ground Improvement Programs (Japan)
AMDAL	<i>Analisis Mengenai Dampak Lingkungan Hidup</i> (Management of Environmental Impact Analysis) (Indonesia)
ANDAL	<i>Analisa Dampak Lingkungan Hidup</i> (Environmental Impact Assessment) (Indonesia)
AQSIQ	General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China
ASEAN	Association of South East Asian Nations
AVS	Acid Volatile Sulphide
BFAR	Bureau of Fisheries and Aquaculture Resources (The Philippines)
BMPs	Better (or Best) Management Practices
BOD	Biochemical/Biological Oxygen Demand
BOU	Benthic Oxygen Uptake
CAA	Coastal Aquaculture Authority (India)
CAQS	Centre for Agri-Food Quality and Safety (China)
CNCA	Certification and Accreditation Administration (China)
CoC	Code of Conduct
COD	Chemical Oxygen Demand
CoP	Code of Practice
CZMA s	Coastal Zone Management Authorities (India)
DA	Department of Agriculture (The Philippines)
Danida	Danish International Development Agency
DAO	Department Administrative Orders (The Philippines)
DARD	Departments of Fisheries (Viet Nam)
DENR	Department of Environment and Natural Resources (The Philippines)
DO	Dissolved Oxygen
DOE	Department of the Environment (several countries)
DOF	Department of Fisheries
DONRE	Department of Natural Resources and Environment (Viet Nam)
ECA	Environmentally Critical Areas (The Philippines)
ECC	Environmentally Compliance Certificate (The Philippines)
ECP	Environmentally Critical Project (The Philippines)
EI	Environmental Impact
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau (The Philippines)
EMP	Environmental Management Plan(s)
EMS	Environmental Management Systems
EOs	Executive Orders (The Philippines)
EPA	Environmental Protection Agency (several countries)
EPB	Environmental Protection Bureau (China)
EPBC Act	Environment Protection and Biodiversity Conservation Act (Australia)

EPRMP	Environmental Performance Report and Management Plan (the Philippines)
EQA	Environmental Quality Act (Malaysia)
EQS	Environmental Quality Standards
ESD	Ecologically Sustainable Development
FAO	Food and Agriculture Organization of the United Nations
FAO	Fisheries Administrative Order (the Philippines)
FARMC	Fisheries and Aquatic Resources Management Council (the Philippines)
FCA	Fisheries Cooperative Association (Japan)
FEMC	Fishery Environment Monitoring Center (China)
FEMN	Fishery Environment Monitoring Network (China)
GAP	Good Aquaculture Practices
GBRMPA	Great Barrier Reef Marine Park Authority (Australia)
GESAMP	Group of Experts on the Scientific Aspects of Marine Environmental Protection
GIS	Geographical Information Systems
GMO	Genetically Modified Organism
ICAR	Indian Council of Agricultural Research (India)
IEE	Initial Environment Examination
ISO	International Standards Organization
JFRCA	Japan Fisheries Resource Conservation Association
LGU	Local Government Units (the Philippines)
MAFF	Ministry of Agriculture, Forestry and Fisheries
MARD	Ministry of Agriculture and Rural Development
MMAF	Ministry of Marine Affairs and Fisheries (Indonesia)
MMT	Multi-partite Monitoring Team (the Philippines)
MoA	Ministry of Agriculture (China, India)
MoE	Ministry of Environment (several countries)
MoLR	Ministry of Land and Resources (China)
MONRE	Ministry of Natural Resources and Environment (Viet Nam)
MoWR	Ministry of Water Resources (China)
MPEDA	Marine Products Export Development Authority (India)
NACA	Network of Aquaculture Centres in Asia-Pacific
NaCSA	National Centre for Sustainable Aquaculture (India)
NALO	National Aquaculture Legislation Overviews (FAO)
NASO	National Aquaculture Sector Overviews (FAO)
NEB	National Environmental Board (Thailand)
NGO	Non-governmental Organization
NOC	No Objection Certificate (India)
NORAD	Norwegian Agency for Development Co-operation
NSW	New South Wales (Australia)
OECD	Organisation for Economic Cooperation and Development
PCR	Polymerase Chain Reaction
PD	Presidential Decree (the Philippines)
PEPRMP	Programmatic Environmental Performance Report and Management Plan (the Philippines)
PHILMINAQ	Mitigating Impact from Aquaculture in the Philippines (EU project)
RAS	Recirculating Aquaculture Systems
RIA	Research Institute for Aquaculture (Viet Nam)
SEA	Strategic Environmental Assessment
SEPA	State Environmental Protection Administration (China)

SEZ	Special Economic Zone
SOA	State Oceanic Administration (China)
SS	Suspended Solids
TCVN	Vietnamese Environmental Standards
TOL	Temporary Occupation Land (Malaysia)
TOR	Terms of Reference
TSS	Total Suspended Solids
UNDP	United Nations Development Programme
VND	Vietnamese Dong (currency)

Summary

BACKGROUND

Countries in the Asia-Pacific region began to establish environmental legislation in the 1970s, and Environmental Impact Assessment (EIA) was an important area for many regulations. Since their inception, most of the EIA laws in the region have been amended in order to expand their coverage, enhance administration and public participation, and improve enforcement. The EIA systems found in the region have significant differences from country to country, particularly with respect to EIA requirements, administrative frameworks and responsibilities, implementation capacity, degree of public consultation and information disclosure, duration and the need for an environmental management plan. The general framework for EIA has an important influence on the application of EIA and monitoring to aquaculture within each country, where it may or may not be considered in EIA legislation as an activity with potential environmental impacts.

EIA AND AQUACULTURE

There are significant differences from country to country in the requirements for EIA or environmental monitoring for aquaculture. The requirements can be summarised as follows.

- Countries in the region include those in which aquaculture projects are specified in EIA legislation, such as the Philippines, and those, such as Thailand, that do not include aquaculture in EIA legislation. In the latter, environmental management responsibilities for aquaculture usually lie within the responsible fisheries and aquaculture ministries and departments.
- The scope of EIA, when applied to aquaculture, is almost entirely focused on individual, large-scale aquaculture, projects.
- EIA legal requirements are commonly focussed on high value, intensive farming, and particularly shrimp and marine cage farming in tropical areas and marine fish farming in temperate areas.
- Strategic environmental assessment (SEA) is a new concept to the region. As of 2005, only China, Hong Kong SAR, Japan, Korea and Viet Nam have legal requirements, to a certain extent, for SEA at national or local levels, or for aquaculture plans. Australia provides one example where environmental assessment is conducted on proposed aquaculture zones in coastal areas, which can be considered a form of SEA.
- Administration of EIA is usually within environmental ministries or departments. In the absence of EIA legislation including reference to aquaculture, the environmental assessment and management of aquaculture usually occurs under wide range of laws, often with key ministry of fisheries or equivalent. The need for improved environmental management of aquaculture is recognised widely, but the regional trend appears to be towards enhanced responsibilities for the sectoral ministries or departments involved with aquaculture.
- Decentralisation of government responsibilities, occurring widely across the region, is leading to delegation of some environmental management decisions from central to local government authorities. This process is leading to more administration and decision-making associated with EIA, and more generally the environmental management of aquaculture, at lower administrative levels. This approach raises considerable challenges, due to limited capacity for

environmental management at local levels, and sometimes unclear or overlapping legal responsibilities and procedures.

- EIA legislation for aquaculture widely includes reference to Environmental Management Plans (EMPs) that include environmental monitoring. Environmental monitoring programs involving aquaculture and the environments where aquaculture is practised are being more widely conducted, usually under larger government monitoring programs outside of EIA procedures. Examples can be found in the extensive environmental monitoring networks for fisheries in China and the developing systems in Viet Nam, both of which involve substantial investment.
- Some general EIA guidelines are now widely available to guide practitioners, but there are fewer focused on aquaculture sector.
- Voluntary instruments or “soft-law” (such as Codes of Conduct or Good Aquaculture Practices) are increasing in number; some linked to certification schemes and market access requirements. These are operated by governments, and also by some NGOs or private sector associations. The increasing proliferation of such instruments and certification schemes appears to be in response to market demand, particularly with exported products, and food safety concerns associated with aquaculture products. The scope and content of these documents varies considerably across the region, and there is a need for better harmonisation of content and approaches.
- Public participation and transparency are widely required in EIA legislation, but the requirement appears to be implemented widely in only a few more developed countries/territories within the region.

PRACTICES

Successful implementation of EIA requires skilled people, access to assessment and monitoring methods, financial and institutional support, and monitoring and enforcement powers, amongst others. The availability of such resources across the region has improved significantly over the past decade, but as can be seen from the various country papers, there is still a noticeable lack of capacity and resources for environmental assessment and management of aquaculture. The status of current practices is summarized as follows.

- Legislation is widely in place, but environmental assessment of aquaculture is still practiced unevenly across the region. The scope of most environmental assessment is oriented towards larger scale projects, with limited consideration of small-scale projects, or the cumulative impacts of large numbers of small-scale aquaculture activities. In terms of the wider environmental impacts of aquaculture in Asia, the effectiveness of EIA as a single tool for environmental management is therefore reduced, as most aquaculture development in Asia is small-scale.
- Methodologies used and the coverage of major environmental issues in environmental impact assessments in practice is also variable. In many lesser-developed countries, where conducted, the focus is in practice mostly on water and sediment quality, which are more easily analysed, and on limited habitat descriptions, with less emphasis on ecological aspects and ecosystem functions. In part, this is a result of limited skills and available methodologies, and limited awareness, resources and capacity for environmental assessment.
- Modelling of carrying capacity and effluent impacts is an important area where the methods are not widely available or skills not in use. In particular, lack of widely available carrying capacity models is noted, although there is increasing interest in development of models relevant to the region’s aquaculture.
- The use of risk-based methods in environmental impact assessment is limited. Only in Australia (and possibly New Zealand) is risk analysis now starting to be used as a methodology for environmental impact assessment.

- Environmental monitoring of aquaculture areas is now being practiced in several countries across the region, but with widely varied and in some cases inappropriate water quality standards. Widely varied water quality standards are found across the region and some standardisation would be useful. Environmental monitoring in individual aquaculture projects as a follow up to EIA is practiced to a very limited extent in most countries, with limited feedback to management improvements or project development.
- Environmental monitoring investments, more generally, and specifically as a follow up to EIAs, are needed in many countries to be better connected to management measures.
- There is increasing interest and practice in the use of voluntary instruments or “soft law” for management of aquaculture, particularly for exported major commodities such as shrimp. These instruments include Codes of Conduct, Codes of Practice, Good Aquaculture Practices, Better Management Practices and other standards and certification schemes.
- Delegation of responsibilities for environmental assessment and management of aquaculture to local authorities under decentralisation policies, such as in Indonesia and the Philippines, brings government managers closer to the farms and has considerable potential to improve environmental management of aquaculture, although implementation is constrained by lack of capacity and financial resources at the local level, as well as lack of clear or complete delegation of responsibilities in others (e.g. Indonesia, Philippines).
- Unclear institutional responsibilities and unclear jurisdictions in practice for environment agencies and sectoral agencies involved with aquaculture are raised as issues in several countries.
- Review processes and degree of consultation are extremely limited in nearly all countries, except for more developed countries/administrative regions in East Asia and Australia. Greater involvement of local stakeholders in the environmental assessment process and monitoring has potential to improve effectiveness and reduce costs.
- Impractical or inappropriate environmental management recommendations, which are not affordable or feasible, is also a concern. The need for practical environmental management measures that are affordable and feasible for farmers is evident from the review.

EFFECTIVENESS

For many countries in the region, the use of formal EIA and monitoring requirements and practices may have had limited effect on the wider aspects of management of environmental impacts of aquaculture at the country or regional scale. The major reason is that formal EIA tends to be focused on large scale individual projects, and much of the development of aquaculture in Asia is associated with small-scale aquaculture, often household level farming, making adoption of formal EIA procedures extremely difficult on an individual farm basis.

The fast pace of aquaculture development, and some sectors such as shrimp and catfish culture, has also made it difficult for environmental regulatory systems to keep pace. Project-based or sectoral EIA should therefore be seen as one tool in an environmental management strategy for aquaculture, to be combined with other measures for an effective overall approach.

Increasingly, voluntary instruments and “soft law”, linked to market access schemes such as certification, are now being used by governments and some private industry stakeholders to improve environmental performance, building on, or as an alternative to, more formal EIA measures. Emphasis in such schemes is towards high value commodities traded on international markets, where quality, and particularly food

safety, are important concerns. There is some evidence that the effectiveness of such voluntary measures, combined with major extension activities, such as in India, has contributed to improved environmental performance, but there is a need for wider application. Further assessment of the environmental benefits of voluntary schemes, such as in India, would be useful to guide future approaches.

Some other key points related to the effectiveness of EIA and monitoring include:

- Potential environmental impacts associated with the aquaculture industry are widely known, but awareness of these potential impacts is not always translated into environmental impact assessments or monitoring.
- In general, the use of data generated by the EIA or ongoing monitoring (by investors, producers, regulators, etc) beyond the immediate EIA appraisal is extremely limited in most countries.
- On-farm use of environmental data, generated through formal or informal environmental monitoring procedures, also appears to be limited in most countries.
- Feedback mechanisms for regular revision and review of the legal requirements for EIA and monitoring procedures and practices exist, and some improvements for aquaculture are being made.
- The general perception of stakeholders (producers, environmental and other NGOs, scientists, etc) about the effectiveness of the requirements is difficult to assess in most countries, without more detailed in-country consultations. The overall “feeling” is that EIA is useful, but it has not always contributed to improved environmental management of the sector, and is viewed more of an administrative burden rather than a management tool.
- More emphasis on addressing small-scale farmers is needed, perhaps through more widespread promotion and use of strategic environmental assessment and regional or sectoral level planning, and voluntary measures that are inclusive of the small-scale farming sector.

IMPROVEMENTS

There are opportunities for improvements to the environmental impact assessment and monitoring related to aquaculture in the Asian region, and more broadly environmental management in the aquaculture sector. Factors that are important in driving improvements to environmental assessment and management of aquaculture in the region include political will, awareness of the need for and potential positive industry benefits from improved management, investment, capacity and trade/marketing issues. The latter in particular have driven several countries to make significant improvements in environmental management through development and investment in implementation of codes and better practice guidelines, with some demonstrated environmental improvements. The following summarises some opportunities and recommendations for improvement:

- Strengthening of legislative systems and clarification of responsibilities for environmental management of aquaculture, both horizontally (between environment and aquaculture sector agencies) and vertically (central to local levels) continues to be needed.
- Improvements in environmental assessment related to scale of project, and levels of risk are needed. The single project approach to EIA, only applicable in practice to large-scale projects, should be complemented by assessments at regional or sector level, and related to the degree of environmental risk. SEA (Strategic Environmental Assessment) legislation is increasingly available, but has seen limited application to aquaculture.
- Considerable initiatives are being taken across the region to improve environmental performance of aquaculture by sectoral agencies (e.g. department of fisheries) and

industry. There has been and is a shift in awareness in government agencies towards the need for better environmental management of the sector, rather than solely promotion of production. This awareness, and associated political will, provides opportunities to introduce improved environmental assessment measures into the process of aquaculture planning and approval where these measures lie outside of environmental agencies. Sectoral agencies with management responsibilities for aquaculture should be encouraged/supported to adopt more environmental management measures and also encourage development and adoption of codes and other voluntary instruments within the private sector. Regional and international cooperation is also necessary to ensure better harmonisation and improved equivalence arrangements in the use of such instruments.

- The scope and use of environmental monitoring for management should be improved. There are good examples of monitoring programs for aquaculture areas, for example the environment and disease monitoring system of fisheries and aquaculture in China, and recently established also in Viet Nam. These initiatives can be improved though by development of standards and indicators, improved data analysis, and creating better links to management. This will require improvements in data collection, handling and processing, and opening up of communication channels vertically and horizontally to responsible government agencies and industry stakeholders.
- There is a need to improve environmental assessment methods and make them widely available.
- Carrying capacity models need to be more widely available, tested and suitable models promoted. Calculations in the EIA to assess carrying capacity of the waterbody and the farms should take into account the other farms in the waterbody and not only individual farm projects.
- Opportunities provided by decentralisation for improvements in local environmental management have not been translated widely into practice because of weak local institutional capacities and sometimes unclear delegation of responsibilities. Capacity building and guidelines to support such initiatives are needed.
- Use of EIA in aquaculture should be brought to an earlier stage in the project cycle with advocacy of more emphasis on EIA and SEA on aquaculture plans or areas. Capacity building and sharing of information on strategic environmental assessment would be one way to promote more widespread testing and adoption of this tool.
- The private sector pays for the conduct of most project-based EIAs, involving mainly larger farms. There is a need to explore means of financial support for the small-scale sector to participate in environmental management schemes, including voluntary schemes.
- Public participation mechanisms, including wider stakeholder involvement in the development of voluntary instruments, should be strengthened to ensure industry ownership and acceptance by public at large.
- The risk analysis approach should be more widely adopted in EIA processes and procedures, to enable focus on key issues and simplified procedures for addressing registration/licensing requirements for large numbers of small farms. Risk analysis can also be used to refine and focus EIA on key issues, and move away from over-simplistic area-based requirements for EIA (e.g. EIA on farms > 50 ha), particularly to target and to focus on key environmental issues related to particular farming systems and locations.
- Much stronger emphasis is also needed on improving environmental management among the small-scale farming sector, through simple regulatory procedures and voluntary measures that support improved environmental management, assisted

by improvements in the financial and technical services that will support the transition to better management. Costs associated with such management also need to be carefully considered; as it is unlikely the management costs can and should be absorbed by the small-scale producer.

Background and scope

“EIA and monitoring in aquaculture” – Component 2 of the FAO Project “Towards sustainable aquaculture: selected issues and guidelines” – includes the compilation, review and synthesis of existing EIA and environmental monitoring procedures and practices in aquaculture. Regional case studies were undertaken to review these issues in selected countries of four composite regions. This review covers the Asia-Pacific region, and specifically the following countries: Australia, China (including China, Hong Kong Special Administrative Region [SAR]), India, Indonesia, Japan, Malaysia, the Philippines, Thailand and Viet Nam. Additional information is also included from Bangladesh, Republic of Korea, Sri Lanka and New Zealand. For each country covered the focus of study is on the top three aquaculture species/commodities produced, although in many cases the status of EIA implementation is such that there is limited difference in approach or implementation between the species/commodities, or farming systems in each country. This case study review for the Asia Pacific region, as in other regions, gives special consideration to four areas related to EIA and monitoring in aquaculture including: (1) the requirements (2) the practice (3) the effectiveness and (4) suggestions for improvements, according to the Terms of Reference outlined in Appendix 1. The preparation of this review is based on country reviews contributed by several authors, which were coordinated and synthesized by M. Phillips of the Network of Aquaculture Centres in Asia-Pacific.

Authors collected information through a number of country analysts responsible for collection of information from each country. Each country analysis was compiled from relevant information as available in sources such as the scientific literature, professional and trade journals, grey literature, internet, regulatory authorities, industry associations, aquaculture or fisheries societies, environmental organizations and individual experts. Additional supplementary information was obtained through a workshop on carrying capacity of aquaculture, held by the Australian Centre for International Agricultural Research, Directorate General of Aquaculture (Indonesia) and the Network of Aquaculture Centres in Asia-Pacific (NACA) held in Lampung, Indonesia, during November 2007 (McKinnon, 2007).

It proved difficult to obtain detailed information on the implementation of EIAs and environmental monitoring in aquaculture in practice, and particularly to analyse in detail the implementation status. Insufficient, lacking or inaccessible information on “practices” and “effectiveness” in some countries was a particular constraint. Nevertheless, it is hoped that the synthesis and review as compiled provides a further stepping-stone of information towards improving the environmental management of the aquaculture sector in Asia. Furthermore detailed reviews of some countries, such as China, India, Malaysia and the Philippines would be warranted, from central to local levels, to provide insight on procedures and practices for environmental management of aquaculture. Such analysis, facilitated in a participatory way involving stakeholders from local to central levels, could also open opportunities for dialogue on improvements in environmental management, recognized as a particularly high priority at the present time in China.

General information on status and trends of aquaculture developments in Asia-Pacific can be found in FAO Fisheries Department (2006), NACA (2006), as well as

NACA's Web site² and FAO's National Aquaculture Sector Overviews³ and National Aquaculture Legal Overviews⁴.

² NACA: www.enaca.org/

³ National Aquaculture Sector Overviews: www.fao.org/fishery/naso/search/en

⁴ National Aquaculture Legal Overviews: www.fao.org/fishery/nalo/search/en

Synthesis of findings

REQUIREMENTS

General aspects of EIA legislation

Countries in the Asia-Pacific region began to establish environmental legislation in the 1970s, and environmental impact assessment (EIA) was an important area for many regulations. EIA systems and laws were gradually implemented across the region, from the 1970s (e.g. Japan and the Philippines), the 1980s (e.g. China and China, Hong Kong SAR, Indonesia, Republic of Korea) and the 1990s (e.g. Cambodia, Thailand, Viet Nam) and in 2000 (e.g. the Lao People's Democratic Republic). Since their inception, most of the EIA laws in the region have been amended in order to expand their coverage, enhance administration and public participation and improve enforcement.

The EIA systems found in the region have significant differences from country to country, as noted in a recent review (World Bank, 2006; 2008a), particularly with respect to:

- *Coverage of the EIA requirements*, such as the type and size of projects or plans. A growing, but still small, number of countries identify the need for EIA on development plans (as opposed to individual projects), including the use of strategic environmental assessment (SEA).
- *Administrative frameworks*. Across the region a range of bodies have been established to manage and implement EIA policy and regulations. Typically this involves ministries of environment or government environment agencies assuming most of the responsibility. The sector ministries, such as those for fisheries and aquaculture, tend to be responsible for sector specific technical guidance. In most cases the environment ministry is required to coordinate with these sector ministries for projects at the national level, but often communication channels are poorly developed for various reasons.
- *Capacity to implement EIAs*. The EIA procedure typically includes the following features; preliminary investigation, formulation of terms of reference (ToR), scoping, baseline study, environmental impact evaluation, mitigation measures, assessment of alternatives, final reporting, decision-making and project monitoring, requiring skilled professionals and financial resources. General guidance materials for EIA practice are widely available, as noted in the bibliography (for example, Sadler and McCabe (2002) and UNU (2007), and in a number of countries government officers and professionals have received extensive training. This capacity is however not evenly distributed in the region and, as will be seen, much less so for aquaculture activities.
- *Public consultation and information disclosure*. An essential step in identifying potential environmental impacts and designing effective mitigation measures is the public consultation process, and this process is stipulated in all the EIA laws and regulations in the region. Some countries/governments (and China, Hong Kong SAR) are reported by the World Bank (World Bank, 2006) as having adopted best practices with wide public involvement, but others less so. Effective public participation relies on the availability of appropriate information, access to which not surprisingly varies considerably across the region. Access to completed EIAs was a constraint to preparation of this regional review.
- *Timing*. The timing and duration for clearance of EIA reports varies considerably from country to country.

- *Environmental management plan (EMP)*. The need for an EMP is widely stipulated in the EIA requirements across the region, but not monitoring. For example, the World Bank (World Bank, 2006) report that in Cambodia, Thailand and Viet Nam follow-up monitoring is not included as a requirement within EIA legislation.

This general framework for EIA has an important influence on the application of EIA and monitoring to aquaculture within each country, where it may or may not be considered in EIA legislation as an activity with potential environmental impacts.

EIA and aquaculture

There are significant differences from country to country in the requirements for EIA or environmental monitoring for aquaculture. The requirements can be summarized as follows:

- The region includes countries in which aquaculture projects *are* specified in EIA legislation, such as the Philippines, and those, such as Thailand, that *do not* include aquaculture in EIA legislation. In these latter countries, environmental management responsibilities for aquaculture usually lie within the responsible fisheries and aquaculture ministries and departments. Table 1 provides further details.
- The scope of EIA, when applied to aquaculture, is almost entirely focused on individual, large-scale aquaculture, projects. Countries differ in the thresholds that trigger an EIA, which are usually focussed on projects covering larger areas, commonly between 10 ha and 50 ha. Scale, production capacity or area may be specified as criteria for triggering an EIA. Small-scale aquaculture farms are generally not subject to EIA, although they may be subject to environmental screening, or other environmental management strategies outside the EIA legislation (e.g. licensing, Good Aquaculture Practice (GAP) regulations, managed by the ministries/departments of fisheries and voluntary schemes). The use of such schemes for managing environmental impacts of aquaculture is increasing, perhaps because they often tend to be within the purview of sectoral ministries and departments.
- EIA legal requirements are commonly focussed on high value, intensive farming, and particularly shrimp and marine cage farming in tropical areas and marine fish farming in temperate areas. Most legislation is oriented towards farms that cover larger areas, related to potential environmental concerns. Small-scale and inland aquaculture systems are less subject to EIA legislation/regulations. Seaweed and mollusc culture is rarely mentioned in EIA legislation or guidelines.
- Strategic environmental assessment (World Bank, 2008b) is a new concept to the region. As of 2005, only China, Hong Kong SAR, Japan, the Republic of Korea and Viet Nam have legal requirements, to a certain extent, for SEA at national or local levels, or for aquaculture plans. Australia provides one example where environmental assessment is conducted on proposed aquaculture zones in coastal areas, which can be considered a form of SEA. India also conducted an environmental assessment on the shrimp-farming sector. China is also increasing attention on environmental assessment of “special programmes” that can include aquaculture development plans. The legal basis for SEA of aquaculture is increasingly present but there has been limited application of the approach in the aquaculture sector to date.
- Administration of EIA is usually within environmental ministries or departments. In the absence of EIA legislation including reference to aquaculture, the environmental assessment and management of aquaculture usually occurs under a wide range of laws, often with the key ministry of fisheries or equivalent. The need for improved environmental management of aquaculture is recognized widely,

TABLE 1
Summary of EIA legislation and aquaculture across the Asia-Pacific region

Country/state	Aquaculture in EIA legislation	Performed by	Environmental assessment and monitoring functions within government sectoral agency	Aquaculture projects subject to EIA/Scope of EIA requirements
Australia	Yes	Private/ government	Yes	Wide ranging requirements – see Australia country analysis
China	Yes	Private/ government	Yes	Aquaculture in sensitive areas – details not specified
China,Hong Kong SAR	Yes	Private	Yes	Coastal fish farm area > 5 ha, or close to designated sensitive habitats EIA not required for freshwater aquaculture
India	No	Private/ government	Yes	EIA for coastal aquaculture > 40 ha Coastal aquaculture farms >10ha simpler environmental assessment/monitoring required
Indonesia	Yes	Private/ government	Yes	Shrimp/fish ponds > 50 ha Freshwater cage farms > 2.5 ha or 500 units Marine cage farms > 2.5 ha or 1,000 units
Japan	Yes	Private/ government	Yes	Yes
Malaysia	Yes	Private/ government	Yes	EIA for coastal aquaculture project in mangrove wetland >50 ha (>10 ha in State of Sarawak) 10–50 ha require reduced procedures
The Philippines	Yes	Private/ government	Yes	Inland aquaculture – water spread area from 300 m ² to 10 ha, but depend on environmental sensitivity Coastal areas – yes, but depends on environmental sensitivity
Sri Lanka	Yes	Private/ government	Yes	Aquaculture projects >4 ha in coastal zone Aquaculture projects >1 ha if in mangrove forest All projects if within designated environmentally sensitive area
Thailand	No	Private/ government	Yes	Not specified in general EIA legislation
Viet Nam	Yes	Private/ government	Yes	EIA for coastal aquaculture projects of 10–200 ha, depending on ecosystem (see Viet Nam country analysis) All other projects subject to simpler procedures.

but the regional trend appears to be towards enhanced responsibilities for the sectoral ministries or departments involved with aquaculture. The costs of EIA are in most countries borne by the farm developers, and commonly conducted by hired experts/consultants, with appraisals by government agencies and expert panels. Malaysia provides an example of a country where registered qualified EIA consultants are available for public review on the internet. Authorities in China are also giving more attention to promoting EIA preparation by qualified individuals and firms.

- Decentralisation of government responsibilities, occurring widely across the region, is leading to delegation of some environmental management decisions from central to local government authorities. This process is leading to more administration and decision-making associated with EIA, and more generally the environmental management of aquaculture, at lower administrative levels. This approach raises considerable challenges, due to limited capacity for environmental management at local levels, and sometimes unclear or overlapping legal responsibilities and procedures.
- EIA legislation for aquaculture widely includes reference to EMPs that include environmental monitoring. Environmental monitoring programmes involving aquaculture and the environments where aquaculture is practiced are being more widely conducted, usually under larger government monitoring programmes outside of EIA procedures. Examples can be found in the extensive environmental

monitoring networks for fisheries in China and the developing systems in Viet Nam, both of which involve substantial investment.

- Some general EIA guidelines are now widely available to guide practitioners, but there are fewer focussed on the aquaculture sector. Malaysia provides one example of a guideline for use in aquaculture and Viet Nam has recently developed EIA guidelines for government and aquaculture farmers.
- Voluntary instruments or “soft-law” (such as Codes of Conduct or Good Aquaculture Practices) are increasing in number; some linked to certification schemes and market access requirements. These are operated by governments, and also by some non-governmental organizations (NGOs) or private sector associations. The increasing proliferation of such instruments and certification schemes appears to be in response to market demand, particularly with exported products, and food safety concerns associated with aquaculture products. The scope and content of these documents varies considerably across the region, and there is a need for better harmonisation of content and approaches.
- Public participation and transparency are widely required in EIA legislation, but the requirement is implemented widely in only a few more developed countries/territories (Australia, Japan and China, Hong Kong SAR) within the region. As an example, environmental assessments of coastal aquaculture zones in Australia include widespread opportunities for public participation, leading to extensive public input and sometimes a long period for decision-making.

PRACTICES

Requirements for EIA, environmental monitoring and other sectoral environmental management measures are in place or increasingly being put in place throughout the Asian region. Successful implementation of these measures requires skilled people; access to assessment and monitoring methods, financial and institutional support and monitoring and enforcement powers, amongst others. The availability of such resources across the region has improved significantly over the past decade, but as can be seen from the various country papers, there is still a noticeable lack of capacity and resources for environmental assessment and management of aquaculture. The status of current practices is summarized as follows:

- Legislation is widely in place, but environmental assessment of aquaculture is still practiced unevenly across the region. The scope of most environmental assessment is oriented towards larger scale projects, with limited consideration of small-scale projects, or the cumulative impacts of large numbers of small-scale aquaculture activities. In terms of the wider environmental impacts of aquaculture in Asia, the effectiveness of EIA as a tool for environmental management is therefore reduced, as most aquaculture development in Asia is small-scale.
- Methodologies used and the coverage of major environmental issues in environmental impact assessments in practice is also variable. In many lesser-developed countries, where conducted, the focus is in practice mostly on water and sediment quality, which are more easily analysed and on limited habitat descriptions, with less emphasis on ecological aspects and ecosystem functions. In part, this is a result of limited skills and available methodologies, and limited awareness, resources and capacity for environmental assessment to address the range of environmental issues that may be associated with development of the aquaculture sector. Table 2 provides a further assessment.
- Modelling of carrying capacity and effluent impacts is an important area where the methods are not widely available or skills not in use. In particular, lack of widely available carrying capacity models is noted, although there is increasing interest in development of models relevant to the region’s aquaculture. Where available (as seen for example in the Philippines and new models from Indonesia), such models

are only being used on a research basis, and are not yet being applied in project or strategic environmental assessments. Transfer of such methods from research to practical application remains a challenge.

- The use of risk-based methods in environmental impact assessment is limited. Only in Australia (and possibly New Zealand) is risk analysis now starting to be used as a methodology for environmental impact assessment. The wider use of risk-based approaches is recognized as potentially helpful to define more precisely the environmental risks and enabling focus in key issues in environmental management and monitoring (GESAMP, 2008).
- Environmental monitoring of aquaculture areas is now being practiced in several countries across the region, but with widely varied and in some cases inappropriate water quality standards. Widely varied water quality standards are found across the region and some standardisation would be useful. There are some large scale environmental monitoring systems in place in China, and being developed in Viet Nam, intended to provide guidance and “early warning” on water quality trends in fisheries and aquaculture areas. These are mostly funded and operated by government agencies. Environmental monitoring in individual aquaculture projects as a follow up to EIA is practiced to a very limited extent in most countries, with limited feedback to management improvements or project development.
- Environmental monitoring investments, more generally, and specifically as a follow up to EIAs, are in many countries not well connected to management measures. There appears to be limited use of monitoring for improvement of environmental management. Viet Nam provides a case where there has been substantial government investment in environmental monitoring of aquaculture areas; however, the information flow from environmental data collection and link to management remains to be established. China has also made substantial investments in a fishery environmental monitoring system, and is in the process of orienting this towards more monitoring and management of aquaculture farming zones in the coastal areas.
- There is increasing interest and practice in the use of voluntary instruments or “soft law” for management of aquaculture, particularly for exported major commodities such as shrimp. In China, several domestic aquaculture commodities are also now being subjected to certification. These instruments include Codes of Conduct, Codes of Practice (CoP), Good Aquaculture Practices, Better Management Practices (BMPs) and other standards and certification schemes. These approaches are starting to show potential to encourage both environmental improvement and self-monitoring of aquaculture farms. The interest among larger more commercially aware farmers in adopting such standards to gain market advantage is noticeable in some larger shrimp producing countries, such as Thailand.
- Delegation of responsibilities for environmental assessment and management of aquaculture to local authorities under decentralisation policies, such as in the Philippines and Indonesia, brings government managers closer to the farms and has considerable potential to improve environmental management of aquaculture. Potential advantages of this approach is constrained by lack of capacity and financial resources at the local level, as well as lack of clear or complete delegation of responsibilities in others (e.g. the Philippines, Indonesia). Recent guidelines developed in the Philippines (PHILMINAQ, 2006a) provide useful examples to support capacity building at local levels.
- Unclear institutional responsibilities and unclear jurisdictions in practice for environment agencies and sectoral agencies involved with aquaculture are raised as issues in several countries. The need for clearly defined responsibilities is

particularly emphasized in countries devolving responsibilities to local government units, as in Indonesia and the Philippines.

- Review processes and degree of consultation are extremely limited in nearly all countries, except for more developed countries/administrative regions in East Asia and Australia. Involvement of public stakeholders in the EIA process and monitoring varies considerably. Greater involvement of local stakeholders in the environmental assessment process and monitoring has potential to improve effectiveness and reduce costs.
- Impractical or inappropriate environmental management recommendations, which are not affordable or feasible, are also a concern. Whilst it proved difficult to conduct a detailed review of project EIAs and to make generalizations, the need for practical environmental management measures that are affordable and feasible for farmers is recognized as a common constraint in the country papers. This is in part related to the widespread view in the aquaculture industry that EIA is more of an administrative procedure than a management tool to improve environmental (and economic) performance.

The following Table 2 provides an overview of the environmental issues generally considered as important in environmental assessments, and the existing methodology and skills base for the different countries, based on inputs from country reviewers.

TABLE 2
Environmental issues in aquaculture – assessment methods and skills base*

Environmental issue	Assessment methods (potential/in use)	Assessment of skills and knowledge available**								
		Aus	Ch	Ind	Ins	Jap	Mal	Phi	Th	Vie
Environmental plan/policy in aquaculture along whole supply chain	Stakeholder consultations Economic/market analysis Life cycle analysis	4	3	3	2	4	3	3	4	3
Siting and ecological consequences of conversion and changes in natural habitats, such as mangroves, with construction of aquaculture and associated infrastructure	GIS/satellite imagery Site visits/ecological studies Stakeholder consultations	4	4	3	3	4	4	4	4	4
Discharge of pond and cage effluent leading to water pollution and sediment changes and accumulation in farming and coastal areas (including carrying capacity)	Simple water quality models Sediment/benthic impact models Carrying capacity models	4	4	2	3	4	4	4	4	4
Seepage and discharge of saline pond water that may cause salinity changes in of groundwater and surrounding agricultural land	Water quality modelling GIS/satellite imagery Habitat mapping/ecological studies	4	3	2	3	4	3	3	4	3
Use of fish meal and fish oil in aquaculture diets, collection of trash fish for feeding carnivores	Ecological studies	3	3	2	2	4	3	3	4	3
Environmental and human health risks associated with chemical use in aquaculture	Health risk analysis Analysis of management practices	4	4		3	4	4	4	3	4
Local/trans-boundary movements concerning spread of genetic materials, exotic species and disease	Risk Analysis	4	3	2	3	4	3	3	4	3
Biodiversity issues primarily arising from collection of wild seed, escapes and genetic impacts, and wildlife	Risk analysis (poorly developed)	4	2	2	3	4	2	2	3	2
Socio-economic impacts related to natural resource use for aquaculture.	Stakeholder analysis/ consultations	4	3	3	3	4	3	3	3	3
Voluntary code of practices or environmental management programmes	Benchmarking against key issues above Stakeholder consultations	4	3	3	2	4	3	3	4	3
Monitoring programmes for aquaculture activities	Water and sediment monitoring	4	4	4	2	4	4	4	3	4

* Qualitative assessment from 1 to 4 (1 = limited or no skills; 4 = complete skills easily available). Limited information available for some countries.

** Aus: Australia; Ch: China, P.R.; Ind: India; Ins: Indonesia; Jap: Japan; Mal: Malaysia; Phi: Philippines; Th: Thailand; Vie: Viet Nam.

EFFECTIVENESS

For many countries in the region, the use of formal EIA and monitoring requirements and practices has likely had a limited effect on the wider aspects of management of environmental impacts of aquaculture at the country or regional level. The major reason is that formal EIA tends to be focussed on large scale individual projects, and much of the development of aquaculture in Asia is associated with small-scale aquaculture, often household level farming. There are estimated to be 14 million aquaculture farmers in Asia (Corsin, Funge-Smith and Clausen, 2007), of which the majority are small-scale, making adoption of formal EIA procedures extremely difficult on an individual farm basis.

Thus, although EIA as a tool has provided some environmental benefits at project level, it has not, as practiced, provided significant environmental benefits to the sector. The fast pace of aquaculture development, and some sectors such as shrimp and catfish culture, has also made it difficult for environmental regulatory systems to keep pace. Project-based or sectoral EIA should therefore be seen as one tool in an environmental management strategy for aquaculture, to be combined with other measures for an effective overall approach.

Increasingly, voluntary instruments and “soft law”, linked to market access schemes such as certification, are now being used by governments and some private industry stakeholders to improve environmental performance, building on, or as an alternative to, more formal EIA measures. Emphasis in such schemes is towards high value commodities traded on international markets, where quality, and particularly food safety, are important concerns. There is some evidence that the effectiveness of such voluntary measures, combined with major extension activities, such as in India, has improved environmental performance, but there is a need for wider application. Further assessment of the environmental benefits of voluntary schemes, such as in India, would be useful to guide future approaches.

Some other key points related to the effectiveness of EIA and monitoring include:

- Potential environmental impacts associated with the aquaculture industry are widely known, but awareness of these potential impacts are not always translated into environmental impact assessments or monitoring. Except in the developed countries of the region, where EIAs tend to be comprehensive, the practical scope of EIAs tends to focus on more easily assessed parameters, particularly water and sediment quality and simple habitat assessments.
- In general, the use of data generated by the EIA or ongoing monitoring (by investors, producers, regulators, etc.) beyond the immediate EIA appraisal is extremely limited in most countries. Australia has used the data generated from monitoring to review and improve procedures (such as the benthic monitoring programme for sea cage farms in Tasmania) but such approaches have not been widely used through the region.
- On-farm use of environmental data, generated through formal or informal environmental monitoring procedures, also appears to be limited in most countries. The development and wider use of voluntary instruments has potential to improve effectiveness in use of on-farm monitoring to improve performance. A wider application of such techniques is required to create wider environmental benefits.
- Feedback mechanisms for regular revision and review of the legal requirements for EIA and monitoring procedures and practices exist, and some improvements for aquaculture are being made. Viet Nam is one example where recent reviews of the EIA process have led to change in approaches towards allocating more responsibility to the sectoral agency for environmental management and delegation of environmental assessment, monitoring and overall management responsibilities to local levels. Viet Nam’s EIA guidelines have also provided more focus on practical measures for the small-scale sector, from an earlier version that was oriented only towards large farm areas.

- The general perception of stakeholders (producers, environmental and other NGOs, scientists, etc) about the effectiveness of the requirements is difficult to assess in most countries, without more detailed in-country consultations. The overall “feeling” is that EIA is useful, but it has not always contributed to improved environmental management of the sector, and is viewed more of an administrative burden rather than a management tool. The application to small-scale farms is viewed with particular concern.
- The large numbers of small-scale farmers continue to be left out of most formal environmental impact assessment and management measures, which to date have had limited effectiveness on this important group of the sector. More emphasis on addressing small-scale farmers is needed, perhaps through more widespread promotion and use of strategic environmental assessment and regional or sectoral level planning, and voluntary measures that are inclusive of the small-scale farming sector.

IMPROVEMENTS

There are opportunities for improvements to the environmental impact assessment and monitoring related to aquaculture in the Asian region, and more broadly environmental management in the aquaculture sector. Factors that are important in driving improvements to environmental assessment and management of aquaculture in the region include political will, awareness of the need for and potential positive industry benefits from improved management, investment, capacity and trade/marketing issues. The latter in particular have driven several countries to make significant improvements in environmental management through development and investment in implementation of codes and better practice guidelines, with some demonstrating environmental improvements. The following summarizes some opportunities and recommendations for improvement:

- Strengthening of government legislative systems and clarification of responsibilities for environmental management of aquaculture, both horizontally (between environment and aquaculture sector agencies) and vertically (central to local levels) continues to be needed as aquaculture continues its expansion across the region. Increased designation of responsibilities for management by sectoral agencies can be an effective option for environmental management, as part of an overall management approach for the sector.
- Improvements in environmental assessment related to scale of project, and levels of risk are needed. The single project approach to EIA, only applicable in practice to large-scale projects, should be complemented by assessments at regional or sector level, and related to the degree of environmental risk. SEA legislation is increasingly available, but has seen limited application to aquaculture. SEA has potential for use in addressing the environmental impacts associated with cumulative impacts, or integration of aquaculture with other sectors, or where there are large numbers of small-scale farmers, but capacity and awareness of the approach appears to be limited to date (World Bank, 2008b). Levels of risk should be considered. For example, enclosed freshwaters would be more at risk to water pollution than open marine environments due to less flushing and longer residence.
- Considerable initiatives are being taken across the region to improve environmental performance of aquaculture by sectoral agencies (e.g. department of fisheries) and industry. There has been and is a shift of awareness in government agencies towards the need for better environmental management of the sector, rather than solely promotion of production. This awareness, and associated political will, provides opportunities to introduce improved environmental assessment measures into the process of aquaculture planning and approval where these measures lie outside

of environmental agencies. Sectoral agencies with management responsibilities for aquaculture should be encouraged/supported to adopt more environmental management measures and also encourage development and adoption of codes and other voluntary instruments within the private sector. Regional and international cooperation is also necessary to ensure better harmonisation and improved equivalence arrangements in the use of such instruments.

- Some improvement in environmental data collection is also required. EIAs should be based on real data collected scientifically, not just a theoretical analysis of historical data. Risks of projects from climate change, such as more frequent storms and increasing sea levels also require more attention, particularly at sectoral or planning level.
- The scope and use of environmental monitoring for management should be improved. There are good examples of monitoring programmes for aquaculture areas, for example the environment and disease monitoring system of fisheries and aquaculture in China, and recently established also in Viet Nam. These initiatives can be improved by development of standards and indicators, improved data analysis and creating better links to management. This will require improvements in data collection, handling and processing, and opening up of communication channels vertically and horizontally to responsible government agencies and industry stakeholders. There should be agreed tropical indicators of environmental impact. Efforts in the Philippines are also developing three scales of monitoring survey targeted at small-scale clusters of farms, aquaculture zones and large scale farms that could be reviewed and more widely applied. Roles and responsibilities between private and government also need to be considered.
- The Association of South East Asian Nations (ASEAN) has started the process of standardizing the water quality standards within the Southeast Asian region. This is a very good initiative and should be continued with the standardisation of EIAs for aquaculture farms (scale/scope/methodology, etc) and standardization of environmental monitoring survey methodology, analysis and equipment; although this should in no way compromise the need for flexibility to focus on and address locally important issues.
- Public consultation and information disclosure in many countries is still limited. Improving the EIA and monitoring information/databases and their public availability is necessary.
- There is a need to improve environmental assessment methods and make them widely available. A useful exercise would be to draw together existing guidelines, both general and specific to aquaculture (see reference list), analyse their effectiveness, and make a synthesis widely available. Such a synthesis should bring together practical methods for EIA, but also with emphasis on SEA and environmental management for the small-scale aquaculture farmer. An internet-based “tool kit” for environmental assessment and management measures for aquaculture, with local language material as needed, might also be helpful.
- Carrying capacity models need to be more widely available, tested and suitable models promoted. Calculations in the EIA to assess carrying capacity of the waterbody and the farms should take into account the other farms in the waterbody and not only individual farm projects. A useful summary of existing carrying capacity models for aquaculture is provided in McKinnon (2007).
- Opportunities provided by decentralisation for improvements in local environmental management have not been translated widely into practice because of weak local institutional capacities and sometimes unclear delegation of responsibilities. Such constraints are recognized in the Philippines where recent “better practice” guidelines have been drafted to assist local governments in environmental management of aquaculture, and provide the basis for capacity building. Such

guidelines could be made more widely available and adapted/translated to local circumstances in several countries with decentralised aquaculture management responsibilities.

- There is a need to particularly enhance implementing capacity at local levels, with an emphasis on those countries where decentralization has given more responsibility to local government, but without the necessary implementation skills. Skills for environmental assessment and monitoring, as well as requirements, are different across the region, and there are also good opportunities for sharing of experiences and capacity building among countries, but ultimately investment will be required by countries themselves.
- Use of EIA in aquaculture should be brought to an earlier stage in the project cycle with advocacy of more emphasis on EIA and SEA on aquaculture plans or areas. It is important to encourage and apply strategic assessment for large numbers of small projects. Government investment will likely be necessary for the conduct of such area based SEA initiatives, as is common, for example in Australia. Capacity building and sharing of information on strategic environmental assessment would be one way to promote more widespread testing and adoption of this tool.
- The private sector pays for the conduct of most project-based EIAs, involving mainly larger farms. There is a need to explore means of financial support for the small-scale sector to participate in environmental management schemes, including voluntary schemes.
- Public participation mechanisms, including wider stakeholder involvement in the development of voluntary instruments, should be strengthened to ensure industry ownership and acceptance by the public at large. Transparency in EIA preparation also needs to be complemented by consistency and transparency in evaluation/appraisal of EIAs.
- The risk analysis approach should be more widely adopted in EIA processes and procedures, to enable focus on key issues and simplified procedures for addressing registration/licensing requirements for large numbers of small farms. Risk analysis can also be used to refine and focus EIA on key issues, and move away from over-simplistic area-based requirements for EIA (e.g. EIA on farms > 50 ha), particularly to target and to focus on key environmental issues related to particular farming systems and locations.
- Much stronger emphasis is also needed on improving environmental management among the small-scale farming sector, through simple regulatory procedures and voluntary measures that support improved environmental management, assisted by improvements in the financial and technical services that will support the transition to better management. Costs associated with such management also need to be carefully considered; as it is unlikely the management costs can and should be absorbed by the small-scale producer.

Country analyses

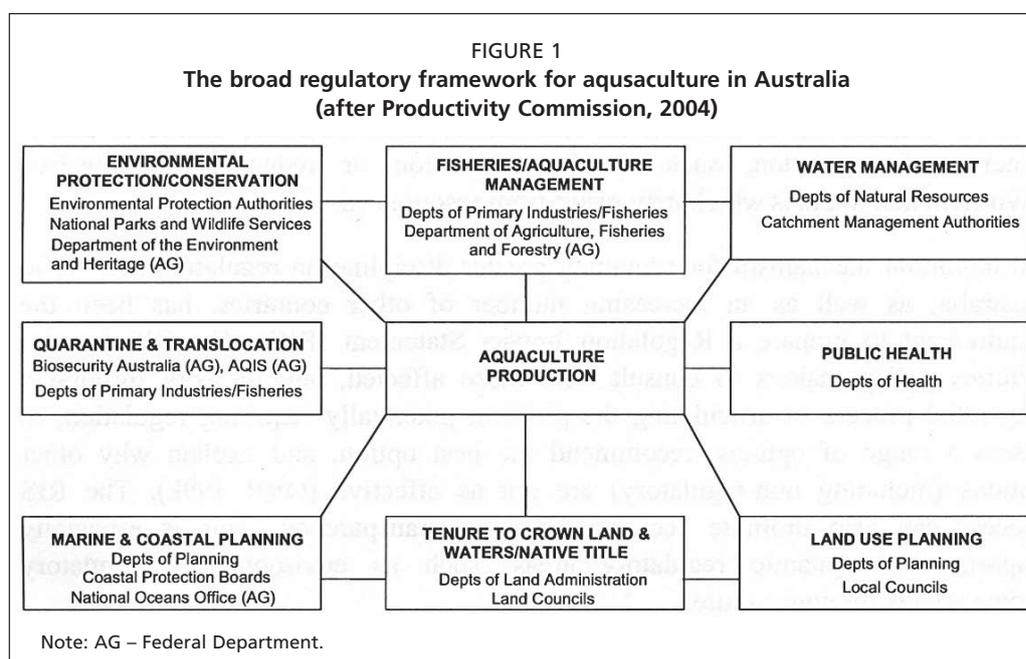
The following provides a review and analysis of application of EIA and monitoring in aquaculture in selected countries in the Asia-Pacific region. Detailed country analysis studies were developed for Australia, China, India, Indonesia, Japan, the Philippines, Thailand and Viet Nam. Brief descriptions on experiences in other countries/territories of the region are also provided.

AUSTRALIA⁵

Requirements

Environmental impact assessment

In Australia, investors in aquaculture must comply with a range of federal, state and local government environmental laws to ensure the long-term environmental sustainability of the industry. Figure 1 shows the broad regulatory framework for aquaculture in Australia (after Productivity Commission, 2004). Although there is no over-arching legislation that requires EIA to be carried out on proposed aquaculture developments, the EIA process may be triggered at any level of government depending on the specific nature of the development.



Administration and responsibilities

The federal government has legislation and regulations to protect matters of national environmental significance, promote ecologically sustainable development (ESD) and ensure standards are maintained in food safety, aquatic animal health, quarantine, trade and taxation (PIMC, 2005). The Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act) intends to protect the environment and streamline national environmental assessment and approvals processes, protect Australian

⁵ Contribution by Fiona Gavine.

biodiversity and integrate the management of important natural and cultural places. An EIA would be required under the EPBC Act if a proposed aquaculture development encroached on areas of National Environmental Significance, National Heritage places and Wetlands of international importance (Ramsar Wetlands). EIA can also be required if the development had a significant impact on the environment in general or the environment of Commonwealth land. There is a standard framework for EIA development and presentation under this Act, but requirements can be tailored on a case by case basis. A policy statement has been developed that gives guidance on when marine offshore developments should be referred under this Act (DEH, 2006).

Proposed developments in or adjacent to, the Great Barrier Reef Marine Park are dealt with by the Great Barrier Reef Marine Park Authority (GBRMPA). Proposals are dealt with on a case-by case basis and an EIA would be required to assess social, environmental and economic issues related to the application.

Individual state and territory governments are primarily responsible for the approval and licensing of aquaculture production within their boundaries. Some states have aquaculture-specific legislation to achieve ESD whereas others use regulations attached to older legislation to ensure ESD, allocation and management of resources, disease notification, access to broodstock or juveniles and compliance with food safety regulations (PIMC, 2005). The regulatory approach also differs where the application involves the use of publicly owned natural resources (such as offshore sites or Crown land) or private land (usually land-based sites). In most states and territories, departments of primary industries (or fisheries), planning, environment and land administration as well as environmental protection authorities administer the regulatory framework and appropriate approvals (Productivity Commission, 2004). Local governments have a role of permitting land-based developments. Table 3 summarizes the responsibilities at federal, state and local level in terms of EIA.

Some states (notably New South Wales (NSW) and Western Australia) require EIA for large-scale aquaculture proposals with potential for significant impacts on the environment (Productivity Commission, 2004), but otherwise EIA is not generally required and an assessment will be made on a case-by-case basis (Table 4).

In Western Australia, the farming of pearls is managed under the provisions of the Pearling Act 1990 and an EIA may be required if the proposal is referred to the Environmental Protection Authority (EPA) for assessment under the Environment Protection Act, 1986 (Everall, 1997). An EIA may be required by the EPA and the

TABLE 3
Summary of responsibilities with respect to EIA

Level of Government	Department	Responsibilities	Public participation and information disclosure
Federal	Department of Environment and Water Resources	Environmental Protection and Biodiversity Conservation Act, 1999	If EIA is required public comment is required on draft before it is finalised. Public enquiry can be requested.
	Great Barrier Reef Marine Park Authority	Great Barrier Reef Marine Park Act, 1975	EIA required.
State	Department of Primary Industries (or Fisheries Agency)	Licensing of aquaculture production (all). Development of regional aquaculture plans for offshore sites. Referral to other agencies as required.	Public consultation required in development of regional plans.
	Environmental Protection Authorities (EPA)	Approval of waste discharges to public waters and setting licence conditions.	
Local	Local Councils	Planning permission required for most land-based developments. Co-ordinates referrals to other agencies. Can request written statement addressing environmental impacts.	Public consultation in planning process.

TABLE 4
State legislation for aquaculture in Australia (Productivity Commission, 2004)

State	Legislation	Responsible Agency	Requirement for EIA
New South Wales	Fisheries Management Act, 1994	NSW Fisheries	Required for large-scale proposals
Queensland	Fisheries Act, 1994	Department of Primary Industries and Fisheries (DPI&F)	Case-by-case basis
	Integrated Planning Act, 1997		
South Australia	Aquaculture Act, 2001	Department of Primary Industries, Resources	Case-by-case basis
Tasmania	Marine Farming Planning Act 1995	Department of Primary Industries Water and Environment	Case-by-case basis
	Living Marine Resources Management Act 1995		
Victoria	Fisheries Act 1995	Fisheries Victoria	Case-by-case basis
	Land Act 1958		
Western Australia	Fish Resources Management Act 1994	Department of Fisheries	Required for large-scale proposals
	Pearling Act 1990		

scope of the EIA must first be defined in an “Environmental Scoping” document that includes:

- regional setting of the proposal (including justification for selection);
- summary of potential environmental impacts, their significance and management responses;
- proposed studies and investigations to be carried out as part of the EIA.

The EIA is then prepared and submitted for assessment and public review prior to approval or otherwise.

Scope of environmental assessment

The scope of environmental assessment required varies between individual states and territories, the production methods employed, the culture environment and the species under culture. Table 5 summarizes some of the issues associated with different production systems in different environments in terms of site, local or off-site impacts.

TABLE 5
Selected potential environmental impacts of aquaculture (Productivity Commission, 2004)

Production system/ species	Potential site impacts	Potential operation – local impacts	Potential operation – off site impacts
Cage culture (marine finfish)	Habitat modification or loss; effects on amenity values	Marine floor degradation; lower water quality; disease; fish escape impact on wild stocks; loss of native wildlife	Disease; fish escapes and impact on wild stocks; cumulative impacts on environment; amenity values
Rack, tray and stick (oysters, mussels)	Habitat modification or loss; effects on amenity values	Marine floor degradation; removal of food for other filter feeders; spread of introduced marine organisms; improved water quality in some areas	Impacts on human health; cumulative impacts on environment; amenity values
Pond culture	Habitat modification or loss; effects on amenity values	Lower water quality; disease; competition with wild stocks; loss of native wildlife	Cumulative impacts on environment; amenity values

Offshore aquaculture

States with significant offshore aquaculture industries (notably Tasmania and South Australia) have statutory marine aquaculture planning with regional aquaculture plans that recommend suitable areas to be allocated for leasing to aquaculture. These plans are developed by the state government and include an EIA of the region and recommend zones suitable for marine aquaculture. In Tasmania, for example, EIAs conducted as part of regional management plans for offshore culture areas collate information on the following topics:

- general characteristics of the area in terms of geography (including climate, winds, geology, rainfall, wildlife habitats), water quality objectives and social and economic description;
- existing uses (shipping, commercial fishing, recreation and conservation);
- suitability of the area for marine farming, including an assessment of potential impacts;
- identification of suitable lease zones and management controls that would relate to these zones;
- once the lease has been allocated for aquaculture development, management controls related to carrying capacity, monitoring and reporting, waste management, disease and other matters are encapsulated into the licence.

The regional plans stipulate general management controls that mitigate negative effects from aquaculture development. These management controls are then incorporated into individual aquaculture licences. When the plans are formalised after a public consultation process, tenders are invited for the leases identified within the plan. Individual licences include environmental conditions to ensure that marine farming operations are sustainable and do not have an unacceptable impact on the marine environment. There is a requirement for baseline studies to be conducted prior to operations commencing and ongoing environmental monitoring.

Victoria and Queensland have also developed statutory planning arrangements recently, whilst Western Australia and NSW have made limited use of statutory planning arrangements, preferring to use EIA to assess individual large-scale developments. Productivity Commission (2004) argues that states not as advanced with planning and implementing marine aquaculture plans may either constrain industry development or lead to *ad hoc* approvals that could result in user conflicts.

Land-based aquaculture

Management of the environmental impacts of land-based aquaculture operations (both coastal and inland) is spread across a number of state agencies (Productivity Commission, 2004). The aquaculture licence granted by the primary industries or fisheries department will incorporate some environmental protection provisions into licences, but operators will also need licences for water diversion, water discharge, works approvals, clearing of vegetation and other activities that impact on the environment (Productivity Commission, 2004). Local councils are responsible for granting development approval and this adds additional layers of complexity, as each council will have a different framework of state planning and development legislation as well as local planning overlays to apply.

The requirement for EIA for land-based sites will be assessed on a case-by-case basis depending on the specific nature and scale of the development. The assessments conducted for inland aquaculture in Australia vary depending on the farming system, management and location of the proposed development. The assessment approach and associated monitoring requirements vary from state to state. In Queensland, when an aquaculture development is deemed to be “low impact”, it is designated a “self-assessable” development and may be carried out without a separate approval from the DPI&F (DPI&F, 2005). The main criteria that determine a development to be “low impact” are (see DPI&F, 2005 for specific details):

- there is no discharge of waste to Queensland waters;
- the species is an indigenous freshwater fish, and;
 - is carried out in ponds or tanks with a total surface area less than 5 ha;
 - is for aquarium display or human consumption only;
 - is a part of an enclosed system no more than 50 m² in area;
 - is outside an area prescribed under the Fisheries Act 1994 as an area from which the fish may be released.

In contrast, aquaculture activities that are considered “high risk” and require specific management arrangements include (DPI&F, 2004):

- aquaculture on potentially flood-prone land;
- aquaculture of species that are non-indigenous to the area;
- use of aquaculture product for bait.

In South Australia, the government recognizes “(1) the diversity of the land-based aquaculture industry, (2) the need for an environmental risk profile classification system and (3) the need to vary EMP and reporting requirements of land-based licenses accordingly”. This “risk-based approach” to assessment is used to allow management and monitoring to be focused on key environmental concerns. Land-based licenses in South Australia are classified into three categories of environmental risk profile; low, medium and high depending on (1) the manner in which water is discharged and (2) the amount of feed input. The classification against environmental risk is noted in Table 6.

TABLE 6

Classification of environmental risk profile for land based aquaculture operations based on discharge type and feed usage (Discharge type - “controlled” = some treatment; uncontrolled = no treatment. Feed type – minor manufactured = limited feed use; major manufactured = intensive feed farming)

Feed type	Discharge type		
	None	Controlled	Uncontrolled
Natural	Low	Low	Low
Minor manufactured	Low	Low	Medium
Major manufactured	Low	Medium	High

In NSW inland aquaculture licences are classified according to the intensity of production whereas in Victoria, licences as classified according to species and specific guidelines have been developed to address “high risk” proposals such as barramundi culture (DNRE, 2002).

The type of production system proposed will have a bearing on the level of resource use and potential impacts on the environment. Systems range from flow-through culture systems (e.g. intensive trout farming) to static pond systems (used in native fish production) to fully enclosed re-circulating aquaculture systems (RAS). Flow-through or “open” culture systems have the highest degree of interaction with natural resources to provide inputs (such as water and dissolved oxygen) and remove wastes from the system. In general, such systems require a higher level of scrutiny in terms of their impact on the environment than “closed” or “semi-closed” systems, although the disposal of wastes which accumulate within closed or semi-closed systems must always be accounted. Flow-through intensive systems are commonly used for the production of salmonids in Victoria and South Australia and would be classified as a “high” risk operation according to Table 6. Although a formal EIA is not generally required in Victoria, prior to development the proponent must submit a range of information (Table 7) to the following agencies (in addition to that required by Fisheries Victoria for their aquaculture licence).

Voluntary instruments

Most sectors of the aquaculture industry have developed codes of practice to standardise environmental operations in their industry. Table 8 shows some of the codes of practice and other voluntary instruments available.

Environmental monitoring

Environmental monitoring requirements for aquaculture in Australia depend on state requirements, species cultured, site characteristics and the culture environment (marine or freshwater).

TABLE 7
Environmental information required for various licenses for salmonid farms in Victoria

Agency	Licence	Environmental data required
Water Authority	Water diversion licence	<ul style="list-style-type: none"> • daily flow requirements; • low flow frequency in the waterway; • type of proposed diversion works and outfall works; • flow monitoring proposals; • operating arrangements; • distance between diversion and discharge points; • existing water quality and impacts of the proposal.
Catchment Management Authority (CMA)	Waterways work permit	
EPA	Discharge licence	<ul style="list-style-type: none"> • average monthly and daily flow distribution within the waterway; • minimum mean daily flow distribution within the waterway; • nutrient concentrations in discharge water; • minimum, monthly and average effluent dilution calculations.
Local authority	Planning permission	<ul style="list-style-type: none"> • existing vegetation and landscape of the site; • listed flora and fauna; • sites of cultural heritage significance and any other notable features of the site.

TABLE 8
Voluntary instruments

Sector	Name of document	Reference
Tuna	Tuna code of practice	
Prawns	Australian prawn farming manual	Robertson, 2006 DPI&F, 2006
Salmonids (inland)	Best Practice Environmental Management Guidelines for the Victorian salmonid aquaculture industry	Gavine <i>et al.</i> , 2006
Recirculating Aquaculture System	Best Practice Environmental Management Guidelines for Recirculating Aquaculture Systems in Victoria	Gavine <i>et al.</i> (in press)

Offshore aquaculture

Environmental monitoring is widely conducted in marine aquaculture in Australia. The actual practice depends on state requirements, species cultured, site characteristics and issues identified during the EIA. A summary of environmental monitoring requirements for selected marine production systems is shown in Table 9. In Victoria, the leaseholder may not be the same as the aquaculture licence holder. In Tasmania salmon culture, once the development has been approved, individual leaseholders are required to undertake baseline assessments. This is a one-off survey undertaken prior to production commencing and if there is a relocation or expansion of lease area by more than 10 percent. Ongoing monitoring is also required for offshore salmon farms. For each lease a video survey must be carried out every six months and a more detailed survey every two years (Table 9). Shellfish farms do not require ongoing monitoring as research has shown that impacts are not significant (Crawford, 2003). Other states, however, do have a requirement for ongoing monitoring of shellfish farms (e.g. Victoria).

Inland aquaculture

The type and level of environmental monitoring programmes and reporting requirements will vary depending on the risk classification from the assessment phase in some states. The environmental monitoring programmes are then developed based on the degree of risk, with higher risk farms requiring additional parameters of increased frequency of sampling. Table 10 provides an example of the frequency of water sampling required for farms with different degrees of environmental risk.

TABLE 9

Summary of environmental monitoring requirements for marine aquaculture by different states (adapted from Crawford, 2003; the asterisk denotes activities to be carried out by the leaseholder)

	South Australia		Tasmania		Victoria	
	Tuna Baseline	Tuna Ongoing	Salmon Baseline (cages)	Salmon (ongoing biennial)	Mussels Baseline	Mussels (ongoing yearly)
Current flow			√		√*	
Bathymetry			√		√*	
Habitat profile			√		√	
Video survey	√		√	√ (six monthly)	√	√
Sediment chemistry						
Redox			√	√	√	
Particle size			√	√	√	
Organic matter			√	√	√	
Stable isotopes			√		√	
Benthic infaunal analysis					√	
Family id		√a	√	√	√	

a/ Not required at this stage

Environmental sampling results are reported to the regulatory authority, and in the case of non-compliance further action may be taken.

In inland aquaculture, there are further differences in requirements by the state. In South Australia, the diversity of aquaculture

systems is recognized and monitoring requirements defined based on an assessment of environmental risk, with monitoring developed based on the degree of risk, with higher risk farms requiring additional parameters of increased frequency of sampling. Table 11 provides an overview of requirements by system.

TABLE 10

Frequency of water quality sampling against degree of risk

Risk profile	Monitoring per year
Low	0
Medium	1
High	3

TABLE 11

Summary of environmental monitoring requirements for inland aquaculture by system

	Flow through systems in Victoria	RAS	Static pond
Water quality	√	√	
Water flow	√		
Feed inputs	√		

Practices

This section considers and analyses the practices applied for EIA and environmental monitoring and difficulties and constraints in implementing such EIA studies and recurrent environmental monitoring efforts.

Environmental assessment methods

In both offshore and land-based aquaculture, environmental standards that the farmer must comply with are incorporated into the relevant licences. The farmers are then required to carry out monitoring of their operations and report back to the regulating agency on a periodic basis.

Offshore aquaculture

Environmental standards that are commonly included in Tasmania salmon aquaculture licences are related to unacceptable impacts on sediment quality and the water column. Licence conditions specific to benthic impacts include (DPIWE, 2004):

- no unacceptable visual, chemical or biological impacts on the benthos 35 m beyond the boundaries of the lease. A variety of standards are given that define unacceptable impacts;
- presence of feed pellets;
- mats of *Beggiatoa* sp;
- increase in organic carbon content of more than three times the levels at the control site;
- negative redox levels 150 mV less than the control site;
- presence of numerous opportunistic polychaetes on the sediment surface;
- fallowed areas should not be restocked until visual evidence shows the sediment surface is free from *Beggiatoa* sp. mats.

Where a significant visual impact is detected outside the boundary a more intensive environmental survey may be triggered. The quality of the water column surrounding the lease area should comply with the standards designated in the licence. In terms of reporting, the farmer is required to provide reports on the following:

- significant incidents of disease and/or fish kills;
- marine pests;
- significant out-gassing from the sediments;
- environmental monitoring.

In Victoria, mussel farmers must provide a video of the substrate of the lease area on an annual basis. Triggers for management intervention are the presence of mats of *Beggiatoa* sp., organic accumulation and/ or the presence of debris.

In South Australia, tuna farmers must comply with an environmental monitoring programme and report annually on the following items:

- description and layout of the site;
- site fallowing plan;
- stocking density, biomass held and mortalities for each sea cage per month;
- amount and type of feed used per month;
- development history for the reporting period;
- comparison of benthic infaunal communities between potentially impacted and control sites;
- interactions with large marine vertebrates;
- details of any disease incidents and chemicals and/or medicines used.

Land-based farms

In Victoria, where intensive flow through culture (classified as “high” risk) is commonly used for the production of salmonids a major concern is the potential impact of wastes discharged on the “beneficial uses” of a waterway. “Beneficial uses” for particular types of waterway are protected under the State Environmental Protection Policy (Waters of Victoria), which also sets water quality objectives for particular segments of the environment (e.g. highlands, coastal plains, etc). Proponents of new and expanding salmonid farms must ensure that their farming activities do not compromise “beneficial uses” reliant on the quality of water, particularly those posed by inputs of nutrients, pathogens and aquatic pests. An Environmental Protection Agency (EPA) licence is required to discharge wastes to the aquatic environment. Compliance with licence conditions will ensure that the impacts of discharges are minimized to protect the beneficial uses of receiving waters.

To comply with the requirements of a Victorian EPA discharge licence, a salmonid aquaculture farmer is required to:

- monitor water flow and quality through the farm as well as other waste streams, their volume and management;
- provide a plan for environmental improvement;

- undertake annual reviews of the operation and submit an annual report, including progress towards environmental objectives;
- notify the EPA of all major events that may impact on the quality of wastewater leaving the property or the overall operation of the farm.

Each year the license holder must submit a report to the EPA that contains the following information:

- explanation of any failure to comply with licence and steps to remedy;
- monitoring results from previous 12 months;
- a “mass-balance” of production for the past year that includes, total biomass of fish, harvested tonnage, total mass of fish feed (and brand name);
- phosphorus (P) and nitrogen (N) balance for the site; N and P in from river; N and P added in feed, N and P harvested from ponds;
- any complaints received and enforcement action by EPA;
- report on the implementation of the environment improvement plan (EIP);
- interpretation and analysis of monitoring data.

Aquaculture developments with a lower risk classification have less stringent monitoring and reporting requirements. Indeed, if they do not discharge to public waters, there is no need for a discharge licence from the EPA.

Monitoring methods

Offshore culture

Methods currently used for baseline and ongoing monitoring in Australia (e.g. Tasmania) are shown in Table 12.

TABLE 12

Monitoring methods used offshore aquaculture in Tasmania

	Method of assessment	Reporting
Current flow	Speed and direction at 30 minute intervals continuously over a six week period at one site in the lease area. Current meter located 2 m above the bottom and accurate to 5 percent, minimum level of detection 2.5 cm/s.	Data presented graphically to standard format.
Bathymetry	Depth measured every 100 m throughout lease area and 50 m beyond using boat with echo sounder and log measuring distance.	Contours drawn on lease area map.
Habitat profile	Location of habitat types must be identified by diver, sonar or video survey.	Sketch on map of lease area.
Video	Video at pre-determined locations. Transect-line to be placed on sea bed at 90° to the lease boundary at the locations.	Written diver notes to be supplied with video tape.
Sediment chemistry	Three undisturbed cores taken using Craib Corer with 50 mm diameter perspex core. Note length of core, colour, plant and animal life, gas vesicles and smell.	Written description required
Redox	Made at sediment-water interface, 1 cm below surface and 4 cm below.	Report results in mV.
Particle size	Top 100 mm of core sub-sampled. Wet sieve method.	Data in excel spreadsheet.
Organic matter and stable isotopes	Top 3 cm core oven dried at 60 °C prior to analysis of total organic carbon (loss on ignition method). Stable isotope analysis done using mass spectrometry.	Data forms part of report.
Benthic infaunal analysis	Van Veen grab or core samples taken at fixed points along the video transect. Samples sieved through 1mm sieve all organisms identified to family level and counted	Original data with K-dominance curves.

Land-based farms

In the case of land-based flow through trout farms in Victoria, Table 13 shows the water quality parameters that need to be monitored six times per year at licensed farms.

Personnel and costs

Costs of environmental assessment and implementation of ongoing environmental management programmes, including monitoring, are borne by the aquaculture farmer. The cost of compliance is noted in Table 14.

TABLE 13
Monitoring methods for "high risk" inland aquaculture in Australia

	Unit	Median	Maximum	Monitoring frequency (per months or year)	Analysis
Non-filterable residue (suspended solids)	Mg/l	5	10	6	Conducted by a nationally accredited laboratory using standard methods
Total phosphorus	Mg/l	0.1	0.2	6	
Total ammonia	Mg/l	0.3	0.4	6	
Dissolved oxygen	Mg/l	Not less than 6.0	≥8.0 or 70 percent	6	
Temperature	°C	No standard but must be reported		6	
pH	Units	6.4–7.7		Annually	

TABLE 14
Estimated costs of compliance with baseline and ongoing monitoring in marine offshore leases (average of costs supplied by several consultants)

	Baseline survey	Six monthly video survey	Biennial survey	Reference
Tasmania	\$A17 000	\$A5 000	\$A15 000	DPIWE (2004)

Costs of compliance for "high" risk inland aquaculture is made up of hydrological monitoring and reporting (\$A3 500 per farm per year) and water quality analysis (\$A3 000).

Difficulties and constraints in practice

In the marine environment, the requirement for monitoring and reporting has been in place for many years. In Tasmania, an industry-wide benthic monitoring programme has been operating since 1997, which ensures that the practices are consistent across the industry.

The current one-size fits all approach to regulating discharge from flow-through salmonid farms in Victoria does not take into account the risk associated with individual farms. Currently ongoing research suggests the need to develop a risk-based approach to ongoing monitoring.

Effectiveness

Technical appropriateness

Offshore aquaculture

The development of environmental management procedures for offshore aquaculture in Australia has benefited from the experience of other countries. Management controls and monitoring requirements for Atlantic salmon culture in Tasmania were derived originally from the results of extensive R&D studies carried out in Europe, notably Scotland and Ireland (Crawford, 2003). They are also consistent with the recommendations of the GESAMP Expert Working Group on Environmental Impacts of Coastal Aquaculture (GESAMP, 1996). They are highly appropriate for monitoring the impact of offshore salmonid aquaculture.

Tasmania has reviewed the data from its industry-wide benthic monitoring programme that has been in operation since 1997 (DPIWE, 2004). The benthic monitoring programme has enabled the compilation of a comprehensive, area-specific dataset, providing information on environmental conditions within marine farming lease areas, at compliance and control sites. Baseline environmental assessments of finfish lease areas in Tasmania indicated that the majority of lease sites:

- experience low current flows (average 3.34 cm s^{-1}) that are often tidally driven, although at times weather conditions appear to significantly influence regional hydrodynamics;

- operate in a depth range of 14–25 metres with a mean depth of 18.6 m;
- operate over muddy/silty sediments devoid of any significant vegetative cover. Small patches of intermittent algae, seagrass and unconsolidated reef were identified within several lease areas.

The review has also indicated changes to the environmental monitoring programme that will simplify monitoring requirements for some farms.

Land-based aquaculture

Current EPA discharge licences require that “high” risk salmonid farmers monitor effluent quality through “spot” sampling of inlet and outlet water. However, the large seasonal variations in waste outputs can render compliance sampling on the basis of spot samples inadequate (Gavine *et al.*, 2006). Natural variations in the inflow water and time required for water passage through a farm also creates a complex relationship that is not easy to resolve. In addition, improvements in farm performance are difficult to pick up in discrete sampling programmes. For this reason, the EPA has moved to the use of feed and production auditing and the application of nutrient mass-balance models to assess the performance of the farm. Mass balance modelling and periodic surveillance of water quality represents best-practice for intensive trout farms (Gavine *et al.*, 2006).

Use of data for improved performance of aquaculture

In general, the data generated from monitoring is used by government and industry to improve environmental performance of the sector.

Impact of EIA and monitoring on environmental protection

The EIA process and monitoring is seen as a part of the environmental management measures and is subject to regular review and change to improve the overall process of environmental protection. The intensive offshore culture of finfish expanded rapidly in South Australian and Tasmanian waters (or coasts) in the late 1980s and early 1990s before appropriate regulations had been developed to manage the environmental (and other) consequences of that expansion. The expansion of the industry was accompanied by increasing public concern about equity in the planning and allocation of waters for aquaculture and about the potential for environmental and visual pollution and navigation conflicts (Everall, 1997). The development of aquaculture-specific legislation that allowed pro-active planning for the industry has gone a long way to addressing public concerns and improving the environmental performance of the industry.

The success of the monitoring programme at land-based sites in protecting the beneficial uses of the river system is largely unknown due to a lack of contemporary data on the impact of these farms on the downstream environment. There is currently a research project underway to investigate this and develop a risk-based approach to the monitoring of land-based farms.

Feedback and review

The application of EIA and environmental management measures in general are subject to regular review in Australia, leading to various changes and developments in recent years.

In Tasmania, the effectiveness of the industry-wide programme in terms of detecting unacceptable impacts was recently reviewed (DPIWE, 2004). That review concluded that:

- there had been localised impacts but no detectable unacceptable deterioration;
- the monitoring programme has proven to be an effective tool for managing the environmental performance of the finfish industry;

- the monitoring programme requires review and adaptation for improved outcomes.

Perceptions of stakeholders

No perceptions of stakeholders were obtained during this review.

Improvements

Regulatory and legislative aspects

At a national level questions have been raised about whether the current environmental regulatory arrangements for aquaculture are appropriate (Productivity Commission, 2004). That is whether production is constrained in some states due to lack of access to suitable sites, tenure and the complexity and number of lease and licence requirements. A “Best Practice” framework of regulatory arrangements for aquaculture in Australia has recently been endorsed by the Primary Industries Ministerial Council (PIMC, 2005). This framework was based on a detailed review of regulatory arrangements for Australian aquaculture (Productivity Commission, 2004) and aimed to achieve a high level of integration across the three (vertical) levels of government involved in the planning and approval process. The recommendations of the “Best Practice” framework were as follows (PIMC, 2005):

- integration of policy and clear legislative objectives – the overall objective and responsibility for aquaculture in each jurisdiction needs to be clarified as does the role of relevant agencies and the inter-relationship between aquaculture and other planning and environmental instruments;
- regional planning in line with appropriate planning and land-use principles – plan for aquaculture in a pro-active and integrated manner to provide confidence and clarity to industry, government and the community;
- zoning for aquaculture – areas considered appropriate for aquaculture development should be zoned using planning instruments;
- transparent and equitable allocation of marine and freshwater resources for aquaculture;
- leasing – investors need security of tenure;
- risk assessment and management strategies commensurate with the level of risk (see technical and scientific aspects below);
- development consent processes – need to be aligned with other development processes;
- licensing – should be more adaptive in nature, need for national approach;
- compliance – licence conditions must be clear and enforceable;
- environmental management systems (EMS) and eco-efficiency – important for enhancing “clean and green” image of Australia.

Technical and scientific aspects

There is a general move to an adaptive or risk-based approach to environmental management in both offshore and land-based sectors. The review of monitoring data from 1997–2002 showed that the current monitoring regime was working well (DPIWE, 2004). DPIWE wants to move to a more adaptive style of management that recognizes the conclusions of the R&D and monitoring programme as well as the environmental credentials that companies have built up over the years and the specific risk associated with some sites. The proposed new programme is designed to rely predominantly on video evidence to detect unacceptable impacts. Where unacceptable impacts are found, a comprehensive benthic survey would be triggered to determine the extent of the impact. An adaptive management approach significantly reduces compliance costs for farmers in Tasmania (DPIWE, 2004). In inland aquaculture, most states already implement some form of risk assessment prior to granting licences. This determines the level of monitoring that is appropriate for developments.

Collaboration

The move towards adaptive management has been largely a result of collaboration between industry and regulatory authorities – an example of building trust through working together.

CHINA⁶

Requirements

Environmental impact assessment

EIA was first formally applied in China (Gu and Sheate, 2005) for construction projects in 1979 when the Environmental Protection Law (Trial) was enacted, and there have been various legal and policy developments since that time. In 1981, the State Council Environmental Protection Commission issued an administrative order for the Guidelines of Environmental Management for Construction Projects for the implementation of EIA that required an environmental impact statement prepared for new or extension of projects with potential for pollution. Further amendments to the law and guidelines were made in 1981, 1986 and 1998. A new EIA law, The Law of the People's Republic of China on Environmental Impact Assessment (China, 2006-2007) came into force in 2003. Under the EIA Law, EIA is defined as a system for (1) analysing, forecasting and assessing the potential impact on the environment after implementation of planning and construction projects, (2) establishing strategies and measures to prevent or alleviate adverse impacts on the environment and (3) implementing follow-up reviews and monitoring.

The EIA Law requires a project developer/owner to submit an “EIA document” to the State Environmental Protection Administration (SEPA) or its local counterpart before commencing construction of any project in China. “EIA documents” are classified into three categories depending on the level of a construction project's potential environmental impact:

- Where the potential impact is “significant”, the developer must prepare an environmental impact report (EI Report) containing a comprehensive assessment of the resulting environmental impact.
- Where the potential impact is “light”, the developer must fill out an environmental impact report form (EI Form) containing an analysis or special assessment of certain aspects of the resulting environmental impact.
- Where the potential impact is “very light”, the developer may simply file an environmental registration form, and assembly of an EIA is not required.

SEPA formulated and published the EIA Classification Catalogue, which provides a reference to determine what type of EIA documents are required for a particular construction project, including large-scale aquaculture projects.

EIA requirements in China have focused mainly on construction and large-scale development projects but the Environmental Impact Assessment Law of 2002 expanded EIA requirements from individual construction projects to government plans for the development of “relevant special programmes” of agriculture, animal husbandry, forestry, water conservation and natural resources, amongst others, which includes aquaculture (Stender, Wang and Zhou, 2003; FAO, 2004-2008, NALO China; Radosevich, 2002). It also includes reference to environmental assessment of plans for utilization of water and land areas, and has expanded the scope of environmental assessment to use of strategic environmental assessment (Tao Tang *et al.*, 2005).

A “Planning Environmental Impact Assessment” regulation (EIA) draft was available for comment in April 2008, and is expected to be officially released during 2008. The purpose is to provide more guidance on strategic environmental assessment,

⁶ Contribution by Fan Enyuan.

and to bring environmental assessment earlier into the decision making process. The application of this approach to aquaculture development in coastal or inland areas is uncertain.

The recent changes in EIA requirements for aquaculture in China, with the latest requirements, are summarized in Table 15.

TABLE 15
EIA requirements for aquaculture in China

EIA requirements	1999		2002		2008	
	Freshwater	Marine	Freshwater	Marine	Freshwater	Marine
EIA report	Not clearly listed	Not clearly listed	Not clearly listed	Projects with 133.3 ha and above in enclosed coastal area	Cage aquaculture and net enclosure aquaculture in sensitive area	
EIA form	Not clearly listed	Not clearly listed	Aquaculture in lakes	Projects with 13.3 ha and above in littoral areas higher than the highest tidemark; projects with 66.7 ha and above littoral areas between the highest and the lowest tidemark; projects with 333.3 ha and above in some open coast area.	Other types of aquaculture in sensitive area	
Environmental registry form	Not clearly listed	Not clearly listed	Other types of aquaculture	Other types of aquaculture in sensitive area	Not clearly listed	
Validity	Invalid		Invalid (valid from 1 January 2003)		In effect (valid on 1 October, 2008)	
1. EIA classification catalogue, The State Environmental Protection Administration (SEPA), 1999						
2. EIA classification catalogue, The State Environmental Protection Administration (SEPA), 2002						
3. EIA classification catalogue, Ministry of Environment Protection (MEP), 2008						

Environmental assessment and aquaculture

Environmental assessment and management of aquaculture, in the broadest sense, is conducted within the framework of various laws and different levels in China:

1. sectoral and regional planning;
2. project development and management;
3. market and aquaculture product quality control level.

The planning and project level may both involve assessment under the national EIA law, but environmental assessment and management procedures are also related to various other legislation applied in China, including the Fishery Law, Marine Environmental Protection Law and others. The market “product level” is increasingly given attention in China to improve the quality and safety of aquatic products, and legislation has been promulgated and implemented recently to address environment-related management issues at this level, including monitoring and management of contaminants of aquaculture products caused from water pollution arising by other sectors.

Administration and responsibilities

EIA and environmental protection agencies

The institutional arrangement for EIA is closely related to the overall institutional structure for environmental protection in China, which reflects a decentralized structure of political and financial administration. The country is administered on a five-tier government structure: central, provincial (autonomous regions and municipalities under direct control of the central government), municipal/prefectural, district/county and town/township governments. Each level of local government is responsible for development and administrative matters in their respective jurisdictions.

The environmental competent authority (SEPA) under the State Council is responsible for national environmental protection in the implementation of integrated supervision and management. Environmental competent authorities in the governments at county level and above are responsible for the environmental protection in their respective jurisdictions. These responsibilities for environmental protection are defined by the 1979 Environmental Protection Law.

The highest national authority for environmental protection is the State Environmental Protection Administration (SEPA), a ministry elevated from a quasi-ministry of the National Environmental Protection Agency (NEPA) in 1998 directly under the State Council. SEPA is responsible for drafting and interpretation of standards, laws and regulations and guidelines, and supervision and inspection of their implementation. SEPA is involved in review and approval of environmental assessment reports for larger projects, such as those with budget funds from the central government and designated as budgetary investment projects, projects dedicated with special funds, nuclear projects, confidential projects and military industrial projects, as well as those cutting across regions or river basins. For other projects requiring only an EIA reporting sheet or EI registration, the documentation will be reviewed and approved, under the authority of SEPA, by the Environmental Protection Bureau (EPB) institutions of the provinces, autonomous regions or municipalities where the construction projects are to be implemented.

At the local government level, the basic structure for environmental authorities from provincial to district/county levels is similar to the national government. The competent authority for environmental protection at each level is the EPB, which conducts supervision and management in their respective jurisdictions. Other departments with some environmental protection responsibilities at the same level of government manage pollution or resource issues in their respective sectors and are supposed to collaborate with the environmental competent authority in environmental supervision and management. Provincial level EPBs focus mainly on macro issues such as policy, regulation and guidance, while district/county EPBs carry out detailed supervision and management tasks. Municipal EPBs have both macro and micro-responsibilities for supervision, management and enforcement, and especially have direct contacts with large enterprises. The relationships between different levels of environmental authorities and between EPBs and other government authorities are structured in vertical and horizontal dimensions. An EPB belongs to two distinct government units. It is vertically part of a chain of the environmental protection functional line from the national environmental authority of SEPA through provincial, municipal, to district/county EPBs and receives policy mandates and programme direction from the upper-level EPB. At the same time, it is horizontally also one of the departments in a local government and relies heavily on that local government for financial support.

SEPA is complemented in its role by other ministries that also have responsibilities touching on environmental protection. They include the ministries of planning and development, economic, trade, urban and rural construction, water resources, agriculture and forestry and transportation. Environmental matters relating to aquaculture and fisheries are considered within the Ministry of Agriculture, and particularly under the Bureau of Fisheries.

In addition to the government authorities, quasi-government institutions such as research and educational institutions play an important role in environmental protection within the overall institutional framework. In the environmental field, an EPB usually has affiliated institutions such as environmental supervision and fee collection offices, environmental monitoring centres and stations and environmental research institutes.

An Environmental Impact (EI) Report or an EI Form must be prepared and issued by an EIA agency certified by SEPA. As of August 2005, China had a total of 973

qualified EIA agencies, among which four are foreign-invested and ten are privately-owned. The majority of qualified EIA agencies are state-owned enterprises, research arms of universities and research institutions (Paul *et al.*, 2006).

The administration of aquaculture, and the environmental management aspects of aquaculture development in inland and coastal waters, also involves various government agencies operating at various levels.

Ministry of Agriculture

The Ministry of Agriculture (MoA) is the highest administrative body in charge of the national fishery industry. Empowered by the State Council, the ministry is responsible for administration of the rural economy, including plant production, animal husbandry, fishery, rural township and village-run enterprises, fodder industry and farm machinery and others. The Bureau of Fisheries (Bureau of Fisheries Management and Fishing Port Superintendence), falling under the MoA, is the main administrative body governing the fisheries and aquaculture sector. The major functions assigned to the Bureau are:

- formulating fishery law and regulations, and inspecting implementation;
- making fisheries development policies, strategies and plans, instructing fishery economic and business system reform;
- administration of the nation's processing and marketing of aquatic products, including setting aquatic product quality standards and enforcing them;
- being responsible for national fishery statistics, resources management and rare aquatic wildlife protection.

As in the case of the environmental administration, there are fishery bureaus in the provinces, autonomous regions, municipalities and counties, which have more or less the same functions as the Bureau of Fisheries in their respective geographical and administrative areas.

According to the permitting process for the Fisheries Law and its implementing regulation, the People's Governments at or above the county level may grant licenses to use state-owned water surfaces and tidal flats to state and collectively owned units to develop aquaculture. The granting of licenses for aquaculture in "planned" coastal areas involves increasing attention to environmental issues, with restrictions on use of fishery habitats and sensitive ecosystems for aquaculture.

Ministry of Land and Resources

The responsibilities of the Ministry of Land and Resources (MoLR) include planning, administrating, protecting and regulating utilization of natural resources such as land, mineral and marine resources (with the exception of marine fishery resources managed by the MoA).

The State Oceanic Administration (SOA) is an administrative agency under the MoLR responsible for the supervision and management of sea area uses and marine environmental protection, as well as safeguarding national maritime rights and interests according to laws and regulations, and organizing and carrying out marine scientific and technical research. SOA is the main administrative body with responsibilities that also relate to the interactions between marine aquaculture and the marine environment.

A number of other ministries, and related institutes and departments at central and lower level administrations also influence, in various ways, the accessing of land and water resources for aquaculture development as discussed further below.

Legislation

Apart from the Environmental Protection Law referred to above, other important national laws relate to the environmental assessment and management of aquaculture in inland and coastal waters. There are also some local (provincial and river basin-wide)

regulations that may be applicable to environmental impact assessment. Amongst the various national laws, the following are considered particularly significant for aquaculture. Further information can be found in the FAO National Aquaculture Legislation Overview for China (FAO, 2004-2008, NALO China).

Fishery Law

The Fishery Law, amended most recently in 2004, is a basic law dealing with fishery management including aquaculture, fishing and fishery resource enhancement, utilization and conservation. The scope of the law includes improving the management of fishery resources, development of the aquaculture and fishing industry and enforcement measures over fishing and aquaculture resources.

The Fishery Law provides a basis for provision of aquaculture licenses. The state is responsible for drawing up plans for the use of water surface areas and defining those areas of water surface and intertidal zone or mudflats suitable for aquaculture purposes. Units or individuals, who wish to use those designated areas, must apply for an aquaculture permit through the competent fisheries administration at or above the county level, and the aquaculture permit will be granted by government at the same level to allow use of the area for aquaculture. The aquaculture licence may also be withdrawn if the individuals or units do not use the designated area within a 12 month period. The zoning of areas for coastal aquaculture, required under the law, is seen as an important tool for environmental management of aquaculture in coastal areas, although capacity for effective planning and management of aquaculture zones varies between local administrations.

The law also has provision for environmental protection during the permitting process, as aquaculture is allowed only in designated areas, and it specifically states that natural spawning, breeding and feeding grounds of fish, shrimp, crab, shellfish and algae in state owned water surfaces and tidal flats as well as their major migration passages cannot be used for siting of aquaculture farms.

Land Administration Law

The use of state-owned and collectively owned land is regulated under the Land Administration Law (1986, as amended in 2004), and deals with land ownership, use and planning issues. It requires the state to formulate an overall plan for land utilization, classifying land into agricultural land (including aquaculture), construction land and unused land. Although the law reaffirms the principle of state/collective ownership of land, it incorporates significant moves towards stronger and more secure individual rights in land used for farming, forestry, livestock and fishery production, in particular where it concerns rights of individual cultivators who make up a collective. The law provides for farmer contracts of 30 years, thus giving the individual formal rights over an area.

Water Administration Law

The Water Law (1988, as amended in 2002), administered by the Ministry of Water Resources (MoWR), regulates the development, utilization, saving, protection, allocation and management of water resources. All water resources are owned by the state. The law requires the state to implement a system of water withdrawal permits and paid use of water resources. In the development and utilization of water resources, domestic water for urban and rural use has first priority, and then other uses should be taken into account. Although the law does not contain any direct reference to aquaculture, the establishment of water conservation facilities, particularly the establishment, utilization and management of water reservoirs will play an important part in fishery production, in particular in freshwater aquaculture development.

Law on the Administration of Sea Areas

The Law of the People's Republic of China on the Administration of Sea Areas took effect in 2002. The law requires sea area users to obtain use rights by applying for sea area use permits, and to pay user fees. The law also provides for the establishment of marine zones, which may be used for aquaculture or other activities. **Article 15** notes that plans for aquaculture industry and other industries involving the use of sea areas shall be made in conformity with the marine function zoning. The law also specifies a maximum of 15 year lease for aquaculture. The State Oceanic Administration (SOA), falling under the MoLR, is the statutory authority responsible for this law.

Marine Environment Protection Law (China, 1999)

The Marine Environment Protection Law, adopted in 1982 and revised in 1999, was enacted "to protect and improve the marine environment, conserve marine resources, prevent pollution damages, maintain ecological balance, safeguard human health and promote sustainable economic and social development". The law does not specifically refer to aquaculture, but it contains various provisions for control of water pollution and protection of habitats, such as mangroves and coral reefs, that would apply to aquaculture development.

Law on Prevention and Control of Water Pollution (China, 2008)

The law was adopted in 1984 for the purpose of preventing and controlling water pollution, and most recently amended in February 2008. Article 9 of the new amendments to the Water Pollution Prevention and Control Act require that a discharger meet: (1) standards for water pollutant discharge and (2) the total control target for major water pollutant discharge. Chapter IV (Section Four) addresses the prevention and control of agricultural and rural water pollution, including specific reference to aquaculture in Article 50 that refers to "scientific determination of breeding density and reasonable utilization of feed and drugs in aquaculture".

Scope of environmental assessment

The scope of the environmental assessment depends on the nature of the proposed project and special programme. According to the Law on Environmental Assessment, the report of the environmental impacts of a construction project shall include the following elements:

- a. an introduction of the construction project;
- b. description of environment surrounding the construction project;
- c. an analysis, prediction and appraisal of the environmental impacts that may be caused by the construction project;
- d. the measures for protecting the environment of the construction project as well as a technical and economical demonstration;
- e. an analysis of the economic gains and losses of the environmental impacts that may be caused by the construction project;
- f. suggestions for carrying out environmental monitoring over the construction project;
- g. conclusion of appraisal of the environmental impacts.

EIA requirements of "relevant special programmes" as specified in the Law on Environmental Assessment shall include the following elements:

- a. an analysis, prediction and appraisal of the environmental impacts that might occur if the programme is implemented;
- b. the countermeasures for predicting or mitigating the unfavorable environmental impacts;
- c. the conclusion of the appraisal.

At the construction project proposal stage, the SEPA or EPB decides the type of EIA required (screening), *i.e.* an EIA report, an EIA form, or an environmental registry form. Four project types require SEPA approval: specifically (1) projects involving state secrets or nuclear facilities, (2) cross-boundary projects involving two or more provinces, (3) projects that are likely to produce cross-boundary pollution, the impacts of which cannot be agreed to by the different provinces, and (4) projects valued at or over 20 million yuan (approximately USD 2.5 million). The provincial, county and municipal levels are involved with approval of other projects.

Environmental aspects are also included through the zoning and licensing systems for aquaculture as required by the laws highlighted above. In particular, the “Regulation guideline for prevention of pollution applied to marine environment pollution caused by marine engineering projects” and “Regulation guideline for prevention of pollution applied to coastal environment pollution caused by coastal engineering projects” request that development, establishment or reconstruction of mariculture of certain scale have to be aligned with the requirement for environmental protection. Use of zoning for sea-based aquaculture is widely promoted in China, although coverage of coastal areas is still incomplete.

Recent EIA legislation requires EIA for freshwater aquaculture in sensitive ecosystems, but guidelines are required to clarify the definitions of sensitivity.

Aquaculture licensing

The aquaculture license system has been adopted based on the Fisheries Law since 1986 with significant implications for environmental management. During the past 20 years, the central and local authorities’ attitude to aquaculture has been promotional, and the administration and management of aquaculture enterprises and individual farmers was relatively weak and considered insufficient. Since 2001, central government has started to strengthen planning of coastal aquaculture in order to reduce disease problems and protect the environment. Capacity for implementation and high priority given to economic performance, at local levels, remain a concern for effective implementation of such policies.

In 2002, MoA made new rules for aquaculture licensing. The Bureau of Fisheries issued a “Trial Scheme to improve the aquaculture licensing system” to extend the policy to the freshwater aquaculture sector. According to the Fishery Law (revised in 2004), provincial and local fishery administrations will have more flexible authority to make a number of supplementary regional regulations which are tailored to local conditions and regional development plans based on the rational utilization of the sea, and locations suitable for aquaculture activities, and areas for aquaculture are allocated in order to avoid conflicts with other activities, such as fishing ports, tourism and sightseeing spots and important national industrial projects. The Bureau of Fisheries of MoA has overall responsibility for the management of the aquaculture license system, although significant capacity is required at the local level for effective implementation.

New farms versus operational farms

Environmental assessment is required for “changed” or “expanded” projects, and as such it appears that aquaculture farms in inland and marine waters would be subject to further environmental assessment. Actual requirements depend on the scale of the farm. In marine waters, this requirement is regulated under the Marine Environment Protection Law, but the implementation situation in freshwater environments is less clear.

Environmental monitoring

Monitoring is a compulsory part of the EIA process in China and it is traditionally carried out during the project construction and operation phases. As a result, monitoring

during the project construction phase may influence the SEPA or EPBs' decision whether to allow the project operations to commence. EPBs and developers share the responsibility for monitoring. In the Environmental Impact Report, monitoring aims at integrating with the proposed environmental management strategy and would detail the extent of monitoring, the sites chosen, time and frequency of sampling, a strategy of data analysis and quality control measures during the construction and operation phases. In addition, the environmental management strategy should identify who is responsible for overall project environmental management and for monitoring individual environmental parameters. Project developers usually undertake routine monitoring of pollution sources and are normally required to focus on the four key issues: air and water pollution, waste and noise.

No specific guideline documents for environmental monitoring associated with the management of aquaculture projects or special programmes were available for review, and it is unclear whether there are any such guidelines available.

Sectoral environment monitoring

China also has an extensive network for environmental monitoring of aquaculture areas, under the Fishery Environment Monitoring Network (FEMN). The Fishery Environment Monitoring Center (FEMC) is based in Beijing (under the MoA), and the network has grown from seven in 1985 to over 100 operating units or sites at provincial and local levels covering 20.58 million ha (MoA and SEPA, 2006). The network covers both inland and near-shore coastal areas, and the system is continuing to expand and the monitoring techniques are improving. The results from the fishery environment monitoring network are published annually in the "Report on the State of the Fishery Eco-Environment in China" by MoA and SEPA (MoA and SEPA, 2006).

Outside of the MoA network, other environmental monitoring programmes have been established. For example, in 2002, SEPA also established offshore eco-environmental monitoring substations in seven major sea areas and gulfs, further expanding the marine area monitored.

Voluntary instruments

Numerous guidelines have been issued, at local level, provincial level, sectoral level and national levels, on various topics related to aquaculture siting, production and marketing, covering the whole supply chain (i.e. from hatchery to consumer), and intended to regulate several quality aspects including general operations, inputs (water, feed, drugs) and environmental protection, in addition to traceability.

At the end of 2002, the government launched the Wholesome Agriculture (including aquaculture) Production Action Plan. There is also increasing interest in certification for aquaculture products, and an increasing number of schemes, such as green certification and organic certification. The growing number of certification programmes and possible competition amongst certification schemes has the potential to result in confusion amongst producers, buyers and consumers (Liu, 2007; Corsin, Funge-Smith and Clausen, 2007), but the following are mentioned.

Safety agri-food certification is a scheme developed by the Centre for Agri-food Quality and Safety (CAQS) of the Ministry of Agriculture. The scheme was formally established in 2003 and it is implemented through three centres of which one is dedicated to fisheries products with 68 provincial level agencies and over 3 000 inspectors.

ChinaGAP is a scheme which was initiated in 2003 by the Certification and Accreditation Administration (CNCA), a government agency under the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ), which is directly under the State Council of the People's

Republic of China. GAP standards for a wide range of commodities were issued in 2005 and began implementation in 2006. Standards have been developed along similar lines to GLOBALGAP, with which a MoU was also signed to benchmark the ChinaGAP standards to the GLOBALGAP scheme. Different from GLOBALGAP, however, products produced in ChinaGAP certified farms are labelled as such. ChinaGAP standards for the aquaculture sector now include an overarching aquaculture base module in addition to another 15 commodity/system-specific modules relevant to several fish species (including tilapia and carp), shrimp, crabs and turtles, that includes various environmental parameters.

The Green Food standard scheme is also promoted by the Ministry of Agriculture through its Green Food Development Center, which is under the Green Food Administration Office. Green Food standards are not organic standards, although the two share some similarities. The Green Food standards address issues beyond food safety to include the environment, fertilizers, pesticides and other chemicals and set maximum dosages for each. Farms compliant to these standards can market products as “Green Foods” on the domestic market. At present there are almost 5 000 certified producers, of which 230 are producers of fisheries products.

The use of voluntary instruments to improve environmental management is also expected to increase in future, as emphasized in The National Eleventh Five-year Plan for Environmental Protection (2006–2010) (English version release date: 5 March 2008) that “China will vigorously popularize the knowledge about environmental science and implement the “environmental science popularization initiative in 10 000 villages of 1 000 towns”. It will promote environmental label and certification, and advocate green consumption, green office and green procurement”.

Practices

Environmental assessment

Environmental assessment and monitoring practices

The State Environmental Protection Administration now has a well-developed EIA procedure and technical guidelines are in place, but these are not specific for aquaculture.

Environmental monitoring procedures are however now well developed to support the fishery environmental monitoring network, to facilitate sample collection and analysis and facilitate comparisons in time and space. The monitoring network reports annually on the following parameters in freshwater and marine environments across China:

- nitrogen and phosphorus;
- COD;
- oil pollution, phenolic compounds;
- heavy metals (copper, cadmium, arsenic, lead);
- pollution incidents.

The Fishery Environment Monitoring Network covers widely fishery waters in China, including inland and coastal aquaculture areas. The focus is mainly on water quality, and adherence to water quality standards in fishery areas.

There has been increasing use of zoning in coastal areas of China, and some models have been developed for assessing carrying capacity. For example, Nunes *et al.* (2003) describe a multi-species model for shellfish polyculture in coastal embayments, and an application of the model to a test site (Sanggou Bay, Northern China) used for large-scale long-line cultivation of the Chinese scallop *Chlamys farreri*, the Pacific oyster *Crassostrea gigas* and the kelp *Laminaria japonica*. Development and improvement

of models for predicting carrying capacity and integrated aquaculture systems is considered an important area for future research and development in China. Increasing research is also being conducted on environmental carrying capacity associated with intensive cage farming (e.g. Cai and Sun, 2006).

Environmental quality objectives

There are three categories of environment quality standards related to aquaculture in China that are used in the environmental assessment process and for monitoring. These cover (i) national standards (GB series), (ii) sectoral standards (SC series) and (iii) "hazard free aquaculture products standards" (NY series), and are briefly described as follows:

The **first set** covers national standards including:

- groundwater environment and quality standards;
- seawater quality standard;
- fishery water quality standard;
- marine sedimentation quality standards;
- environment requirements of production sites for hazard free aquaculture product.

Surface Water Quality Classification and Standards

National standards for surface water quality are detailed in regulation GB3838-1983, and have been successively revised in 1988 (GB3838-1988) and in 2002 (GB3838-2002). Surface waterbodies are ranked into five quality classes according to their utilization purposes and subsequent protection objectives, as defined in a regional zone classification issued by the municipal EPB:

- Class I is mainly applicable to spring water and to national nature reserves.
- Class II is mainly applicable to first class protected areas for main drinking water sources, for the protection areas of rare fish species, and for spawning grounds for fish and shrimp.
- Class III is mainly applicable to second class protected areas for main drinking water sources, and to protected areas for the common fish and for swimming areas.
- Class IV is mainly applicable to water for industrial use and entertainment which has no direct contact with the human body.
- Class V is mainly applicable to waterbodies for agricultural use and landscape requirement.

Chemical criteria are applicable to these five classes (Burgeap and Sogreah, 2007).

Quality Standard for Marine Water

According to Quality Standard for Marine Water (GB3097-1997) issued by SEPA, national marine waters are divided into four quality-grades associated with different environmental functions:

- Marine fishery waters, marine nature reserves and protected areas for rare and endangered marine species are identified as Class I environmental function areas that should meet Grade I national marine water quality standards.
- *Mariculture* area, sea bath, sea sports or entertainment areas where people have direct exposure to seawater as well as industrial water in direct relation to human food are Class II environmental function areas that should meet no lower than Grade II national marine water quality standards.
- Generally, industrial water areas and coastal scenic spots are Class III environmental function areas that should meet no lower than Grade III national marine water quality standards.

- Waters such as port area and marine development areas are Class IV environmental function areas that should meet no lower than Grade IV national marine water quality standards.

All marine aquaculture activities should be operated under the quality of seawater in compliance with the requirements of Grade II marine water quality standards. According to SEPA (SEPA, 2006a), there are a total of 651 coastal environmental function areas in coastal seas across China. Among them, 80 fall into Class I, 268 into Class II, 73 into Class III and 230 into Class IV.

Water Quality Standard for Fisheries

Water Quality Standard for Fisheries (GB11607-89), issued by SEPA regulates requirements and quality standards for fishery activities. No specific indicators have been developed for aquaculture, but there is ongoing work on establishment of standards for aquaculture. The Bureau of Fisheries (Bureau of Fisheries Management and Fishing Port Superintendence), falling under the MoA, is responsible for interpretation of the standards.

The second set of standards available is sectoral standards, which are issued by the Ministry of Agriculture:

- standard testing method for antibiotic residues;
- chemical residue in fishery products;
- malachite green, nitrofurans testing methods;
- mollusc toxin (PSP);
- shellfish poison;
- environment request for producing marine shellfish;
- specifications for ecological environment monitoring of fisheries;
- requirements for water discharge from mariculture;
- requirements for water discharge from freshwater pond aquaculture.

A third (final) set of standards has been developed – “hazard free aquaculture product standards” - that were issued by the Ministry to Agriculture and address the following:

- freshwater aquaculture water quality;
- mariculture water quality;
- aquatic product drug residue content limit;
- code for the use of veterinary drug products in aquaculture;
- aquafeed safety limit;
- limit of hazardous substances in fisheries products;
- criteria for assessing environment of production sites.

The “hazard free aquaculture product standards” are generally regarded as one part of the sectoral standards of MoA but with a different serial number.

Environmental monitoring

The Fishery Environment Monitoring Network, coordinated by the Bureau of Fisheries, is well developed in China. The 2006 annual report mentions that the fishery ecological environment in China remains good in general while some parts were seriously polluted by nitrogen, phosphate, oil and copper (MoA and SEPA, 2006). Environmental contamination as a food safety risk has become a new priority in the aquaculture sector (Ellis and Turner, 2007). In March 2007, the Ministry of Health released a draft of a new food safety coordination law to the public via the internet. In 2006, the Bureau of Fisheries of the Ministry of Agriculture announced a nationwide inspection targeting forbidden chemicals in the fish market.

Personnel and costs

The costs of conducting an EIA and monitoring associated with an EIA are normally paid for by the company making the application. The costs of the Fishery Environment Monitoring Network and the analysis of results are paid for by government budgets. Costs associated with compliance with environmental monitoring and application for certificates at the farm level are normally paid for by the farmers.

Difficulties and constraints in practice

The legal basis for EIA and environmental management is comprehensive, but the major concern relates to implementation, particularly at the local level. A common theme in several reports on EIA and environmental management in China is the need for strengthening of environmental management capacity among local government and the farming community. The major difficulties include:

- impacts of other sectors on aquaculture environments and proper assessment and management of these impacts;
- a concern raised during the recent FAO workshop on aquaculture certification (FAO, 2008) highlighted the difficulties that small farmers face in funding and conducting environmental monitoring required for compliance with increasing certification requirements.

The quality of environmental assessment has been a concern of SEPA who has taken measures to improve the conduct of EAs. New EIA Qualification Rules from SEPA impose stricter supervision of EIA agencies and also encourage various reforms, including foreign participation in reorganization of the EIA agencies in order to make the EIA service market more competitive. The EIA Qualification Rules strengthen the continuing supervision powers of SEPA after the qualification certificates are issued to EIA agencies. SEPA conducts selective inspections on such EIA agencies from time to time, publishes the inspection results and imposes administrative penalties (as discussed below) on those found in violation of relevant rules and regulations.

Effectiveness

Technical appropriateness

The methods used for environmental assessment and monitoring are being improved. However, for aquaculture, the need to improve the standards for monitoring of environmental conditions in farming areas is recognized.

Use of data to improve performance of aquaculture

Environmental monitoring data generated through the Fishery Environment Monitoring Network is being used to identify and respond to pollution problems, and also for reporting on the state of aquatic environments (e.g. MoA and SEPA, 2006). An annual report on the fishery environment is published which is used by government to review both the environmental status of fishery waters and environmental trends. Provincial governments are also increasing attention to water quality and some also release an annual report on fishery environmental quality. These reports include both aquaculture and fishery environments.

Impact of EIA and monitoring on environmental protection

Fishery authorities generally consider that the pollution from other sectors is a serious environmental concern. The use of environmental assessment within planning studies and licensing procedures is considered to have contributed to environmental protection.

Feedback and review

Environmental monitoring data is increasingly used to take management measures. The extent of use of environmental monitoring data in the aquaculture industry is uncertain

as no detailed consultation was conducted with private farmers during the preparation of this review. The public consultation process for environmental assessment in China was strengthened by the release of the Environmental Assessment Law and has been strengthened since then (Moorman and Ge, 2006) China's Measures for the Disclosure of Environmental Information also became effective on 1 May 2008, and are expected to further improve public participation and review of environmental information, with benefits to both the aquatic environments used by aquaculture, and the sustainable development of the sector.

Perceptions of stakeholders

No information was available on this topic.

Improvements

The following recommendations for improvements have been synthesized from the various reports reviewed (including synthesis from SEPA (2006b) and OECD (OECD, 2006a; 2006b)), The National Eleventh Five-year Plan for Environmental Protection (2006–2010) (English version release date: 5 March 2008) and consultations with experts in China, and are assumed to be generally valid:

- strengthening environmental policy implementation at the local level, where economic priorities to date have over-ridden environmental concerns;
- improving awareness of need to consult and involve stakeholders in environmental management, planning and decision-making;
- strengthening monitoring, inspection and enforcement capabilities at local levels, and use of environmental data to improve management.

And, specifically relevant also for aquaculture:

- strengthening efforts to protect and improve water quality in coastal waters and adjacent regional seas from land-based pollution sources, and upgrade environmental management regulations and government oversight in the aquaculture industry;
- protection of the marine environment is emphasized in the Eleventh Five Year plan which specifically mentions the need for improved pollution control for mariculture;
- development of standards and guidance for ecological aquaculture. China has a long history of ecological aquaculture, but recognizes the need for research and development to provide a scientific basis for most suitable models;
- improvement in environmental assessment and carrying capacity procedures for coastal aquaculture;
- improvement in guidelines for planning and zoning of aquaculture areas;
- the need for clarity on environmental standards for aquaculture effluent and water quality for aquaculture areas. Several standards are issued at state level, and now provinces are developing various implementation standards;
- investigation, monitoring and control of marine pollution stepped up by improving the pollution monitoring network;
- development of regulations on EIA process for different scales of aquaculture;

A short complementary review of the environmental impact assessment procedures for China, Hong Kong SAR, is also provided in Box 1.

BOX 1

EIA in aquaculture in China, Hong Kong SAR

In China, Hong Kong Special Administrative Region (SAR), an EIA Ordinance was enacted in 1997 to provide for assessing the impact on the environment of certain projects and proposals, for protecting the environment and for incidental matters. The EIA Ordinance is administered by the Hong Kong Environmental Protection Department, which maintains a web site (China, Hong Kong SAR, 2008) that provides details of the procedures and a comprehensive list of supporting guidelines. Aquaculture is included in the list of projects requiring an EIA, which applies only to marine cage fish farming. The Ordinance states that among the designated projects requiring an environmental permit is “A fish culture zone – (a) more than 5 ha in size; or (b) a boundary of which is less than 500 m from the nearest boundary of an existing or planned – (i) marine park or marine reserve; or (ii) bathing beach.” Freshwater aquaculture is not included within the scope of projects requiring an EIA. An example on expected scope and content of the EIA report is provided in Annex A. A detailed assessment of all aquaculture zones was conducted in China, Hong Kong SAR in 1990, providing perhaps the only examples of a sector-wide environmental assessment in the region (Wu *et al.*, 1999). The outcome led to changes in the management of aquaculture zones, largely for marine fish cage culture.

Source: Contribution by Michael Phillips and Koji Yamamoto (NACA)

INDIA⁷**Requirements***Environmental assessment*

In India, environmental impact assessment of certain development activities is a requirement under the law. As per the Environmental Impact Assessment Notification, 2006 issued under Environment (Protection) Act, 1986, developmental projects, those listed in the Schedule of the said notification, attract clearance under the same notification. However, in the Environmental Impact Assessment Notification, 2006 aquaculture projects are not listed, hence, they do not attract the provisions of the said notification. All developments in the Coastal Regulation Zone area attract the provisions of Coastal Regulation Zone Notification, 1991 that has been issued under the Environment (Protection) Act, 1986. Earlier the aquaculture units falling in the Coastal Regulation Zone area attracted the Coastal Regulation Zone Notification, 1991 and clearance under the said notification was required for such projects. However, the Coastal Aquaculture Authority Act, 2005 overwrites the Coastal Regulation Zone Notification, 1991. Hence, clearance under Coastal Regulation Zone Notification, 1991 for aquaculture units is not mandatory. However, other facilities such as processing units, ice plants, feed plants, etc. required for aquaculture units would attract the provisions of Coastal Regulation Zone Notification, 1991.

As noted by the Aquaculture Authority (Aquaculture Authority – India, 2001), “although we have fairly elaborate policies and legislation governing issues related to industries”, there is no specific environmental legislation designed specifically for aquaculture or shrimp farming”.

Aquaculture is not specifically named within existing EIA legislation and it is separately regulated under the Coastal Aquaculture Authority (CAA), under the Department of Animal Husbandry, Dairying and Fisheries of the Ministry of Agriculture. The Coastal Aquaculture Authority Act, 2005 (24 of 2005) enacted

⁷ Contribution by Michael Phillips, Narayan Kutty and Koji Yamamoto.

by the Central Government on 23 June 2005 provides for the establishment of the Coastal Aquaculture Authority for regulating aquaculture in coastal areas and matters connected therewith or incidental thereto. The Act mandates the Central Government to take measures for regulation of activities connected with coastal aquaculture.

“Coastal aquaculture” is defined as “culturing, under controlled conditions in ponds, pens, enclosures or otherwise, in coastal areas, of shrimp, prawn, fish or any other aquatic life in saline or brackish water; but does not include fresh water aquaculture”. There is also no reference to offshore or open sea aquaculture. The Coastal Aquaculture Authority is responsible for the following functions:

- i) to make regulations for the construction and operation of aquaculture farms within the coastal areas;
- ii) to inspect coastal aquaculture farms with a view to ascertaining their environmental impact caused by coastal aquaculture;
- iii) to register coastal aquaculture farms;
- iv) to order removal or demolition of any coastal aquaculture farms which is causing pollution after hearing the occupier of the farm;
- v) to enter on any coastal aquaculture land, pond, pen or enclosure and
 - a. make any inspection, survey, measurement, valuation or inquiry;
 - b. remove or demolish any structure therein;
 - c. do such other acts or things as may be prescribed.
- vi) to perform such other functions as may be prescribed.

The emphasis of the CAA has been on shrimp farms, with a strong attention to environmental impacts and management. It also issues guidelines for planning and overall management of the coastal aquaculture sector.

Administration and responsibilities

The following Table 16 provides an overview of some of the other agencies and institutions involved directly and indirectly in environmental management of aquaculture in India.

The States have significant responsibility for management of coastal aquaculture in India. The Table 17 shows some of the state government department responsibilities in coastal aquaculture development.

TABLE 16
Agencies and institutions involved in environmental management of aquaculture

Institution (s)	Responsibilities
Coastal Aquaculture Authority (CAA)	The CAA regulates aquaculture in coastal areas. Further details can be found at http://aquaculture.tn.nic.in
Ministry of Agriculture (MOA)	MOA is the Central Government Ministry with responsibility for aquaculture and fisheries (through the Department of Animal Husbandry, Dairying and Fisheries)
The Indian Council of Agricultural Research (ICAR)	ICAR operates under the Ministry of Agriculture as an autonomous national organization which conducts and promotes research and training in the field of agriculture and allied sciences, including several specialised research institutes involved with aquaculture.
The Marine Products Export Development Authority (MPEDA)	MPEDA was constituted in 1972 under the Marine Products Export Development Authority Act 1972 (No.13 of 1972). MPEDA is concerned with export promotion and supports fisheries and aquaculture in various ways related to increasing seafood exports, specifying standards, processing, marketing, extension and training.
Ministry of Environment and Forests (MOEF)	MOEF is a cabinet Ministry in the Government of India, and is responsible for the planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programmes in the country.
State Agricultural Universities (SAU)	Several of the State Agricultural Universities have full fledged fisheries faculties including Departments of Fishery Environment. These are also technically within the ICAR though they function under the States. Some State level EIA studies are conducted by SAUs.
Private associations	Private sector associations involved with aquaculture, including the farmers' associations, All India Shrimp Hatchery Association, and others that are also active in extension, information exchange and promotion of better management among members.

TABLE 17

State agencies and institutions involved in environmental management

Institution (s)	Responsibilities
State Fisheries Department	Formulation of action plans for marine, freshwater and brackish water fisheries and aquaculture, promotion and extension of support services for modernization and intensification of production methods, controlling input delivery and quality control and market infrastructure development. State Department is also involved in review of CAA license applications. District fisheries authorities, where present, are under the management of the State Government. District Department also involved in review of CAA license applications
Industries Department	Formulation of policies for coastal industrial development such as coastal special economic zones (SEZs). Government of Andhra Pradesh has issued orders for formulating SEZ Policy to provide a comprehensive framework for establishment, operation and sustainability of aquaculture enterprises within the coastal SEZs in the State. Fish and shrimp processing, hatcheries and aquaculture farms are treated as polluting industries and need a No-objection certificate from state pollution control board/development commissioner for establishment within SEZ.
State Pollution Control Board	The Board constituted in 1976 functions through its zonal offices in coastal regions. The Board is responsible for the enforcement of the provisions of the Water (Prevention and control of Pollution) Act, 1974, Water Cess Act 1977, The Air (Prevention and control of Pollution) Act 1981, The Environment (Protection) Act, 1986 and Hazardous Chemicals and Wastes Handling Rules of 1989.
Environment, Forests, Science and Technology Department	Promotion of environmental conservation and management and coordination of various state and central agencies. Preparation of coastal zone management plan and implementation of Coastal Regulation Zone notification is one of the responsibilities of the Shore Area Development Authority functioning under this Department.
Irrigation Department	Basin-wide planning of state water resources, management of farmers irrigation associations, watershed development
State Ground Water Directorate	Estimation and monitoring of groundwater resources and suggest measures for maintaining water balance.
Panchyat Raj and Rural Development Department	Planning, construction, maintenance of rural water supply, minor irrigation of command areas of less than 40 ha. Implementation of development and welfare programmes for coastal communities. Implementation of Water, Land and Trees Act 2002.

TABLE 18

Further agencies and institutions involved in environmental management

Institution (s)	Responsibilities
Acharya N G Ranga Agricultural University (ANGRAU)	Education, research, extension and training in fisheries and aquaculture through Fisheries College and research institutes.
Andhra Pradesh Environmental Training and Research Institute (EPTRI)	Training, research and consultancy in various environmental aspects including water quality monitoring, GIS mapping etc.
Jawaharlal Nehru Technological University (JNTU)	Education, training and research in water resource engineering including aquaculture farm engineering
National Environmental Engineering Research Institute (NEERI)	Has regional stations undertaking research and consultancy on environmental impact analysis and water resource engineering.
Central Marine Fisheries Research Institute (CMFRI)	Under the Indian Council of Agricultural Research (ICAR), this institute undertakes research and development in fisheries resources management, mariculture and technology transfer.
Central Institute of Brackishwater Aquaculture (CIBA)	Located at Chennai and also under ICAR, this institute undertakes research and development in managing and promoting brackishwater aquaculture and technology transfer.
Central Institute of Freshwater Aquaculture (CIFA)	Located at Chennai under ICAR, this institute undertakes research and development in managing and promoting freshwater aquaculture and technology transfer.
Central Institute of Fishery Technology (CIFT)	Located at Vishakapatnam and also under ICAR, this institute undertakes research and development in fishery technology including value addition.
Indian National Centre for Ocean Information Services (INCOIS)	Under the Department of Ocean Development, Government of India, Hyderabad this centre provides information on potential fishing zones and has excellent facilities for fishery forecasting by using GIS and RS.
National Remote Sensing Agency (NRSA)	This agency, under the Department of Space, Government of India, undertakes consultancy and research on using RS and application of GIS for coastal aquaculture planning.
Andhra Pradesh State Remote Sensing Application Centre (APSRAC)	This centre undertakes research and training in GIS and EIA studies on aquaculture.
The State Institute of Fisheries Technology, Kakinada (SIFT)	Under the Andhra Pradesh State Fisheries Department, this institute provides training and extension services in the area of scientific pond management, seed and feed testing and technical services.
Marine Products Export Development Authority (MPEDA)	Operates as part of the Ministry of Commerce, Government of India. Provides technical support for the development of shrimp farming through subsidy for farm development, processing and hatcheries. Training, research and trade promotion are other important activities of the MPEDA.

There are a number of research, development and training institutes supporting aquaculture development in India as summarized in the Table 18.

Other statutory authorities and R&D organizations for coastal area management, including environmental management responsibilities, under central and state government are also noted below.

TABLE 19

Statutory and R&D organizations for coastal area management

National Coastal Zone Management Authority (NCZMA)	Established under the provisions of the Environment Act 1986, coordinates actions of the State Coastal Zone Management Authorities and the union Territory Coastal Zone Management Authorities, assesses development proposals, reviews violation of provisions and actions against violation and prepares integrated coastal zone management plans.
State Coastal Zone Management Authority (SCZMA)	Responsible for the preparation of the integrated coastal zone management plan as per the CRZ (Coastal Regulation Zone) and to look into the violations of CRZ, identification of ecologically sensitive areas and preparation of area specific management plans.
Integrated Coastal and Marine Area Management Project Directorate (ICMAM)	Established under the Department of Ocean Development in 1998 at Chennai this directorate has the mandate of capacity building, consultancy and research in ICAM
National Institute of Ocean Technology (NIOT)	An autonomous organization of the Department of Ocean Development (Government of India) which undertakes research and training in the sustainable utilization of coastal and ocean resources.

Policies

A summary of policies and acts related to shrimp aquaculture is shown in Table 20.

TABLE 20

Policies and acts related to shrimp farming in India

Policy	Legal framework
42 nd Constitutional Amendments Article 48 A	The 1977 Constitution (Amendment) Act Article 48 specifically places an obligation on the nation to protect the environment. Protection of the environment is one of the fundamental duties of the citizen.
Aquaculture Authority of India	Constituted by the Government of India in 1997 under the Environment Act 1986 within the administrative control of the Ministry of Agriculture in response to the Supreme Court directive for the regulation of shrimp farms in coastal zone. Became Coastal Aquaculture Authority (see above).
National Coastal Zone Management Authority (NCZMA)	This Authority was constituted under the provisions of the Environment Act in 2001 for coordinating the state CZMAs and examination of proposals for the modification of coastal zone management plans and approvals. But this is only an advisory committee which meets whenever necessary and reconstituted once in every two years.
National Biodiversity Authority	Constituted by the MOEF under the Biodiversity Act 2002 and rules 2004 to promote conservation, sustainable use and equitable benefit sharing by constituting state Biodiversity Boards and Biodiversity Management Committees at the Panchayat level to prepare biodiversity registers.
Central Ground water Authority (CGWA)	The CGWA has been constituted in 1997 under Environment Act to regulate indiscriminate drilling and withdrawing of ground water and to issue necessary regulatory directive to protect ground water.
Policy statement for the abatement of pollution, MOEF, 1992	The Environmental Impact Assessment Notification for certain type of activities including large-scale shrimp aquaculture. The public hearing and environmental management plan are also part of the procedure for obtaining no-objection certificates as per 1997 and 2001 amendments to the Environment Act 1986. National Biodiversity, Strategy and Action Plan (NBSAP) and the National Environment Policy 2004 documents on shrimp farming.
A P Farmers Management of Irrigation Systems Act 1997	Under this Act a structure of farmers' organizations consisting of water users associations, has been created and given the responsibility of water management under command areas. As per the latest revisions it is also possible to form such an institutional structure for the users of creek/river water for shrimp farming.
A P Pan chayat Act 1953	This Act provides for the duties of a Panchayat to minor irrigation works having a command area of less than 40 ha and also maintenance of drinking water system.
A P Forest Act 1967	Under this Act the government may declare any wasteland as protected forest. Provision also exists for the formation of joint forest management committees. Thus it could play an important role in the rehabilitation of the unutilized shrimp developed area.
A P Water, Land and Trees Act 2002	This Act is designed to promote water conservation and tree cover and to regulate the exploitation and use of ground and surface waters. The A P Water, Land and Trees Authority will supervise the implementation of the Act as per the rules framed under the Act.
Factories Act 1948	Compulsory disclosure of information by the occupier and community has a right to be provided information (applicable with respect to shrimp processing industries).

Scope of environmental assessment

The process of application for a Coastal Aquaculture Authority licence involves submission by a shrimp farmer/developer to a district level committee, following which the application is forwarded to the Directorate of Fisheries of the State/Union Territory as the Nodal Agency, and then with recommendation to the CAA for permission. The approval process was established principally to address environmental issues with the establishment of farms in the coastal area, considering both the siting of farms in relation to environmentally sensitive ecosystems and operational practices.

The scope of the Coastal Aquaculture Authority licence application includes environmental issues. The “Application for Authorization/approval of Shrimp Culture Farm/Shrimp Culture Pond: other than traditional and improved traditional which are already operating/proposed to be set up/constructed outside the coastal regulation zone as defined by the Coastal Regulation Zone notification (outside 500 m above HTL in the coastal area) and outside 1 000 m of Chilka and Pulicat lakes including bird sanctuaries namely Yadurapattu and Nelapattu (under Directions 6,7 and 9 of the orders of the Hon’ble Supreme Court of India in Judgement dated 11.12.1996 on Writ Petition (Civil) No.561 of 1994)” includes a number of environmental issues including:

- siting, with information to be provided with reference to the coastal zone regulation;
- farm design and layout;
- reference to an EIA or Environmental Management Plan (EMP) if carried out;
- effects of salinity, use of feeds and siltation;
- presence of effluent treatment plant.

The application is screened by a committee at state and district local levels and also includes site visits by the committee members, individually or collectively. Whilst EIA is encouraged in the process, the application does not require an EIA to be successful unless farms are beyond a certain size based on farm area.

According to CAA/MOA guidelines, shrimp farms with a net area of 40 ha or more should conduct an EIA and incorporate an environmental monitoring and management plan (EMMP). All farms of 10 ha and more, but less than 40 ha are also required to furnish detailed information on the aforesaid aspects in the application. For farms greater than 10 ha, an Environmental Impact Statement is required to be submitted with the CAA application. Most Indian shrimp farmers are small-scale farmers and therefore are not required to carry out a full EIA or EMP. This is a concern where clusters of small farmers around small creeks may lead to self-pollution, although this concern may be addressed through improved local management measures. Strategic environmental assessment or similar processes on aquaculture plans are not conducted. There is some interest in integrated coastal zone management at state level, but to date limited or no plans involving aquaculture have been prepared.

The EIA and management/monitoring plan, prepared as part of the application for CAA licence should be submitted for review by the District Committees/Nodal Agencies. The Committees involve various government departments, including the State Pollution Control Board, and are reviewed by a range of relevant departments. In Goa, for example, according to the Coastal Aquaculture Authority (2006), the committees are established as follows:

- District level committees (DLC) for regulating coastal aquaculture are headed by the Collector (Head of Civil Administration) of the District, and Assistant Director of Fisheries of the respective district as Member Secretary. The other members include the following from the State Administration:
 - Deputy Director, Agriculture;
 - Director, Science, Technology and Environment;
 - Senior Town Planner, Town and Country Planning;

- Executive Engineer, Irrigation Department;
- Senior Extension Officer, Brackishwater Fisheries Development Agency (BFDA);
- Representative of Goa, State Pollution Control Board.
- The State-Level Committee (SLC) is headed by the Secretary (Fisheries) with Director of Fisheries as the Member Secretary. The other members of the committee are:
 - Collectors from the two District Aquaculture Committees;
 - Director, Agriculture;
 - Director, Science, Technology and Environment;
 - Chief Town Planner, Town and Country Planning;
 - Executive Engineer, Irrigation Department;
 - Representative of MPEDA, Karwar;
 - Chief Executive Officer, Brackishwater Fisheries Development Agency (BFDA);
 - Chief Engineer, Irrigation Department;
 - Member Secretary, Goa, State Pollution Control Board.

New farms versus operational farms

The Aquaculture Authority application and registration process covers existing and new farms. The Aquaculture Authority licence is for the period of five years. During renewal it may have to include any modifications during that five year period.

Environmental monitoring

Environmental monitoring is required under the CAA licenses as noted above, to include the items specified in the EMMP.

The guidelines of the Ministry of Agriculture define standards for wastewater as defined in Table 21.

TABLE 21
Guidelines/standards for wastewater from coastal aquaculture farms in India

Parameters	Final discharge point	
	Coastal marine waters	Creeks/estuaries
pH	6.0–8.5	6.0–8.5
Suspended solids (mg/l)	100	100
Dissolved oxygen (mg/l)	Not less than 3.0	Not less than 3.0
Free ammonia (as NH ³ -N) mg/l	1.0	0.5
Biochemical oxygen demand – BOD (mg/l)	50	20
Chemical oxygen demand – COD (mg/l)	100	75
Dissolved phosphate (as P) (mg/l)	<0.4	<0.2
Total nitrogen (as N) (mg/l)	2.0	2.0

It may be noted that the effluents/solid waste generated from the aquaculture units should meet the standards prescribed by the concerned State Pollution Control Boards or UT Pollution Control Committees. All units of the aquaculture farm should obtain necessary clearances/No Objection Certificate under the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention and Control of Pollution) Act, 1981.

Guidelines and voluntary instruments

There are a number of guidelines and voluntary based approaches to environmental management in India, issued in the form of codes of practice and best practice guidelines by a number of government agencies. These are mostly focused on coastal aquaculture.

TABLE 22
Guidelines and voluntary instruments for aquaculture in India

Guideline/voluntary instrument	Origin	Scope
Ministry of Agriculture issued Guidelines for Sustainable Development and Management of Brackish Water Aquaculture (1995).	MOA, Department of Animal Husbandry, Dairying and Fisheries	The overall purpose of the Guidelines is to assist in formulating appropriate shrimp farming management practices and adopting measures for mitigating the environmental impact for management of shrimp pond wastes and utilisation of land/water resources in a judicious manner. They recommend States to identify lands that are fit for aquaculture and to discourage the conversion of agriculture land for aquaculture. The Guidelines also recognize the importance of wastewater treatment and prescribe standards for the treatment of wastewater discharged from aquaculture systems, hatcheries, feed mills and processing plants.
Guidelines on adopting improved technology for increasing production and productivity in traditional and improved tradition systems of shrimp farming	Coastal Aquaculture Authority (CAA, 2006)	Management of shrimp farming and effluent treatment. Water quality management and monitoring are described in paragraph 3.6 and 3.7 with providing optimal water quality parameters
Effluent treatment systems in shrimp farms	Aquaculture Authority	
Guidelines for Sustainable Aquaculture	MPEDA (2008)	Recommend appropriate management practices and measures for mitigating the environmental impact and utilisation of the land/water resources
Extension pamphlets/ Brochures	Central Institute of Brackishwater Aquaculture (CIBA), ICAR, Ministry of Agriculture and MPEDA	Provide farming practice for each step of the production

The guidelines issued by the Coastal Aquaculture Authority Act mandates the central government to take all such measures as it deems necessary or expedient for regulation of coastal aquaculture by prescribing guidelines, to ensure that coastal aquaculture does not cause any detriment to the coastal environment and the concept of responsible coastal aquaculture contained in the guidelines shall be followed in regulating coastal aquaculture activities to protect the livelihood of various sections of people living in the coastal areas. The CAA has issued a number of guidelines as noted in Table 22. Other guidelines on various aspects have been issued by the Ministry of Agriculture, Indian Council for Agriculture Research and the Marine Products Export Development Authority also as noted in Table 22.

These voluntary instruments consider mostly coastal aquaculture, mainly shrimp farming, and not inland aquaculture. MPEDA is presently drafting better management practice guidelines for *Macrobrachium rosenbergii*. The Government of Andhra Pradesh has brought in similar regulation for fresh water aquaculture including fresh water prawn farming. Committees of similar nature have been formed to license farms. MPEDA has been included as a member in the district level committees.

Practices

Environmental assessment

The practices used for environmental assessment of aquaculture in India are guided by the scope of EIA requirements as specified in the Coastal Aquaculture Authority application, as well as the items directly referred to in the application, which give special reference to the following environmental issues:

- farm location, and whether a whole or part of the farm land falls within mangroves, wetlands and other land types;
- nearby land uses, including environmentally sensitive habitats;
- water source;
- potential impacts on water logging of adjacent areas or pollution of drinking water sources;
- existence of wastewater treatment facilities;

- use of supplementary feeds, drugs and medicines;
- activities that may cause siltation, turbidity, with detrimental implications for local fauna and flora.

The coverage of the assessment within the licensing procedure is therefore quite wide.

Environmental monitoring

The scope of the environmental management and monitoring plan as required for larger scale farms, and as specified by the Coastal Aquaculture Authority, should cover the following items:

- impact on the water sources in the vicinity;
- impact on ground water quality;
- impact on drinking water sources;
- impact on agricultural activity;
- impact on soil and soil salinisation;
- wastewater treatment;
- green belt development (as per specifications of the State Pollution Control Board).

No detailed guidelines are however available on the monitoring requirements.

Personnel and costs

The practices and quality of EIAs has been discussed by the Ministry of Environment and Forestry in the Criteria for Registration of EIA Consultant Organizations (NRBPT, 2006). The quality problems associated with EIA as outlined in the introduction to the criteria include:

- improper/inadequate scoping for the EIA;
- consultants having inadequate understanding of EIA;
- poor quality of inputs to EIA;
- problems of “cut and pasting” in EIA reports;
- lack of checks on competence of EIA consultants;
- no liability of EIA consultants;
- very few in house reports.

In response to these problems, the MOEF has provided more guidance on report structure, checklist and scoping, and the National Registration Board for Personnel and Training (NRBPT), a constituent of the Quality Council of India, has launched a scheme for registration of EIA consultant organizations. This scheme provides detailed requirements for registration of organizations, and is intended to support improvement in the skills of organizations and persons conducting EIAs and to facilitate access to competent organizations.

Difficulties and constraints in practice

The main difficulties in implementation are:

- large number of farms involved;
- large numbers of small-scale farmers;
- lack of follow up monitoring;
- sometimes uncertain land ownership and complex leasing (renting) arrangements related to some existing small-scale farms;
- several of the aquaculture activities are undertaken in a disorganized manner. Some of them are temporary/illegal (being undertaken within mangrove area, wetlands, etc.).

Recent initiatives by the newly established National Centre for Sustainable Aquaculture (NaCSA) have however been highly successful in encouraging licensing of farms in aquaculture societies, with around 100 societies registered by early 2008.

Effectiveness

Technical appropriateness

There is good subject-wide coverage of the major environmental issues in coastal aquaculture. However it is recognized that the implementation of EIA can be improved.

Use of data for improved performance of aquaculture

The data obtained to date have not been directly used for improving environmental performance of aquaculture. Indirectly, the sectoral assessment conducted for the Aquaculture Authority of India has contributed to improved management of the sector.

Impact of EIA and monitoring on environmental protection

The implementation of the registration system has had a positive effect on environmental protection. However, a continued and wider coverage of the small-scale sector, which is the dominant type of aquaculture farming, would improve environmental protection

Feedback and review

There is some feedback and review of EIA data, for example in the case of the Environmental Impact Assessment Report submitted to the Supreme Court of India. Here, a total of 1 130 responses were obtained from the public prior to completion of the report.

Perceptions of stakeholders

The perception among many aquaculture stakeholders is that EIA is an administrative requirement, rather than management tool.

Improvements

Recommended improvements received from various contributors to this review include:

- further development of a framework for EIA and monitoring procedures for aquaculture. Some concerns also have been expressed that the scope of the EIA should be reviewed to cover the following in addition to those listed in the Coastal Aquaculture Authority Act:
 - effluent impacts;
 - social impacts;
 - air and noise pollution.
- development of EIA and monitoring procedures for mariculture, particularly given the growing interest in sea-farming in India (e.g. grouper, cobia farming);
- streamlining of procedures to improve the time taken for approval of CAA applications;
- development of systems for involving large numbers of small-scale farmers in the registration system, building further on the NaCSA model that has been highly successful in registration of small-scale farmers through societies;
- development of integrated plans for coastal areas that clearly identify suitable locations for aquaculture, and environmental assessments and management plans developed in the specified aquaculture zones;
- development of environmental management systems for inland aquaculture, with most focus to date having been on coastal shrimp farming.

INDONESIA⁸

Requirements

Environmental impact assessment

The Environmental Management Act No.23 (1997) provides the basis for application of EIA, which is required to engage in any business or activity likely to have a major and significant impact on the environment. In this regard, aquaculture is specified in the category of “fisheries” and subject to the EIA procedure (AMDAL), as established by Decree of the State Minister of the Environmental Affairs No.3/2000 and the Ministry of Environmental Decree No. 308, 2005, which specifies the types of activities for which an Environment Impact Analysis is compulsory. The two relevant Indonesian terms related to EIA are as follows:

- AMDAL *Analisis Mengenai Dampak Lingkungan Hidup* (Management of Environmental Impact Analysis); and
 - ANDAL *Analisa Dampak Lingkungan Hidup* (Environmental Impact Assessment)
- Government Regulation No.27/1999 re Analysis of Environmental Impacts (1999)

provides that, when required, the EIA is part of the licensing procedure for the conduct of the concerned activity. It has been applied widely to large-scale coastal shrimp farm projects⁹.

The 2004 Fisheries Law also requires a specific licence called SIUP (Surat Izin Usaha Perikanan) to engage in the fishery business, including aquaculture. However, small-scale fishermen and aquaculture farmers are exempt from such a requirement. Procedures for the granting of fisheries and aquaculture licences are regulated by Government Regulation No.54 of 2002 on Fisheries Business. The SIUP for the conduct of aquaculture in fresh, brackish or marine waters by an Indonesian company must be issued by the Provincial Governor or by the Regent or Head of the District/Municipality, depending on the location of the farm. An EIA is among the documents required by companies when applying for the SIUP (other items include business plan, NPWP (tax identification number), company charter and aquaculture site location).

The Ministry of Marine Affairs and Fisheries have also issued various legal documents concerning the planning and operation of aquaculture farms, several relating to the environmental aspects of aquaculture development. The most important legal instrument is the Indonesian Fisheries Act No 31, 2004 which provides the basis for a number of environmental management measures within the aquaculture sector.

Administration and responsibilities

The administration of the environment and natural resources in Indonesia is being strongly influenced in recent years by the decentralization policy, with increasing decentralization of management responsibilities to the provincial, district and municipality governments. This process has significant implications for the practical management of environment and aquaculture, because of generally weak capacity existing at local levels of the administrative system.

The legal framework for environmental management in Indonesia has developed over the past two decades and according to a recent review by the Asian Development Bank (ADB, 2005) is well developed and tends to meet international standards. However, the increasingly decentralized policy setting in Indonesia has significant implications for *implementation*, and requires that some of the existing laws, regulations and technical guidelines are revised or renewed (ADB, 2005). The ADB review also notes the need for stronger enforcement of environmental laws and regulations, particularly in the field of environmental impact assessment.

⁸ Contribution by Michael Phillips and Koji Yamamoto.

⁹ Although it has been widely applied, obtaining copies of EIA documents proved very difficult.

TABLE 23
Institutional responsibilities related to aquatic environmental management

Institution (s)	Responsibilities
Central level	
Ministry of Environment (MOE)	The responsibility of the MOE is to formulate policies and coordinate the environmental management programmes.
Ministry of Marine Affairs and Fisheries (MMAF)	MMAF was established in 1999 with the mandate to formulate policies and coordinate and manage marine and coastal exploration activities.
Ministry of Forestry (MOF)	MOF is responsible for regulating and managing commercial forest concessions, agro-industry activities and terrestrial and marine protected areas.
Badan Pengendalian Dampak Lingkungan (BAPEDAL) (Environmental Impact Management Agency).	This agency merged with MOE in 2002, with the principal task of management of environmental impacts, including (i) prevention and control of pollution and environmental damage, and (ii) improvement of the environmental quality in accordance with the existing legislation.
Provincial level	
Provincial Fishery Service (DKP-Dinas Keluatan dan Perikanan)	Responsible for fishery and aquaculture management at provincial level
Badan Pengendalian Dampak Lingkungan Daerah BAPEDALDA	Regional offices of BAPEDAL
District/municipality level	
District/municipality Fishery Service (DKP)	Responsible for fishery and aquaculture management at district/ municipality (kabupaten/kota) level

The institutional responsibilities for EIA and related aquatic environmental management matters are outlined in Table 23.

The key environmental laws as related to EIA in Indonesia are as follows:

Environmental Management Law No. 23/1997

The Environmental Management Act (EMA) superseded EMA No. 4/1982 and provides the basic (or umbrella) environmental law in Indonesia. It covers the principles, objectives and targets of environment management in Indonesia, rights and duties and the community roles, authorities to manage the environment, and the function of sustaining the environment. Of particular interest: Article 8 of the Law covers the environmental policy and management aspects in relation to the natural resources including the genetic resources; and Article 37 provides the community the rights to file for class action and provides the legal basis for the environment organizations to file suits against government on behalf of the public interest against unsustainable environmental practices.

Environmental Impact Assessment

The process of EIA, known in abbreviated Bahasa Indonesia as AMDAL, is a key responsibility of MOE and is an important instrument in determining the impact of projects on the environment. The Environmental Impact Management Agency's (BAPEDAL) tasks include the implementation of the national environmental policy, the preparation of guidelines on environmental impact management, the coordination of EIA processes, the monitoring and management of waste discharge, the promotion of environmental awareness and the settlement of environmental disputes.

With the government policy of decentralisation, local institutions have increasing responsibilities for management of aquaculture that includes environmental impact assessment and management. The Law 22/1999 and GR 25/2000 devolve around 80 percent of AMDAL's responsibilities to the districts. In light of serious technical capacity limitations in the districts, MOE was, in 2005, working on revising GR 25/2000 to resolve the potential areas of conflict between the national and district authorities in such areas as environmental permitting, AMDAL approval process, and others (ADB, 2005). The intention is to provide more emphasis on implementation at provincial levels.

Indonesian Fisheries Act No 31, 2004.

The Indonesian Fisheries Act provides significant responsibilities to MMAF and is likewise involved in strengthening environment-related legislation, recently particularly from a food safety perspective. Recent trade concerns with the European Union in particular have led to several initiatives to update legislation related to use of drugs and chemicals and overall environmental management of the aquaculture sector. Among recent initiatives include Good Aquaculture Practice and Good Hygienic Practice Decrees and guideline documents.

Scope of environmental assessment

The EIA procedure is defined in Government Regulation No.27/1999 and the Decree of the State Minister for the Environment No. 40/2000 on working procedures for the Commission for Appraisal of Environment Impact Analysis (2000). Applications for EIAs are filed with the national, regional or municipal commission of appraisal, depending on the location of the concerned activity. Activities affecting national security are assessed by the national commission. Applicants must prepare an environmental impact study, an environmental management plan and an environmental monitoring plan. The relevant authority must grant or deny the authorization within 75 days from the application, silence meaning approval. If the project is not implemented within three years from the EIA, the authorization is declared as expired.

According to the Ministry of Environment Decree No. 17, 2001, the requirement for EIA related to aquaculture is established based on project area size as follows:

- An EIA is required for the cultivation of shrimp/fish breeding ponds, exceeding 50 ha, with or without processing plant.
- For cage farms, including floating cages and pen system culture in freshwater lakes, an EIA is required if the area is more than 2.5 ha, or more than 500 cage units.
- For marine cage farms, including floating cages and pen system culture in coastal areas, an EIA is required if the area is more than 2.5 ha, or more than 1 000 cage units.

Small-scale farms below these sizes are exempt. As most of the aquaculture farms in Indonesia are small-scale, the majority of farms in inland and coastal waters are not subject to EIA, although they are subject to other licensing/permitting requirements, as well as voluntary measures such as Good Aquaculture Practice. There is no use of Strategic Environmental Assessment to date. The EIA requirement also does not cover all forms of aquaculture, for example seaweed farming, hatcheries and other land and sea-based activities appear not to be covered, although they are by licensing requirements.

New farms versus operational farms

EIA is only applied to new farms, and not to farms that are expanding in size.

Public participation and information disclosure

The AMDAL process has no provision for public review, except provision for participation of NGOs as community representatives on AMDAL review committees. As noted in the ADB review (ADB, 2005), in terms of accessing information, it has been extremely difficult for the public to participate in decisions affecting the environment. As far as is known, EIA documents are also not disseminated to local communities.

Environmental monitoring

Environmental impact monitoring should be specified in the EIA, according to the environmental management law. In practice, there appears to be limited environmental monitoring following EIA approval for most projects, although there are exceptions. For

example, the Asian Development Bank project “Earthquake and Tsunami Emergency Assistance Project” conducted an environmental screening process for all emergency assistance projects in the fisheries sector in the Province of Nanggroe Aceh Darussalam and the island of Nias during 2006 and 2007, followed by follow up environmental monitoring. Further implementation of environmental monitoring beyond closure of the project will depend on local government and private sector funds being available, which in many instances appear to be limited for small-scale aquaculture development.

Larger scale aquaculture projects, such as the big shrimp farm projects of Dipasena in south Sumatra do conduct regular environmental monitoring of water quality, and submit reports to local environmental agencies.

Voluntary instruments

There are an increasing number of mandatory and voluntary-based approaches to environmental management in Indonesia, issued in the form of Good Aquaculture Practice documents and guidelines. The Directorate General of Aquaculture and Ministry of Marine Affairs and Fisheries has recently issued Decrees concerning “Good Aquaculture Practice” (Indonesia, 2007a; 2007b) which are mandatory requirements, although at a very early stage of implementation. A major purpose of such documents is to promote improved hygienic practices in aquaculture, particularly for exported products, but the documents do contain issues of environmental concern where they relate human health (e.g. control of antibiotics).

TABLE 24
Recent Good Aquaculture Practice documents for aquaculture in Indonesia

Voluntary instrument	Origin	Scope
Good Aquaculture Practice	Directorate General of Aquaculture, MMAF	Hygienic practices for aquaculture, with an emphasis on export products (shrimp, tilapia, milkfish, catfish)
Good Hatchery Practices	Directorate General of Aquaculture, MMAF	Hatchery practices with an emphasis on chemical and drug residue free production

The MMAF is also in the early stages of elaborating a system for certification of aquaculture farms, initially with an emphasis on intensive shrimp farms. This has been prompted in particular by concerns in EU export markets over drug residues in aquaculture products.

Practices

Environmental assessment

Limited information was available on environmental quality standards, objectives and methods used to determine environmental impacts in EIAs. Carrying capacity models are in the early stages of development for marine fish cage farms in Indonesia (Halide, Brinkman and McKinnon, 2008), but these are yet to be put into practical use in EIA, or regional planning, within the given institutional framework. Rachmansyah (2004) estimated the carrying capacity of Awarange Bay in South Sulawesi around 36 tonnes of fish biomass under 28 ha potential area for marine fish farming, using carrying capacity models. The carrying capacity model is also available for review online, with the intention of encouraging its wider use and development (Australian Institute of Marine Science, 2008).

Environmental monitoring

Water quality standards in Indonesia are available, divided into two categories:

1. National Water Quality Standards (NWQS);
2. Local Water Quality Standards (LWQS) that may be established to support and protect the designated uses of water at a specified area.

A Local Water Quality Standard for a particular parameter may be different from the National Water Quality Standard for that same parameter. The concentration may be

either higher or lower, depending on local conditions. If the waterbody has a number of uses, the Local Water Quality Standards applied to it are for the most sensitive use.

National Water Quality Standards have been established for aquaculture as noted below.

Water quality standards for shellfish farming are established by Decree of the Minister of Marine Affairs and Fisheries No. Kep.17/MEN/2004 on Indonesian Shellfish Sanitation System (2004). This shellfish sanitation system includes the classification of “shellfish growing areas” in four categories, according to the microbiological quality of waters:

- Class A, permissible areas;
- Class B, permissible areas under certain conditions;
- Class C, limited areas;
- Class D, off-limit areas.

Such areas may be closed and reopened, after a re-evaluation procedure confirming the deterioration or improvement of the quality of waters with regard to shellfish breeding. Such a decision is taken under the responsibility of MMAF. Aquaculture Development Centers under the Directorate of Aquaculture, known as Technical Implementing Units, which are the major institutions implementing the monitoring programmes (Sukadi, 2006).

Concerning wastewater discharge, two texts are worth mentioning, neither of which, however, makes reference to aquaculture effluents. The discharge of effluents and waste into marine waters is covered by Government Regulation No.19/1999 re Control over marine contamination and/or damage (1999). In addition, the Decree of the State Minister for Environmental affairs No.110/2003 on the Guidelines on stipulation of accommodating capacity of load of water pollution in water sources (2003) proposes two mathematic models for the assessment of pollution capacity of waterbodies and watercourses (FAO, 2006-2008 NALO Indonesia).

Personnel and costs

The cost of preparing the EIA is borne by the project developer. No information on actual costs for conduct of an EIA, or follow up environmental monitoring, was available.

Difficulties and constraints in practice

The difficulties and constraints in practice include:

- limited follow up monitoring, related to both funding concerns and unclear feedback to improved management;
- limited capacity, particularly at local levels for appraisal of EIA;
- lack of enforcement of EIA procedures;
- lack of coverage of small-scale farmers;
- unclear institutional responsibilities.

Effectiveness

ADB (2005) notes that the effectiveness of implementation of the existing natural resource management regulations in Indonesia, including EIA, is in question for several reasons:

- the variety of national, provincial and district level organizations responsible for administering the administrative, legal and implementation aspects of the natural resources management sectors;
- lack of cross-sectoral coordination;
- understanding of laws and capacity to implement them in the district levels as a serious challenging problem.

These general constraints apply equally to the aquaculture sector, implying that a significant focus is required on building up the provincial and district level capacity for

implementation of environmental management laws and regulations, and creating and sustaining cross-sectoral coordination efforts. Enforcement capability is also generally weak given that mandate/authority for enforcement is spread over multiple agencies with limited capacity. Inadequate implementation of spatial planning laws for example is widely accepted in Indonesia to have resulted in loss of coastal mangroves and resulted in growth of low yield fish ponds which are not captured by existing single project EIA systems.

Technical appropriateness

The lack of effective EIA measures suggested the need for significant improvement in the approach to EIA and aquaculture in Indonesia. The ongoing work on development of spatial planning approaches, linked to awareness raising and capacity building at local government level through ongoing DGA/ACIAR projects (McKinnon, 2007), may lead to improvements.

Use of data for improved performance of aquaculture

The data from EIA and monitoring is generally not used for improving the performance of aquaculture practices. The organization and sharing of data collected is very limited. The more market driven approaches related to implementation of Good Aquaculture Practice (GAP), certification and market access requirements might lead to improvements in the use of data to promote improved environmental management of aquaculture. However, substantial improvements in the organization of data within the implementing agencies, from local to central level, will be required to put in place an effective system for use of environmental data to improve performance of aquaculture practices.

Impact of EIA and monitoring on environmental protection

The use of EIA for larger farms has likely had some positive impacts on environmental protection at the local level, however, the data to evaluate these impacts is not available. The difficulties in use of EIA for small-scale aquaculture farmers (which make up the bulk of production for the aquaculture sector in Indonesia, and cumulatively can create significant environmental impacts), suggests that the impact of the EIA on overall environmental protection in the sector has been limited. The need for attention to improved environmental management measures involving the small-scale sector is emphasized.

Feedback and review

No effective feedback mechanisms within government structures exist for monitoring of on-farm improvements, for review of data and for facilitating management improvements, at the on-farm level, the level of farm clusters and at the sectoral level. The decentralization process has also made the system for such feedback more complicated. Improvements in information flow and relating such information flow to management decisions in a decentralized context are needed.

Perceptions of stakeholders

No detailed information is available on perceptions of stakeholders to the EIA procedures, although informal comments on EIA suggest that the process is viewed more as a legal formality than a management measure to improve performance of aquaculture investment. Private sector associations in Indonesia, are however, increasingly aware of food safety and market issues. For example, the Shrimp Farmers Association of Indonesia has been active in working with MMAF in the promotion of Good Aquaculture Practices.

Improvements

There are significant opportunities for improvement in the use of EIA, monitoring and related management measures to improve the environmental management of aquaculture in Indonesia:

- More coordinated multi-sectoral approaches, through more effective local level planning are needed, to prioritize natural resources management interventions, or impacts of different sectors, including aquaculture.
- Local capacity building is required. Devolution of authority at local levels requires a significant effort to improve the capacity at the local levels for implementation of better management of aquaculture. In a country as large as Indonesia, the devolution of authority to the local government and community groups for resources management and allocation decisions could be more effective than a centralized approach. Local government units and citizens were not involved in natural resource decision-making and management processes during previous highly centralized governments; limited capability is consequently left at the local levels. Capacity building is needed for the required human resources and institutional development to keep pace with the decentralization process and as aquaculture expands significantly in Indonesia as a government priority sector.
- Public participation in EIA procedures and access to information on EIA is presently limited and could be improved.
- Use of Strategic Environmental Assessment of farmer clusters or sectoral management plans.
- Integration of aquaculture into cross-sectoral resources planning. Because of the complexity and the many issues that must be addressed, environmental management of aquaculture should be integrated across habitats, governmental units and sectors. An integrated ecosystem approach would address linkages between development, human activities, biophysical processes and sectoral activities in both terrestrial and marine environments, although this will be difficult to implement in practice.
- Spatial land use planning can be an effective tool for achieving integration of environment, economic and social concerns into the policy and planning process; some new experiences are emerging from pilot projects involving marine aquaculture in Sulawesi, and fish cage culture in reservoirs in central Java. Such approaches should be further expanded and promoted.
- Private sector involvement in the management of coastal and inland resources should be promoted. There is increasing awareness of environmental issues in larger private sector enterprises, mainly as a result of trade related problems, and as such there is awareness and now growing opportunities to promote better environmental management in the sector. The government has recently adopted legislation to promote “corporate social responsibility” in the private sector, which may provide incentives for larger aquaculture businesses to adopt improved environmental and social management measures.
- The widespread promotion of voluntary measures such as codes of conduct, and similar sectoral management instruments, is recommended to encourage more pro-active environmental management in the private aquaculture industry. These approaches can be complementary to the EIA approach, together providing better coverage of environmental management across the sector.

JAPAN¹⁰

Requirements

Environmental impact assessment

The Basic Environmental Law (Japan, 1993) is the legal basis for Japanese environmental policies. The purpose of this law is to clarify the responsibilities of environmental conservation to the state, local government, industry and citizens. The law is intended to promote comprehensive and systematic policies for environmental conservation to ensure healthy and civilized living for present and future generations, as well as to contribute more generally to the welfare of mankind. Article 20 of this law refers to the execution of environmental impact assessment for activities such as alteration of land shape, construction of new structures and environmental conservation considerations based on the results of the EIA.

The Environmental Impact Assessment Law (Japan, 1997), implemented from 1999 and revised in 2005, sets forth procedures and contains other provisions designed to define the responsibilities of the government regarding EIAs and to ensure that EIAs are conducted properly and smoothly with respect to large-scale projects that could have serious environmental impacts. The law also prescribes measures to reflect the results of EIAs in implementation of such projects and in determining the content of such projects.

The Law does not directly refer to aquaculture. However, prefecture and city governments can set ordinances on EIA following the Environmental Impact Assessment Law (Japan, 1997), taking account of local conditions. Not all prefecture or city governments include aquaculture activities as mandatory to conduct EIA under their Ordinance. Forty-seven prefecture governments and 13 city governments have set their own ordinance for EIA, of which 21 have a requirement for EIA on agriculture, which under the definition of agriculture may include aquaculture (Ministry of Environment, 2006). Prefectures with important aquaculture industries have established EIA criteria for aquaculture farms. Scale or expansion of the farming area is one of the criteria for EIA requirement, for example a farm larger than 15 ha is required to conduct EIA in Okinawa prefecture, while the threshold is 50 ha for Hokkaido and Aichi prefectures.

In practice, no EIAs have been conducted for aquaculture, and environmental management responsibilities are largely delegated and assigned to the Fisheries Cooperative Associations (FCAs) under the Fisheries Law of Japan.

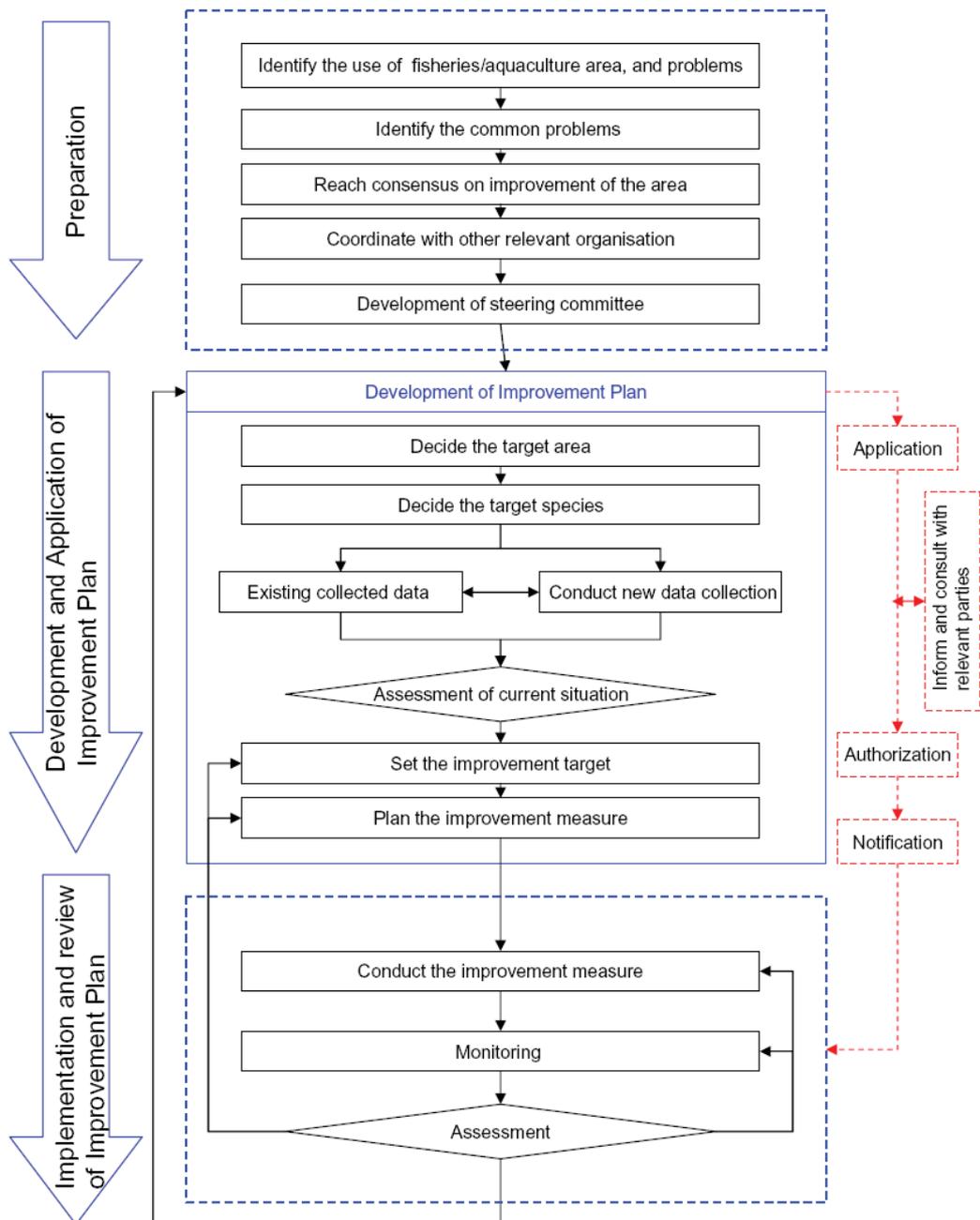
The Fisheries Law (1949, revised 1962) is the principal law for regulation of fisheries activities and is administered by Ministry of Agriculture, Forestry and Fisheries (MAFF), within which many regulatory tasks are delegated to prefecture governments (FAO, 2005-2008 NALO Japan). The Fisheries Law states that fisheries rights, including aquaculture, are granted by the prefecture governor to a fisheries cooperative association, which distributes rights among its members. Rights are exclusive to that member association (FAO, 2005-2008 NALO Japan, Yokoyama, Nishimura and Inone, 2007). Under this right, the FCA conduct management and evaluation of fisheries activities, including environmental assessment and monitoring related to aquaculture.

The Law to Ensure Sustainable Aquaculture Production (Japan, 1999) is the first law to specifically target aquaculture and is intended to reduce risks of aquatic animal diseases and to improve environmental conditions. The law requires individual FCAs, or multiple associations, to jointly develop and implement "Aquaculture Ground Improvement Programs (AGIPs)", and submit these programs to the prefecture government (Fig. 2). For example, Saroma-ko FCA, which manages scallop and Pacific oyster farms in Saroma-ko Lagoon in Hokkaido, instituted AGIP which

¹⁰ Contribution by Hisashi Yokoyama and Koji Yamamoto

established voluntary regulations regarding water/sediment qualities, number and size of aquaculture facilities and production, method and frequency of monitoring farm environments, framework to facilitate the preservation of farm environments and so on. FCAs for fish farming by floating cages aquaculture such as Yusu FCA in Ehime Prefecture, major producer of red seabream, and Azuma FCA in Kagoshima Prefecture, major producer of yellowtail, established similar AGIPs. Particularly, the former FCA noted that producers should take dead fish away from fish cages and should report the number and size of dead fish and the cause of death to the FCA, while the latter FCA promoted polyculture in which fish and seaweed culture are integrated, and planting trees around the farm location.

FIGURE 2
Procedure for development, implementation and review of Aquaculture Ground Improvement Programme in Japan



Source: JFRCA (2007)

Within this national and prefectural framework of laws and policy, FCAs establish their own regulations regarding control and specific items of operation, such as the area, duration and methods of mariculture.

Land based aquaculture facilities that are not based on public waterbody do not require fisheries rights and therefore do not take part in FCAs or Aquaculture Ground Improvement Programs.

FCAs are also developed in major lakes and reservoirs where capture fisheries, aquaculture and leisure fishing are present. Due to its closed and hazard prone environment, the Law Concerning Special Measures for Conservation of Lake Water Quality (Clean Lake Law) (1984 revised 2004) was enacted to conserve lake environments by regulating activities discharging wastes or impacting the lakes. This law regulates surrounding domestic activities as well as agricultural activities such as cage aquaculture of carp, which had not been regulated by the conventional Water Pollution Control Law (1970). The Clean Lake Law regulates carp farms that have more than a 500 m² cage area, and respective prefectural governments set their ordinances to regulate management of those farms.

Administration and responsibilities

Table 25 summarizes the administrative responsibilities under the fisheries laws as related to environmental management of aquaculture.

TABLE 25

Administrative responsibilities for environmental management of aquaculture

Institution (s)	Responsibilities
Ministry of Agriculture, Forestry and Fisheries (MAFF)	Administration of Fishery Law.
Japan Fisheries Resources Conservation Association (JFRCA)	Establishes Environmental quality standards (EQSs) for aquaculture grounds. Provides guidance for the implementation of the Aquaculture Ground Improvement Programs (AGIPs).
Prefecture government	Grants licences to the FCA. Authorises the AGIPs
Fisheries Cooperative Association (FCA)	Links the central and prefectural governments to individual farmers. Implementation of official fisheries projects Manages day-to-day practices of farmer members.

Scope of environmental assessment

Accompanying Japan's rapid economic growth during the 1960s, the discharge of industrial wastes and sewage effluents resulted in eutrophication of coastal waters. Within the MAFF, the Fisheries Agency is responsible for preserving and managing marine biological resources and fishery production activities. The Fisheries Agency recognized eutrophication as a serious threat to inshore fisheries, and requested the Japan Fisheries Resources Conservation Association (JFRCA) to devise Environmental Quality Standards (EQSs) in inshore fishery grounds for assessment of the environments. In 1983, JFRCA established the 'EQSs at coastal fisheries grounds', based on three indicators of water quality (i.e. dissolved oxygen, chemical oxygen demand and acid volatile sulphides).

Japanese environmental legislation is closely tied to legal safeguards for coastal fisheries. Ten years after the EQSs were established, the Basic Environmental Law (Japan, 1993) was enacted, requiring the government to establish EQSs to be achieved and maintained in public waters to protect human health and conserve the living environment. Although not specific to aquaculture, the standards take into consideration the potential health hazards associated with the intake of listed substances through drinking water and/or fish and shellfish. In addition, bodies of water, including coastal waters, were classified based on water usage, and the EQS values were established for each class.

In Japan, the legislation framework was constructed fundamentally to protect fisheries and mariculture environments from sewage and industrial effluents. In the 1960s and 1970s, when fish farming had developed increasingly, most people including fish farmers, government officers and researchers did not recognize the need to assess fish farm environments before commencement of farming. Such tendencies have been continuing to 1999, when the Law to Ensure Sustainable Aquaculture Production was enacted. Even this law does not require an assessment of environments before the commencement of aquaculture.

Therefore, for most fisheries grounds in Japan there have been no cases of environmental impact assessments conducted prior to the establishment of aquaculture, and the scope of the ‘environmental assessment’ is focused on the monitoring of environmental parameters and evaluation of assimilative capacity.

New farms versus operational farms

To screen proposed investment and development of new aquaculture operations, the prefecture government will set up an *ad hoc* committee that consists of local government officials, FCA representatives and academia representatives. In the case of larger numbers of fishermen willing to conduct different types of aquaculture within a relatively large but sheltered location, special “Demarcated Fishery Rights” can be applied under the Fisheries Law (FAO, 2005-2008 NALO Japan; Yokoyama *et al.*, 2006).

Public participation and information disclosure

Public participation is emphasized in the EIA legislation for Japan. Regarding fisheries legislation and policies, the public are able to obtain administrative information from the MAFF Web site. Some information is available in electronic form via the web site, and other material only available as hard copy. There is also a government information portal (e-Gov, www.e-gov.go.jp), where administrative information for all ministries can be searched, including documents related to Aquaculture Ground Improvement Programmes (AGIP).

Environmental monitoring

In support of implementation of the Law to Ensure Sustainable Aquaculture Production (Japan, 1999), MAFF issued Basic Guidelines to Ensure Sustainable Aquaculture Production (Japan, 1999). These guidelines state the FCAs themselves should conduct regular environmental monitoring, amongst the other guidance for sustainable aquaculture production. More specifically, the initial analysis of existing aquaculture ground should be conducted during the AGIP’s development process, broadly covering the ground condition, its changes over time, local characteristics, identification of environmental problems and internal and external causes. Although this system is based on voluntary activities, in the case the FCA does not utilize its aquaculture grounds in line with the basic guidelines, and the environmental conditions of its aquaculture grounds deteriorate, the prefectural governor may recommend that the cooperative association take necessary measures for improving aquaculture and re-evaluation of the AGIPs.

If the cooperative association does not follow the recommendation, the prefectural governor may make the environmental status of the FCA’s fisheries area public. However, no such cases have arisen as yet. The main objective of the legislation is to change the farmer’s mind as “the farm is located in public waters and does not belong to the farmer’s property”. Most FCAs have established AGIPs, which are starting to get the farmers’ attention, and improve the aquaculture environment.

Voluntary instruments related to environmental assessment and monitoring of aquaculture in Japan are noted in Table 26. JFRCA (2007) published a manual for

implementation of AGIPs for leaders of FCAs and administration officers, as well as for producing many brochures for farmers. Another instrument provided by academia is a personal computer program/software 'Kukai' (Nishihara, Miyazu, Kyoto) designed by Kadowaki (Kadowaki, 1992), which shows the optimum amount of feed based on data on environmental conditions, culture conditions and cultured fish.

TABLE 26

Voluntary instruments for environmental management of aquaculture

Voluntary instrument	Origin	Scope
Manuals for development and implementation of Aquaculture Ground Improvement Programmes	Japan Fisheries Resources Conservation Association (JFRCA)	Supporting document for assisting FCA to develop and implement the AGIPs
Personal computer software 'Kukai'	Kadowaki, Kagoshima University.	Calculating appropriate amount of fish feed depending on number of fish, fish size, DO content in seawater, water temperature, tidal cycle, etc.

Practices*Environmental quality standards*

Abiotic and biotic components of aquaculture environments have been used as indicators for environmental monitoring of coastal fisheries grounds and aquaculture farms. The former includes chemical oxygen demand (COD), dissolved inorganic nitrogen and dissolved oxygen (DO) in water, and COD, ignition loss, total organic carbon, total nitrogen, total phosphorus and acid volatile sulphide (AVS) in the sediment. The latter includes the species composition and community parameters of macrofauna, microflora and microbial biomass. In 1983, JFRCA established EQSs at coastal fisheries grounds based on three indicators of water quality (*i.e.* dissolved oxygen, chemical oxygen demand and acid volatile sulphides) (JFRCA, 1983). Shortly afterwards, the JFRCA proposed an "Organic Pollution Index" (JFRCA, 1985).

An environment is defined as slightly deteriorated when the effects of eutrophication begin to appear in the benthic community as indicated by the occurrence of organic pollution indicators and a decrease in species diversity. A highly deteriorated environment is one in which eutrophication has serious impacts on the benthic community, resulting in exclusive dominance of pollution indicators, a decrease in biomass and ultimately azoic conditions.

Dissolved oxygen is one of most important factors controlling life in aquatic organisms. The JFRCA recommends maintaining a DO of >6 mg/L in the bottom layer in coastal waters to ensure healthy growth of aquatic animals. A DO content of 4.3 mg/L was established as one of environmental quality standards for the minimum limit in inshore fisheries grounds, and a DO of <2.9 mg/L indicated critical conditions for survival of benthic animals. COD is closely correlated with the amount of organic matter in sediments. The JFRCA proposed >20 mg/g (dry sediment) and >30 mg/g of COD as EQS to indicate slightly deteriorated environments and highly deteriorated environments, respectively. These EQS values are widely adopted in Japan except in the northern part, where environmental deterioration seems to be less conspicuous than in central and southern parts of the country, even in areas with high COD values due to the low water temperatures. AVS is produced when organic matter decomposes under anoxic conditions. As the organic loading rate increases and de-oxygenation proceeds, the AVS content in sediments increases. The JFRCA proposed >0.2 mg S/g (dry sediment) and >1.0 mg S/g of as EQS to indicate slightly deteriorated and highly deteriorated environments, respectively. The Organic Pollution Index was first calculated from a selection of bottom quality oriented environmental factors, including COD, AVS, ignition loss, total nitrogen, total phosphorus and mud content of the sediment, the Shannon-Weaver's species diversity index of macrofauna (H'), and from a principal component analysis of the environmental data from ten representative enclosed areas

(JFRCA, 1985). Improvements have been made in the calculation methods, and several formulae composed of a reduced number of environmental factors (e.g. COD, AVS and mud content) have been proposed (JFRCA, 2000). The calculation methods and some problems are discussed in Ohwada (2001).

The Law to Ensure Sustainable Aquaculture Production (Japan, 1999) together with the Basic Guidelines to Ensure Sustainable Aquaculture Production (Japan, 1999) set environmental quality standards (EQS), which are regulations designed to protect the environment of the waterbody and/or aquaculture organisms, based on three indicators; (1) DO content of water in fish cages, (2) AVS content in the sediment and (3) the occurrence of macrofauna under aquaculture facilities (Table 27). The farm environments are identified as healthy when the values of these indicators are within the thresholds. At the same time, EQS for critical environments, which are used to signal that urgent countermeasures are necessary, have been identified.

The DO value for a healthy environment that was defined in the law is based on studies reporting that yellowtail requires more than 5.7 mg/L of DO for normal growth (Harada, 1978). The law also establishes 3.6 mg/L of DO as a minimum for mariculture farm environments, which represents an intermediate value between 2.9 mg/L of DO, which is at the extreme margin of survival for yellowtail, and 4.3 mg/L of DO, when feeding activity of yellowtail begins to decrease (Harada, 1978). The AVS standard in the sediments is based on the “Omori-Takeoka theory” (Omori, Hirano and Takeoka, 1994), as described in the following section. Recent studies, however, have found that it is difficult to determine the standard value by field investigations (Yokoyama and Sakami 2002; Abo and Yokoyama, 2003). In the law, the macrofaunal standard only specifies that benthic organisms should be alive. A healthy environment is identified in terms of the existence of live macrofauna throughout the year; while a critical environment is identified from the azoic conditions persisting during half a year or more. This EQS, although without biological basis, is convenient in terms of ease of monitoring by farmers. The procedures for environmental monitoring of aquaculture farms are specified by the Director General of the Japan Fisheries Agency in a Notification announced on 30 August 1999.

TABLE 27
Summary of monitoring requirements and criteria

Item	Indicator	Criteria for identifying healthy farms	Criteria for identifying critical farms
Water in cages	Dissolved oxygen	>5.7 mg/L	< 3.6 mg/L
	Acid volatile sulphide (AVS)	Less than the value at the point where the benthic oxygen uptake rate is maximum	>2.5 mg S/g dry sediment
Bottom environment	Benthos	Occurrence of macrobenthos throughout the year	Azoic conditions for >6 months

Environmental monitoring

The effects of organic matter loading from fish and shellfish farming on the environment have been the subject of considerable research since mariculture commenced in Japan, and there are many reports on water and sediment qualities and benthic fauna in and around fish farms. As aquaculture developed, year-after-year enrichment of the sediment has been reported from various localities in southwestern part of Japan (e.g. Arizono and Suizu, 1977; Kanbe, 1983; Hirayama, 1992; Yokoyama, 2002). There is a significant correlation between the seasonal and annual organic carbon load from the fish cages and AVS contents in the sediment (Pawar *et al.*, 2002). Tanigawa *et al.* (2007) monitored the sediment quality at a newly established fish farm site and found the increase in AVS contents from 0.03 mg S/g just before the start of farming to 0.46 mg S/g after 14 months.

Benthic animals are also clearly subjected to elevated levels of sedimentation and organic enrichment. Several studies have been conducted to monitor the mariculture environments (Tsutsumi, 1995; Yokoyama 2000; Sasaki and Oshino, 2004). These studies showed that the following are all typical effects of mariculture farming on the macrobenthos: a reduction in species richness and/or species diversity; a decrease in the number of large-sized species; the disappearance of echinoderms; the appearance of dense populations of the opportunistic polychaete *Capitella* sp.; and an increase in total macrofaunal abundance during the process of organic pollution and azoic conditions in the final stage.

Evaluation of the assimilative capacity

Assimilative capacity methods are to evaluate existing farm environments objectively and conduct aquaculture within the range of the assimilative capacity of their environments. In Japan, methods have been developed to assess the assimilative capacity of bays for mariculture. Omori *et al.* (1994) developed a model to determine the upper limit of fish production based on the oxidation of loaded organic matter. In this model, the rate of benthic oxygen uptake (BOU), defined as the *in situ* oxygen consumption by benthic animals and bacteria living in the sediment, was used as an indicator of the activity of the benthic ecosystem. They found a peak of BOU along a gradient of organic loading, and took this peak as an indicator of the maximum phase in the process of remineralisation. Based on this model, Takeoka and Omori (1996) presented a method to determine the assimilative capacity of fish farms using the AVS content in the sediment, because there is usually a positive correlation between the organic loading and AVS. This concept, the so-called “Omori-Takeoka theory”, which states that AVS should be less than the maximum value of BOU at each fish farm, was adopted as one of EQSs in the Law to Ensure Sustainable Aquaculture Production.

On the basis of the model presented by Omori *et al.* (1994), Abo and Yokoyama (2003) developed a three-dimensional numerical model, which takes advection, dispersion, deposition and decomposition of organic matter from the mariculture system into account. They showed the upper limit of organic matter loading to grids of 100×100 m across the fish farm ground in terms of the equivalent weight of oxygen. Some measures currently being implemented are aimed at conducting mariculture within the range of the assimilative capacity of the surrounding ecosystem by siting farms in deeper, more seaward areas where the water current velocity is faster. In order to provide site selection guidelines for fish farming and to determine the upper limit of fish production, Yokoyama and colleagues proposed two indices based on studies on the macrofauna and chemical factors of the water and sediment. One index is ‘ED’ (Embayment Degree; after Yokoyama *et al.*, 2007), while the other index is ‘ISL’ (Index of Suitable Location; after Yokoyama *et al.*, 2004).

The equation for the Embayment Degree (ED) index is:

$$ED = (L/W)(20/D_s)(45/D_m)$$

where L is the distance (km) from the bay mouth to the fish-farm site, W is the width (km) of the bay mouth, D_s is the water depth (m) at the fish-farm site.

The equation for the Index of Suitable Location (ISL) is:

$$ISL = DV^2$$

where D is the water depth (m) at the fish-farm site and V is the time-averaged current velocity (m/s).

Personnel and costs

The responsibility for the Aquaculture Ground Improvement Program rests with the FCAs, who submit a report to the provincial government. The costs of developing the AGIPs and environmental monitoring programmes are covered by the FCAs. However for small FCAs, the costs are subsidised through the technical support of the prefectural fisheries station.

Difficulties and constraints

Presently, not all FCAs are capable of conducting environmental monitoring efforts due to technical and resource limitations. Only limited numbers of large scale and well-organized FCAs are conducting environmental monitoring efforts themselves, and the majority of the FCAs rely on public authorities such as the prefectural fisheries stations to fulfil the law and the guidelines.

Effectiveness

Technical appropriateness

In Japan, AVS is currently recognized as the most effective indicator for monitoring of the aquaculture environment. The absorbent-column method has been shown as a convenient method for measuring AVS. A procedure for the analysis of AVS is provided by Montani (2003). Recent studies regarding the AVS standard in the EQSs (Table 27 above) have found that it is difficult to determine the standard value through *in situ* investigations (Yokoyama and Sakami, 2002; Abo and Yokoyama, 2003). Abo and Yokoyama (2003) recommended use of the numerical model that was developed based on the Omori-Takeoka theory instead of *in situ* investigations for the practical application of the EQS. Various efforts have been made to re-evaluate and improve the standards and monitoring practices (Yokoyama, 2003; Tamura and Miyamura, 2004; Uede, 2007; Tanigawa, Yamashita and Koizumi, 2007; Yokoyama *et al.*, 2006; 2007). The EQSs, however, have remained the same since establishment of the guidelines in 1999.

Use of data for improve performance of aquaculture

Under the AGIPs, the intention is to utilize the environmental assessment and monitoring data, through analysis and evaluation of the aquaculture activities, such as location of the farm, species, culture density and feeding practices. In the case of well-organised FCAs, the data is analysed and considered as information for improvement and evaluation of effectiveness of planning and management. For the rest of the FCAs, prefectural fisheries stations are again providing the service to assist FCAs to effectively exploit the data. Whilst some data are used, it seems likely that further improvements in the use of data for management could be made. For example, Azuma FCA collects water quality data on a daily basis and also has been conducting assessment of water and soil quality twice a year for the whole aquaculture ground, in cooperation with Kagoshima University for the past 20 years (JFRCA, 2007). Saroma-ko FCA has monitored water and sediment qualities and fauna and flora in Saroma-ko Lagoon to maintain scallop and Pacific oyster farms (Maekawa, 2002). In recent years, the FCA has tried to reveal the material flow in the lagoon for estimating the upper limit of production. A project team that consists of the Mie Prefecture government, universities and public and civil research institutes has been formed to develop methods for the environmental remediation of Ago Bay, where the pearl oyster farming has been conducted for more than a hundred years. The team has confirmed the benefits of an automatic water quality measurement system and tidal flats that were rebuilt using enriched sediments under pearl farming rafts (Kokubu *et al.*, 2004).

Impact of EIA and monitoring on environmental protection

The benefits of the monitoring efforts are observed mostly in closed and intensive culture areas where eutrophication, (and associated red tides) as well as fish disease outbreaks were present. In these cases, environmental improvements have been made to reduce impacts on the environment, and improve environmental conditions for aquaculture.

Feedback and review

As a part of effective communication mechanism for feedback and review, MAFF welcome public comments at their Web site (MAFF, 2008) including categories for general inquiry, opinions regarding establishment or revision of the law, as well as archived comments. Recently, a review of the Law to Ensure Sustainable Aquaculture Production (Japan, 1999) was conducted and MAFF welcomed public comments on their Web site until early 2007.

Perceptions of stakeholders

For those places where aquaculture has been carried out for a long time and where environmental degradation and disease outbreaks have been experienced, there is strong consensus on the need for environmental management. In such places, the FCAs are well-organized and independently conducting environmental studies, as well as contributing to ongoing prefectural government studies. However, a large number of small FCAs often claim their production area is in a healthy condition and there are no strong incentives to conduct or improve environmental assessment or environmental monitoring.

Improvements

For aquaculture, EIA has not been formally implemented in the country as yet and environmental management is delegated to the local Fishery Cooperative Associations. Although the framework for environmental monitoring systems is stated by laws established by the responsible fishery authorities, with guidelines provided for implementation, the majority of the FCAs are not actively implementing environmental management measures, unless otherwise the area has gone through noticeable environmental degradation or disease outbreaks.

Possible improvements therefore include:

- Capacity building and awareness raising campaigns for FCAs by the public authorities such as ministries and prefectural fisheries stations.
- Development of clear and practical indicators and methods for FCAs to independently assess and manage their farming environment. It is necessary to review and improve the environmental indicators used, including development and modification of simulation programs considering topographical and oceanographic data.
- Investigations have shown that locating culture facilities in deep, offshore (near bay mouth) areas, is optimal for sustaining high production. This approach requires a large amount of investment for building facilities that are able to withstand strong winds and waves. Most mariculture in Japan is conducted in inshore, sheltered areas on a small-scale family-type operation often staffed by aged workers. It is necessary to integrate small-scale farming into more large-scale, intensive industry for environmentally responsible and sustainable mariculture.
- Development of market incentives to improve environmental management of aquaculture areas. Marine Stewardship Council (MSC) labelled capture fisheries products have started appearing in Japanese markets, but there is no such scheme as yet available for aquaculture products. Collaboration with producers (FCAs) and other stakeholders such as NGOs and certifiers may be one way for the industry to move towards more sustainable aquaculture production.

MALAYSIA¹¹

Requirements

Environmental impact assessment

Under the Malaysian constitution, the use of land and water resources is under the jurisdiction of the respective states. Hence, each state is empowered to enact land law and policy independently. Most of the federal law (e.g. environmental and fisheries law) has universal application to all states, except Sabah and Sarawak. Sabah and Sarawak are members of the Federation, but some constitutional safeguards give them a greater degree of autonomy than the other states. Sabah and Sarawak each have state laws covering land, forestry, protected areas, wildlife, inland fisheries and aquaculture.

Although the Environmental Quality Act (EQA) was enacted in 1974 as the major federal environmental law in Malaysia, it was not until 1987 that the environmental impact assessment procedures were introduced under the EQA. The EIA is required for some 19 categories of activities prescribed under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987. In Sabah, the EIA system was initiated under the Conservation of Environment Enactment 1996 and the Conservation of Environment (Prescribed Activities) Order 1999. In view of new challenges in environmental management, these enactment and order were replaced by the Environment Protection Enactment 2002 and Environment Protection (Prescribed Activities) Order 2005, and came into force on the 3 January 2006.

In Sarawak, the Natural Resources and Environment Ordinance 1993 (amended in 1997) stipulates the statutory requirement for Environmental Impact Assessment (EIA) for development activities having impacts on the environment. The Natural Resources and Environment (Prescribed Activities) Order was enacted in 1994 and amended in 1997.

Aquaculture development is identified as one of the prescribed activities in environmental law in Malaysia. Table 28 summarizes prescribed activities related to

TABLE 28

Prescribed activities related to aquaculture development in EIA Order in Malaysia

State	Legislation	Prescribed activities required EIA report	Prescribed activities required proposal for mitigation measures report
All States in Peninsular Malaysia	<ul style="list-style-type: none"> Environmental Impact Assessment Order of 1987 (Prescribed Activities) 	<ul style="list-style-type: none"> Aquaculture project which involves an area of more than 50 ha 	
Sarawak	<ul style="list-style-type: none"> Natural Resources and Environment (Prescribed Activities) (Amendment) Order 1997 	<ul style="list-style-type: none"> Conversion of mangrove swamps into industrial, commercial or housing estate exceeding 10 ha in area Creation of lakes, ponds or reservoirs for the rearing of fish or prawn exceeding 50 ha in area, which may pollute inland water or affect sources of water supply Fish culture and other forms of fishing on a commercial scale which involve the setting up of fishing appliances and equipment in the rivers or water courses, which may endanger marine or aquatic life, plants in inland waters or erosion of river banks 	
Sabah	<ul style="list-style-type: none"> Environment Protection Enactment (Prescribed Activities) (Environmental Impact Assessment) Order 2005 	<ul style="list-style-type: none"> Conversion of wetland forests into fisheries or aquaculture development covering an area of 50 ha or more Creation of lakes or ponds for fisheries or aquaculture development covering an area of 50 ha or more 	<ul style="list-style-type: none"> Conversion of wetland forests into fisheries or aquaculture development covering an area of 10 ha or more but less than 50 ha Creation of lakes or ponds for fisheries or aquaculture development covering an area of 10 ha or more but less than 50 ha

¹¹ Contribution by Tan Kim Hooi.

aquaculture development in EIA Order in Peninsular Malaysia, Sabah and Sarawak. Generally, EIA is mandatory for aquaculture projects with an area of more than 50 ha. However, the EIA Order in Sabah and Sarawak also contain additional provisions. An EIA report is also mandatory for conversion of mangrove swamps into industrial development including aquaculture projects in Sarawak. In Sabah, a proposal for mitigation measures report is required for aquaculture development covering an area of 10 ha or more but less than 50 ha.

In addition to the requirement of environmental impact assessment, licensing of aquaculture premises and culture systems is mandatory under the Fisheries Act 1985, Sarawak State Fisheries Ordinance 2003, and Sabah Inland Fisheries and Aquaculture Enactment 2003. Other relevant legislation pertaining to aquaculture development is the National Land Code 1965, which provides provisions to the Land Office for leasing of state land as the Temporary Occupation Land (TOL) for development purposes including aquaculture development. The holder of a TOL is given a temporary right to occupy the land and the right may be renewed subject to sub-section 93. The Land Office can impose certain conditions/prescriptions on the development of the land.

Administration and responsibilities

Table 29 shows the relevant administrative institutions and their roles in aquaculture development in Malaysia. The administration of EIA Orders in Peninsular Malaysia, Sabah and Sarawak is the responsibility of Department of Environment (DOE), Environment Protection Department (EPD) and Natural Resources and Environment Board (NREB), respectively. For prescribed activities, no development activity shall be carried out or commenced until the EIA report required to be submitted to the above mentioned authorities is approved and the authorities have given permission in writing for such activities to be undertaken or commenced. In Malaysia, EIA studies are carried out by experts or consultants who have been duly registered and approved by the authorities. The authorities maintain an environmental consultant reference list and environmental laboratory reference list of all of these environmental experts or consultants. The list of registered consultants is available for public review. (DoE – Malaysia, 2008a).

Aquaculture premises and culture systems are licensed by Department of Fisheries Malaysia (DOFM), Sabah Fisheries Department and Inland Fisheries Division of Sarawak Department of Agriculture. For prescribed activities, the license will only be issued by the fisheries authorities after the submission of an approved EIA report. The aquaculture license also contains several terms and conditions to be strictly adhered to by the operators for the sustainability of the aquaculture industry. These terms and conditions include pond design, farm layout plan, water quality management, environmental management and others. Failure to comply will incur the risk of being fined or having a license revoked.

Public participation and information disclosure

Public participation is required under federal EIA procedures in Malaysia, although requirements for participation may be lessened under some state laws. Some detailed EIA reports, and a list of EIA reports approved and under review, are available on the web site of the Department of Environment (DoE – Malaysia, 2008b).

Scope of environmental assessment

The EIA procedure adopted in Malaysia consists of three major steps, as follows:

1. preliminary assessment of all prescribed activities;
2. detailed assessment of those prescribed activities for which significant residual environmental impacts have been predicted in the preliminary assessment;
3. review of assessment reports.

TABLE 29
List of relevant institutions and their roles in aquaculture development in Malaysia

State	Institution	Legislation	Provisions / Responsibilities
All States in Peninsular Malaysia	Department of Environment	<ul style="list-style-type: none"> • Environmental Quality Act 1974 • Environmental Impact Assessment (EIA) Order of 1987 (Prescribed Activities) • Environmental Quality (Sewage and Industrial Effluents) Regulations 1979 	<ul style="list-style-type: none"> • Prescribed activities (EIA) • Monitoring and enforcement in the post-EIA • Prohibition, restriction and control of pollution • Monitoring of river pollution and water quality
	Department of Fisheries Malaysia	<ul style="list-style-type: none"> • Fisheries Act 1985 • Fisheries (Marine Culture System) Regulations 1990 • Fisheries (Cockles Conservation and Culture) Regulations 2002 	<ul style="list-style-type: none"> • Implementation of aquaculture development zone • Aquaculture licensing • Enforcement and monitoring of aquaculture premise based on conditions imposed in the permit or license • Import and export of fish
Sarawak	Natural Resources and Environment Board, Sarawak	<ul style="list-style-type: none"> • Natural Resources and Environment Ordinance 1993 • Natural Resources and Environment (Prescribed Activities) Order 1994 • Natural Resources and Environment (Prescribed Activities) (Amendment) Order 1997 	<ul style="list-style-type: none"> • Prescribed activities (EIA) • Monitoring and enforcement in the post-EIA • Prohibition, restriction and control of pollution • Monitoring of river pollution and water quality
	Inland Fisheries Division, Department of Agriculture, Sarawak	<ul style="list-style-type: none"> • State Fisheries Ordinance 2003 	<ul style="list-style-type: none"> • Aquaculture licensing • Enforcement and monitoring of aquaculture premise based on conditions imposed in the permit or license
	Sarawak River Board	<ul style="list-style-type: none"> • Sarawak Rivers Ordinance 1993 	<ul style="list-style-type: none"> • Monitoring of river pollution and water quality
Sabah	Environment Protection Department, Sabah	<ul style="list-style-type: none"> • Environment Protection Enactment 2002 • Environment Protection Enactment (Prescribed Activities) (Environmental Impact Assessment) Order 2005 	<ul style="list-style-type: none"> • Prescribed activities (EIA) • Monitoring and enforcement in the post-EIA • Restrictions on discharge of pollutants into water • Restrictions on activities affecting vegetation • Monitoring of river pollution and water quality
	State Fisheries Department, Sabah	<ul style="list-style-type: none"> • Sabah Inland Fisheries and Aquaculture Enactment 2003 	<ul style="list-style-type: none"> • Implementation of aquaculture development plan • Aquaculture licensing • Enforcement and monitoring of aquaculture premise based on conditions imposed in the permit or license • Import and export of fish • Transportation of fish from peninsula Malaysia and Sarawak to Sabah, and <i>vice versa</i> • Control of fish diseases in aquaculture premise
Local	District Land Office	<ul style="list-style-type: none"> • National Land Code 1965 	<ul style="list-style-type: none"> • The leasing of state land as the Temporary Occupation Land (TOL) for development purposes including aquaculture development.

The scope of environmental assessment should include all relevant aspects of the environment.

As noted above, the requirement for conduct of an EIA depends on the size of the proposed aquaculture farm and farms covering smaller areas are not subject to an EIA. Sea-based aquaculture farms (marine fish farms, seaweed farms) are also not included. Environment impacts are to some extent controlled for smaller farms (in inland and coastal areas) by simpler licensing procedures. The use of codes of practices (CoPs) is also being promoted by the Department of Fisheries Malaysia to encourage more environmentally sound aquaculture planning and management.

No strategic environmental assessment is applied to aquaculture plans, although informal environmental assessments have been conducted in association with preparation of zoning plans for aquaculture development in some states of Malaysia. For example, the preparation of a master plan for aquaculture development in Sabah included an environmental assessment of the proposed aquaculture activities in Sabah and potential aquaculture zones (Rayner, 1998).

Review of EIA reports is carried out internally by the Department of Environment (DOE) with assistance from the relevant technical agencies for preliminary assessment reports and by an *ad hoc* review panel for detailed assessment reports. Recommendations arising out of the review are transmitted to the relevant project approving authorities for consideration in making a decision on the project. According to the DOE's Client Charter, the periods allocated for a review of a term of reference and EIA report are as follows:

- Preliminary EIA report – five weeks;
- Terms of Reference for the preparation of detailed EIA Report – four weeks;
- Detailed EIA report – 12 weeks.

The DOE maintains a list of experts who may be called upon to sit as members of any review panel established. The selection of the experts depends on the areas of environmental impacts to be reviewed.

New farms versus operational farms

In practice, EIA is only conducted on new farms.

Environmental monitoring

The process of environmental impact assessment includes preparation of an environmental management plan, and identifies requirements for an environmental monitoring plan, specified by DOE to include the following:

- baseline studies for air, water and noise prior to the earthwork for data comparison during future monitoring;
- to identify and justify sampling stations for air, water and noise (on map);
- effluent discharge point must be identified and reported;
- frequency of monitoring;
- sampling method for air, water and noise.

To ensure compliance by project proponents, the authorities mobilize its officers to carry out monitoring and enforcement activities at project sites. The authorities may seek to compound offences for anyone for committing compoundable offences. In the serious case where there is low or no compliance, a stop work order may be issued by the authorities.

The monitoring of water quality of rivers and coastal marine waters is mainly done by environment agencies. Other agencies involved in monitoring of water quality (on a case by case basis) are fisheries research institutes, the Sarawak River Board and the Drainage and Irrigation Department.

Voluntary instruments

The Malaysia Aquafarm Certification Scheme is a voluntary scheme managed by the Department of Fisheries Malaysia for aquafarmers to promote good farming practices, *i.e.* more responsible and environmental friendly practices at the farm level to ensure product quality and safety, consistency in production and remain competitive in the global market. Important elements incorporated into the scheme are ISO 9002, SSOP (Standard Sanitary and Operating Procedures), Product Standards and Specifications, compliance with the Aquaculture's Code of Practice and Good Aquaculture Practices (DoF - Malaysia, 2008) and other terms and conditions as determined by the Department of Fisheries Malaysia. The farm categories covered by the scheme include:

- shrimp farming in brackish water ponds;
- freshwater fish in cages/pens;
- marine finfish in cages/pens;
- freshwater fish in ponds/tanks;
- marine finfish in ponds/tanks.
- marine finfish/shrimp hatcheries;
- freshwater fish/prawn hatcheries;
- molluscs culture (on-bottom, rafts/racks);
- ornamental fish.

One of the objectives of the voluntary scheme is to improve the product safety and quality and “to make the industry more responsible, more eco-friendly to ensure sustainable development for the future”. The certification is provided by the DOF. Farms are required to be of suitable size, productive, competitive and manageable, specifically:

- for shrimp farms, a minimum 5 ha EFA (Effective Farmed Area), or a minimum production of 50 metric tonnes/year;
- for tilapia in net floating cages a minimum size of 3 600 m² EFA, OR a minimum number of 100 cages (minimum dimension of 6’x 6’), OR a minimum production of 150 metric tonnes/year.

The scheme is presently voluntary, although DOF Malaysia plans for it to become mandatory.

Practices

Environmental assessment

The scope of environmental assessment and some suggested methodologies are provided in the Department of Environment “EIA Guidelines for Fishing Harbours and/or Land Based Aquaculture Projects” (DoE – Malaysia, 2008c). Environmental quality objectives are available, for water quality in inland and coastal waters of Malaysia, which are used to assess impacts on water quality.

Environmental monitoring

Environmental monitoring is required as a follow up to EIA and the details are required to be specified in the environmental management plan. Responsibilities for monitoring are with the developer, but government may also conduct monitoring to verify compliance. The federal and state government also carries out regular monitoring of marine and inland waters, although not specifically targeted at aquaculture.

The Department of Environment has been conducting monitoring of rivers since 1978, primarily to establish the status of water quality, detect changes and identify pollution sources; a total of 927 manual sampling stations are located within 120 river basins throughout Malaysia. Water quality data is used to determine the water quality status whether it is in the clean, slightly polluted or polluted category and to classify the rivers in Class I, II, III, IV or V based on the Water Quality Index (WQI) and Interim National Water Quality Standards for Malaysia (INWQS) every year. WQI is computed based on six main parameters:

- Biochemical oxygen demand (BOD);
- Chemical oxygen demand (COD);
- Ammoniacal nitrogen (NH₃N);
- pH;
- Dissolved oxygen (DO);
- Suspended solids (SS).

Other parameters such as heavy metals and bacteria are measured in some rivers. Automated water quality monitoring is also conducted in selected locations (DoE – Malaysia, 2008d). Marine environmental monitoring is also conducted by government

authorities throughout Malaysia. Surface and marine water standards are also available for classification of water quality and determining impacts of effluent discharge. The standards are available on the Department of Environment web site (DoE – Malaysia, 2008a).

Personnel and costs

The costs of EIA and monitoring are to be paid for by the developer.

Difficulties and constraints in practice

A number of other EIA issues and problems have been identified in Malaysia (Harun, 1994), and these are comparable to those in other developing countries in the region:

- lack of awareness of the strength of EIA as a planning tool. Many still perceive EIA as a “stumbling block” to development;
- perception that carrying out an EIA study would delay project approval and implementation;
- EIA not carried out prior to final project design, so that issues such as siting and technology are not considered;
- lack of base-line data on environmental quality;
- poor prediction of impacts;
- limited public participation.

The absence of a framework for environmental planning at a regional (catchment or coastal) level is also considered a major constraint on the effectiveness of the federal as well as state EIA procedures. Because EIA is administered essentially as a project-based tool, its ability to anticipate and manage cumulative impacts is also limited. The other major drawback of the current dual EIA procedures is that most types of aquaculture, particularly small-scale farms, fall outside the formal requirements for EIA. The environmental management requirements associated with these farms are however increasingly being considered through the licensing system, and the promotion of voluntary codes of conduct and certification schemes. Voluntary codes of practice and good aquaculture practice schemes are therefore becoming more important as tools to address potential environmental impacts and improve environmental management of the sector.

Effectiveness

Technical appropriateness

The methods used for EIA of aquaculture projects in Malaysia are considered appropriate, with technical capacity being available in many Malaysian EIA consulting firms for coverage of major environmental issues in aquaculture. The focus on individual project EIAs for large projects, rather than on strategic planning of aquaculture, limits the effectiveness of EIAs as an overall environmental management tool.

Use of data for improved performance of aquaculture

To date, it appears that EIA and environmental monitoring data have been used only in a limited way in improving environmental performance of aquaculture. Most of Malaysian aquaculture farms fall outside the formal requirements for EIA. On-farm monitoring is encouraged under the voluntary code of practice and good aquaculture practice, and is required for certification.

Impact of EIA and monitoring on environmental protection

The main emphasis of the Department of Fisheries Malaysia is to promote environmental improvements, including food safety aspects of aquaculture production, through encouraging industry to adopt codes of conduct and good aquaculture practice guidelines.

Feedback and review

No information is available on this subject.

Perceptions of stakeholders

The perceptions of stakeholders contacted informally suggest that EIA, whilst important for larger scale aquaculture development, as applied, has had limited impact on the environmental management of the aquaculture industry. The larger number of small-scale farmers, currently outside of existing EIA requirements limits the effectiveness of EIA as a sectoral environmental management approach.

5.6.4 Improvements

The main emphasis of the Department of Fisheries Malaysia is to promote environmental management improvements from a sectoral perspective, including food safety aspects of aquaculture production, through encouraging industry to adopt codes of conduct and good aquaculture practice guidelines.

THE PHILIPPINES¹²

Requirements

Environmental impact assessment

The apex of the hierarchy of laws is the 1987 Constitution which provides the general guidance for the management and use of all natural resources in the Philippines. All laws, rules, regulations and other acts of the government therefore, must be consistent with the provisions of the Constitution. In case of inconsistencies, the provision of the Constitution shall govern (Art. 7, the Civil Code of the Philippines).

Second in importance to the Constitution are all laws, called the Republic Acts (RAs), passed by the Congress of the Philippines. Prior to the enactment of the 1987 constitution, however, the President of the Philippines exercised legislative powers through issuance of Presidential Decrees (PDs) and Executive Orders (EOs). These PDs and EOs also have the force and effect of a law unless amended or repealed by a Republic Act under the 1987 Constitution. A common norm in interpreting laws with related and/or conflicting provisions is to use either the most recent law or the special law, whichever is applicable. Treaties entered into by the Philippines and ratified by Congress also have the same force and effect of law. The Executive Branch of government is responsible for implementation of all laws and treaties. To carry out this task, appropriate EOs or Administrative Orders (AOs), memoranda or circulars are issued. EOs or AOs are signed by the President of the Philippines. The various Department Secretaries issue Department Administrative Orders (DAOs) in matters pertaining to their own departments.

At the local level, Local Government Units (LGUs) have certain legislative powers that are exercised through their respective local legislative councils or “sanggunian”. LGUs cannot promulgate ordinances which violate the Constitution, any existing laws passed by Congress, or executive issuances promulgated by the Executive Branch.

Environmental laws relating to aquaculture in the Philippines emanate from four major fundamental laws of the land, the Presidential Decrees (PD)1151, PD 1586, the Republic Act (RA) 7160 (Local Government Code of 1991) and the most recent Fisheries Code of 1998 (RA 8550). Interpretation, application, implementation and enforcement of these laws, however, needs a basic understanding of the country’s governance structure as a key step in appreciating the relatively complicated hierarchy of executive and legislative mandates distributed among the many different government implementing and enforcing agencies (Table 30).

¹² Contribution by Nelson Lopez and Patrick White

The first policy dealing with the Environmental Impact Statement System was first introduced in 1977 by Presidential Decree (PD) No. 1151, known as the “Philippine Environmental Policy”. Section 4 explicitly requires “*all agencies and instrumentalities of the national government, including government-owned and controlled corporations, as well as private corporations, firms and entities to prepare an EIS for every action, project or undertaking which significantly affects the quality of the environment.*” Presidential Decree 1586 formally established the Philippine EIS system in 1978. Consistent with PD 1151, it states that Environmentally Critical Projects (ECPs) and projects within Environmentally Critical Areas (ECAs) require the submission of an EIS. Section 4 provides that “*no person, partnership or corporation shall undertake or operate any in part such declared ECP or project within an ECA without first securing and Environmental Compliance Certificate (ECC)*”. Sanctions are provided for its violation. PD 1586 was implemented through the issuance of administrative regulations and guidelines. The Presidential Decree 1586 addresses aquaculture both directly and indirectly. It identifies certain types of aquaculture as ECPs, e.g. inland-based fishery projects with water spread area from 300 m² to 10 ha, and ECAs, *i.e.* lakes and coastal waters, and in theory at least aquaculture development in these locations should be subject to environmental assessment.

The issue of Department Administrative Order No. 96-37 1996 by the Department of Environment and Natural Resources (DENR) further strengthens the EIS system in the Philippines. This was followed by Administrative Order No. 42, issued by the Office of the President to rationalize its implementation and to address the deficiencies in the EIS system and make it a more effective means of environmental management. In 2003, DAO 2003-30 was issued to further streamline the EIS system and strengthen its implementation process. The provisions contained herein, are the basis for the EIS system being followed at the present time. Under Section 1, Article 1, it is stipulated that “*consistent with the principles of sustainable development, it is the policy of DENR to implement a system-oriented and integrated approach to the EIS system to ensure a rational balance between socio-economic development and environmental protection for the benefit of present and future generations.*” The implementing agency is the Environmental Management Bureau (EMB) under the DENR.

There are in addition a number of relevant environmental measures addressed in the Philippine Fisheries Code. The code reiterates the mandates of the Local Government Code and provides the broad framework for the use, conservation and management of fisheries resources. The Fisheries Code stipulates specific provisions in aquaculture including the issue of licensees and permits for certain activities. As an implementing order pursuant to Section 47 of RA 850, the Department of Agriculture through the Bureau of Fisheries and Aquatic Resources (BFAR) issued Fisheries Administrative Order 214 series of 2001 (FAO 214) or the Code of Practice for Aquaculture that outlined a wide range of measures intended to strengthen environmental assessment and management of the aquaculture sector, including specific reference to the EIS procedures and environmental assessment.

Administration and responsibilities

Regulation of aquaculture is performed primarily by the Department of Agriculture’s Bureau of Fisheries and Aquatic Resources (DA-BFAR) and the LGUs. The former exercises direct authority over public lands, governed by fishpond lease agreements and national waters beyond the 15 km limit of municipal waters. Additionally it may exercise general rule-making and standard-setting functions implementing the Fisheries Code, which allows it to exercise general supervision over the LGUs in their exercise of jurisdiction over aquaculture activities within their respective territories.

LGU regulatory authority is governed by the Fisheries Code as well as certain provisions of the Local Government Code. This regulatory authority springs

primarily from its licensing and land use planning jurisdiction, as well as some environmental controls granted under environmental laws. The LGUs have the key role and responsibilities to manage impacts of development and pollution within their jurisdictional area, within the framework and guidance provided by legislation and policy established at the national level. The LGU has a critical role in ensuring that all development projects within its jurisdiction that are either ECPs or projects in ECAs are subjected to the EIA review process.

The Department of Environment and Natural Resources also plays an important role in the regulation of aquaculture, though indirectly, on account of its jurisdiction over various aspects of environmental management. The “Environmental Impact Statement Policy” designates the DENRs Environmental Management Bureau (EMB) and the DENR Regional Offices as implementing agencies. EMB is responsible for review and issuance of Environmental Compliance Certificates for ECPs. The DENR Regional Offices reviews and issues ECCs for projects located in ECAs.

A joint Department of Agriculture-DENR Memorandum Order No. 01 of 2001 was implemented to promote better coordination of environmental management in the fisheries sector, including aquaculture.

The main institutions and their roles in environmental assessment and management of aquaculture development in the Philippines are summarized in Table 30.

TABLE 30
Relevant institutions and their roles in aquaculture development in the Philippines

Institution	Legislation	Provisions / Responsibilities
Department of Environment and Natural Resources (DENR)	Philippines Environmental Policy, 1977, PD 1151 Environmental Impact Statement Policy, PD 1586	<ul style="list-style-type: none"> • Prescribed activities (EIA) • Environmental management bureau of DENR as implementers of EIS policy • Issuance of Environmental Compliance Certificate through regional DENR office • Enforcement and monitoring jointly with BFAR and LGU as members of the Multipartite Monitoring Team (MMT)
Bureau of Fisheries and Aquatic Resources (BFAR) of Department of Agriculture	Fisheries Code of 1998, RA 8550	<ul style="list-style-type: none"> • Implementation of fisheries code, including environment related aspects • Provisions for aquaculture licensing of some activities (fish pond lease agreements, national waters >15 km from shore)
Local Governing Units	Republic Act RA 7160 and Local Government Code of 1991	<ul style="list-style-type: none"> • Management impacts of development in jurisdiction • Provisions for certain aquaculture licensing (pens, cages within the municipal waters, 15 km from the shoreline).

Public participation and information disclosure

The World Bank supported SEPMEs-PEISS Project, managed by the Environmental Impact Assessment and Management Division (EIAMD) has recently prepared a handbook on multi-stakeholder participation in the EIA process in the Philippines (Tuyor *et al.*, 2007). Other national guidelines also emphasize the importance of public consultation although in practice it appears that the level of consultation is probably limited and it is generally recognized that participatory procedures in the EIA process should be improved.

The Code of Practice for Aquaculture (see below) also includes reference to aquaculture data management and creation of a database on environmental, social and land use impacts including collection and publication of statistics on aquaculture.

Scope of environmental assessment

The DENR-EMB Permitting Procedures (DENR-EMB, Philippines (2008a)) (Sec. 1.2, p.7) specify that EIA applies only to “Inland-based fishery project with water spread

area from 300 m² to 10 ha". Implied on this provision is the clear coverage of EIA on lake-based aquaculture (*i.e.* pen and cages) but not pen/cages operations in coastal/municipal waters. The PD 1586 also addresses aquaculture indirectly. It identifies Environmentally Critical Areas where projects would be subject to environmental assessment. PD 1586 includes lakes and coastal waters as ECAs and in theory at least aquaculture development in these locations should be subject to environmental assessment.

Environmental review procedures for all projects as specified in EIA legislation are as follows:

1. Initial Environmental Examination (IEE). The IEE should contain a brief description of the project, expected impacts and measures to be undertaken to control, manage or minimize impacts of the project on the environment. The project proponent (farmer, investor) submits the IEE to DENR-EMB Regional Office. The IEE is normally conducted by a person or agency hired by the project proponent.
2. IEE Review. DENR-EMB processes and reviews the IEE as to the accuracy and sufficiency of information on the project and its impact and to ensure that the environmental management plan will sufficiently address adverse impacts. The DENR-EMB Regional Office may conduct on site investigations or public consultations during the course of the review. Affected LGUs, communities and other stakeholders are required to provide inputs during public consultations to ensure that their concerns are addressed.
3. Decision on Requirements for EIS (Environmental Impact Statement). The DENR Regional Executive Director determines whether the project IEE may further require an EIS, is acceptable as is, or is unacceptable. The project or its Environmental Compliance Certificate (ECC) may be denied if there may be potentially severe adverse impacts on the environment. EIS is required for projects that may cause significant impacts, involving large areas, altering landscape or relocating communities. An ECC may be issued without preparation of an EIS, if the DENR determines that one is not required. Aquaculture projects appear to be mainly subject to this lower level approach, provided that they are not situated at ECAs, *i.e.* (1) national parks, watershed reserves, wildlife preserves and sanctuaries; (2) areas set aside for aesthetic, potential tourist spots; (3) areas which constitute the habitat of endangered species or indigenous Philippine wildlife; (4) areas of unique historic, archaeological, geological or scientific interest; (5) areas which are traditionally occupied by cultural communities or tribes; (6) areas frequently visited and or hard-hit by natural calamities; (7) areas with critical slope; (8) areas classified as prime agricultural land; (9) recharge areas for aquifers; (10) waterbodies; (11) mangrove areas; and (12) coral reefs, or the development of fishpond will not utilize an area equal to or greater than 25 ha for inland-based, *e.g.* lakes, rivers, bays, or equal to or greater than 100 ha for projects in coastal areas.
4. Environmental Compliance Certificate (ECC). The DENR Regional Executive Director determines whether the ECC will be granted or denied. The EMB-DENR has the primary mandate of monitoring under the Philippine EIS system. However, the stakeholders have an equally significant role as well. Monitoring involves four main strategies, *i.e.* desk review of documents, field assessment and validation by EMB, monitoring by the Multipartite Monitoring Team (MMT) and by third party auditors (if necessary).

In general, ECC applications for aquaculture projects are based on the EIS or IEE report. In case the IEE report of the aquaculture project fails to address all environmental issues or concerns, the application will be upgraded to and require an EIS report.

Item 1.5.2 on Programmatic Environmental Performance Report and Management Plan (PEPRMP) is supposed to address an area-based EIA in aquaculture, but this provision does not specifically state how and when it is to be applied, and has never been implemented in coastal and lake-based aquaculture. No strategic environmental assessment has therefore been conducted for aquaculture plans or area based aquaculture developments, although provision exists in law for such an approach.

The scope of the BFAR issued Administrative Order 214 series of 2001 (FAO 214) that defines the Code of Practice for aquaculture (PHILMINAQ, 2006a) includes specific reference to the EIS procedures and relevant environmental assessment measures in several sections. The following are of particular note as they include reference to environmental assessment:

- Site Selection/Evaluation (Sec.2), which requires that the DA-BFAR, in consultation with the DENR, LGUs and Fisheries and Aquatic Resources Management Council (FARMC) shall identify and evaluate potential sites for aquaculture to ensure that ecological and social conditions are sustained and protected.
- Farm Design and Construction (Sec. 3), which states that Environmental Impact Statements (EISs) shall be required to be submitted to the DENR for review and evaluation before initiating any development activity or construction. The Section states further that fish cages, floating or stationary shall be installed and kept at least one meter between units, and at least 20 m between clusters to provide water exchange. Fish pens on the other hand shall be spaced 200 m apart and marine fish cages shall be operated only in definite zones established by the LGU concerned in consultation with the Municipality/Community FARMC.
- Carrying Capacity (Sec. 13), which refers to the establishment of criteria for the determination of the carrying capacity of lakes.

In addition, the Code of Practice for aquaculture includes reference to water usage, water discharge and sludge/effluent management, use of drugs, chemicals and potentially toxic pesticides and fertilizers, stock selection, stocking practices, introduction of exotic species and GMOs, feed, feed use and management and fish health management.

New farms versus operational farms

Environmental legislation requires environmental assessment for new and expanded operations of existing farms, covering the two categories (A or B) of aquaculture projects as detailed below. Expansions of existing projects are required to submit an environmental performance report and management plan, documentation showing actual cumulative environmental impacts of projects, with proposals for expansions. The environmental performance report and management plan should also describe the effectiveness of current environmental mitigation measures and plans for performance improvement. If the projects for expansion are co-located projects, the proponent is required to submit a programmatic environmental performance report and management plan (Tuyor *et al.*, 2007).

Category A Aquaculture Programme and Projects

Category A projects are those considered “Environmentally critical projects or projects with significant potential to cause negative environmental impacts”

Programmes/projects under this category must prepare either:

- *Programmatic Environmental Impact Statement (PEIS)*, which is documentation of comprehensive studies on environmental baseline conditions of a number of projects (“co-located”) in nearby areas. The programme statement should include an assessment of the carrying capacity of the area to absorb impacts from co-located projects. Recently, it has been used for Mariculture Zones/Parks.
- *Environmental Impact Statement (EIS)*, on the other hand, refers to documents of studies on the environmental impacts of a project including the discussions

on direct and indirect consequences upon human welfare and ecological and environmental integrity. The following is the specific documentation required for new and existing projects, either co-located or single project.

A. New project: Co-located

At the minimum, the PEIS should contain the following:

- executive summary;
- summary matrix of scoping agreements as validated by EMB;
- project description;
- eco-profiling of air, land, water and relevant people aspects;
- environmental carrying capacity analysis;
- environmental risk assessments (if found necessary during scoping);
- environmental management plan;
- duties of environmental management unit;
- proposals for environmental monitoring and guarantee funds;
- accountability statements.

As regards *Environmental Impact Statement* (EIS) the following documentation is required for new and existing projects:

A. New project: Area plan

At the minimum, the EIS should contain the following:

- executive summary;
- summary matrix of scoping agreements as validated by EMB;
- project description;
- eco-profiling of air, land, water and relevant people aspects;
- environmental carrying capacity analysis;
- environmental risk assessments (if found necessary during scoping);
- environmental management plan;
- duties of environmental management unit;
- proposals for environmental monitoring and guarantee funds;
- accountability statements.

B. New project: Single project

At the minimum, the EIS should contain the following:

- EIS executive summary;
- scoping report identifying critical issues and concerns as validated by EMB;
- project description;
- baseline environmental conditions focusing on the sectors (and resources) most significantly affected by the proposed action;
- impact assessment focused on significant environmental impacts;
- environmental risk assessments (if determined by EMB as necessary found during scoping);
- environmental management plan;
- supporting documents, e.g. technical/socio-economic data, certificate of zoning, etc;
- proposals for environmental monitoring and guarantee funds;
- accountability statements;
- other clearances.

C. Existing projects for expansion: Co-located projects

The document required is a *Programmatic Environmental Performance Report and Management Plan (PEPRMP)*. PEPRMP refers to documentation of actual cumulative environmental impacts of co-located projects with proposals for expansions. The PEPRMP should also describe the effectiveness of current environmental mitigation

measures and plans for performance improvement. The maximum processing time in deciding to grant or deny an ECC is 120 working days after the PEPRMP has been accepted by DENR-EMB.

At the minimum, the PEPRMP shall contain the following:

- project description of the co-located projects;
- documentation of the actual environmental performance based on current/past environmental management measures implemented;
- an EMP based on an environmental management system framework and standard set by EMB.

D. Existing projects for expansion: Single projects

The document required is an *Environmental Performance Report and Management Plan (EPRMP)*. EPRMP refers to documentation of the actual cumulative environmental impacts and effectiveness of current measures for single projects that are already operating. Similar to the EIS, the EPRMP should be submitted to the EMB Central Office and reviewed by an EIA Review Committee (EIARC) and endorsed by the EIA Division Chief to the approving authority (EMB Director). The maximum processing time in deciding to grant or deny an ECC is 90 working days after the EPRMP has been accepted by DENR-EMB.

At the minimum, the EPRMP shall contain the following:

- project description;
- baseline conditions for critical environmental parameters;
- documentation of the actual environmental performance based on current/past environmental management measures implemented;
- detailed comparative description of the proposed project expansion and/or process modification with corresponding material and energy balances in the case of process industries;
- an EMP based on an environmental management system framework and standard set by EMB.

Documentary requirements for Category B Aquaculture Projects

A. New projects

The document required is an *Initial Environmental Examination (IEE) Report*. IEE refers to the document required of proponents describing the environmental impact of, and mitigation and enhancement measures for, non-critical projects or undertakings located in an ECA. The IEE replaces the Project Description required under DAO 21, series of 1992. It should be submitted to the EMB Regional Office where the proposed project is to be located. The review shall be undertaken by the EIA Division and endorsed by the EIA Division Chief. The approving authority will be the DENR-EMB Regional Director. The maximum processing time in deciding to grant or deny an ECC is 60 working days after the IEE Report has been accepted by DENR-EMB.

At the minimum, the IEE Report shall contain the following:

- project description;
- a brief of the environmental setting and receiving environment, including the primary and secondary impact areas;
- a brief description of the project or undertaking and its process of operation;
- a brief description of the environmental impact of the project or undertaking, including its socio-economic impact;
- a matrix of mitigation and enhancement measures;
- a documentation of the consultative process undertaken, when appropriate;
- other clearances and documents that may be determined and agreed upon during scoping.
- accountability statements of the preparer and the proponent.

B. Existing projects for expansion: Co-located projects

The document required is a *Programmatic Environmental Performance Report and Management Plan (PEPRMP)*. This should be submitted to the DENR-EMB RO where the projects are located, reviewed by an EIA Review Committee (EIARC) and endorsed by the EIA Division Chief. The approving authority will be the DENR-EMB Regional Director. The maximum processing time in deciding to grant or deny an ECC is 60 working days after the PEPRMP has been accepted by DENR-EMB RO concerned.

At the minimum, the PEPRMP shall contain the following:

- project description of the co-located projects;
- documentation of the actual environmental performance based on current/past environmental management measures implemented;
- an EMP based on an environmental management system framework and standard set by EMB.

The PEPRMP should present the actual cumulative environmental impacts of co-located projects with the proposed expansions. The PEPRMP should also describe the effectiveness of current environmental mitigation measures and plans for performance improvement.

C. Existing projects for expansion: Single projects

The document required is an *Environmental Performance Report and Management Plan (EPRMP)*. Similar to the IEE Report, the EPRMP should be submitted to the DENR-EMB RO concerned, reviewed by the EIA Division and endorsed by the EIA Division Chief. The approving authority will be the DENR-EMB Regional Director. The maximum processing time in deciding to grant or deny an ECC is 30 working days after the EPRMP has been accepted by DENR-EMB RO concerned.

At the minimum, the EPRMP shall contain the following:

- project description;
- baseline conditions for critical environmental parameters;
- documentation of the actual environmental performance based on current/past environmental management measures implemented;
- detailed comparative description of the proposed project expansion and/or process modification with corresponding material and energy balances in the case of process industries;
- an EMP based on an environmental management system framework and standard set by EMB.

If new single or new co-located aquaculture projects are classified as Environmentally Critical Projects (ECP) and are located in Environmental Critical Areas (ECAs) or non-ECAs then the report type required is provided in Table 31 (DENR-EMB, Philippines (2008b)).

TABLE 31
Reports required for aquaculture projects classified as Environmentally Critical Projects

Fish pond development projects			
Project type	Project size parameter	Project size	Report type requirement
Inland based e.g. lakes and rivers	Total water spread area to be utilised	≥25 hectares	EIS or ECC
Coastal waterbodies	Total water spread area to be utilised	≥100 hectares	EIS or ECC

If new single or new co-located aquaculture projects are classified as Non Environmentally Critical Projects in Environmental Critical Areas then the report type required is provided in Table 32.

TABLE 32
Reports required for aquaculture projects classified as Non-Environmentally Critical Projects

Fish pond development projects			
Project type	Project size parameter	Project size *	Report type requirement
Inland based e.g. lakes and rivers	Total water spread area to be utilised	≥ 1 hectares but < 25 hectares	Initial Environmental Examination (IEE) or IEE checklist or ECC
Coastal waterbodies	Total water spread area to be utilised	≥ 1 hectares but < 100 hectares	EIS or ECC

* All projects greater than 1 hectare require a Project Description Report (PDR) which is the basis for a request for the issuance of a Certificate of Non-Coverage (CNC).

Environmental monitoring

Environmental monitoring requirements should be identified during the preparation of the EIS and included within the Environmental Compliance Certificate. There are various modes of compliance monitoring depending on the classification of a project, *i.e.* compliance monitoring by EMB, self-monitoring by proponents, monitoring by third party auditors and monitoring by so-called multipartite monitoring teams (MMT).

- a. Compliance monitoring by EMB. At the institutional level, a periodic monitoring of environmental impacts and compliance with ECC conditions as well as applicable laws, rules and regulations shall be the responsibility of the EMB regional office, with assistance from the central office if necessary. Compliance monitoring focuses on the status of delivery of commitments made in the Environmental Management Plan and meeting the terms and conditions as stated in the ECC.
- b. Self-monitoring by establishments. It is the primary responsibility of the proponent to meet the conditions set in the ECC as well as those commitments made in the EMP. The proponents are expected to conduct regular self-monitoring and submit requisite reports to DENR-EMB.
- c. Monitoring by third party auditors. Third party auditors are independent service providers accredited by the appropriated government agency and engaged by an establishment to conduct an environmental audit. Their services are usually required as an alternative to MMT for Classified A projects.
- d. Monitoring by MMT. Multipartite monitoring teams are formed to encourage public participation, greater stakeholders vigilance and provide check and balance mechanisms during monitoring. They are composed of representatives from the DENR, the proponent, stakeholders, LGUs, locally accredited NGOs or Peoples' Organizations, the community, EMB regional office, relevant government agencies and other sectors that may be identified during the negotiation. MMTs are tasked to monitor project compliance to ECC and EMP and other requirements as may be specified by DENR.
- e. Sectoral monitoring. In addition to the EIA provisions of the DENR, however, BFAR in collaboration with the LGUs and FARMCs has launched a programme on aquaculture environmental impact monitoring, particularly in mariculture parks and lake-based zonified areas for fish pen/fish cage operations basically following the provisions of FAO 214.

Voluntary instruments

There are no voluntary instruments as such in use by the aquaculture industry in the Philippines, but the Government of the Philippines through the BFAR has prepared a Code of Practice for Aquaculture (which is not voluntary, but mandatory and legal in nature) that includes specific reference to environmental assessment and monitoring, and that more generally is to improve the environmental management of aquaculture in the country (Table 33).

In addition, provisions under RA 8550 (which are not voluntary but obligatory and legal in nature) address “missing links” in DENR-EIS implementation as applied in aquaculture:

- Art.III, Sec. 45. No fish pens/cages or traps shall not be allowed in lakes two years after the approval of RA 8550;
- Sec.103 (b) stipulating penalties to individuals’/operators’ failure to conduct yearly reports on fishpond, fish pens or cages;
- Sec 103 (e) Unlawful to construct and operate fish pens, cages without licence or permit;
- Sec. 47 Creation of Code of Practice for Aquaculture;
- Sections 51–55 specific provisions on cage farming;
- Sections 12 and 13 of the Fisheries Code states a reiteration of compliance to DENRs EIS and ECC.

TABLE 33
Code of Practice for Aquaculture based on FAO, 214

Item	Scope
Site selection/evaluation	Identification and evaluation of potential sites for aquaculture.
Farm design and construction	Requires environmental impact statements (EIS) and provides requirements for fish cage and fish pen installation. Installation guidelines for cages and fish pens
Water usage	Construction and operation of deep wells for freshwater supply and efficient water use
Water discharge and sludge/effluent management	Effluents, sediments management and disposal other wastes. Species requirements for water quality standards.
Use of drugs, chemicals and potentially toxic pesticides and fertilizers	Use of therapeutic agents and other chemicals used in fish farming without endangering food safety or threat to environment.
Stock selection, stocking practices (Sec.7)	Stocking of healthy fry and fingerlings.
Introduction of exotic and GMOs (Sec. 8)	Introduction of exotic and genetically modified organisms bio-safety standards.
Feed, feed use and management (Sec. 9)	Feed management, quality and techniques to minimize wastage.
Fish health management (Sec. 10)	Health management and quarantine procedures
Aquaculture data management (Sec. 11)	Database for environmental, social and land use impacts including collection and publication of statistics on aquaculture.
Carrying capacity (Sec. 13)	Criteria for the determination of the carrying capacity of lakes.

Source: after PHILMINAQ, 2006a

Practices

Environmental assessment

Although there is a well-established legal framework for environmental assessment of aquaculture, actual implementation in terms of project inclusion and scope of environmental assessment is still weak. Such problems are not specific for the aquaculture sector, but according to a recent World Bank/ADB report are common throughout the Philippines EIS system (Tuyor *et al.*, 2007). Recently, there has been work under the Philippines-EU funded project PHILMINAQ (PHILMINAQ, 2006a) on the development of carrying capacity models for milkfish (coastal) fish cage farming and tilapia cage culture in inland lakes in the Philippines, monitoring systems and government management guidance that show scope for wider application.

Environmental monitoring

Environmental monitoring requirements are highlighted in general above. The need to improve procedures and methods for the environmental monitoring of aquaculture

is well recognized by BFAR and a number of simple points for improvement in monitoring environmental performance at the farmer/farm level have been identified as follows:

a. Environmental indicators

- legally required permits and documentation;
- environmental monitoring of waterbodies, e.g. pH, TAN, BOD, CFC and sediments, e.g. TSS, redox potential;
- data from workshops and consultations;
- eco-profiles of aquaculture farms and areas.

b. Environmental monitoring

- 6 months, 12 months and 18 months time period;
- parameters, procedures/methods, geographical location and frequency of monitoring are defined;
- cross check environmental monitoring data with the reference standards;
- regular evaluation of environmental performance, put into writing and disseminated, *i.e.* “record of the performance review”.

Tuyor *et al.* (2007) also considers that the Philippine EIS system has a complex but poor system of follow-up and monitoring and virtually no evaluation study to determine and improve performance from projects. The feedback from monitoring to management is therefore a weak point requiring attention.

Personnel and costs

The costs of preparation of the environmental assessment and monitoring requirements are normally borne by project developers. For mariculture zones/parks, the costs of environmental assessment of the plans are being borne by government. Monitoring of these areas is also assisted by government funding.

Difficulties and constraints in practice

The major difficulties and constraints in practice to implementation of improved environmental assessment and monitoring of aquaculture in the Philippines have been summarized recently (PHILMINAQ, 2006b) as follows:

- Lack of clarity about the scope of authority. Local government staff are unclear about what their responsibilities really mean and how to go about fulfilling them.
- Inconsistencies and conflicts between national government agencies, and between national government agencies and local government units. Furthermore, non-implementation of the Joint DA-DENR Memorandum Order No. 01 of 2001, designed to assist cooperation between the responsible agencies for fisheries and environment, has hampered effective environmental management of the aquaculture sector.
- Lack of enforcement remains a continuing concern. There are sufficient laws and regulations covering aquaculture, but in many cases, enforcement is lacking or extremely weak. The reasons for this include a lack of knowledge on aquaculture management by enforcement staff; lack of funding for boats and petrol to check licences; lack of operational budgets and lack of trained coastal law enforcement units.

More generally, Tuyor *et al.* (2007) emphasize the following difficulties in implementation of the EIS system, most of which are relevant for aquaculture:

- it is administered by a central government agency; the role of local governments is very limited;
- the manner of its implementation is highly regulatory and control-oriented, emphasizing compliance to rigid bureaucratic procedures;

- more attention is paid to the procedural rather than on the technical aspects, resulting in generally poor quality environmental assessment characterized by voluminous reports and lack of focus and depth of analysis on critical issues and impacts;
- it has many overlaps with other laws as the EIS system tends to incorporate requirements of laws that are already handled by other agencies. These overlaps are becoming worse as new laws passed after Presidential Decree 1586 tend to include provisions that modify the EIS system;
- there is a complex but poor system of follow-up and monitoring and virtually no evaluation study.

These concerns, rather than purely technical matters and access to methodologies, are the principle difficulties with respect to implementation of effective environmental assessment and environmental monitoring for aquaculture in the Philippines.

Effectiveness

Technical appropriateness

Environmental assessment for aquaculture is in practice limited to a few larger projects, but has limited effectiveness for large numbers of small-scale farms. The increasing application to mariculture zones could improve its effectiveness, but techniques for assessment and monitoring need to be improved and implementable to improve the quality of the environmental assessment and decision-making.

The EIS system's contribution as a planning tool has been limited. The planning contribution could be achieved by implementation of the Programmatic Environmental Assessment introduced in 1995. The application to the aquaculture sector has been limited to date, and the techniques for environmental assessment of plans poorly developed in the country.

Use of data for improved performance of aquaculture

Data collected through the environmental assessment process and the subsequent monitoring is not well used for improving the performance of aquaculture. New guidance documents prepared by the PHILMINAQ project to assist local government units in better environmental management emphasize the importance of simple environmental data collection and use of the data for management adjustments/improvements. Implementation of these guidelines, a substantial challenge, will be necessary to see achievements "on the ground".

Impact of EIA and monitoring on environmental protection

Environmental assessment can be a good tool for environmental protection. However, it can also be used more narrowly to support economic interests. Government guidelines clearly state the pursuance of economic development as a priority. This may indicate that the government somehow recognizes civil society and environmental concerns as a weakening factor and the government is getting bolder in pushing for more economic objectives. The recent World Bank/ADB review of environmental assessment in the Philippines suggested that the use of EIS had not been effective in improving environmental management (Tuyor *et al.*, 2007) and interestingly suggested that slow approval procedures and "swamping" of the system with environmental requirements for small and medium enterprises may even have contributed to slow economic growth.

In the aquaculture sector, the use of environmental assessment has probably not contributed to overall environmental protection for habitats and aquatic resources. The recent emphasis on more regional planning, mariculture zones and application of sectoral management tools such as codes of practice and certification are likely to prove more effective and as such should continue to be pursued, with regular performance review, and incorporation of necessary improvements from such reviews.

Feedback and review

Existing environmental assessment procedures do provide for periodic review of the EIS to assess whether the mitigating measures are effective or unnecessary and whether change in EMP suffices. In practice, these feedback and review mechanisms are commonly not used. Since the promulgation of the Local Government Code, there has been an increase in the local government's ability to engage and influence the EIA process. Such influence remains controversial, if certain decisions are to be made in the light of political interests. The Local Government Units sometimes do not have enough technical competence to make sound judgements, and more capacity building is required at this level.

Perceptions of stakeholders

There is a perception from non-government organizations that the environmental assessment system leaves the community out of the process. The flow of communication between stakeholders, especially local communities must be improved and the use of simple language and communication in the EIS process is required.

Improvements

To date, there has been limited application of environmental assessment to most aquaculture projects in the Philippines, although there is a legal basis for applying environmental assessment widely within the aquaculture sector, both as part of a formal EIA process managed through the DENR system or sectoral management agencies.

A major trend in the country is to develop an effective system of local management in line with the government decentralisation policy, and a major challenge for improvement is to incorporate environmental management of aquaculture into that process.

The following suggestions are made for improvement:

- The focus of improved environmental management of aquaculture needs to be directed towards the local government units and increased responsibility given to farmers and farmer associations. This will require substantial capacity building, as well as addressing the various other constraints of decentralised EIA as highlighted in Tuyor *et al.* (2007).
- EIA legislation does not currently state directly that marine-based aquaculture activities are included. The DENR-EMB Permitting Procedures (Sec. 1.2, p.7) specify that EIA applies only to "Inland-based fishery projects with water spread areas from 300 sqm. to 10 ha". Implied on this provision is the clear coverage of EIA on lake-based aquaculture (*i.e.* pens and cages) but not pen/cages operations in coastal/municipal waters. There is a need therefore to review the present scope of environmental assessment and ensure proper coverage of the environmental risks, both in terms of farming systems and ecosystems where farms might be located. A key objective should be to identify the key risks, to key ecosystem and social values, and strategies to address these risks, rather than adopting a further simplistic "area-based" (*i.e.* farms over 10 ha) type approach.
- The quality of environmental assessments should be improved and supported through guidelines, capacity building, competency development and better collaboration between producers, producer organizations, EIA and monitoring experts, regulators, NGOs and certifiers, in the process of environmental assessment and monitoring.
- Environmental assessment reports and monitoring information should be made available via the internet and other publications. Mechanisms to share learning and outcomes of experiences on the ground should also be explored.
- The prospects for environmental assessment need to be reviewed in the light of national development interests and environmental objectives and focus on key

environmental risks and outcomes. The use of strategic environmental assessment of plans and zones has potential to enable more strategic application of resources for environmental assessment. Similarly, the effectiveness of the use of sectoral approaches (e.g. codes of practice) versus more formal EIA legal procedures should be reviewed in relation to costs, practicality and environmental and economic outcomes.

- In 2008, a Joint Administrative Order No. 1, series of 2008 (JAO) between the DENR, Department of Interior and Local Government (DILG) and the Department of Agriculture (DA) has been drafted for signatures of the Department Secretaries concerned. This JAO is entitled: Defining/Identifying the areas of cooperation and collaboration among the Department of Agriculture (DA), Department of Environment and Natural Resources (DENR) and the Department of Interior and Local Government (DILG) in the planning, management and control of aquaculture development to mitigate impacts on the environment. Implementation of this JAO should be a priority.

THAILAND¹³

Requirements

Environmental impact assessment

The Enhancement and Preservation of Natural Environmental Quality Act (1992) specifies that large scale projects that might cause significant environmental impacts should submit an EIA report to the Office of Natural Resources and Environmental Policy and Planning (previously Office of Environmental Policy and Planning) of the Ministry of Natural Resources and Environment. The first mandatory requirement for EIA was issued in 1981, under Section 46 of the Enhancement and Conservation of National Environmental Quality Act 1992. Guidance on EIA procedure is provided by the Environmental Impact Bureau, Office of Environmental Policy and Planning (now the Office of Natural Resources and Environmental Policy and Planning or ONEP). EIA reports must be prepared only by registered consultants, research institutes, or universities registered with ONEP (Thailand, 2006).

Examples of listed projects requiring EIA identified by the Ministry of Natural Resources and Environment for the approval of the National Environmental Board (NEB) are: dam or reservoir construction, irrigation projects, commercial airports, hotels or resorts, mass transit systems and expressways and certain industrial projects (*i.e.* petrochemical, iron or steel, cement *etc.*).

Aquaculture is not mentioned under EIA legislation in Thailand, although the principle and analysis framework of EIA may be applied to aquaculture. A classical example is the prohibition of shrimp ponds in freshwater areas in 1998. Environmental studies were conducted showing potential impacts on soil salinization as well as social conflicts in resource use, leading to a ban on construction of shrimp ponds growing black tiger shrimp in freshwater zones using the authority of the Prime Minister via the Provincial Governors in affected areas, under Section 9 of the Enhancement and Conservation of National Environmental Quality Act 1992.

Although EIA is not legally required for aquaculture, the environmental assessment, monitoring and management of aquaculture activities in Thailand are also conducted under the responsibility of the Ministry of Agriculture and Cooperatives as well as other central, provincial and local governments. Various legal instruments cover the environmental aspects of planning and operational management of aquaculture activities in Thailand, covering a wide range of relevant environmental issues.

¹³ Contribution by Rattawan Tam Munkung

Aquaculture farm siting is relevant to the Land Development Act (1983), Land Code (2001), and the Enhancement and Preservation of Natural Environmental Quality Act (1992) concerning the prohibited zones for aquaculture in the environmentally protected areas and pollution control areas. For instance, ponds are not allowed to be constructed in designated mangrove areas. Also, farmers have to submit the document for proving their right on the land through the Department of Forestry or Ministry of Natural Resources and Environment for farm registration; and the layout of new farms should be approved by local authorities. In the case of farm renting, the contract of farm renting must be submitted as a supporting document for farm registration. The suitability of sites in terms of water and soil quality, water supply and access to inputs is another limiting factor in controlling the expansion. No clear legislation is in place for designation of marine areas for cage culture or other marine aquaculture operations, although this is an area of increasing interest to government and investors. Operational aspects for inland and coastal farms are also well covered under various legal arrangements, much of which is administered and implemented by the Department of Fisheries (DoF) under the Ministry of Agriculture and Cooperatives. Considerable emphasis is placed on coastal aquaculture, and particularly shrimp farming, due to its high value and importance as an export earner to the country. Table 34 summarizes some of the formal environment-related management measures.

TABLE 34

Environment-related management measures for aquaculture in Thailand

Environmental issues/aspects	Management activities
National policy and plans for aquaculture to incorporate environmental aspects	Development of national policy and plan of environmental management in aquaculture
Environmental evaluation of farming locations	Farm location evaluation and registration
Quality control of main inputs (broodstock, post-larvae, feed, chemicals and therapeutic agents)	Provision of the list of registered non-pathogen broodstock sources to prevent the introduction of new disease
	Quality control of post-larvae by detecting pathogens
	Monitoring of feed quality in terms of chemical properties especially the minimum nutritional requirements
	Prohibition of some chemicals and antibiotics usage that may lead to human health impacts
Provision of instructions on the usage of therapeutic agents to prevent the contamination in final products	Provision of instructions on the usage of therapeutic agents to prevent the contamination in final products
	Development of effluent standard of wastewater from coastal aquaculture and monitoring the coastal water quality
Effluent impacts from coastal aquaculture and monitoring	Development of effluent standard of wastewater from coastal aquaculture and monitoring the coastal water quality
Certification systems of food safety management and environmental management programme of hatchery, farm and harvesting activities	Development and monitoring of the certification systems of environmental management programme of hatchery, farm and harvesting activities, including technical guidance on how to implement the certification criteria so as to minimize the environmental impacts associated with production activities, including the issues of social responsibility.

Administration and responsibilities

At the national level, the NEB has the authority to pursue policy and plan for enhancement and conservation of national environmental quality and to approve environmental quality management plans at the provincial level. NEB plays an important role in overall environmental management in all activities that could lead to significant impacts to the public, including aquaculture. However, environmental assessment, monitoring and management practices for aquaculture are under the sectoral responsibility of the Department of Fisheries (DoF) of the Ministry of Agriculture and Cooperatives. There are also other organizations (institutions) involved in some aspects of the operational control of aquaculture, for instance, Department of Livestock and Pollution Control Department.

At the local level, strategic plans for development of aquaculture, and other uses of natural resources, are prepared at provincial or district (known as Tambon) level according to the national policy and plans from the national government. Provincial/district government and provincial fishery offices are the main organizations responsible for aquaculture operational control, environmental assessment, monitoring and management within their territory. There is increasing emphasis on decentralisation of environmental management responsibilities to the provincial and district levels in Thailand. The list of institutions responsible for environmental management of aquaculture is given in Table 35.

TABLE 35

List of institutions responsible for environmental management of aquaculture

Institution (s)	Department	Responsibilities
Ministry of Natural Resources and Environment	Office of Natural Resources and Environmental Policy and Planning	Overall environmental policy and planning for the national level in all activities
	Department of Forestry	Identification of suitable land areas for aquaculture activities
	Department of Land Development	
Ministry of Agriculture and Cooperatives	Pollution Control Department	Pollution control by setting effluent standards and monitoring the water quality in rivers
	Department of Fisheries (DoF)	National policy on production and operational control, including environmental assessment, monitoring and management for aquaculture (as well as fisheries)
Ministry of Public Health	Department of Livestock	Control of feed quality and veterinary drug usage
	Department of Medical Science	Testing of contamination in flesh meats
Ministry of Industry	Department of Industrial Work	Control of hazardous substances production, import and export and uses

Within DOF, there are several units responsible for aquaculture, including:

- Standard Control of Aquatic Product Division to examine and issue health certificates for exporting;
- Development of Aquatic Product Industry Division to develop post-harvest technology;
- Fisheries and Aquaculture Management Division to establish laws and legislations for controlling and managing fisheries and aquaculture activities;
- Research and Development of Coastal Fisheries Institute to develop aquaculture technology and examine the aquaculture operations especially in coastal zones to meet food safety and environmental standards;
- Research and Development of Freshwater Fisheries Institute to develop aquaculture technology and examine aquaculture operations especially in freshwater areas to meet the food safety and environmental standards;
- Knowledge Transfer of Research and Development Institute to transfer knowledge to farmers.

Scope of environmental assessment

The scope of EIA reports as defined in Thailand's EIA guidelines should include the following:

1. purpose of project as well as its benefits, including the permit license, land use right or any other documents;
2. project description in terms of type, size, production capacity; project justification, project size and access to the site; project implementation timetable; reasons for site selection; detailed information of project activities (e.g. raw material, energy,

- infrastructure requirement, number of workers, detailed actions of project construction and operation); pollution and wastes generated from the project construction and operation; and detailed information on waste management systems;
3. environmental conditions to reflect the present state in four main elements: abiotic resources (*i.e.* minerals, soil, etc.), biotic resources (*i.e.* animals, plants, etc.), human use value (*i.e.* land use) and quality of life value (*i.e.* socio-economic, health, historical and recreation values).
 4. environmental impacts from the project including direct, indirect, short- and long-term impacts must be assessed and addressed according to the severity of impacts, which should cover irreversible and irretrievable loss of environmental values, based on the predicted future impacts, with technical justification;
 5. measures to mitigate environmental impacts or compensate for any damage incurred;
 6. comparison of advantages and disadvantages of alternative sites as well as no project development, to provide understanding of site suitability and options;
 7. monitoring plan to ensure the effectiveness of preventive measures, and to include description of monitoring site, parameters, frequency, environmental standards, methodologies and frequency of monitoring reporting.

Although EIA is not legally required for aquaculture, environmental assessment is conducted within the context of several procedures associated with the planning of aquaculture operations. In general, these procedures are applied mainly to shrimp farming, and not to small-scale freshwater aquaculture in inland areas. Shrimp farming, as a major export aquaculture activity in Thailand, has received the most significant attention, including inland shrimp aquaculture.

The overall environment management policy and plan in aquaculture is set at the national level. Based on the policy directives of National Economic and Social Development Plans, aquaculture production and management plans are set accordingly. Management strategies are then addressed in the policy of the Department of Fisheries as well as other related organizations. For instance, the target of aquaculture production in the 9th National Economic and Social Development Plan (2002–2006) was an increase of 5 percent annually. Issues concerning cost-effectiveness, environment-friendly aquaculture production systems, post-harvest technology development and hygiene management, and enhanced competitiveness of aquaculture products in international markets are highlighted.

Environmental evaluation of farm location is conducted for farm registration. The provincial fishery offices are involved in the farm registration, and are required to coordinate with the local government Tambon Administration Organization (TAO); the latter is involved in the approval of layout of the new farm, which is not to be operated in prohibited areas such as mangroves or any other sensitive areas that might lead to social conflicts. Moreover, it is the authority of TAO to monitor and control the aquaculture activities to avoid causing negative environmental impacts.

Environmental monitoring

Environmental monitoring is conducted within the scope of several management activities associated with aquaculture in Thailand.

Environmental monitoring of aquaculture activities in a specific area or community are the responsibility of the provincial fishery offices. These tend to be practical and linked to farm management and effluent monitoring, for instance, providing services on disease control, pond and effluent management (*i.e.* checking the water quality during the culture period or testing discharge wastewater quality during or after harvest).

Considerable environmental monitoring efforts are conducted within the framework of management initiatives for shrimp farming, being implemented by DoF. These efforts cover:

- Monitoring associated with farm certification and use of voluntary instruments as noted below.
- DoF has developed the online traceability system called “ThaiTraceShrimp” (available online at www.thaitraceshrimp.com) to provide supply chain data. Fisheries Movement Documents (MD) are also used to regulate the “movement” of aquatic animals, which requires hatcheries and farms to provide data on sources of broodstock, post-larvae and other inputs so that any contamination of shrimp products can be traced back along the production chain.
- Monitoring of broodstock and post-larvae quality control. The control of disease in broodstock is implemented strictly, particularly for imported shrimp. According to the DoF regulation concerning the import of white shrimp (*Peneaus vannamei*), only specific pathogen free broodstock may be imported, from registered bio-secure hatcheries. There must be no movement within 15 days, and after that movement is allowed with the attachment of a movement document. The list of registered broodstock sources is provided by DoF.
- Monitoring of feed quality control. DoF checks the quality of aquaculture feeds (*i.e.* nutrient levels of feeds available in the market) regularly, under the Animal Feed Control Act (1992) administered by the Department of Livestock.
- Residues in aquatic animals are monitored under the Food Act (1979) and Drug Act (1967). A residue monitoring plan is also a requirement of trade with the European Union, and is submitted annually for EU review (Thailand, 2007a).
- Effluent standard of wastewater from coastal aquaculture. Water pollution from coastal aquaculture is subject to control through effluent standards for coastal aquaculture set by the Marine Environmental Division of the Pollution Control Department. The range or maximum permitted values of effluent water quality parameters are provided in Table 38.

Voluntary instruments

In recent years, there has been increasing use of voluntary measures to encourage and support improved environmental management of aquaculture in Thailand (Pongthanapanich and Roth, 2006). The two principle initiatives (DoF Thailand, 2002a; 2002b) are:

- Good aquaculture practice “GAP” programme (DoF Thailand, 2008b), which focuses on assuring hygiene and food safety of aquaculture products. GAP was developed initially for shrimp farming, but the programme has recently expanded to include marine fish and tilapia.
- Code of Conduct for Responsible Shrimp Farming, which covers product safety plus environmental and social responsibilities.

These certification systems of food safety management (Good Aquaculture Practices, GAP) and environmental management (Code of Conduct for Responsible Shrimp Aquaculture, CoC) were developed by DoF, in consultation with a range of industry stakeholders. They include standards for certification, and are supported by technical guidelines for farmers and certifiers on how to implement certification for hatchery, farm and harvesting activities. GAP is focused on assuring hygiene and food safety of aquaculture products (Table 36) whilst CoC addresses environmental protection, regulatory compliance, quality and safety, efficiency, social responsibility, education and training (Table 37).

DOF has recently reviewed the implementation of these certification programmes and an updated version of GAP and CoC will add some new aspects; for example the environmental management aspects of CoC will also include the reforestation and energy conservation, and animal welfare is also being considered. The new version will also put more emphasis on data recording systems (DoF Thailand, 2008a).

TABLE 36

Major elements of the Good Aquaculture Practice guideline (DoF Thailand, 2008b)

Item	Scope
1. Site Selection	Near water supply source, no pollution source and legal land with the farm being registered.
2. Pond management	General pond management includes hatchery layout, pond preparation, water preparation, health checking of broodstock, water quality monitoring
3. Feed, feeding and post-larvae production	Use of registered and good quality feeds, effective feeding, production of live feeds according to requirement of larvae in each stage, use of registered chemicals and drugs for shrimp health management or water quality control.
4. Post-larvae health management and disease treatment	Monitoring of shrimp health and disease infection, use of registered veterinary drugs according to the instructions provided
5. Sanitary condition of hatchery facilities	Sanitary control of hatchery areas and facilities, sanitary toilet with no contamination to hatchery production systems, good solid waste management, the total and faecal coliforms in water used meets the requirement
6. Harvesting and transport	Planning of harvesting, harvesting method with shrimp quality control, movement documents for transporting
7. Data recording	Data recording and updating of hatchery production activities

TABLE 37

Major elements of the Code of Conduct for Responsible Shrimp Farming

Item	Scope
1. Site selection	Site selection such as outside mangrove zones and legal land with the farm being registered.
2. Pond management	General pond management such as farm layout, pond preparation, water and pond soil quality check, water management and other daily farm operations.
3. Pond stocking	Stocking such as density, suitable seed size and quality.
4. Feed and feeding management	Feed management such as feed storage and feed management for efficient food conversion ratio (FCR)
5. Shrimp health management	Shrimp health management such as daily health check, disease control and prevention.
6. Drugs and chemicals	Therapeutic agents and chemicals, in which only specified therapeutants are used and only when absolutely necessary
7. Effluents	Wastewater treatment before effluent discharge, including sludge treatment and farm sanitation methods.
8. Harvesting	Harvesting and distribution such as harvesting plan and methods, quality and antibiotic residue checking.
9. Social responsibility	Social responsibility concern over labor welfare and participation with local community.
10. Farmer associations	Farmers association and training.
11. Record keeping	Farm record keeping to facilitate evaluation (Use of farm manual to record farm production systems and management activities).

Both the above programmes target and provide opportunities for product certification, for export and domestic markets. Some private certification schemes are also emerging in Thailand – national and international – which also include reference to environmental assessment and management. Examples of other certification schemes applied in Thailand are Organic (Naturland) and ACC (Aquaculture Certification Council) required by buyers/customers in EU and the United States of America respectively.

These programmes involve farm monitoring, training and auditing for certification, which at present is mainly conducted by DoF. The evaluation guidelines assign different weights to each standard, ranging from 5–15 percent. The final score is given based on the average of the summation of score in individual standards. However, the new version of GAP/CoC will assign different levels (critical, major and minor) to each criterion (DoF Thailand, 2008b). For the certification procedure, the development of certified auditors, certifying body and accreditation body based on the ISO/IEC Guide 65 is being considered.

The planning for aquaculture sites is also included in CoC and GAP documents. The importance of suitable location of shrimp farms is emphasized as a key factor

for food safety, and to help minimize environmental and social impacts. A guideline provides further details; for example the guideline for site selection notes that a good farm must be located in non-acidic soil, close to a good quality seawater source and far from other pollution sources. The CoC also broadly covers the major environmental issues associated with operational management as shown in Table 37. A sludge storage pond is also required in CoC provisions to prevent one of the major impacts of shrimp farming on water quality in coastal ecosystems.

Practices

Environmental assessment

There are no environmental assessment methods identified for aquaculture as part of a formal EIA process required by law. Nevertheless, various environmental assessment approaches and methods are in use in Thailand for assessing impacts of aquaculture on the environment:

- Environmental assessment for environmental policy. Aquaculture environmental management policy is evaluated and assessed for improvement through quality assurance systems used for evaluating the performance of governmental organizations.
- Land use for aquaculture activities. The land areas used for aquaculture activities are assessed by using aerial photos and geographical information systems (GIS). Moreover, potential impacts on soil salinization, particularly for inland shrimp farming, as well as social conflicts in land use have been assessed through various scientific research projects conducted by government research and development institutes and universities.
- Assessment of broodstock, post-larvae and feed quality. Broodstock and post-larvae quality is assessed using quality criteria based on physical characteristics and pathogen detection techniques. For feed quality control, chemical properties of feeds in terms of percent protein, percent fat, percent phosphorus, percent fibre, percent ash and moisture content are checked randomly from the feeds available in the market to determine if minimum nutritional requirements are reached. Feed plants in Thailand are also subject to various certification requirements, including recently certification that feeds do not contain GMO ingredients. Veterinary drugs and other residues are also checked occasionally in feeds as part of the government residue control plan.
- Assessment of residues of chemicals and therapeutic agents. There is an extensive programme of residue testing through sampling of aquaculture products. Moreover, it is legally compulsory to use only chemicals and therapeutic agents that are approved for aquaculture activities.
- Assessment of water quality. Coastal water quality is assessed with a Marine Water Quality Index (MWQI) covering the integration of dissolved oxygen, pH, suspended solid, coliforms, total nitrogen, total phosphorus, ammonia-N, nitrate-N, pesticides and toxic elements monitored in 240 water quality monitoring stations throughout the country. MWQI is ranged from 0 to 100 by applying weighting factors to different parameters (sub-index) measured and integrated into the final index score: 0–25 very bad, >25–50 bad, >50–80 fairly good, >80–90 good and >90–100 very good.
- Assessment for GAP and CoC certification. The applicants (hatchery operators, farmers or harvesting teams) must submit the application form together with supporting documents such as right on land, hatchery/farm layout and production systems, a shrimp-club or association membership document, and others to the provincial fishery office. The auditing form consists of a checklist of evaluation criteria that are used by the auditor to evaluate compliance to certification standards. In the case of non-compliance, guidelines on how to improve will be

given to the farm, and corrective actions must be conducted within a period of time indicated in corrective action plans. Another auditing will be conducted again before the certificate can be issued.

- Assessment for food safety. Sampling of product for export, especially to European countries, is conducted and samples are tested for various residue contaminants by DoF. A certificate is issued by the DoF Standard Control of Aquatic Product Division, to the processing factories as evidence of food safety for quality control purposes at the port of entry in destination countries.

Environmental monitoring

Environmental monitoring is conducted within the scope of several management activities associated with aquaculture in Thailand, as noted earlier. Aquaculture operational controls in various environmental management schemes are monitored mainly by DoF as well as other institutions (detailed in Table 35). On-farm monitoring is also conducted, particularly on larger farms. The practices of environmental monitoring in aquaculture include the following:

- Monitoring of environmental management in aquaculture. Environmental monitoring of aquaculture activities in a specific area or community is the responsibility of provincial fishery offices. These offices conduct regular monitoring in aquaculture areas, and on farms, with an emphasis on water quality and disease testing.
- Monitoring of farming locations for farm registration. The Tambon Administration Organization is responsible for checking if the farm is located in mangrove or any sensitive areas that might lead to social conflicts. Aquaculture activities will also be monitored so as not to cause negative environmental impacts on the local environment and community. Most such monitoring is conducted through site inspections.
- Monitoring of broodstock and post-larvae quality control. Quality control and disease status of broodstock and post-larvae are checked by using the PCR (polymerase chain reaction) techniques for most serious pathogens. There are many laboratories, both from DoF and private companies, providing such a service. Most farmers are aware of the importance of quality shrimp post-larvae, and will request a certificate of disease status for any shrimp post-larvae purchased.
- Monitoring of feed quality control. The control of aquaculture inputs especially feed is described in the Animal Feed Control Act (1992) administered by the Department of Livestock. The act regulates the content and quality of feed used for aquaculture. Within DoF, feed sampling from markets is conducted once every four months by provincial fishery offices and the samples are sent to the DoF Aquatic Animal Feed Research Institute to check nutritional values. The Aquatic Animal Feed Research Institute is also responsible for the study, analysis and research of aquatic animal feed.
- Monitoring of residues in aquatic animals. The Food Act (1979) gives authority to fisheries officers to collect a sample of aquatic animals for testing from any place but not from a processing plant. The samples are tested by the Department of Medical Science, Ministry of Public Health and by the DoF laboratories. Private facilities are also available in Thailand.
- Monitoring of chemicals and hazardous substances for aquaculture activities. The Drug Act (1967) provides the authority for collection and testing of samples of inputs and aquatic products. Fisheries officers who have the authority for sample collection are: the Director, the Deputy Director, the Provincial Fisheries station head, the fisheries officer of Department of Aquatic Feeds and Department of Aquatic Diseases of the Research and Development Institute of Freshwater and the Research and Development Institute of Coastal Aquaculture and the head

of Career Promoting and Developing Department of the Provincial Fisheries Offices.

- Effluent standards for coastal aquaculture developed by the Pollution Control Department (PCD) aims to control the water pollution problems (Pollution Control Department, Thailand, 2007) (Table 38). The water quality is checked twice a year during rainy and dry seasons, sampling and analysing is done by the Seawater Quality Unit of the PCD. The water sampling method for effluent standard examination control must be grab sampling from a discharge point in the coastal aquaculture area. The analytical method must be based on the Standard Methods for the Examination of Water and Wastewater (APHA, AWWA and WEF), Practical Handbook of Seawater Analysis (Strickland and Parsons), Methods of Seawater Analysis (Koroleff), Determination of Ammonia in Estuary (Sasaki and Sawada) Methods of Seawater Analysis (Grasshoff) and /or Manual for Water and Wastewater Examination of Environmental Engineering Association of Thailand and WEF.
- Monitoring procedures have also been developed under the Good Aquaculture Practices and Code of Conduct schemes operating for shrimp farming. These include:
 - self monitoring (recording keeping) by farmers;
 - monitoring by government authorities (mainly DoF provincial offices that are equipped with environmental monitoring facilities).
- Certification standards for CoC and GAP are aimed to ensure that the production of shrimp and other aquaculture products is practiced with food safety and environmental considerations. Especially in CoC, the main environmental issues associated with production processing are included: site selection, broodstock capture, feed quality and feeding management, water and wastewater, chemical and therapeutic agent uses and sludge disposal. However, the standards are rather subjective without complete guidance on compliance. Moreover, there are some environmental issues of concern that are not yet captured by the certification system, for instance feed ingredients, their sources and digestibility levels. The legal requirement on effluent standards of coastal aquaculture is also not stated clearly in the CoC, as well as the monitoring system. DoF has recently completed a review of the CoC and GAP programmes, and are planning various improvements.
- Monitoring associated with traceability. DoF has also launched a traceability scheme to provide market incentives for shrimp farmers to adopt the CoC and GAP. Fisheries Movement Documents are used to track the “movement” of aquatic animals so that aquaculture products and contamination can be traced back along the production chain.

TABLE 38
Effluent standards for coastal aquaculture

Parameter	Unit	Range or maximum permitted values	Method for examination
1. pH	-	6.5–9.0	pH meter
2. BOD (biochemical oxygen demand)	mg/l	20	azide modification by synthetic seawater
3. SS (suspended solids)	mg/l	70	glass fibre filter disc
4. NH ₃ -N (ammonia nitrogen)	mgN/l	1.1	modified idophenol blue
5. Total phosphorus	mgP/l	0.4	ascorbic acid
6. H ₂ S (hydrogen sulfide)	mg/l	0.01	methylene blue
7. Total nitrogen	mgN/l	4.0	(1) persulfate digestion (2) nitrogen analyser

Source: Thailand, 2004; 2005

Personnel and costs

The costs of much environmental monitoring are borne by government. In a few cases, with larger shrimp farms, the company will also invest in environmental monitoring, as part of ongoing management or certification requirements. Testing of shrimp post-larvae for disease is often paid for by the farmer and there are a number of private laboratories in Thailand offering various environmental and analytical services for the aquaculture industry.

Difficulties and constraints in practice

Various organizations are responsible for environmental management of aquaculture activities. The operational control of aquaculture production activities together with the monitoring of environmental management overlaps between responsible organizations, thus the implementation is not as effective as it could be.

Although water quality in natural waters is monitored, this monitoring has limited connection to a preventive management approach. For instance, modelling of nutrient enrichment and/or eutrophication from aquaculture (both positive and negative impacts) is not yet included in the framework of environmental monitoring for coastal aquaculture, which tends to be somewhat “static” in nature. The challenge in future is to link investments in environmental monitoring more closely to management objectives for aquatic ecosystems and waterbodies.

With respect to certification, a GAP checklist is provided for auditors with suggestion of improvement if standards are not met. For auditing, the final scores of GAP are based on the average score of compliance levels (very good, good, fair and bad). However, the qualifications of auditors are not clearly defined. Average scores applied in GAP may also give a misleading result. In a similar way, CoC gives different levels of scores (4, 3, 2, 1 and 0) for compliance in different criteria categories together with the application of grouping and weighting of main clauses afterwards. Highest weighting factors are given to the criteria numbers 2, 5, 6 and 7 (15 percent) followed by the criteria numbers 1, 3, 8 and 10 (10 percent) and the criteria numbers 9 and 11 (5 percent) (referred to the criteria or standards in Table 38). The final scores of CoC linked to the period of being certified (ranging from six months to two years) may give an incorrect impression of the farm’s performance. Monitoring systems also need to be improved, not only when the certificate needs to be extended. Farmers are responsible for compliance at all times and probably more monitoring is needed between issuance and renewal of certification.

Effectiveness

Technical appropriateness

Farm siting assessments and monitoring

Aquaculture is not allowed in mangrove forests and the type of land use for aquaculture is identified based on the suitability of site for farming (in terms of water supply, soil property, infrastructure and the distance from other sources of pollution) together with the land use document or licence for rented farms. However, those factors are mainly focused on new farms and a number of constraints exist:

- There are still small numbers of non-registered farms; however, a significant effort over the past two years has reduced substantially the number of unregistered shrimp farms, with now over 95 percent of shrimp farms now registered. Small-scale freshwater farms are mainly un-registered.
- It still remains difficult to control the number of farms in a particular area and to maintain farming levels within carrying capacity. Interactions of aquaculture with other activities in the same area are not yet considered for site selection or ongoing management. Addressing such issues has so far proved difficult within current management practices.

Operational control

The operational control activities are mainly focused on shrimp aquaculture, as it is the main commodity cultured, and subject to various export controls, so it is discussed here in detail. The measures for operational control are generally regarded as more effective and technically appropriate. Some areas where further technical improvements and management measures may be warranted are:

- Broodstock and post-larvae quality is controlled by PCR and other pathogen detection methods. The biodiversity impacts from introduction of *Penaeus vannamei* which is an exotic species have not been completely assessed and monitored. The presence of *P. vannamei* in rivers has been reported, though there is no evidence as yet for any negative impacts on aquatic ecosystems.
- Improvements on efficiency in use of post-larvae and broodstock. For indigenous *P.monodon*, further research and development of a domesticated broodstock would reduce pressures on wild resources and marine ecosystems.
- Feed quality control involves regular monitoring of nutritional values and residues. Ingredients and their sources and pollution impacts of feeds are not well researched. Of particular concern is the use of fishmeal in feed production, and the need to reduce future use of fish meal in aquatic animal diets.
- Monitoring of water quality in rivers and coastal areas is conducted on a regular basis but there is less attention to wastewater discharge and individual pond monitoring. A major constraint is related to the financial and human resources required for sampling numerous ponds. There is a need for cost-effective and better integrated environmental monitoring programmes to cover the large number of aquaculture farms and key aquaculture environments.

Use of data for improved performance of aquaculture

In general environmental data collected through monitoring is increasingly being used to improve environmental performance of aquaculture. Concerns over the biodiversity issues related to the use of wild *Penaeus monodon* broodstock as well as the introduction of non-local species have led to the development of domesticated technology for white shrimp. Scientific information from research studies conducted by universities and other agencies on potential impacts of shrimp farming in freshwater areas was used for a policy-making decision to ban black tiger shrimp farming in freshwater areas. Control measures from importing countries have also been used as the framework for development of management strategies at the national level so as to assure compliance with importing requirements, such as the extensive residue monitoring systems required for marketing Thai shrimp in EU markets.

Impact of EIA and monitoring on environmental protection

EIA for aquaculture is not a legal requirement. Application of sectoral management measures, such as GAP and CoC, are considered to have had a positive environmental impact at farm and country level. For example, widespread application of the GAP procedure has reduced the use and occurrence of harmful antibiotics in aquaculture.

Feedback and review

Stakeholder consultations on GAP and CoC have been extensive, and have been taken into consideration in the development of certification standards. There is also regular dialogue between government, particularly the Department of Fisheries, and industry stakeholders, in development of policy and addressing the various problems and opportunities that have emerged as the aquaculture industry has grown in Thailand.

Perceptions of stakeholders

The following perceptions are provided as regards EIA and monitoring in aquaculture:

- **Policy makers.** Cooperation between private companies and governmental organizations is particularly important in Thailand, as several large private companies are advanced in terms of research and development and have an established negotiating position in the markets. Industrial knowledge is essential to support strategic planning and policy development, and has been used for development of sectoral environmental management measures. The importance of environmental issues in international trade ensures that the issues are given high attention by policy makers.
- **Hatchery operators.** The availability of broodstock and the quality of post-larvae are important for the sustainability of the aquaculture industry. Environmental management not only of hatcheries but also of farms (the buyers of shrimp post-larvae) is critical for hatchery operators. EIA is not perceived as a significant issue of concern. However, the growing use of certification, including various environmental management measures, is considered a concern, particularly the potential costs and benefits of such schemes.
- **Farmers.** The quality (water, post-larvae and feed) and cost of main aquaculture inputs (energy and feed, in particular) and price are the major focus of farmers. The present low and fluctuating shrimp price in particular is a key factor of concern to shrimp farmers. Farmers are particularly interested in economically efficient production, price and marketing information from processors to be able to plan farming accordingly. In terms of environmental management, many Thai farmers have learnt from past experiences and adapted themselves to be more systematic and concerned more about the environmental consequences along the whole supply chain. For instance, use of prohibited therapeutic agents is no longer practiced due to the concern over the rejection of products. Incentives also apply; for example bank loans require GAP or CoC certification, linking environmental management issues with farm investment. A major concern of farmers at the present time is technical feasibility and financial implications associated with certification schemes, including domestic GAP and CoC and international schemes emerging as requirements from some buyers and importers.
- **Processors.** Processors are more concerned about the requirements from importing countries, both on food safety and environmental management aspects. The cost implication on food safety implementation is directly related to the production processing activities, excluding the harvesting method that is one of the critical points of control. Processors are concerned with quality from pond to processing factory and with environmental issues which have become one of the marketing factors, especially regarding exporting commodities.
- **Consumers.** Consumers in Thailand and major importing countries are increasingly aware of food safety and environmental issues associated with aquaculture products. Thailand has responded successfully to consumer needs, and is actively involved in improving quality control and increasingly involved in certification schemes for aquaculture products.

Improvements

The following suggestions are made for improvements in the application of environmental assessment and monitoring in Thailand:

Policy issues

Policy and planning of aquaculture will need to systematically address the roles and responsibilities of governmental organizations in dealing with issues associated with the whole supply chain of aquaculture production activities, and supporting legal

requirements as well as provide opportunities for the involvement of associated stakeholders.

Importing control measures must be considered as the framework of policy analysis, such as standards on food safety control, environmental management, or the new international standard on Food Supply Chain Management (ISO 22000) and international certification/environmental labelling systems.

Marketing strategies must be included in the policy and planning for sustainable aquaculture. Environmental requirements from importing countries also need attention, in terms of technical and economical practicality.

Technical aspects

Improvements in application of EIA principles. Although EIA is not legally required for aquaculture, the tools for environmental assessment (e.g. carrying capacity assessments) and monitoring could be more effectively used within the scope of existing legal measures for planning and siting of aquaculture farms. Four areas in particular require attention:

- environmental assessment and monitoring for shrimp farm groups within a particular area, with particular emphasis on cluster management for small-scale farms;
- environmental assessment for development of marine fish farms, including procedures for zoning of aquaculture areas;
- environmental assessment as a planning tool for area-based aquaculture development;
- integrated system of environmental management with application of risk management strategies especially at hatchery and farm levels.

Improvements in application of ecological and human health risk assessment. Adoption of risk based approaches to determine key environmental impacts and focus on key environmental issues of concern in assessment and monitoring. Use of risk analysis in the use of chemical and therapeutic agents in aquaculture to respond to consumer's concern on health risks should be a priority area.

Improvements in application of eutrophication potential modelling. Wastewater is a public concern and modelling of eutrophication potential should be used to set targets for environmental improvements. Modelling on eutrophication potential should be performed at the planning as well as the production stages for better management.

Improvements in application of simulation modelling to estimate the carrying capacity. Use of simulation modelling of environmental footprints associated with the inputs and outputs required to achieve the target production volume along the whole production chain. Eutrophication potential modelling should be conducted especially in areas where the number of farms is already dense so as not to exceed the carrying capacity of supporting ecosystems.

Improvements in use of voluntary instruments and certification. The standards for certification should be technically and economically feasible for all scales of farming operations, with a technical guidance on how farmers can comply and address key environmental risks. Moreover, the scoring and certification systems of both GAP and CoC could be developed further, and possibly simplified, to focus on key food safety and environmental risks. More importantly, public participation in the standard development and certification procedure should be conducted and seminars or workshops provided to farmers for a clear understanding on the implementation and auditing procedures.

Improvements in use of associated market incentives. Declaration of non-use from all producers along the whole supply chain should be encouraged for declaring compliance of non-use of prohibited chemicals and therapeutic agents. The approach will also help in reducing analytical costs.

Improvements in research on optimizing the input levels. Research on comparing different farming systems to identify the environmentally preferred system, and benchmarking the environmental performance of different technology options are needed for sustainable aquaculture development. Alternative protein sources to reduce the demand on fishmeal and fish oil used for feed production should be emphasized, including the optimization of nutrition, digestibility and potential organic loading in wastewater. The potential utilization of aquaculture wastes for recycling should be further investigated. Energy use and management strategies for reduction of carbon emission also require further research.

Improvements in research on feed. Requirements of feed information in terms of ingredients and their sources as well as digestibility level should be considered, and research on fishmeal substitution leading to a low-cost as well as low-pollution feed formula encouraged.

Improvement in GAP and CoC monitoring and auditing procedure. The auditing procedure and monitoring systems of GAP and CoC should be developed for a cost effective and credible approach. There should be more than one auditor in an auditing team and auditors should have an aquaculture or environmental background and receive proper training. The certification standards should be updated periodically to address new environmental risks.

Personnel and facility issues

Capacity building on aquaculture technology and better management practices. Training courses, workshops or seminars to disseminate new knowledge of aquaculture technology as well as better management practices will help to minimize adverse effects on the environment. Moreover, experience sharing among farmers, groups, or even different countries is useful for innovative technology development. Education activities on how to supply information for traceability systems should be conducted together with financial and technical assistances on computerised traceability systems.

Capacity building in auditing for certifiers in both the public and private sectors is also required.

Human and institutional capacity building at provincial level. Laboratory facilities to support the feed quality checking, disease detection and environmental analysis should be upgraded with the ability to test the required parameters according to national and international standards. Provincial fisheries offices also require improvement to at least provide basic services for water quality monitoring of aquaculture areas.

VIET NAM¹⁴

Requirements

Environmental impact assessment

EIAs have been carried out in Viet Nam since 1993 after the first Law on Environmental Protection was promulgated. Initially, government focused on industrial sectors including existing enterprises and new project investments and aquaculture was not

¹⁴ Contribution by Tran Thi Thu Ngan

initially included. It was subsequently incorporated in 1994 under the Decree No 175/CP dated 18 April 1994.

Annex No 1 of Decree No 175/CP states that “all aquaculture development projects with total areas over 200 ha must prepare an EIA report for appraisal by the Ministry of Science, Technology and Environment (MOSTE¹⁵) before granting a License of Investment” and “all aquaculture development projects with total areas less than 200 ha must conduct EIA reports to be appraised by the Provincial Department of Science, Technology and Environment before granting the License of Investment”.

EIA requirements were further developed through the new Law on Environmental Protection in 2005 and new Decree No 80/CP and new Circular No 08/2006/TT-BTNMT which require EIAs for aquaculture and Strategic Environmental Assessment (SEA) for development plans. The new law comprises a Chapter III “Strategic Environmental Assessment. Environmental Impact Assessment and Commitment of Environmental Protection” regulating EIA for different levels and/or scopes of development plans and projects. Article No 14 of the new law identifies the activities requiring a SEA, including socio-economic development plans at national level, strategies, sectoral development plans, provincial plans, land use plans, forest development, natural resource exploitation in the region or inter-provinces and plans of river-basin integrated management. Whilst aquaculture is not specifically mentioned, it can be argued that the scope of SEA covers aquaculture.

Environmental assessment, monitoring and management of aquaculture activities in Viet Nam are also conducted under the responsibility of the Ministry of Fisheries, now the Ministry of Agriculture and Rural Development¹⁶, as well as other central, provincial and local government agencies. Various legal instruments cover the environmental aspects of planning and operational management of aquaculture activities in Viet Nam.

Administration and responsibilities

At central levels, the Ministry of Natural Resources and Environment (MONRE) has overall responsibility for administration of the environmental impact assessment process. The Department of EIA Appraisal in MONRE has responsibility for conduct of EIA appraisals. At the provincial level, the provincial Department of Natural Resources and Environment (DONRE) plays an important role in EIA appraisal. The DONRE administratively sits within the Provincial administration, and therefore the Provincial People Committees (PPCs) are the final authorities responsible for granting approval. At the district level, the District People’s Committees (DPCs) have a role in appraisal of smaller projects, and also follow up monitoring and management activities.

EIA reports must be appraised by the concerned authorities before granting investment licenses or other approvals to proceed with the project. The MONRE and PPCs are responsible for appraising EIAs and SEAs using Appraisal Councils. The People’s Committees at district level are responsible for appraising the simpler “Commitment of Environmental Protection¹⁷”. The “Commitment of Environmental Protection” is an EIA type applied for small/household business according to the new Law and Decree on Environment Protection. The new Law on Environmental Protection and new Decree (No 80/2006/ND-CP) and Circular (No 08/2006/TT-BTNMT) also provide for involvement of other relevant government ministries to organize the EIA Appraisal Councils, and be responsible for EIA appraisal.

¹⁵ Now MONRE – the Ministry of Natural Resources and Environment

¹⁶ The former Ministry of Fisheries (MOFI) of Viet Nam was merged into the Ministry of Agriculture and Rural Development (MARD) in late 2007.

¹⁷ The “Commitment of Environment Protection” replaces the “Registration of Securing Environmental Standard”.

The Environment Law (Articles No 18 and 24) specify that the project owners and households are responsible for conducting and presenting the EIA to government, in terms of preparation of EIA reports or payment of services for consultancy, and appraisal fees. Normally, the owners of farms/enterprises hire consulting companies, universities and research institutes due to the specialized skills needed and availability of facilities for environmental sampling and analysis.

Recent trends in EIA management in Viet Nam are towards decentralization down to the Provincial People's Committees and District People's Committees and the intention is that Provincial and District authorities will be responsible for environment management during operation of aquaculture farms in their administrative territory in consultation with the Provincial Department of Natural Resource and Environment.

Scope of environmental assessment

The scope and responsibilities for environmental assessment are defined in the Decree and Circular and the specific requirements for conduct of environmental assessment for aquaculture are as follows:

1. Projects requiring SEA. Projects requiring strategic environmental assessment as defined in EIA legislation include:
 - national strategies and plans for socio-economic development;
 - sectoral strategies and national sectoral development plans;
 - provincial or regional strategies and plans for socio-economic development;
 - land use planning, forest protection planning, and other natural resources exploitation and use of natural resources between provinces and regions;
 - development planning of economic zones;
 - integrated planning of river basins crossing provincial boundaries.

The legislation, therefore, could apply to aquaculture, but to date there has been no application of SEA to aquaculture plans or strategies in Viet Nam.

2. Projects requiring EIA. Aquaculture projects are assessed depending on the nature of the aquaculture project, and can be subdivided into three types:

Group 1: EIA reports that must be appraised by the Ministry of Natural Resource and Environment;

- projects using a part or whole land or water surface area of national parks, natural conservation zones, biosphere reserves and areas of national heritage, historical and cultural importance;
- projects involving cutting of protected forest, tidal mangrove forests and special forest with total area over 20 ha, or cutting natural forests with total area over 200 ha;
- sandy soil aquaculture projects with total area over 100 ha.

Group 2: EIA reports that must be appraised by Provincial Committees;

- all projects with potential to cause adverse impacts to water sources of river basin, coastal zones and protected ecosystem areas;
- all projects using a part of natural conservation, national parks and historical works which are protected by national or provincial governments;
- intensive/semi-intensive aquaculture projects with total water surface areas of 10 ha and over;
- extensive aquaculture projects with total water surface areas of 50 ha and over;
- all other sandy soil aquaculture projects.

Group 3: Projects that do not require a full EIA, but require a "Commitment of Environment Protection"

- This type of EIA is applied for all remaining aquaculture projects or household farms. All documents required for the "Commitment of Environmental Protection" will be appraised by District People's Committees.

Public participation and information disclosure

Public participation and information disclosure in the EIA process is regulated in the Circular No 08/2006/TT-BTNMT. The owners of projects must present all the information of aquaculture projects and environmental issues at the commune level, and the EIA reports must receive comments from People's Committees and the Committee of Homeland Frontier at the commune level where the projects are located. This consultation must be done before submitting the EIA to the Appraisal Council.

This process should provide information to communities surrounding the project site and assist authorities in making decisions based on the benefits and concerns of communities and design of mitigation measures. In practice, it is not clear how well this process works. Information is also available on EIA procedures from MONRE and DONRE at central and at provincial levels respectively and guidelines and documents are available.

New farms versus operational farms

EIA is normally required for new farms, but an additional EIA would be required when there are changes in scope of projects and/or the project is carried out after 24 months from the date of EIA approval.

Environmental monitoring

Chapter X of the Law on Environmental Protection regulates environment monitoring and information. There are four types of environment monitoring including:

- national environment status monitoring;
- monitoring of sectoral environment impacts;
- provincial status environment monitoring;
- monitoring of environment impacts caused by all kinds of production activities, including aquaculture and fisheries.

All are conducted under the responsibilities of different agencies at different administrative levels. The national environment status monitoring in aquatic ecosystems is the responsibility of MONRE. The fisheries sectoral management agencies including Ministry of Agriculture and Rural Development (MARD) and Provincial Departments of Fisheries (DARD) are in charge of environment monitoring for the aquaculture and fisheries sector and owners of aquaculture farms are considered as responsible for environmental monitoring at their aquaculture farms. There is, at present, limited sharing of environmental monitoring information between fisheries sectoral agencies and MONRE (or DONRE at provincial level).

The new Circular (No 08/2006/TT-BTNMT) emphasizes environmental management after the EIA report during operation of all projects in general and aquaculture projects in particular. The Circular sets up procedures for implementation of pollution control activities, environmental monitoring, inspection and reporting to the authorities at different levels depending on the scope and environment sensitivity of the project.

TABLE 39
Voluntary instruments for aquaculture in Viet Nam

Voluntary instrument	Origin	Scope
GAP	NAFIQAVED	Shrimp farms, but GAP for catfish under development
COC	NAFIQAVED	Shrimp farms
HACCP	NAFIQAVED, private	Mollusk farms, particularly for EU export
Marine Stewardship Council (MSC) certificate	Private	Ben Tre province clam farming undergoing assessment for MSC certification
Organic shrimp standards	Private	Extensive shrimp farms in one enterprise in Ca Mau province, exported to organic markets in Europe

Voluntary instruments

Apart from the use of EIA, there has been increasing attention in Viet Nam to the control of environmental impacts of aquaculture through Good Aquaculture Practice (GAP) and Code of Conduct (CoC) programmes, to date mainly focussed on shrimp and recently catfish (Table 39). These have been initiated by the Danida-supported Fisheries Sector Programme Support (FSPS) and the former National Fisheries Quality and Veterinary Department (NAFIQAVED, now the National Agro-Forestry & Fisheries Quality Assurance Department (NAFIQAD) under MARD) and the approaches are presently being piloted in some aquaculture areas. A new regulation on mandatory and voluntary certification of aquaculture products was approved in early 2008 and certification standards are under preparation.

The GAP and COC application in pilot farm areas are intended to encourage farmers to implement improved environmental management and monitoring at farm level. The results from pilots have received a good response from farmers and processing plants, and the government plans to expand the programme in the coming years, in terms of number of farmers and other aquaculture commodities.

Practices

Environmental assessment

Although the legal basis for EIA of aquaculture projects is quite strong in Viet Nam, there is still limited application of EIA to aquaculture in practice. The reason is that most aquaculture development in Viet Nam is conducted on a small-scale and therefore has not been subject to formal EIA requirements. This gap is recognized in very recent legal changes, but actual implementation remains a challenge.

EIA reports are available for sandy soil shrimp farming and a large-scale shrimp farming company (ATI) in the central provinces of Viet Nam, and environmental assessment has been conducted on many aquaculture plans produced in coastal provinces. The most common EIA is the provincial lower level EIA conducted for aquaculture projects leading to the Commitment of Environment Protection, and there are many of these. The exact number of reports prepared is uncertain.

A review of district aquaculture plans conducted for UNDP¹⁸ during 2003 revealed that plans do give some consideration of environmental protection, although most lacked separate environmental impact assessments and focus on limited assessments of water quality and treatment, water irrigation, land use and shrimp disease control.

Environment assessment methods for aquaculture are commonly limited largely to water and sediment quality and the methods are changed according to the type and scope of aquaculture projects. The benchmarks for assessing environment quality and impact are based on the Viet Nam environmental standards for water quality, soil quality and some others indicators, otherwise known as TCVNs¹⁹. Water quality and other environment quality standards are available in Viet Nam and can be used as a basis for assessments of environmental impacts, including TCVNs-1995, TCVNs-1996, TCVNs-1998, TCVNs-1999, TCVNs -2000.

In order to ensure the reliability of assessment, the project owners are required to indicate the source of data and evaluate those data sources. All methodologies used must also be listed in the EIA report, together with an assessment of their reliability. The EIA report must also include the measures required to control environment pollution, together with the estimated costs and timeframe for implementation. All these new requirements of EIA would be helpful in strengthening the effectiveness of EIA implementation in aquaculture development in Viet Nam.

¹⁸ Unpublished report prepared by RIA-1 and NACA

¹⁹ TCVNs are standard documents issued by the Government of Viet Nam

There have been no formal SEAs conducted for aquaculture either, although some local planning and environmental assessment initiatives have been taken under donor funded projects (e.g. NORAD in Ha Long Bay) and some universities have developed tools for assessing carrying capacity (Nha Trang University) but these tools have been used only for research and have not yet been applied in more formal planning and EIA procedures.

Environmental monitoring

The recently released EIA guidelines for aquaculture prepared with assistance from Danida specify that the major sampling and techniques follow the TCVN – Environmental Standards, which are harmonised with international standards (ISO). The analytical techniques adopted depend on the facilities available in each laboratory.

Environmental monitoring is a requirement of the EIA but in practice there is very limited follow up on EIA reports or the “lower level” EIA conducted. The environment monitoring methods tend not to be clearly stated in EIA reports, except in a general way by indicating application of TCVNs for sampling and analysis of environment quality parameters.

The Ministry of Natural Resources and Environment is responsible for setting environmental indicators, but unfortunately, such environment indicators have not been issued yet for aquaculture.

Environment and disease monitoring

Within the context of national environmental monitoring for aquaculture, Viet Nam has recently strengthened the environmental monitoring of aquaculture areas and aquatic environments. The Ministry of Fisheries (now MARD) has recently invested in establishment of an “Environmental, Disease Monitoring and Warning System” in the whole country. The system comprises four regional centres located at the MARD Research Institutes for Aquaculture (RIA1, RIA2, RIA3 and RIMF) with responsibilities as follows:

- RIA No 1 is in charge of monitoring of environment and disease for six provinces from Haiphong to Thua Thien – Hue with an emphasis on areas with concentrated aquaculture development.
- RIA No 2 is in charge of monitoring of environment and disease at aquaculture areas of Mekong delta provinces from Ca Mau to Ho Chi Minh City, including Ba Ria – Vung Tau provinces.
- RIA No 3 is in charge of monitoring of environment and disease at aquaculture areas of central provinces from Da Nang to Binh Thuan province in concentrated aquaculture areas.
- RIMF is in charge of monitoring of environment and biodiversity of marine aquaculture areas, fish ports from Quang Ninh – Haiphong to Tra Vinh and four marine protected areas (Cat Ba, Bach Long Vy, Con Co and Phu Quoc).

The monitoring stations are selected with different purposes, as baseline monitoring stations, impact monitoring stations and monitoring stations at water intakes for major aquaculture areas. In general, these stations could provide a valuable service in monitoring environmental conditions in coastal areas. However, at present the detailed operational procedures have not been developed, except for the RIA 1 programme in the Northern provinces, and the link to management actions also requires further work.

The three RIAs have also set up their own monitoring parameters, with some similarity among major parameters and some different parameters to reflect local conditions. To date, there has been limited overall coordination or umbrella programme design, which is leading to concerns about expense in monitoring of unnecessary

TABLE 40
Monitoring parameters for coastal aquaculture

Parameter	Unit	Range or maximum permitted values (where provided)	Analytical method
1. pH	-	6.5–9.0	pH meter
2. Dissolved oxygen (DO)	mg/l	4–8	
3. Biochemical oxygen demand (BOD)	mg/l	20	azide modification by synthetic seawater
4. Chemical oxygen demand (COD)			Potassium permanganate (KMnO ₄)
5. Suspended solids (SS)	mg/l	70	Filtration using glass fibre filter disc
6. NO ₂ -N	mgN/l	0–0.005	SMEWW(Standard Methods, 2006) 4500-NO2-B
7. NO ₃ -N	mgN/l		Cadmium reduction method
8. NH ₃ -N (ammonia nitrogen)	mgN/l	<0.02 (as NH ₃)	SMEWW 4500-NH3
9. Total phosphorus	mgP/l	0.4	Ascorbic acid
10. Total nitrogen	mgN/l		TCVN 5987 – 1995
11. H ₂ S (hydrogen sulfide)	mg/l	0.01	Methylene blue
12. Oil	mg/l		TCVN 5070 – 1995
13. <i>Vibrio</i> spp			Total plate counts
14. Algae			
15. Pesticides			HPLC
16. Heavy metals			Atomic absorption spectrometry

parameters within limited budgets. The programme is constrained by a certain lack of systematic approach and harmony at national level (although the information and data are sent to MARD periodically), which will cause difficulties in data analysis and synthesis of environment and disease status for aquaculture across the whole country in future. The necessary links between data collection, synthesis and early warning systems for farmers have yet to be established. The key water quality and other monitoring parameters currently agreed by MARD are noted in Table 40. These are monitored off-farm.

Frequencies of sampling at the time of preparation of this review are as follows:

- RIMF: minimum of two times a year in selected locations, once in the dry and once in the rainy season. One time per year for corals and marine protected areas (MPA).
- RIA-3: Five times a year in February, April, June, August and November
- RIA-1: No regular monitoring because of limited budgets, but monitoring carried out depending on budget from March to August every year.
- RIA-2: Automatic sampling stations for pH, DO in every 2–3 hours in selected locations. Other environment parameters every three months. Aquatic animal disease sampling planned for every two months.

Major sampling and techniques follow the Vietnamese Environmental Standards (TCVN), which have been harmonised with international standards (ISO). Analytical techniques used in practice depend on the equipment of each laboratory although the TCVN Environmental Standards are widely used for most routine and major parameters. Disease sampling tends to be based on the skills and equipment available, and may vary between laboratories.

Data collection and analysis

There are different channels of data collection in regional centres under the MARD environmental monitoring system:

- one channel is secondary data collection through the provincial Departments of Fisheries (DARD), aquatic resources protection offices, extension centres, farms and meteorological offices;

- the other channel is data collection through sampling and laboratory analysis directly by the coordinating research institutes, or designated provincial authorities.

The data collected through the environmental monitoring system are analysed against the environmental quality standards as set in the TCVN and other indicators for biodiversity and assessment of risk of deteriorating water quality. One problem is that data are interpreted in different ways in different centres creating some problems in interpretation.

The regional centres of RIA-2 and RIA-3 used risk indicators for water quality and disease warning. The regional centre of RIA-2 has good data collection and sampling sites as well as data storage and interpretation, and their monitoring programme was designed methodically and sufficiently detailed to ensure provision of reliable and credible information. Each centre is required to submit quarterly reports, which are sent to MARD following the MARD format. The reporting format is different between regional centres as the frequencies of those centres are different. The written reports summarize the results of each sampling time in such a way that it reduces the value of data.

Another reporting flow comes from the monthly or occasional reports sent from provincial fishery authorities (DARDs). These reports are not regular or obligatory for every province. The regional centre of RIA-2 sends monthly data to all DARDs in the southern provinces. The centre at RIA-3 is sending data to MARDs when they recognize disease issues and obtain data. The regional centre of RIA-1 and RIMF are involved in some information sharing with DARDs, DONREs and farmers. In general, though, there is limited flow of information back to aquaculture farmers as MARD is presently considered the final entity, having all information on environment and disease issues for aquaculture in Viet Nam.

Although environment monitoring is receiving increasing attention by the aquaculture sector of Viet Nam, further work is needed to improve design and coordination and to facilitate better sharing of results. Information sharing is not yet fully open and mechanisms need to be put in place to encourage this practice and better use of the collected data for management.

Personnel and costs

The costs of the (project/farm-level) EIA are borne by the project owner, including costs of conduct and appraisal of the EIA, as specified in the EIA legislation. Any environmental monitoring required in the environmental monitoring plan also requires investment from the project owner/investor.

The costs of environment and disease monitoring are high for small farms in Viet Nam. This is one of the reasons why MARD has invested in establishing a common monitoring system for the whole country. The financial source comes from government budgets. The total budget for four regional centres is 3.55 VND billion (approx USD 221,875²⁰) for the year 2007. Recent reviews have shown that the personnel of all regional centres are staff from research institutes, who in some cases have other professional duties. In interviews conducted with some regional centres, it appears that there is insufficient staff to cope with the huge numbers of sampling sites and provinces, and that further investment is required.

Difficulties and constraints in practice

EIA has to date only been conducted for a few large aquaculture projects. The “Registration of Securing Environmental Standards”, replaced recently by the Commitment of Environment Protection is a lower level procedure that is increasingly

²⁰ 1 USD = Approx. 16,000 Vietnamese Dong (2008)

applied to smaller aquaculture projects with total areas less than 200 ha. Unfortunately, EIAs are not conducted for small aquaculture farms/households that prevail in Viet Nam and together cause significant environment concern. Another implementation concern is that the owners of projects prefer to apply for Commitment of Environment Protection, a shorter and simpler method, rather than full EIA reports, to save costs associated with full EIA requirements.

Although progress has been made with application of EIA for aquaculture development in Viet Nam in recent years, there are a number of difficulties and constraints to implement EIA and monitoring in practice including:

- Limited recognition of incentives for the owners of aquaculture farms to conduct EIA. Lack of enforcement of existing laws, and difficulties in dealing with large numbers of small-scale farmers. The lack of SEA in the aquaculture sector and skilled people to apply this approach is a constraint.
- The perception that EIA work for aquaculture is completed with the EIA report. Most farmers are not aware of the importance of environment monitoring for farming activities.
- The lack of capacity and high costs of environment monitoring in the provinces where the major aquaculture farms are developing, including Ca Mau, Soc Trang, Bac Lieu and others in the southern provinces. These provinces are far from laboratories and environmental monitoring centres in Ho Chi Minh City, and Can Tho university. Farm locations and lack of local services lead to high transportation costs as well as poor quality analytical results.
- The provincial environmental authorities (DONREs) do not have enough capacity for environment monitoring in terms of facilities and human resources. In the northern provinces, only the Quang Ninh province DONRE has set up two environmental monitoring stations for aquaculture. Some provinces could have environmental monitoring centres for periodic monitoring of environmental quality. Most of their activities focus on monitoring the status of environment to prepare the status of environment report, with limited link to management. In the southern provinces where the major aquaculture development occurs, such as Ca Mau, An Giang and Ben Tre, DONREs carry out limited environmental monitoring works for aquaculture, even when this is a major sector bringing income to provincial budgets.
- The capacity of DONREs to conduct environmental monitoring is still weak in terms of facilities, laboratories and skilled staff. Most of the provincial laboratories conduct sampling and analysis of simple parameters such as DO, pH, turbidity and conductivity via portable equipment. Other parameters such as TSS, BOD, COD, nitrogen and phosphorus require more sophisticated laboratories which are available only in Ho Chi Minh City or Can Tho university.

Such constraints limit the use of environmental monitoring in management of the sector and undermine aquaculture farmers' interest and commitment to environmental monitoring and environmental management at provincial and farm levels in most provinces of Viet Nam.

Effectiveness

Technical appropriateness

In general, the EIA for aquaculture development in Viet Nam has been developing in recent years, but practical implementation is still limited. The small-scale sector, the bulk of producers in Viet Nam, is effectively excluded from the system. The exclusion of this part of the sector suggests the approach and/or methods for environmental assessment need to be improved to cover this important part of the sector.

Significant environmental assessment by individual small-scale farmers is an unrealistic option and cluster-based assessment/monitoring approaches might work

better. Larger regional approaches, such as SEA, also need to be explored. Environmental risk analysis might also be used to focus environmental assessment on key system risks and ecologically sensitive locations.

Use of data for improved performance of aquaculture

EIA is generally seen as an administrative procedure rather than a management tool. The use of monitoring data to improve performance is extremely limited.

The recently developed environment and disease monitoring system is intended to assist in management, but as yet the links to management measures have not been established. Improvements in connecting this system to management offers scope to provide positive impacts in performance of aquaculture, particularly to protect investments in crowded or highly productive aquaculture areas (e.g. catfish farming in the Mekong delta).

The usage of environmental monitoring information for improved management is different in provinces. Some DARDs use information for warning farmers in the case of emergency disease problems. The response to monitoring results depends on the capacity of management of DARDs and DONREs in provinces. The environment monitoring programme for aquaculture has just started and links to management have not yet been worked out.

The application of voluntary instruments like GAPs for small farms and farm clusters in southern provinces is likely to bring higher effectiveness when the farmers and farmers' associations could cooperate to manage the environment. Market incentives for GAP products, and resulting higher prices as achieved in some pilot projects, will also provide an incentive for farmers to engage in such schemes.

Some abandoned aquaculture areas and environment pollution problems in aquaculture zones have led to increasing awareness which has driven recent changes in legal requirements for EIA procedures and practices for aquaculture. These changes need to be built on by further investment in environmental management of the sector by government and private business.

Impact of EIA and monitoring on environmental protection

Most unplanned expansion of aquaculture farms development in Viet Nam in the past years has occurred without effective EIA and environment management. There are several big aquaculture projects that have conducted EIA according to the law, but implementation of environmental management and monitoring has been weak. One concern is that penalties were insufficient to enforce compliance, together with a weakness in capacity and resources of local authorities' for appraisal and follow up monitoring and management.

Feedback and review

Generated data and information are not yet used effectively for improving performance in aquaculture development as the information whilst available to MARD and provincial DARD has probably not been effectively linked to farmers and investors or used for management. However, the information could be used in aquaculture planning in some provinces and districts. There is no mechanism to ensure that the producers/investors can access generated data from the environmental monitoring system.

Investment in environmental monitoring by MARD can be considered as highly positive changes and signals for improved environment management in the future. Although these systems require further development, the outcome of environment monitoring systems is highly appreciated as the first sectoral environment monitoring programme after MONRE, with significant potential to benefit the environment and sectoral development in the future.

Perceptions of stakeholders

Producers, environmental and other NGOs, scientists and others have experienced environmental pollution as well as economic losses as a consequence of pollution and disease in recent years in many aquaculture areas. However, there is doubt that present systems are effective in meeting the challenge in practice.

The new legal framework and policies of MONRE and MARD have set up a system for environmental management of aquaculture in Viet Nam. The practices of provincial and district authorities in implementation of these policies and legislation will have an important influence of environmental management of aquaculture in Viet Nam. Change in perceptions at the local level encouraged and supported by national policy are a key to future progress and improvements.

Improvements

The new law on environment protection and associated regulations emphasize the decentralization of EIA to district level as well as a delegation of environment management responsibilities to different sectors, instead of only MONRE. Further, the use of voluntary instruments such as GAP and COC provide additional incentives towards better environmental management. These measures provide a strong legal foundation for future improvements in the environmental management of the sector although a number of improvements are required to support implementation:

- EIA appraisal, management and inspection at the district level needs more trained staff. To date, there has been limited preparation of human resources for this new function leading to lack of capacity in terms of quality and quantity.
- MARD also has new environment management tasks, especially in EIA appraisal and environment monitoring. This means that MARD has to prepare the necessary human and financial resources. Although the regional centres (RIAs) are using available staff for environment monitoring, there is a need to strengthen staff at the MARD level in the Department of Science and Technology.
- The Commitment of Environment Protection will be required for small farms and could be carried out at district level while environment monitoring and pollution control will not be easily implemented by most small farms. This situation encouraged MARD to establish the environment, disease monitoring and warning programme for the aquaculture sectors. Unfortunately, the budget is insufficient for the task (for example, regional centre of RIA-3 received around VND 100 million for environment monitoring in 2007, enough for staff salary, power and water, but with limited fieldwork).
- It is necessary to have a mechanism of information sharing and service provision to finance environment monitoring rather than only looking for government budget. Sharing costs between the private sector and government is required. Regional centres for example could be providing environment monitoring services for aquaculture enterprises and subsidize a part of the cost to small farms.
- Improvements are needed in the MARD environment and disease monitoring system; in particular a more consistent umbrella programme design in terms of methods, purposes of the programme and feedback to management. Among four regional centres, the regional centres of RIA-2 and RIA-3 have been designed methodically and specifically with baseline sampling sites, impact sampling sites and common regional sampling sites, but the lists of parameters are too broad. Prioritization of parameters lists through some reconnaissance monitoring is necessary to cut out unnecessary parameters after a period of monitoring. Too many sampling parameters cause high costs under limitations of budget and skilled staff.
- National indicators are needed for trend analysis and management decisions in the environment, disease monitoring and warning systems, which could help

MARD respond to an emergency situation. National indicators are needed for environmental factors, aquatic animal disease pathogens and biodiversity.

- To avoid bias in results and warnings to farmers, there should be a standardization of data interpretation and periodic calibration or inter-laboratories testing between regional centres to improve the quality of monitoring results and response to situation.
- It is also necessary to appraise the efficiency and effectiveness of existing EIA and monitoring requirements and practices, as stipulated in both obligatory and voluntary instruments, with particular emphasis on an effort to expand GAP and BMP application for existing farms to improve environment management in Viet Nam aquaculture. However, enforcement of new requirements of EIA for aquaculture should be strongly encouraged and supported.
- Use of SEA in aquaculture should be further explored to see its practicality and effectiveness in environmental management of the aquaculture sector, for assessment at the farm cluster level and for regional planning.

OTHER COUNTRIES²¹

In other Asian countries/territories, there are varied requirements and application of EIA and environmental monitoring to aquaculture, as described briefly below.

Bangladesh

The following description is based on FAO's NALO for Bangladesh (FAO, 2005-2008 NALO Bangladesh). The Environmental Protection Act (1995) aims to protect the environment and to control and mitigate environmental pollution. It establishes the Department of Environment (DoE) under the Ministry of Environment and Forest (MoEF), headed by a Director General. The main strategies under the act include, *inter alia*, declaration of ecologically critical areas and restriction on the operation and process which can be carried out or cannot be initiated in the ecologically critical areas, environmental clearance for industrial enterprises and projects, setting water quality standards for particular uses of water and promulgation of acceptable limits for discharging and emitting waste, as well as the formulation and definition of environmental guidelines.

The act has been implemented by the Environment Conservation Rules (1997), according to which all new industries and projects must apply for an Environmental Clearance Certificate. Industries are classified according to their potential impact on the environment into four categories - Green, Orange-A, Orange-B and Red. Green industries are automatically granted a certificate. Orange categories must submit considerable further information and plans, and may be subject to field inspection. The highly polluting categories Orange-B and Red must in addition conduct a detailed EIA and prepare environmental management plans satisfactory to DoE. Schedule 1 of the Rules provides the category classification of most common industries but does not include aquaculture projects. The processing of fish, prawns and shrimps is categorized under Orange-B.

EIAs have been conducted for several donor funded fisheries and aquaculture projects, but they are not applied for domestic investments in aquaculture or its associated infrastructure.

Cambodia

Environmental impact assessment legislation has been put into place in Cambodia (UN, 2002), but it is understood that to date EIA has not been applied to aquaculture, because most aquaculture development is small-scale.

²¹ Compiled by Michael Phillips and Koji Yamamoto (NACA)

Following the December 1996 Law on Environmental Protection and Natural Resource Management, the Council of Ministers has approved a Sub-Decree in August 1999 (No: 72 ANRK.BK) that stipulates that EIAs are required on various kinds and scales of projects (Cambodia, 1999). The sub-decree specifies the general requirements, procedures and responsibilities, and instructed the Ministry of Environment to formulate rules and guidelines for implementation. The sub-decree identifies various (mainly large scale) projects that require an EIA. However, these projects do not include aquaculture (fishing ports are the only specified fisheries related activities requiring an EIA).

The Department of Fisheries, with support of the International Fund for Agricultural Development, conducted a review of fisheries and aquaculture development and environmental impact in 2001 (Cambodia DoF, 2001). The review provides a useful insight into the environmental management of aquaculture in Cambodia, and future requirements. The review emphasized the importance of EIA, but no specific recommendations were provided on application of EIA in the aquaculture sector.

Myanmar

There are no provisions for EIA of aquaculture in Myanmar (FAO, 2005-2008 NALO Myanmar), although the environmental aspects of aquaculture siting and operations are to some extent covered under specific aquaculture and fisheries laws. The Law relating to Aquaculture No. 24/89 regulates the application for aquaculture leases and licences and the Marine Fisheries Law No 9/1990 and the Freshwater Fisheries Law No 1/1991 contains various licensing requirements for aquaculture activities, including a number of directives with a bearing on food safety.

Lao People's Democratic Republic

The 1991 Constitution provides that “all organizations and citizens must protect the environment and natural resources: land, underground, forests, fauna, water sources and atmosphere” (FAO, 2006-2008 NALO Lao People's Democratic Republic). A general duty to protect the environment is also established in the Law on Agriculture.

The main authority in the field of environmental matters is the Science, Technology and Environment Organization (also translated as Science, Technology and Environment Agency). Under the terms of the Environmental Protection Law (1999), any project or activity that may potentially affect the environment is subject to an Environmental Impact Assessment. An Environmental Impact Report must be submitted according to the rules issued by the Science, Technology and Environment Organization, as implemented by the relevant sectoral authority. Hence the Ministry of Agriculture is in charge of implementing the EIA rules concerning aquaculture projects.

Nepal

Environmental impact assessment is legally required in Nepal, according to Environment Protection Act, 1996 and Environment Protection Regulation 1997. The main thrusts of the Act and the Regulation are pollution control and environment assessment. Aquaculture as such is not included in the regulation, and to date as far as is known no EIAs have been applied to the development of aquaculture in Nepal.

Pakistan

No information available.

Republic of Korea

The Basic Environmental Policy Act (1990) sets down the objectives and directions in the Republic of Korea for the country's environmental preservation policies and provides the framework for environmental protection (FAO, 2005-2008 NALO

Republic of Korea) . Under this act, a large number of other laws have been enacted that relate to specific areas of the environment, such as the Nature Environment Conservation Act (1991) which aims, *inter alia*, to prevent the extinction of endangered species through conservation of biological diversity. The environmental laws and regulations are administered and implemented by the Ministry of Environment (MoE), which is the primary government agency responsible for the overall protection of the country's environment.

The Act on Assessment of Impacts of Works on Environment, Traffic, Disasters and Population (1999) generally deals with the assessment of impacts on the environment, among others. Projects that are subject to an assessment of impacts include, *inter alia*, the development of water resources, the utilization and development of rivers, the cultivation and reclamation of public waters as well as other projects that have an impact on, *inter alia*, the environment, and which are further prescribed by Presidential Decree. The act generally puts environmental impact assessments under the management of MoE, which may further determine the items of EIAs. With respect to projects that affect the marine environment, the act imposes an obligation on MoE to consult with the Ministry of Maritime Affairs and Fisheries.

The Republic of Korea has well-established planning and zoning systems for aquaculture and a more detailed analysis of these systems would be more widely relevant to the region.

Sri Lanka

The National Environmental Act (1980, as amended in 1988) makes provision for the protection, management and enhancement of the environment, for the regulation, maintenance and control of the quality of the environment, and for the prevention and control of pollution (FAO, 2004-2008 NALO Sri Lanka). The Act establishes the Central Environmental Authority for its administration. Part IV C of the Act requires the approval of "project approving agencies" for "prescribed projects" following an Initial Environmental Examination (IEE) or EIA. According to the National Environmental (Impact Assessment) Regulations (1992), the Ministry of Fisheries and Aquatic Resources is considered a "project approving agency" for fisheries matters.

The "prescribed projects" that require an IEE or EIA are further defined by an Order, issued in 1993 under section 23Z of the National Environmental Act. They include the following aquaculture projects:

- aquaculture development projects over 4 ha, if located wholly or partly outside the coastal zone as defined by the Coast Conservation Act;
- projects that involve conversion of forests covering an area exceeding 1 ha into non-forest use, if located wholly or partly outside the coastal zone as defined by the Coast Conservation Act;
- aquaculture projects irrespective of their size and irrespective whether or not they are located within the coastal zone, if located within environmentally sensitive areas (as further defined by Part III of the Order).

The procedure to be followed by the "project approving agencies" is regulated in the National Environmental (Procedure for Approval of Projects) Regulations (1993). The applicant should submit as early as possible preliminary information on the project as requested by the agency, which must acknowledge receipt of such preliminary information in writing within six days. In consultation with the Central Environmental Authority, the agency decides within 14 days whether an IEE must be held or within 30 days whether an EIA must be held. The agency sets the terms of reference for the IEE or EIA. In drafting the terms, the agency may take into consideration the views of state agencies and the public. Upon receipt of the IEE or EIA report, the agency can grant approval (upon specified conditions) or refuse approval (with reasons).

The North Western Province has its own statutes and authority for environmental

matters. The North Western Province Environmental Statute (1990) provides for the establishment of the North Western Province Environmental Authority, which acts as “project approving agency” and administers IEEs and EIAs for the North Western Province, including aquaculture.

A recent review (Samarakoon and Rowan, 2008) provides an analysis of the environmental assessment practices in Sri Lanka, with a particular focus on ecology. Two-thirds were IEE surveys, while the remaining third advanced to full EIA. A representative sample of 130 EAs (both IEEs and full EIAs) spanning a broad range of project types, scales and environmental settings was selected to evaluate the quality of the ecological investigations within the published environmental impact statements (EISs). These were assigned into five classes of “explanatory power”, on the basis of their scientific content in relation to survey, analysis and reporting of ecological interests. Within most EISs, the ecological impact assessment (EcIA) was restricted to the lowest two categories of ecological assessment, *i.e.* tokenistic presentation of reconnaissance-level species lists without further analysis of the development implications for individual organisms or communities. None of the assessments reviewed provided statistically rigorous analysis, which would be required if ecological impact studies are to include quantitative and testable predictions of impact, which could then be followed up by appropriate post-impact monitoring programmes. Attention to key local issues such as biodiversity or ecosystem services was also notably underrepresented. The paper concluded that despite the existence of a sound legislative framework in Sri Lanka, the analysis contained within EISs generally fails to convey meaningful information to the relevant stakeholders and decision makers involved in protecting ecological interests and promoting sustainable development.

The paper further concluded that introduction of strategic environmental assessment is considered an important tool to strengthen the institutional capacity of Sri Lankan government authorities to implement current regulations and, in particular, to combat the cumulative effects of incremental development.

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ANNEX A**EXAMPLE OF EIA REPORTING FORMAT FROM CHINA, HONG KONG SAR****CONTENTS OF AN ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT (China, Hong Kong SAR. 2008)**EXECUTIVE SUMMARY IN ENGLISH AND CHINESE

- Summary of main issues, findings, conclusions and recommendations

INTRODUCTION

- Background of the project
- Purpose of the EIA study
- The approach

DESCRIPTION OF THE PROJECT

- Key project requirements
- Site location and site history
- Nature, scope and benefits of the project
- Size or scale, shape and design of the project
- Project timetable and phasing of the project
- Means by which the project will be implemented
- Any related projects
- Type, scope, scale, frequency and duration of the construction, operational or decommissioning (if relevant) activities
- Background and history of the project, including considerations given to different options, and the project's different siting or alignment
- Description of scenarios with or without the project

ENVIRONMENTAL LEGISLATION, POLICIES, PLANS, STANDARDS AND CRITERIA

- Applicable environmental ordinances and regulations
- Applicable government environmental policies and plans
- Applicable environmental standards and criteria
- Other references

DESCRIPTION OF THE ENVIRONMENT

- Baseline environmental conditions
- Environmental trends

DESCRIPTION OF ASSESSMENT METHODOLOGIES

- Assessment methodologies, assumptions and criteria, including sample calculations and input and output files of a typical model run for all mathematical modelling

IDENTIFICATION OF ENVIRONMENTAL IMPACTS

- Potential environmental impacts including the types, characteristics and estimated quantities of emissions, discharges, wastes, potential risks, disturbances or displacement associated with the activities relating to the project during construction, operation and decommissioning phases
- Description of resources or receivers which are vulnerable to change or environmental impacts

PREDICTION AND EVALUATION OF ENVIRONMENTAL IMPACTS

- Prediction of environmental impacts (including beneficial or adverse; direct or indirect; short term or long term; reversible or irreversible; transboundary; cumulative)

- Evaluation of predicted environmental impacts against applicable environmental legislation, policies, plans, standards and criteria

MITIGATION OF ADVERSE ENVIRONMENTAL IMPACTS

- Measures to eliminate, reduce or remedy adverse environmental impacts

DEFINITION AND EVALUATION OF RESIDUAL ENVIRONMENTAL IMPACTS

- Definition and evaluation of net environmental impacts with mitigation measures in place

ENVIRONMENTAL MONITORING AND AUDIT

- Need for and scope of monitoring and audit
- Environmental monitoring and audit requirements, if found to be necessary, and the related environmental monitoring and audit programme

CONCLUSIONS AND RECOMMENDATIONS

SCHEDULE OF RECOMMENDED MITIGATION MEASURES

- A schedule of all mitigation measures recommended in the EIA report, listing out what the mitigation measures are, by whom, when, where and to what requirements, and including the key environmental monitoring and audit requirements

APPENDIX

- Responses to comments received

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