FAO
FISHERIES AND
AQUACULTURE
TECHNICAL
PAPER

527

ISSN 2070-7010

Environmental impact assessment and monitoring in aquaculture

Requirements, practices, effectiveness and improvements

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Clockwise from top left: seabream cages, Izmir Bay, Turkey (courtesy of Guzel Yucel Gier); carp fingerling ponds, Antsirabe plateau, Madagascar (courtesy of FIMA Photo Library); fish ponds for culture of Nile tilapia, African catfish and African bonytongue, Cameroon (courtesy of José Aguilar-Manjarrez); intensive shrimp farming ponds, Baja California, Mexico (courtesy of Acqua & Co S.r.l; FIMA Photo Library).

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Requirements, practices, effectiveness and improvements

by
Aquaculture Management and Conservation Service
Fisheries and Aquaculture Management Division
FAO Fisheries and Aquaculture Department

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2009

ISBN 978-92-5-106334-7

Preparation of this document

This document contains the main outputs of Component 2 of the FAO project "Towards sustainable aquaculture: selected issues and guidelines". Component 2 focused on environmental impact assessment and monitoring in aquaculture, in particular on the relevant regulatory requirements, the practice, the effectiveness and suggestions for improvements.

The report includes four regional review papers on EIA and monitoring in aquaculture in Africa, Asia-Pacific, Europe, Latin America and North America, a special study on EIA as applied to salmon aquaculture, as well as a global review and synthesis report which draw on the findings of the review papers, covering relevant information from more than 35 countries. The report includes a review of implementation by countries of environmental impact assessment in aquaculture according to information reported to and collected by FAO, and a case study on EIA and monitoring for clusters of small-scale cage farms in Bolinao Bay, the Philippines.

In addition, this document provides both the Report of the Technical Workshop on Environmental Impact Assessment and Monitoring in Aquaculture, held at FAO headquarters in Rome from 15 to 17 September 2008, which reviewed and discussed findings of all above review and synthesis papers, as well as possible elements for guidelines, which are based on these reviews and the outcomes of the workshop.

FAO's Aquaculture Management and Conservation Service (FIMA) of the FAO Fisheries and Aquaculture Department commissioned the preparation of the review and synthesis papers and organized the technical workshop, with financial support provided generously by the Government of Japan. FAO/FIMA acknowledges with appreciation the technical inputs by all experts, authors and workshop participants, all of whom have contributed to this publication. Coordination of Component 2 activities and technical review of this document was done by FIMA staff including U. Barg (lead), D. Soto and J. Aguilar-Manjarrez, with the assistance of J. Hambrey (editing, synthesis, facilitation of workshop discussions) and J.L. Castilla (desktop publishing).

The printed version of this document provides the introductory pages including the Foreword, Executive summary and the Background, as well as the Global review and Synthesis of reviews of EIA and monitoring in aquaculture in four regions and for salmon aquaculture, which is presented in Part 1 of this publication. The accompanying CD-ROM attached to the inside back cover provides readers with the full content of this publication including (see Contents): all of Part 1 - Reviews and synthesis; Part 2 - Workshop report; Part 3 - Towards policy guidelines; and Part 4 - Appendices.

Abstract

This document contains the main outputs of Component 2 of the FAO project "Towards sustainable aquaculture: selected issues and guidelines". Component 2 focused on environmental impact assessment and monitoring in aquaculture, in particular on the relevant regulatory requirements, the practice, the effectiveness and suggestions for improvements. The report includes four regional reviews on EIA and monitoring in aquaculture in Africa, Asia-Pacific, Europe, Latin America and North America, a special study on EIA as applied to salmon aquaculture, as well as a global review and synthesis report which draw on the findings of the review papers, covering relevant information from more than 35 countries. In addition, this document provides the Report of the Technical Workshop on Environmental Impact Assessment and Monitoring in Aquaculture, held at FAO headquarters in Rome from 15 to 17 September 2008.

The global and regional reviews in this study and the associated technical workshop draw on experience from throughout the world in the application of EIA and monitoring to aquaculture development. In practice most aquaculture is small-scale and is not subject to EIA or rigorous monitoring. More emphasis needs to be placed on environmental management frameworks which can address the environmental issues associated with large numbers of small-scale developments – including strategic environmental assessment, risk analysis, management plans for waterbodies and/or groups of farms, monitoring and response procedures.

Where EIA is applied there is mixed experience. Several weaknesses were identified in the regional reviews and at the workshop, including lack of consistency in assessment; lack of appropriate standards; lack of integration between levels and divisions of government; inadequate or ineffective public consultation; lack of assessment skill and capacity; limited follow-up in terms of implementation and monitoring; and excessive bureaucracy and delays. There is very little hard evidence on cost effectiveness.

Monitoring is of fundamental importance to effective environmental management of aquaculture, and without which EIA itself is largely pointless. The main weakness identified was limited implementation of monitoring requirements as developed in EIA environmental management plans, and limited analysis, reporting and feedback of farm level and wider environmental monitoring programmes into management of individual farms and the sector as a whole.

The key to more effective use of both EIA and monitoring procedures will be to nest them within a higher level strategic planning and management framework, including clear environmental objectives and quality standards. More rigorous risk analysis should be used to inform the focus of both EIA and monitoring.

FAO.
Environmental impact assessment and monitoring in aquaculture.
FAO Fisheries and Aquaculture Technical Paper. No. 527. Rome, FAO. 2009. 57p.
Includes a CD-ROM containing the full document (648 pages).

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EIA and monitoring for clusters of small-scale cage farms in Bolinao Bay: a case study

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Towards policy guidelines

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The participants at the FAO Technical Workshop on Environmental Impact Assessment and Monitoring in Aquaculture, held from 15 to 17 September 2008, in Rome, at FAO headquarters, reviewed, discussed and contributed to the completion of the above materials, as well as to finalization of the Workshop report. Their contact details can be found in Annex 2 of the Workshop report, Part 2 of this publication.

Foreword

By providing nearly 50 percent of fish consumed worldwide, aquaculture increasingly contributes to global food fish supplies and to the alleviation of malnutrition, hunger and poverty, especially in developing countries. However, some aquaculture practices have also caused negative effects, including environmental impacts. Concerns and criticism have been voiced against some aquaculture developments. A key issue in this context is to provide adequate information about the environmental impacts of aquaculture operations. Such information is also important for the management and regulation of aquaculture developments, both at farm and sector levels. The FAO Code of Conduct for Responsible Fisheries, adopted in 1995, encourages governments and concerned stakeholders to promote environmental assessment and management of aquaculture.

The FAO Ministerial Meeting in 1999 and the Committee of Fisheries Sub-Committee on Aquaculture in 2002 reiterated the need for enhanced efforts by the international aquaculture community to work towards more sustainable and responsible aquaculture production practices. In 2003, the second session of the COFI Sub-Committee on Aquaculture welcomed the offer of the Government of Japan to financially support targeted efforts of the FAO Fisheries and Aquaculture Department in addressing most pressing issues of aquaculture sustainability worldwide. With the generous support of the Government of Japan, FAO's Aquaculture Management and Conservation Service (FIMA) developed and implemented the FAO project "Towards sustainable aquaculture: selected issues and guidelines" (GCP/INT/936/JPN). The project focused on the following themes:

1. Food safety of aquaculture fish
2. Environmental impact assessment and monitoring in aquaculture
3. Use of wild fish/fishery resources for aquaculture production
4. Use of wild fish and/or other aquatic species to feed cultured fish and its implications to food security and poverty alleviation
5. Ecosystem approach to aquaculture

The second project component on **Environmental Impact Assessment and Monitoring in Aquaculture** aimed to address key issues of environmental assessment and monitoring in aquaculture with a view to generate strategic advice and technical guidance information for use in policy-making, capacity-building and training in the sector, in particular on improved use of EIA and monitoring approaches in aquaculture, and on complementary measures useful and effective in further promoting sustainable aquaculture development. This second component complemented efforts under the fifth project component on the development of guidelines on the ecosystem approach to aquaculture. The outputs generated by this project, including Component 2, are expected to assist FAO member countries in the promotion and implementation of the provisions of the Code of Conduct for Responsible Fisheries.

FIMA greatly appreciates all expert contributions leading to the publication of this Technical Paper, including those by reviewers, workshop participants, resource persons as well as by FAO colleagues in the Fisheries and Aquaculture Department and the Development Law Service.

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Executive summary

The Aquaculture Management and Conservation Service of FAO's Fisheries and Aquaculture Department conducted review studies on environmental impact assessement (EIA) and monitoring in aquaculture in Africa, Asia-Pacific, Europe, North America, Latin America and in marine salmon cage aquaculture, covering more than thirty-five of the top aquaculture producing countries in the world. The reviews studied the application of EIA and monitoring in aquaculture focusing on: (i) regulatory requirements; (ii) practice; (iii) effectiveness; and (iv) possible improvements of EIA and monitoring in aquaculture. These reviews were synthesized into a global review. A technical expert workshop (September 2008, Rome, FAO) reviewed and discussed the findings and suggestions of all reviews, and developed relevant conclusions and recommendations for use by authorities, policy and decision-makers, private sector and other stakeholders interested in the promotion of sustainable aquaculture.

GENERAL SCOPE OF EIA AND MONITORING

Environmental impact assessment may be defined as: *"The process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made".*[1]

In practice, most countries have their own definitions and guidance, although these are broadly similar across the globe. Full EIA is usually conceived as applying to new, large-scale developments. EIA serves two main purposes: to inform a consenting or licensing decision; and to identify mitigation measures which will minimize any possible environmental impacts.

Monitoring may apply to:

- the practical implementation of conditions or plans arising from an EIA;
- the state of the environment in the vicinity of a farm which has been subject to EIA (by the farmer or by the authorities); and
- the state of the environment more widely, which may be influenced by one or many farms and other activities.

APPLICATION OF EIA TO AQUACULTURE

EIA is most commonly applied to intensive marine finfish culture (especially salmon culture) and to proposals for large scale shrimp farm developments. However, some countries with significant large-scale aquaculture industries (including Japan, Thailand, some states in the United States of America and parts of Europe) do not apply EIA to aquaculture development, but rather rely on a range of alternative environmental management procedures.

Full EIA is not applied to the bulk of global aquaculture production. This is because most aquaculture production is small-scale, and in many cases is a traditional activity. It is notable that EIA is not generally applied to agriculture for similar reasons. However, there are less rigorous forms of environmental assessment (environmental declarations, initial environmental assessment, etc.) which are increasingly applied as part of the permitting or licensing procedure for small-scale aquaculture developments.

The variation in the degree and nature of application is important, and reflects the diversity of aquaculture enterprises and development context. EIA is just one tool for

[1] IAIA. 1999. Principles of Environmental Impact Assessment Best Practice. www.iaia.org/modx/assets/files/Principles%20of%20IA_web.pdf.

the environmental management of aquaculture, which needs to be adapted according to circumstances.

EIA PRACTICE IN AQUACULTURE

EIA practice varies significantly, although usually follows standard national and international guidelines. The first stage is usually ***screening*** to determine if EIA, or what level of EIA, is required. Most countries apply thresholds which may include area, production volume, intensity, technology or species. In some cases EIA is triggered by specific characteristics, such as introduction of alien species. Several of the reviews presented in this publication reveal the need for more rigorous application of risk assessment as part of the screening process, and this was strongly endorsed by workshop participants.

The second phase – ***scoping*** to determine the issues to be addressed in the assessment – should also be informed by a risk assessment process. The application and thoroughness of risk assessment at this stage is highly variable, and, when neglected, may allow for a lack of focus in the EIA itself. It is arguable that key stakeholders should be involved at this stage, but this is unusual in practice.

Assessment of significance of the possible impacts lies at the heart of EIA, and depends crucially on the skill, knowledge and impartiality of the EIA practitioner. Given that in many cases the practitioner is the developer or someone hired by the developer, quality control of this stage is crucial. Some countries address this through registers of approved EIA consultants; others through training or standard review procedures. Public disclosure of EIA reports allows for wider public review and scrutiny.

In practice the key to more consistent and rigorous assessment is to develop clear environmental objectives and quality standards which serve as benchmarks for the assessment. In many countries these remain inadequate or inappropriate to particular waterbodies. Effective assessment also requires accurate ***prediction*** of possible effects. Modelling of benthic effects and chemical dispersal/assimilation is well developed for marine finfish farming, and is slowly being extended to include wider and more subtle effects on the environment. Such modelling approaches may be more difficult for complex freshwater and estuarine systems with large numbers of farms, but simple mass balance predictions can give useful insights.

Stakeholder consultation is often a specific requirement of more comprehensive EIA and is generally recommended in most EIA guidance materials. The reviews show that with a few notable exceptions, public participation in scoping and assessment is limited. This probably reflects the significant costs and political complexity of public involvement, and the lack of decision-making procedures which can cope with the range of opinions and interests likely to be expressed. While public involvement is to be encouraged – especially in relation to more subjective issues of landscape, cultural and socio-economic impact, and as a form of quality control – the difficulties and sensitivities should not be underestimated. There are important issues relating to national versus local interests, representation, and the power and communication skills of particular interest groups. These dimensions of public consultation must be well understood and well managed.

Mitigation measures and/or an environmental management plan are often seen as key outputs of an EIA, and may serve as conditions for the issue of a consent or licence. However, generic mitigation measures are increasingly promoted through codes of practice or standard regulations. It is important therefore that any mitigation measures identified in an EIA do not simply replicate these standard provisions, but rather focus on much more specific site-related issues.

Decision-making procedures such as consenting or licensing are again highly varied. Usually a large number of institutions are consulted and final decisions made by technical or representative individuals or committees. The degree of stakeholder involvement or participation is often limited. Several of the reviews highlight the lack of coordination and integration between different sectors and levels of government, and the time and cost associated with the process. Others highlight the lack of public involvement at this stage – or where there has been public involvement, the political fallout that may ensue.

Monitoring the implementation of mitigation measures or plans, and the quality of the local environment, was found to be weak in many countries, although authorities in some countries do conduct random checks on farms that have been through the EIA process. Analysis of monitoring information, and feedback into better farm and sector management were also found to be weak, except in the case of some of the major salmon producing countries.

EFFECTIVENESS OF EIA

The reviews were unable to offer significant evidence to demonstrate or confirm the effectiveness or cost-effectiveness of EIA as an environmental management tool. This reflects the lack of a credible baseline; the limited application of EIA to aquaculture; and the lack of effective monitoring, analysis and feedback. Limited application and effectiveness of EIA also seems to be confirmed in FAO's surveys of progress made in the implementation of the Code of Conduct for Responsible Fisheries (CCRF), as described in Part 1 of this publication. In several countries, EIA is seen as a bureaucratic exercise required to obtain a license, rather than as an effective environmental management tool.

MONITORING

The workshop participants agreed that monitoring is the priority for effective environmental management of aquaculture. Without monitoring we have little understanding of the key environmental issues relevant for a given location, or knowledge of the effectiveness of any management interventions, including EIA. Despite this, monitoring was weak in many countries – both at farm level and for the wider environment. Where it is applied, there is often limited analysis and feedback into farm or sector level management. Authorities in some countries, including China, Viet Nam, and many European countries, have embarked on ambitious monitoring programmes for different waterbodies.

Monitoring and associated data analysis can be complex and expensive. Workshop participants agreed on the need for effective scoping and risk assessment to ensure a clear focus for monitoring and cost effective implementation. The existence of environmental quality objectives and standards should also provide a framework for reporting, and increase relevance of the analysis.

There are significant opportunities for greater farmer participation in monitoring programmes. This would increase farmer responsibility at the same time as generating useful applied data. There are examples of this from several countries, including Norway.

INSTITUTIONS AND DECISION-MAKING

Decision-making is a key issue for effective EIA. Several of the reviews highlighted inconsistency; lack of transparency; lack of coordination/integration; and subjectivity. While many of these issues can be addressed through development of agreed thresholds, standards, criteria, and guidance more generally, there will remain a need to make trade-off decisions about highly subjective sociocultural issues, including tradition,

community, landscape and so on. This should be explicitly recognized in drawing up EIA and related procedures.

There is huge variation in decision-making structures and procedures to address these issues (e.g. committees, ad hoc panels, governors, commissioners, facilitators) and much experience to draw on.

Another important issue is institutional responsibility for EIA, monitoring and related procedures. The choice of lead institution will inevitably influence the weight afforded different considerations and perspectives. Typically, responsibility is assigned either to the environment department/agency or to the sectoral (fisheries/aquaculture/agriculture) department/agency, although there is a range of other arrangements. There are strengths and weaknesses in both these approaches, with the former tending to be more precautionary and more "neutral", and the latter more supportive of well managed development, and usually better placed to implement and monitor through its stronger contacts with the industry. Whichever takes the lead, it is essential that they work closely together to draw on the strengths and knowledge of each.

STRENGTHS AND WEAKNESSES OF EIA AND MONITORING IN AQUACULTURE

The adoption of EIA legislation in many countries and its application to some forms of aquaculture has undoubtedly raised awareness of the environmental issues associated with aquaculture, and this in itself is likely to lead to better environmental management. It is universally agreed that monitoring is essential for better environmental management.

However, many weaknesses were identified in the reviews, of which the following in particular stand out:

- The difficulty of addressing the cumulative impacts of many small-scale developments through conventional EIA.
- The lack of environmental objectives and standards – especially suited to the local context – against which to assess impacts and design mitigation.
- The excessive scope and lack of focus on key issues of much EIA and monitoring activity.
- The lack of institutions and capacity to coordinate, manage, implement and review EIA, monitoring and environmental management tools more generally.
- The lack of engagement and trust between regulators and farmers.
- Limited participation or engagement of key stakeholders; or where this does take place, poor management and inadequate conflict resolution.
- The lack of effective monitoring, analysis and feedback into sector management, as well as into management of individual farms, or groups/clusters of farms.

These are all indicative of a tendency for governments and regulatory authorities to focus on particular techniques (such as EIA) rather than on an adaptive management system for the sector. It is important that such a system be "nested" with elements at national level, at waterbody level, and at farm level.

OTHER TOOLS FOR THE ENVIRONMENTAL MANAGEMENT OF AQUACULTURE

Regulation

Irrespective of licensing, EIA or sector planning initiatives, many countries have well established legislation and regulation to control and manage pollution and waste discharges from industrial activities. This has been extended to agriculture in recent decades, and many countries now apply controls to aquaculture – especially the more intensive production systems. In some cases these regulations cover almost all the major environmental effects of aquaculture, including: discharge of nutrients and chemicals; import and movement of stock and eggs; introduction of alien species; disposal of mortalities; and product quality. Specific permits or consents may be required for these various activities, and various forms of assessment may be required in order to gain these consents. In effect, this standardizes environmental management and reduces

the need to address many issues in EIA. In those cases where EIA is required, it will address the extent to which the farm is expected to be compliant with these standard controls; in a few cases the EIA may inform the nature or level of licence specific consents.

Codes of practice

In recent years codes of practice, best management practices (BMPs), codes of conduct, etc., have been introduced throughout the world – promoted by government, by international organizations, and by the private sector. They are seen as a tool which addresses many environmental management issues while at the same time has the potential to confer market advantage. Perhaps most importantly these can be promoted among large numbers of small-scale producers in situations where both EIA and regulation would be unworkable. BMPs or codes can also be used as a tool within the regulatory process. For example, in the United States of America adherence to BMPs may be set down as a licence condition.

THE WAY FORWARD

A comprehensive set of recommendations was developed at the workshop and these are presented in the workshop report (Part 2 of this publication). Most of these recommendations have been organised and elaborated as key elements for guidelines (Part 3) which presents a brief overview and summary of the main recommendations.

1. Diversity

Aquaculture development and the social, economic and geographic contexts in which it takes place, are hugely varied and management systems should be developed taking into account this diversity.

2. Efficiency

It is essential that the environmental management process is efficient, avoiding delays and waste of resources and efforts, and that it facilitates the responsible development of aquaculture and its contributions to sustainable development.

3. Management framework

EIA and monitoring should be implemented as part of a wider management framework or "system" for aquaculture. At minimum, such a system should comprise: (i) policy and strategy; (ii) agreed environmental objectives and associated indicators, standards and reference points; (iii) mechanisms by which such objectives can be achieved for the sector (e.g. EIA, codes of conduct, regulation, zoning); (iv) monitoring strategy; and (v) feedback mechanisms to inform and refine management interventions. The framework should also define institutional responsibilities and procedures.

Such a system should nest elements at several geographic scales which will depend on geographic, economic and administrative systems, but might include national strategy, waterbody level management plan and farm group or "cluster" plan. It should seek a balance between the need for consistency and a level playing field on the one hand, and the need for flexibility, participation and adaptation to local needs and circumstances on the other.

Strategic environmental assessment (SEA) may be used to inform the development of the management system at different levels.

4. Management units

Effective organization and representation of farmers is a precondition for effective dissemination and application of environmental management measures. Where there are large numbers of small-scale farmers this may require government assistance/facilitation.

In some cases farmers may be organized into small management groups or "clusters". In other cases, authorities may help establish aquaculture "parks", regions or zones in order to streamline and facilitate environmental management and reduce conflict. Care is however needed with any clustering initiative so as not to exacerbate biosecurity (disease) and environmental capacity issues through overconcentrated development.

5. Environmental capacity

Understanding environmental capacity is key to the management of cumulative impact and to answering the question: how much aquaculture can be sustained in a particular area? Although it is often difficult to determine accurately, there are now a variety of approaches which allow rough estimates to be made. These, coupled with effective monitoring, can be refined over time. Again, these estimates may be made at different scales according to the nature of geography, ecology and administrative units.

6. Risk-based approach

Environmental assessment, monitoring and management response all need to be focused on priority issues in order to improve cost-effectiveness. Risk analysis should be a key tool in developing overall strategy and in defining more specific requirements for EIA and monitoring. More attention also needs to be paid to socio-economic issues when considering both consenting and mitigation.

7. Simplicity

Most aquaculture takes place in poor regions. Monitoring regimes should take account of what is practical and feasible, as well as what is scientifically desirable. Minimizing the number of parameters, using local knowledge and indicators, developing simple sampling procedures may all contribute to more widespread, affordable and useful monitoring programmes.

8. Institutions and decision-making

There needs to be clear responsibility for decision-making in planning and consenting procedures, and the skills and capacity to address both technical issues and more subjective cultural and socio-economic issues. The latter may require well-managed public consultation and participation.

Better coordination and integration between different levels and sectors of government is essential to reduce delay and bureaucracy.

Clarity and transparency in decision-making should ensure more thorough quality control, and more predictability and consistency. Publication and easy access to key documentation – and especially to EIA documentation – is essential.

9. Capacity building for environmental assessment and management in aquaculture

Capacity building has multiple dimensions all of which should be addressed:

- rights and responsibilities;
- sector specific guidance and toolkits;
- training;
- availability and dissemination of predictive models, shared access to better information,
- awareness and extension, farmer organisation; institutional processes, coordination, decision support, managing consultation and participation.

All these issues are further elaborated in the global review and synthesis report (Part 1) and more detail and practical examples can be found in the regional reviews and salmon study (Part 1). A specific example of the management of small-scale aquaculture in Bolinao Bay, Philippines, is presented in Part 1. Further discussion and more detailed recommendations can be found in the key elements for guidelines (Part 3) and in the workshop report (Part 2).

Background

INTRODUCTION

Aquaculture is recognized as a significant and continuously growing food production sector (NACA/FAO, 2001; Brugère and Ridler, 2004; FAO, 2006a; 2007; 2009). It provides income, employment and can significantly contribute to supply of much needed protein and food security in general. However, some aquaculture practices have also caused negative effects on the environment and on local communities. The result in many cases has been that serious concerns have been expressed, particularly about the overall environmental sustainability of some aquaculture practices.

Providing adequate and generally accepted information about the environmental impacts of aquaculture operations has proven very useful. Awareness of the environmental impacts of aquaculture has steadily grown over the past decades. There have been many efforts by concerned government authorities, aquaculture producers, scientists, as well as environmental advocacy groups and other stakeholders, at local, national and international levels to address the issues of environmental impacts of aquaculture. As a response, there has been also a general trend to improve environmental assessment and management practices in aquaculture. In the 1970s FAO had already started technical advisory initiatives on assessment and management of environmental impacts of aquaculture, as well as on regulatory, legal, policy and planning measures useful for the management of aquaculture farms and the aquaculture sector as a whole. With a view to further promote the sustainable development of aquaculture, FAO over the past decades, often in collaboration with partners, launched national, regional and inter-regional technical cooperation projects, published relevant technical documentation and guidelines, and promoted international cooperation and networking on sustainable aquaculture development (for example, Beveridge, 1984; Maine and Nash, 1987; Van Houtte, Bonucci and Edeson, 1989; Insull and Nash, 1990; Barg, 1992; FAO/NACA, 1995; Van Houtte, 1995; Insull and Shehadeh, 1996; FAO, 1995; 1997; 1998; Aguilar-Manjarrez and Nath, 1998; GESAMP, 2001; FAO/NACA/UNEP/WB/WWF, 2006; Brugère and Hishamunda, 2007; FAO, 2008a).

Of particular importance for the promotion of sustainable aquaculture has been the development and adoption in 1995 of the FAO Code of Conduct for Responsible Fisheries (CCRF) (FAO, 1995). The CCRF was developed in an intergovernmental negotiation process and is recognized as one of the most significant international governance instruments for fisheries and aquaculture worldwide. The CCRF has recognized both the potential for significant growth in aquaculture as well as the potential of aquaculture practices to cause environmental and social impacts. In its General Principle No. 6.19, the CCRF calls for:

> *6.19 States should consider aquaculture, including culture-based fisheries, as a means to promote diversification of income and diet. In so doing, States should ensure that resources are used responsibly and adverse impacts on the environment and on local communities are minimized.*

More specifically, the CCRF, in its Articles 9.1.2 and 9.1.5, calls for environmental impacts assessment and monitoring in aquaculture (see Box 1). Given the importance of environmental impact assessment and monitoring in aquaculture, the FAO

BOX 1

CCRF Article 9 – Aquaculture Development. Provisions of Articles 9.1.1 – 9.1.5 (FAO, 1995)

9.1 Responsible development of aquaculture, including culture-based fisheries, in areas under national jurisdiction.

9.1.1 States should establish, maintain and develop an appropriate legal and administrative framework which facilitates the development of responsible aquaculture.

9.1.2 States should promote responsible development and management of aquaculture, including an advance evaluation of the effects of aquaculture development on genetic diversity and ecosystem integrity, based on the best available scientific information.

9.1.3 States should produce and regularly update aquaculture development strategies and plans, as required, to ensure that aquaculture development is ecologically sustainable and to allow the rational use of resources shared by aquaculture and other activities.

9.1.4 States should ensure that the livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture developments.

9.1.5 States should establish effective procedures specific to aquaculture to undertake appropriate environmental assessment and monitoring with the aim of minimizing adverse ecological changes and related economic and social consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemicals, and other aquaculture activities.

www.fao.org/DOCREP/005/v9878e/v9878e00.htm#9

Questionnaires[1] on Progress in the Implementation of the CCRF in its section on aquaculture do include questions to FAO Members regarding the existence and development of regulatory measures and procedures for environmental impact assessment and monitoring in aquaculture. Generally, the responses by FAO Members so far indicated that there is a wide range of diverse types of EIA and monitoring procedures, and that the extent of development, implementation and effectiveness of such EIA and monitoring procedures, where existing, also varies form country to country. An overview and synthesis of countries' responses to CCRF questionnaire items on EIA and monitoring in aquaculture are provided in this publication by Soto, Aguilar-Manjarrez and Irde (2009).

In many cases, EIA and monitoring procedures in aquaculture do not exist, are not sufficiently developed or implemented, and often appear to be inadequately designed to provide key information on changes in the ecological features of the specific environments sustaining given aquaculture practices. Often, there are little or no efforts to ensure regular monitoring of environmental performance and environmental

[1] The CCRF provides that FAO, in accordance with its role within the United Nations system, will monitor the application and implementation of the Code and its effects on fisheries and the Secretariat will report accordingly to the FAO Committee on Fisheries (COFI). All States, whether Members or non-members of FAO, as well as relevant international organizations, whether governmental or non-governmental should actively cooperate with FAO in this work. A questionnaire, developed for use in biannual surveys, is being forwarded to all FAO Members, non-members, regional fishery bodies, inter-governmental and international non-governmental organizations. The responses are compiled by FAO's Fisheries and Aquaculture Department and results are reported to COFI, in form of progress reports which can be found on FAO's home page at www.fao.org/fishery/ccrf/publications/monitoring. Since the establishment of the COFI Sub-Committee on Aquaculture in 2001, progress reports on aquaculture provisions of the CCRF are prepared for the sessions of this Sub-Committee (FAO, 2008b).

BOX 2
EIA and monitoring in aquaculture (FAO, 1997)

When formulating programmes or requirements for environmental assessments and monitoring, due consideration should be given to the diversity of aquaculture practices (including, in particular, the species used and the culture methods applied) and their environmental settings. However, in many cases, particular emphasis will need to be given to simplicity, flexibility and affordability of environmental assessments and monitoring, in order to facilitate the acceptance and enforcement of such measures. Consultation and participation of interested and affected parties in the formulation of requirements for environmental assessment and monitoring should be encouraged. A detailed evaluation of financial, manpower and time requirements for any such effort should precede their implementation to demonstrate their cost-effectiveness and feasibility.

ftp://ftp.fao.org/docrep/fao/003/W4493e/W4493e00.pdf

outcomes of aquaculture farm management measures, after the completion and submission of the EIAs required for the establishment of aquaculture farms.

In view of significant issues associated with the development and implementation of EIA and monitoring schemes in aquaculture, FAO's Technical Guidelines for Responsible Fisheries in support of the implementation of CCRF Article 9 on Aquaculture Development (FAO, 1997) suggested a pragmatic, adaptive and flexible approach to the application and enforcement of regulatory EIA and monitoring requirements in aquaculture (see Box 2).

THE PROJECT

Given the significance of EIA and monitoring requirements in aquaculture governance, a project was developed with a view to addressing information and capacity development needs in many FAO member countries. "Environmental Impact Assessment and Monitoring in Aquaculture" is one component of the FAO project "Towards sustainable aquaculture: selected issues and guidelines" (GCP/INT/936/JPN), which was implemented by FAO's Aquaculture Management and Conservation Service, with the financial support of the Government of Japan.

This project was designed to facilitate the compilation of strategic information which could contribute to improved and effective environmental assessment and management of aquaculture resulting from improved and targeted application of EIA and monitoring approaches in aquaculture. This project resulted in the present publication which provides a first global overview of existing requirements, procedures and practices of environmental impact assessment and monitoring in aquaculture as well as a comprehensive discussion of relevant experiences, effectiveness and suggestions for improvements, including complementary measures useful and effective in further promoting sustainable aquaculture development.

This project facilitated the preparation of five reviews. Four regional review studies were prepared to cover the compilation and review of existing EIA and environmental monitoring procedures and practices in aquaculture in selected countries of the following four composite regions.

Africa:	Egypt, Madagascar, Nigeria, South Africa, the United Republic of Tanzania, Uganda;
Asia-Pacific:	Australia, China, India, Indonesia, Japan, Malaysia, Philippines, Thailand, Viet Nam;

Europe & North America:	Czech Republic, France, Greece, Hungary, Italy, Netherlands, Poland, Spain, Turkey, the United Kingdom of Great Britain and Northern Ireland , as well as Canada and the United States of America;
Latin America:	Brazil, Colombia, Cuba, Ecuador, Honduras, Mexico

A fifth special case study focused on EIA and monitoring in marine cage aquaculture of salmon in Canada, Chile, Ireland, New Zealand, Norway, the United Kingdom of Great Britain and Northern Ireland and the United States of America. A global review and synthesis report was prepared based on these four regional case studies and the salmon aquaculture study.

In the context of this project FAO organized a Technical Workshop on Environmental Impact Assessment and Monitoring in Aquaculture, held from 15 to 17 September 2008 at FAO headquarters in Rome. The workshop discussed and reviewed the above regional reviews, the special salmon aquaculture case study, a global review and synthesis, an analysis of available CCRF questionnaire responses, national aquaculture sector overviews and national aquaculture legal overviews, and produced a range of conclusions, recommendations and elements for guidelines on EIA procedures, monitoring and environmental management frameworks relevant to aquaculture.

THIS TECHNICAL PAPER

This Technical Paper is organized in four parts. **Part 1** (Reviews and synthesis) provides the global review and synthesis on EIA and monitoring in aquaculture, followed by the four regional reviews and the fifth special case study on EIA in salmon aquaculture, as well as a review of implementation by countries of environmental impact assessment in aquaculture according to information reported to and collected by FAO, and a case study on EIA and monitoring for clusters of small-scale cage farms in Bolinao Bay, the Philippines. The Report of the Technical Workshop on Environmental Impact Assessment and Monitoring in Aquaculture, held in Rome during 15-17 September 2008 can be found in **Part 2**. Information and guidance developed in Parts 1 and 2 was synthesized to a set of suggested elements which could be useful in developing or advancing policy guidelines on improved environmental assessment and management in aquaculture, and these are summarized in **Part 3** (Towards policy guidelines). Three Appendices compiled in **Part 4** provide readers with background materials on the terms of reference for the preparation of review papers, the description of Project Component 2, and on the use of terms, in particular EIA, monitoring and strategic environmental assessment (SEA).

It is emphasized that information on general principles and elements of EIA requirements, procedures, and related definitions, is generally available, for example, in such publications as produced by the United Nations Environment Programme (Sadler and McCabe, 2002) and the International Association for Impact Assessment (IAIA, 1999).

For the purposes of this Project and this publication, the review of regulatory EIA requirements involved consideration of relevant legal texts. However, since legal texts at times are prone to modifications or amendments, readers are invited to always cross check and search for most recent legal texts as they may be relevant to aquaculture. FAO offers online references and access to legal texts and to description of legal and institutional context of aquaculture at national levels. Readers are encouraged to visit the following online resources:

FAOLEX is a comprehensive and up-to-date computerized legislative database, one of the world's largest electronic collections of national laws and regulations on food, agriculture and renewable natural resources. FAOLEX is operated by FAO's Legal Office. http://faolex.fao.org/faolex/

ECOLEX is a database providing the most comprehensive, global source of information on environmental law. ECOLEX is operated jointly by FAO, IUCN and UNEP. www.ecolex.org/start.php

National Aquaculture Legal Overviews. The NALOs are a collection of comparative national overviews of aquaculture laws and regulations from the top 40 aquaculture producing countries. These have been prepared by the FAO Aquaculture Management and Conservation Service in collaboration with the FAO Development Law Service. www.fao.org/fishery/nalo/search/en

National Aquaculture Sector Overviews. The NASO collection consists of overviews covering the general aspects of aquaculture and culture-based fisheries at the national level. www.fao.org/fishery/naso/search

However, readers are again invited to consider that these online resources might also need to be checked for most recent relevant documentation.

Finally, readers are invited to consider this Technical Paper in the overall context of FAO's present efforts of contributing technical information and strategic guidance in support of sustainable development of aquaculture worldwide. Major efforts in this context include the development of guidelines on the Ecosystem approach to aquaculture (Soto, Aguilar-Manjarrez and Hishamunda, 2008) as well as other ongoing work on planning and policy development in aquaculture, aquaculture governance, risk analysis, best management practices in aquaculture and certification of aquaculture products (FAO, 2006b; 2006c; 2008c; 2008d; 2008e; Kapetsky and Aguilar-Manjarrez, 2007; Bondad-Reantaso, Arthur and Subasinghe, 2008; GESAMP, 2008).

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