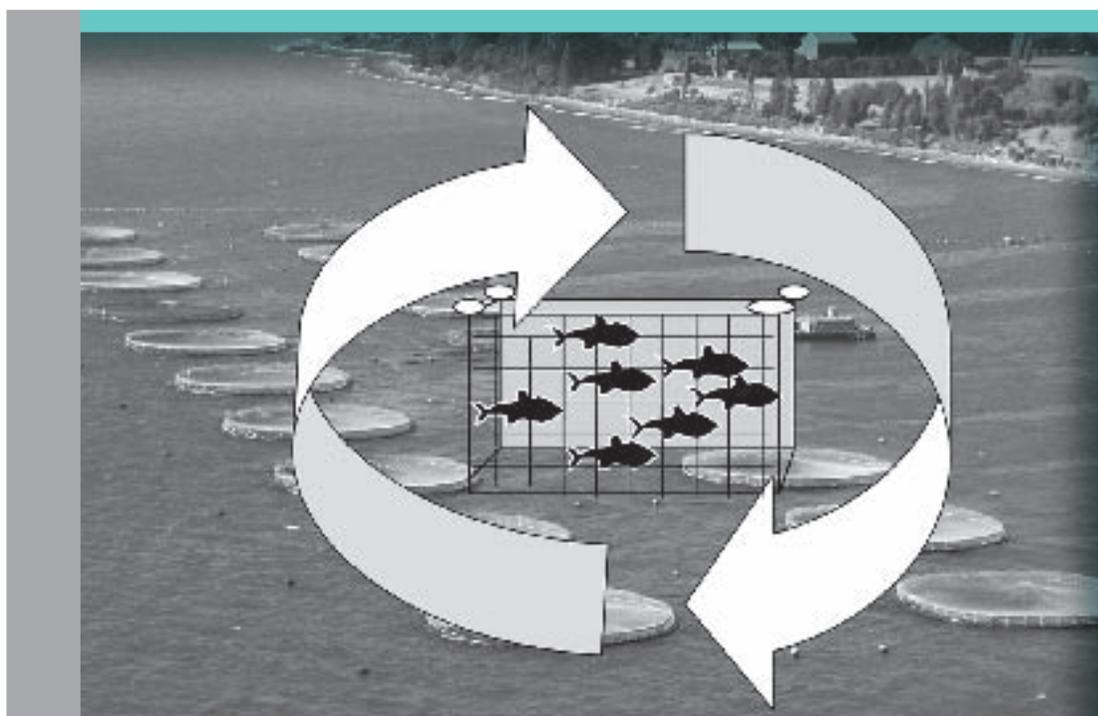


# Building an ecosystem approach to aquaculture

FAO/Universitat de les Illes Balears Expert Workshop  
7–11 May 2007  
Palma de Mallorca, Spain



Universitat de les  
Illes Balears



*Cover photo:* The background photo taken on 22 February 2004 (Courtesy of Fernando Jara) shows a high-tech 2 000 tonnes Atlantic salmon farm in the Reloncaví estuary, 41° Lat. S and 72° Lon. W. Chile's interior southern sea, within its intricate system of protected fjords and channels, provides prime conditions for aquaculture. Mild temperatures and abundant regular freshwater inputs represent competitive advantages for raising alien species, such as salmon and trout, making Chile one of the world's top producers of farmed salmon.

---

**Copies of FAO publications can be requested from:**

SALES AND MARKETING GROUP  
Communication Division  
Food and Agriculture Organization of the United Nations  
Viale delle Terme di Caracalla  
00153 Rome, Italy

**E-mail:** [publications-sales@fao.org](mailto:publications-sales@fao.org)

**Fax:** +39 06 57053360

**Web site:** <http://www.fao.org>

# Building an ecosystem approach to aquaculture

---

FAO/Universitat de les Illes Balears Expert Workshop  
7–11 May 2007  
Palma de Mallorca, Spain

Edited by

**Doris Soto**

**José Aguilar-Manjarrez**

Aquaculture Management and Conservation Service  
FAO Fisheries and Aquaculture Department

and

**Nathanael Hishamunda**

Development and Planning Service  
FAO Fisheries and Aquaculture Department

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the authors and do not necessarily reflect the views of FAO.

ISBN 978-92-5-106075-9

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders. Applications for such permission should be addressed to:

Chief

Electronic Publishing Policy and Support Branch

Communication Division

FAO

Viale delle Terme di Caracalla, 00153 Rome, Italy

or by e-mail to:

copyright@fao.org

© FAO 2008

# Preparation of this document

This publication represents the proceedings originated from the Food and Agriculture Organization of the United Nations/Universitat de les Illes Balears Expert Workshop *Building an ecosystem approach to aquaculture* convened in Palma de Mallorca, Spain, from 7–11 May 2007. Twenty-two internationally recognized experts representing different regions of the world and providing a wide range of expertise in the areas of aquaculture environmental, social and economic issues contributed scientific discussions and papers on various aspects of the ecosystem approach to aquaculture.

The workshop was jointly organized by the Aquaculture Management and Conservation Service of the FAO Fisheries and Aquaculture Department and the Universitat de les Illes Balears in Spain. The proceedings were compiled and technically edited by Doris Soto, José Aguilar-Manjarrez and Nathanael Hishamunda, of the FAO Fisheries and Aquaculture Department, with the assistance of the experts.

We acknowledge Ms Tina Farmer, Ms Françoise Schatto for their assistance in quality control and FAO style, Mr José Luis Castilla Civit for layout design and Doris Soto for cover design.

# Abstract

Aquaculture growth worldwide involves the expansion of cultivated areas, a higher density of aquaculture installations and farmed individuals and greater use of feed resources produced outside of the immediate culture area. Such evolution of the sector could carry negative impacts on the environment and on portions of the society when unregulated and badly managed. In response to the explicit request of the Third Session of the Committee of Fisheries (COFI) Sub-Committee on Aquaculture to improve the management and enhance the socio-economic impacts of aquaculture, the Aquaculture Management and Conservation Service (FIMA) of the FAO Fisheries and Aquaculture Department initiated in 2006 an effort to look into the development and application of the ecosystem approach to aquaculture. This activity is funded under a Japanese Trust Fund Project (Towards Sustainable Aquaculture: Selected Issues and Guidelines) and conducted in collaboration with the FAO Fisheries and Aquaculture Development and Planning Service (FIEP).

Several activities have taken place to support sustainable aquaculture, including the workshop coorganized with the Universitat de les Illes Balears that took place from 7–11 May 2007 in Palma de Mallorca, Spain on “Building and ecosystem approach to aquaculture”. The workshop participants, a multidisciplinary and multinational group of experts, agreed that: “*An ecosystem approach for aquaculture (EAA) is a strategy for the integration of the activity within the wider ecosystem in such a way that it promotes sustainable development, equity, and resilience of interlinked social and ecological systems*”. Such strategy should be guided by three main principles that should ensure the contribution of aquaculture to sustainable development: i) aquaculture should be developed in the context of ecosystem functions and services with no degradation of these beyond their resilience capacity; ii) aquaculture should improve human well-being and equity for all relevant stakeholders; and iii) aquaculture should be developed in the context of (and integrated to) other relevant sectors. Three scales/levels of EAA application were identified and discussed: the farm; the waterbody and its watershed/aquaculture zone; and the global, market-trade scale. These proceedings present the output of this workshop and include contributed papers on: concepts, principles, scales and management measures; human dimensions; economic implications; and legal implications; that are relevant for an ecosystem-based management to the sector. Two comprehensive review papers cover the status of brackish, marine and freshwater aquaculture under the light of an ecosystem-based management, indicating the major shortfalls and opportunities for such an approach are also included.

Clearly, the implementation of the EAA will require changes in human behaviour and understanding of ecosystem’s functioning; it will also require the development of institutions capable of integrating different sectors including aquaculture, especially in terms of shared agreed objectives and standards. As some of the reviews point out, scarce participatory processes, poor understanding of social sustainability requirements and poor governance hinders the widespread adoption of an ecosystem approach to aquaculture. Therefore more guidance is needed on these matters; these proceedings attempt to contribute to that by providing baseline information and some initial guidance.

**Soto, D.; Aguilar-Manjarrez, J.; Hishamunda, N. (eds).**

Building an ecosystem approach to aquaculture. FAO/Universitat de les Illes Balears Expert Workshop. 7–11 May 2007, Palma de Mallorca, Spain.

*FAO Fisheries and Aquaculture Proceedings*. No. 14. Rome, FAO. 2008. 221p.

# Contents

Preparation of this document	iii
Abstract	iv
<b>Genesis of the workshop</b>	<b>1</b>
<b>Workshop development and findings</b>	<b>3</b>
<b>Workshop recommendations and the potential role of FAO</b>	<b>7</b>
<b>Annex 1 – Agenda</b>	<b>8</b>
<b>Annex 2 – List of participants</b>	<b>10</b>
<b>CONTRIBUTED PAPERS</b>	
<b>Applying an ecosystem-based approach to aquaculture: principles, scales and some management measures</b>	<b>15</b>
DORIS SOTO, JOSÉ AGUILAR-MANJARREZ, JORGE BERMÚDEZ, CÉCILE BRUGÈRE, DROR ANGEL, CONNER BAILEY, KENNY BLACK, PETER EDWARDS, BARRY COSTA-PIERCE, THIERRY CHOPIN, SALUD DEUDERO, SHIRRA FREEMAN, JOHN HAMBREY, NATHANAEL HISHAMUNDA, DUNCAN KNOWLER, WILLIAM SILVERT, NURIA MARBA, SYNDHIA MATHE, RICARDO NORAMBUENA, FRANÇOIS SIMARD, PAUL TETT, MAX TROELL AND ALEXANDRE WAINBERG	
<b>Human dimensions of an ecosystem approach to aquaculture</b>	<b>37</b>
CONNER BAILEY	
<b>Economic implications of an ecosystem approach to aquaculture</b>	<b>47</b>
DUNCAN KNOWLER	
<b>Legal implications of an ecosystem approach to aquaculture</b>	<b>67</b>
JORGE BERMÚDEZ	
<b>REVIEWS</b>	
<b>An ecosystem approach to marine aquaculture: a global review</b>	<b>81</b>
BARRY COSTA-PIERCE	
<b>An ecosystem approach to freshwater aquaculture: a global review</b>	<b>117</b>
JOHN HAMBREY, PETER EDWARDS AND BEN BELTON	

# Genesis of the workshop

## BACKGROUND

### Building an ecosystem approach to aquaculture

There is an agreed definition of the ecosystem approach to fisheries (EAF)<sup>1</sup> and an advanced proposition for the ecosystem approach to aquaculture has been outlined by FAO (2006).<sup>2</sup> The purpose of EAA should be to plan, develop and manage the sector in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by aquatic ecosystems. This implies the use of proper instruments, processes and structures to deal effectively with issues of environmental, social, technical, economic and political nature. Following the EAF and pursuing sustainable development, the EAA should have three main objectives within a hierarchical tree framework: i) insuring human well-being; ii) insuring ecological well-being; and iii) facilitating the achievement of both, i.e. effective governance.

Clearly, although building an ecosystem approach to aquaculture is not new, there is a need to develop a more coherent and practical framework mostly focusing on producing guidelines for policy-making which should reach beyond just the farm.

### Proposed scales

FAO (2006)<sup>2</sup>, discussing the EAA as an emerging issue, proposed the following scales/levels as relevant for its implementation/application: 1) at the farm level; 2) at the waterbody and its watershed/aquaculture zone; and 3) at the global, market-trade scale. The EAA framework should also apply to all productive scales (from small-scale to intensive, large scale farming) and should also consider temporal scales.

### Proposed principles

The EAA should respond to sustainable development principles. There have been multiple initiatives and publications related to sustainable development and the use of natural resources; according to Muir (1996), this is a reaction against considering living resources as free goods, external to the development process. Jacobs *et al.* (1987) set five relevant requirements: integration of conservation and development, the satisfaction of basic human needs, the achievement of equity and social justice, the provision for social self-determination and cultural diversity and the maintenance of ecological integrity. An EAA should improve the acceptance of aquaculture by avoiding impairing ecosystem resilience and by offering new societal opportunities with equity. Therefore, it would be possible, for example, to apply/certify a comprehensive sustainable-label (S-Label) to aquaculture products which have followed EAA guidelines.

Indeed, current governance situation of aquaculture (and other sectors) in most countries and regions seems to be quite far from integrated management or having an ecosystem perspective (considering other users of aquatic systems) and there are very few examples of such approach (e.g. a strategy for ecologically sustainable development

<sup>1</sup> FAO. 2003. The Ecosystem Approach to Fisheries (EAF). FAO Technical Guidelines for Responsible Fisheries No. 4, Suppl. 2. Rome. 112 pp. (available at [www.fao.org/docrep/005/y4470e/y4470e00.htm](http://www.fao.org/docrep/005/y4470e/y4470e00.htm))

<sup>2</sup> FAO 2006. Sustainable growth and expansion of aquaculture: an ecosystem approach. State of the World Fisheries and Aquaculture (SOFIA), 2006. (available at [www.fao.org/docrep/009/A0699e/A0699E06.htm#6.2](http://www.fao.org/docrep/009/A0699e/A0699E06.htm#6.2)).

(ESD) in Australia<sup>3</sup>), therefore primary targets (but not only) for these efforts and for developing EAA guidelines are policy-makers.

In response to the explicit request of the Third Session of the Committee of Fisheries (COFI) Sub-Committee on Aquaculture to improve the management and enhance the socio-economic impacts of aquaculture, FAO-FIMA initiated an effort to look into the development and application of the ecosystem approach to aquaculture.

Several activities have been planned towards this objective including the workshop coorganized with the Universitat de les Illes Balears which took place from 7–11 May 2007 in Palma de Mallorca, Spain.

### **OBJECTIVES**

The main objectives of this workshop were to:

1. agree on concepts, principles and scale approaches for an ecosystem approach to aquaculture (EAA) considering the information provided as background above);
2. analyze present evidence, availability of knowledge and tools; and
3. identify further requirements/steps in order to elaborate guidelines for EAA.

The workshop agenda is provided in Annex 1.

### **PARTICIPATION**

The workshop was attended by twenty-two internationally recognized experts representing different regions of the world and providing a wide range of expertise in the areas of aquaculture environmental, social and economic issues. The farming and governance sectors were also represented. The list of participants is provided in Annex 2.

---

<sup>3</sup> [www.environment.gov.au/esd/national/nsesd/strategy/index.html](http://www.environment.gov.au/esd/national/nsesd/strategy/index.html)

# Workshop development and findings

As indicated in the agenda (Annex 1), the workshop consisted of plenary presentations and brainstorming discussions on a wide variety of topics, including aquaculture production systems, ecosystem based management, economic and social implications, law and policy.

The FAO Secretariat introduced the workshop by presenting an overview of sustainability approaches in aquaculture and a proposition for an initial EAA framework. This information has been included here in the Background section. Several presentations were made thereafter. They covered a review of coastal, marine and freshwater aquaculture considering present situation regarding EAA implementation. Other papers covered the potential legal and policy implications of an EAA by addressing national and international issues and also the economic and social dimensions were discussed. Other presentations highlighted some of the practices and tools for implementing EAA. These included reviews on integrated mariculture in world temperate zones, in one enclosed ecosystem (the Mediterranean Sea) and in tropical regions of the world. Additional presentations discussed some tools which can be used to support the implementation of an EAA such as the use of geographic information systems (GIS) and the role and practicality of sustainability indicators. Thereafter, three working groups were formed to discuss concepts, principles and scales of EAA, as well as some management measures.

## Major findings and agreements

The experts agreed on the following definition for EAA: *“An ecosystem approach to aquaculture is a strategy for the integration of the activity within the wider ecosystem in such a way that it promotes sustainable development, equity, and resilience of interlinked social and ecological systems”*. This definition essentially recaps that of the ecosystem-based management as proposed by the Convention on Biological Diversity and also takes into account the article 9 of the Code of Conduct for Responsible Fisheries (CCRF), referring to aquaculture.

The EAA should respond to three principles: i) Aquaculture should be developed in the context of ecosystem functions and services (including biodiversity) with no degradation of these beyond their resilience capacity, ii) Aquaculture should improve human well-being and equity for all relevant stakeholders; and iii) Aquaculture should be developed in the context of (and integrated to) other relevant sectors. Experts agreed on three scales/levels of EAA application: the farm; the relevant waterbody and its watershed and the global, market-trade scale while the policy level scale previously proposed in the workshop prospectus was felt to be cross cutting.

Additionally, experts identified some aquaculture practices which policy-makers could use when promoting EAA. These include: integrated aquaculture in general and integrated multitrophic aquaculture (IMTA) in particular; ecosystem-based approaches for mitigating negative impacts of aquaculture; inter-sectoral integration when appropriate; broadening stakeholders participation; use of appropriate incentives; use of local and other relevant knowledge; and promotion of EAA-specific research (e.g. estimate carrying capacity at farm level, at the level of the aquaculture zone, the region, etc.).

### **Current status of the Aquaculture sector and possibilities for the EAA implementation: contributed papers**

The contributed papers offer a broad spectrum of issues and facts which can be extremely useful in the developing of EAA guidelines. Definitions, principles, scales and management measures achieved by the experts are presented by Soto *et al.* (pp. 15–35). Social implications of EAA are analyzed by Bailey (pp. 37–46), economic implications are dealt with by Knowler (pp. 47–65) and the legal implications of an EAA are discussed by Bermúdez (pp. 67–79). Two review papers offer a global perspective on the current situation and perspectives for implementation of EAA. Marine and coastal systems are reviewed by Costa-Pierce (pp. 81–115) while freshwater systems are reviewed by Hambrey, Edwards and Belton (pp. 117–173).

Bailey (2008) analyses the social implications of EAA and argued that social and biophysical dimensions of ecosystems are inextricably related such that a change in one dimension is highly likely to generate a change in the other, he also indicates that an ecosystem approach to aquaculture cannot follow a precise blueprint, which is why the concept of adaptive management is important. He identifies seven issues that are directly related to resilience of social systems including i) entrepreneurial opportunity and employment generation; ii) gender relations; iii) economic diversification; iv) infrastructural development; v) food supply; vi) user conflicts; and vii) balances in wealth, income, and power. There are examples worldwide of aquaculture activities where some of these issues are considered properly but in general, greater efforts must be done particularly at the level of policy-making.

EAA also implies looking at the economics of aquaculture production from a broader social and environmental perspective. Knowler (2008) proposes the use of an agro-ecosystem framework. He introduces the concept of marginal opportunity cost, which measures what society must give up to obtain a little more of some particular good or service (e.g. farmed shrimp) recognizing the full set of costs incurred from production, regardless of where they occur or on whom they fall. Hence this captures the idea of an EAA from an economic perspective. The paper also recognizes that it is difficult to “internalize externalities” without a better idea of the extent of the externalities at issue. The author concludes with a plea for more and better valuation estimates but also recognizes a need for evaluations of the effectiveness of such exercises.

Bermúdez (2008) calls for a sound reflection about the implementation of EAA from a legal perspective, indicating the need for an integration of scientific, practical, economic and social aspects. EAA legislation will have to consider some specific “principles” such as: i) a holistic, multidisciplinary approach; ii) avoiding unnecessary complexity of measures which might paralyze aquaculture activity; iii) the consideration of “two-speed aquaculture”, that is, the fast developing industrial aquaculture, and the slower, smaller, rural and family-type aquaculture. The diversity of aquaculture practices worldwide, with different production scales, represents a challenge in devising appropriate legal solutions. Effective law enforcement and the need to adapt to specific conditions may be another challenge to be faced by governments as well as by local management.

The global reviews provide an in depth view of current practices both in marine areas and in freshwater. Costa-Pierce (2008) analyses the global status of mariculture and finds that overall, there is a great deal of global, multidisciplinary research and development information and good progress towards an ecosystem approach at the farm level which can inform managers. At the commercial level, there has been a notable transition globally towards an EAA in the industrial/commercial sector for two, major commodities – molluscs and shrimp – over the past ten years. At the commercial scale for marine finfish, there is some progress but not enough towards an ecosystem approach globally. There are few technological or scientific issues remaining to implement an EAA. His review finds that scarce participatory processes, poor

understanding of social sustainability requirements, and poor governance hinders the widespread adoption of an ecosystem approach to aquaculture, which will require a much tighter coupling of science, policy, and management.

Through literature review and eighteen case studies Hambrey, Edwards and Belton (2008), address the relevance of the ecosystem approach to freshwater aquaculture (mainly in Asia). Case studies include some examples where aquaculture has threatened sustained delivery of ecosystem services including biodiversity. Extensive and semi-intensive systems typically have a lesser effect over a greater area; while intensive systems usually have a more severe but more localised effect. As the authors point out, their case studies suggest that inland aquaculture generally improves human well-being and equity. Aquaculture generates employment for the poor, economic activity from the sale of low as well as high-value species in national and in some cases international markets, and low-cost fish for domestic consumption. Benefits generated through employment of the poor in the supply, processing and distribution chain can be substantial and significantly greater than those directly associated with small-scale farming. The authors recognize that to implement the ecosystem approach will require the development of institutions and associated integrated management systems which can deliver such an approach at realistic and practical scales, taking full account of the needs and impacts of other sectors, and this is a huge challenge. The key is to develop institutions capable of integration, especially in terms of shared agreed objectives and standards.

## REFERENCES

- Bailey, C.** 2008. Human dimensions of an ecosystem approach to aquaculture. In D. Soto, J. Aguilar-Manjarrez and N. Hishamunda (eds). Building an ecosystem approach to aquaculture. FAO/Universitat de les Illes Balears Expert Workshop. 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceedings*. No. 14. Rome, FAO. pp. 37–46.
- Bermúdez, J.** 2008. Legal implications of an ecosystem approach to aquaculture. In D. Soto, J. Aguilar-Manjarrez and N. Hishamunda (eds). Building an ecosystem approach to aquaculture. FAO/Universitat de les Illes Balears Expert Workshop. 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceedings*. No. 14. Rome, FAO. pp. 67–78.
- Costa-Pierce, B.** 2008. An Ecosystem Approach to marine aquaculture: a global review. In D. Soto, J. Aguilar-Manjarrez and N. Hishamunda (eds). Building an ecosystem approach to aquaculture. FAO/Universitat de les Illes Balears Expert Workshop. 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceedings*. No. 14. Rome, FAO. pp. 81–115.
- Hambrey, J., Edwards, P. & Belton, B.** 2008. An ecosystem approach to freshwater aquaculture: a global review. In D. Soto, J. Aguilar-Manjarrez and N. Hishamunda (eds). Building an ecosystem approach to aquaculture. FAO/Universitat de les Illes Balears Expert Workshop. 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceedings*. No. 14. Rome, FAO. pp. 117–221.
- Jacobs, P., Garner, J. & Munro, D. A.** 1987. Sustainable and equitable development. In P. Jacobs and D. A. Munro (eds) *Conservation with Equity*. IUCN, Cambridge, England.
- Knowler, D.** 2008. Economic implications of an ecosystems approach to aquaculture (EAA). In D. Soto, J. Aguilar-Manjarrez and N. Hishamunda (eds). Building an ecosystem approach to aquaculture. FAO/Universitat de les Illes Balears Expert Workshop. 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceedings*. No. 14. Rome, FAO. pp. 47–65.
- Muir, J.F.** 1996. A systems approach to aquaculture and environmental management. In J.D. Baird, M.C.M Beveridge, L.A. Kelly, & J.F. Muir (eds). *Aquaculture and water resource management*. Blackwell Science, UK, pp. 19–47.

Soto, D., Aguilar-Manjarrez, J., Brugère, C., Angel, D., Bailey, C., Black, K., Edwards, P., Costa-Pierce, B., Chopin, T., Deudero, S., Freeman, S., Hambrey, J., Hishamunda, N., Knowler, D., Silvert, W., Marba, N., Mathe, S., Norambuena, R., Simard, F., Tett, P., Troell, M., & Wainberg, A. 2008. Applying an ecosystem-based approach to aquaculture: principles, scales, and some management measures. In D. Soto, J. Aguilar-Manjarrez and N. Hishamunda (eds). Building an ecosystem approach to aquaculture. FAO/Universitat de les Illes Balears Expert Workshop. 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceedings*. No. 14. Rome, FAO. pp. 15–35.

# Workshop recommendations and the potential role of FAO

## **RECOMMENDATIONS**

The workshop recommended that as an initial first step, guidelines should focus on policy-making and emphasizing the different scales/levels and their interconnection. An enabling environment is crucial to adopt the EAA. There is a need for an enabling framework for an ecosystem sustainable development approach facilitating different sectors and institutions to talk amongst each other and to promote coordinated actions (e.g. legislation, management measures etc.). It will be necessary to promote and develop institutions and associated integrated management systems which can deliver such an approach at realistic and practical scales.

Markets are key and driven by consumers who can be a major tool to promote the EAA. Therefore, efforts must be made to keep them well informed about benefits of EAA to favour producers that make efforts to implement such strategy.

## **THE POTENTIAL ROLE OF FAO**

FAO should continue efforts to help the implementation of the EAA and the main follow-up activities to this workshop included the compilation of all review papers and the meeting report being presented in these proceedings. Additionally, FAO will organize a second workshop in which general EAA guidelines will be reviewed, analysed and agreed upon by a wide range of stakeholders, particularly policy-makers of different regions, backgrounds and nationalities.

FAO shall continue to make efforts to assist aquaculture sector to growth in a manner that contributes to poverty alleviation and to sustainable development in general.

# Annex 1 – Agenda

## BUILDING AN ECOSYSTEM APPROACH TO AQUACULTURE (EAA): INITIAL STEPS FOR GUIDELINES

Palma de Mallorca, Spain 7–11 May 2007

DATE	TIME	ACTIVITY
7-05-07		Arrival of participants and informal welcome
8-05-07	9.00	Welcome by organizers at IUB Campus
<b>BACKGROUND INFORMATION AND ANALYSIS OF CURRENT SITUATION (INCLUDING SOME GLOBAL REVIEWS): FOOD FOR THOUGHT AND TO ENLIGHTEN FURTHER DISCUSSIONS</b>		
	9.15 – 9.30	Introductory presentation on FAO initial views for EAA (as compared to EAF) and objectives, structure and outputs of the meeting - D. Soto
<b>Reviews</b>		
	9.30 – 10.30	EAA in coastal and marine areas: a global review. - B. Costa-Pierce
	10.00 – 10.30	EAA in freshwaters: a global review. - J. Hambrey, P. Edwards
	10.30 – 10.45	Discussion
	10.45 – 11.00	Coffee
<b>Contributed papers</b>		
	11:00 – 11.20	Economic implication within an EAA framework. - D. Knowler
	11:20 – 11:40	Social implications within an EAA framework; C. Bailey
	11:40 – 12.00	Policy and legal implications for an EAA framework; J. Bermúdez
	12.00 – 13.00	Discussion
	13:00 – 14.30	Lunch
<b>Some tools for EAA</b>		
	14.:30 – 15:30	Presentations on Integrated Aquaculture (marine-coastal): INTAQ in Temperate systems - T.Chopin; INTAQ in The Mediterranean - D. Angel; INTAQ in Tropical systems - M. Troell
	15.30 – 15:50	GIS as a tool for EAA - J. Aguilar
	15:50 – 16:10	EAA Indicators: W. Silvert (general), F. Simard (IUCN efforts for the Mediterranean Sea)
	16:10 – 16:40	Coffee
	16:40 – 17:30	Discussion
	17:30 – 18:00	Organization of working groups and activities
<b>9-05-07</b>		
<b>Agreeing on principles and scales</b>		
	09:00 – 09:30	Three Working Groups, each dealing with different scales and reviewing evaluating proposed principles.
	10:30 – 11:00	Coffee
	11:00 – 13:00	Working Groups Discussions
	13:00 – 14:30	Lunch
	14:30 – 17:30	Working Groups Discussions
	17:30 – 20:30	Visit tour to Palma de Mallorca and dinner in town

---

**10-05-07****Plenary discussion after summarizing major findings**

<b>09:00 – 10:30</b>	<b>Plenary</b>
<b>10:30 – 11:00</b>	<b>Coffee</b>
<b>11:00 – 13:00</b>	<b>Working Groups Discussions</b>
<b>13:00 – 14:30</b>	<b>Lunch</b>
<b>14:30 – 15:30</b>	<b>Working Groups Discussions</b>
<b>15:30 – 16:00</b>	<b>Coffee</b>
<b>16:00 – 17:30</b>	<b>Working Groups Discussions</b>

---

**11-05-07****Plenary**

<b>09:00 – 10:30</b>	<b>Plenary discussion: Agreement on definitions</b>
<b>11:00 – 13:00</b>	<b>Coffee</b>
<b>11:00 – 13:00</b>	<b>Plenary and conclusions: the way forward</b>
<b>13:00 – 14:00</b>	<b>Lunch and adjourn</b>

## Annex 2 – List of participants

### BELIZE/FRANCE

**Syndhia Mathe**

*Resource economics*

University of Montpellier 1 (UM1)

LASER/CEP

Faculté de Sciences Economiques

Avenue de la Mer

Site de Richter CS 79606

34960 Montpellier cedex 2, France

E-mail: [syndhia.mathe@univ-montp1.fr](mailto:syndhia.mathe@univ-montp1.fr)

### BRAZIL

**Alexander Weinberg**

*Organic integrated farming*

Alexandre Alter Wainberg, M.Sc.

PRIMAR

Caixa Postal 36

Goianinha, RN, Brazil

CEP 59173-000

Tel: (+55) 84 9401 1385

Fax: (+55) 32465 808.

E-mail: [piau.nat@terra.com.br](mailto:piau.nat@terra.com.br)

Web site: [www.primarorganica.com.br](http://www.primarorganica.com.br)

### CANADA

**Duncan Knowler**

*Environmental Economics*

Associate Professor

School of Resource and Environmental Management

Simon Fraser University

8888 University Drive

Burnaby, British Columbia

V5A 1S6 Canada

Tel: (+1) 604 291 3421

Fax: (+1) 604 291 4968

E-mail: [djk@sfu.ca](mailto:djk@sfu.ca)

Web site: [www.rem.sfu.ca/econ/](http://www.rem.sfu.ca/econ/)

**Thierry Chopin**

*Multitrophic aquaculture*

*seaweed farming*

University of New Brunswick

Department of Biology

Institute of Coastal Marine Science

Centre for Environmental and Molecular

Algal Research. P.O. Box 5050

Saint John, N.B., E2L 4L5, Canada

Tel: (+506) 648 5507/5565

Fax: (+506) 648 5811

E-mail: [tchopin@unbsj.ca](mailto:tchopin@unbsj.ca)

Web site: [www.unbsj.ca/sase/biology/chopinlab/](http://www.unbsj.ca/sase/biology/chopinlab/)

### CHILE

**Jorge Bermúdez**

*Environmental policy*

Law School, Pontificia Universidad

Católica de Valparaíso (PUCV)

Avenida Brazil 2950

Valparaíso, Chile

Tel: (+56) 32 227 3492

E-mail: [jorge.bermudez@ucv.cl](mailto:jorge.bermudez@ucv.cl)

Web site: [www.deradam.ucv.cl](http://www.deradam.ucv.cl)

**Ricardo Norambuena**

*Policy and institutional aspects*

Jefe Departamento de Acuicultura

Subsecretaría de Pesca

Bellavista 168 piso 17

Valparaíso, Chile

Tel: (+5632) 250 2741

Fax: (+5632) 250 2740

E-mail: [rnorambu@subpesca.cl](mailto:rnorambu@subpesca.cl)

### ISRAEL

**Dror Angel**

*Integrated aquaculture temperate systems*

Recanati Institute for Maritime Studies

Haifa University

Mt Carmel, Haifa 31905 ISRAEL

Tel: (+972) 4828 8130

Fax: (+972) 4824 0493

E-mail: [adr@research.haifa.ac.il](mailto:adr@research.haifa.ac.il)

**Shirra Freeman***Economical aspects*

Department of Geography and  
Environmental Studies, Haifa University,  
Mt. Carmel, 31905, Israel  
Tel: (+972) 4 678 2314 / 52 853 5605,  
Fax: (+972) 4 678 9052  
E-mail: shirra@c-pl.com

**PORTUGAL**

William Silvert

*EAA modelling, indicators*

Centre of Marine Sciences (CCMAR)  
Faculty of Marine and Environmental  
Sciences (FCMA)  
University of the Algarve  
Campus de Gambelas  
8005-139 Faro, Portugal  
Tel: (+351) 919 355 925  
E-mail: silvert@ualg.pt

**SPAIN****Salud Deudero***Marine invasions*

Laboratorio de Biologia Marina  
Departament de Biologia  
Guillem Colom, Campus Universitari  
Universitat de les Illes Balears  
Cra. de Valldemossa, km 7.5  
07122 Palma de Mallorca  
Illes Balears, Spain  
Tel.: (+34) 971 17 3138  
Fax : (+34) 971 17 3184  
E-mail: salud.deudero@uib.es

**Nuria Marba***EAA marine sea bed*

Institut Mediterrani d'Estudis Avancats  
Miquel Marqués 21  
07190 Esporles  
Illes Balears, Spain  
Tel.: (+34) 971 611720  
Fax: (+34) 971 611720  
E-mail: nuria.marba@uib.es

**François Simard***IUCN, NGO views*

Advisor on Fisheries and Maritime  
Affairs  
IUCN Center for Mediterranean  
Cooperation  
IUCN Global Marine Programme  
Tel: (+34) 952 028 430  
E-mail: francois.simard@iucn.org  
Web site : [www.uicnmed.org](http://www.uicnmed.org)  
[www.iucn.org/marine](http://www.iucn.org/marine)

**SWEDEN****Max Troell***Integrated Aquaculture, tropical systems*

Beijer International Institute of  
Ecological Economics  
The Royal Swedish Academy of Sciences  
P.O. Box 50005  
SE-104 05 Stockholm, Sweden  
Tel: (+46) 086 739 532  
E-mail: max@beijer.kva.se

**THAILAND****Peter Edwards***EAA, ecological social issues*

Emeritus Professor,  
Asian Institute of Technology,  
593 Lat Prao Soi 64,  
Bangkok, 10310, Thailand  
Tel: (+66) 2 538 6551  
Fax: (+66) 2 530 0660  
E-mail: pedwards@inet.co.th  
pedwards@ait.ac.th

**UNITED KINGDOM****Kenny Black***EAA, carrying capacity*

Head of Ecology Department  
Scottish Association for Marine Science  
Dunstaffnage Marine Laboratory  
Oban, Argyll  
Scotland  
PA37 1QA  
Tel: (+44) 01631 559259  
Fax: (+44) 01631 559001  
E-mail: kenny.black@sams.ac.uk  
Web site: [www.sams.ac.uk](http://www.sams.ac.uk)

**John Hambrey***EAA freshwater*

Hambrey Consulting

Crancil Brae House

Strathpeffer

Ross-shire IV14 9AW, United Kingdom

Tel/Fax: (+44) 01997 420086

Mobile 07899 876992

E-mail: john@hambreyconsulting.co.uk

Web site: www.hambreyconsulting.co.uk

**Paul Tett***EAA modelling, carrying capacity*

School of Life Sciences, Napier

University, 10 Colinton Road,

Edinburgh EH10 5DT, United

Kingdom

E-mail: p.tett@ichrachan.u-net.com

**UNITED STATES OF AMERICA****Conner Bailey***EAA-Sociology*

Professor of Rural Sociology

202 Comer Hall

Auburn University

AL 36849-5406, United States of America

Tel: (+1) 334 844 5632

Fax: (+1) 334 844 5639

E-mail: bailelc@auburn.edu

Web site: www.ag.auburn.edu/~cbailey/

**Barry Costa-Pierce***EAA marine and coastal*

Director and Professor

Rhode Island Sea Grant College

Program

129 Coastal Institute Building

Narragansett, R.I. 02882-1197, United

States of America

Tel: (+1) 401 874 6800

E-mail: bcp@gso.uri.edu

**FOOD AND AGRICULTURE  
ORGANIZATION OF THE UNITED  
NATIONS (FAO)****Doris Soto***EAA ecological aspects*

Senior Fishery Resources Officer (FIMA)

Fisheries and Aquaculture Department

Food and Agriculture Organization of  
the United Nations (FAO)

Viale delle Terme di Caracalla

00153 Rome, Italy

Tel: (+3906) 570 56149

Fax: (+3906) 570 53020

E-mail: Doris.Soto@fao.org

**José Aguilar-Manjarrez***GIS for EAA*

Fishery Resources Officer (FIMA)

Fisheries and Aquaculture Department

Food and Agriculture Organization of  
the United Nations (FAO)

Tel: (+3906) 570 55452

Fax: (+3906) 570 53020

E-mail: Jose.AguilarManjarrez@fao.org

**Nathanael Hishamunda***Aquaculture socio-economics*

Fishery Planning Officer (FIEP)

Fisheries and Aquaculture Department

Food and Agriculture Organization of  
the United Nations (FAO)

Tel: (+3906) 570 54122

E-mail: Nathanael.Hishamunda@fao.org