

Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia



**Mangrove-Friendly Aquaculture Program
Government of Japan Trust Fund**

**Aquaculture Department
Southeast Asian Fisheries Development Center
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Preface

Use of mangrove ecosystems for aquaculture has about four hundred years of history in Indonesia and the Philippines, where they were converted primarily into shallow ponds (called *tambak*, *punong*, or *palaisdaan*) for milkfish farming. Mangrove swamps were used for traditional fish ponds because they could not be used for agriculture or for habitation. Nobody seemed to own them, and it seemed that anybody could use them or harvest forest and fishery products from them. Mangrove swamps and forests were regularly watered during high tide and could be developed into ponds by simply clearing the trees and putting a dike around an area with very little excavation.

Over the past 30 years, aquaculture systems and technologies have diversified and intensified, particularly in Asia. Starting in the 1980s, a strong Japanese market for shrimps induced farmers and governments to convert milkfish farms and mangrove swamps to shrimp farms. Although shrimp farming has been carried out in mangrove areas in many countries, there has come a slow realization that mangroves are not the best site for modern aquaculture. New technologies require deeper ponds and more excavation. Once excavated, soil with high iron sulfide content is exposed and becomes highly acidic. At high stocking density and high feeding rate, higher water exchange rates are required and these could no longer be provided by tidal action.

Of course, mangrove ecosystems were exploited and converted in many other ways as tropical maritime countries developed and needed more food, fuelwood, timber, land, roads, ports, and foreign exchange. Mangrove ecosystems have definitely been nature's gift to developing countries. This gift is like a bank account containing big capital that is earning big interest. As responsible recipients of this gift, developing countries are best advised to use just the interest (new growth and production) and leave the capital (the ecosystem) intact. Governments now promote sustainable use of mangrove ecosystems for a variety of uses beneficial to the greatest number. Thus, more aquaculture systems are now integrated within the more or less intact mangrove ecosystem rather than in place of clear-felled mangrove forests.

This *Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia* is a collection of guidelines defined and agreed upon by the SEAFDEC and ASEAN Member Countries during consultations in 2004. The SEAFDEC Aquaculture Department enjoins the aquaculture sector and all other users of mangrove ecosystems to be responsible stewards of the gift of mangroves. The payback is food security and sustainable livelihoods.



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Introduction

Mangrove ecosystems: importance, status, and threats

Mangrove ecosystems (or simply ‘mangroves’) are the tide-influenced wetland complex consisting of mangrove forests, estuaries, lagoons, and associated habitats along the coasts and around islands in the tropics and subtropics. The mangrove forest consists of seawater-adapted flowering trees and shrubs, and the many associated ferns, fungi, and algae, including many epiphytes. The ‘true mangrove’ plants are members of the genera *Rhizophora*, *Bruguiera*, *Ceriops*, *Avicennia*, *Sonneratia*, *Xylocarpus*, *Heritiera*, and *Excoecaria*.

Mangroves support microscopic to large, terrestrial and aquatic (marine and freshwater), transient and resident wildlife. The mangrove physical environment includes waterways, mudflats, salt pans, and islands, with a wide range of salinities, daily tidal flood and ebb, and anaerobic mud bottoms.

For much of history, people have regarded mangroves as wastelands to be converted into more useful forms. Thus, mangrove areas around the world have been clear-felled and converted into human settlements, roads, piers, aquaculture ponds, agriculture farms, industrial sites, and other uses. The scale of conversion and loss of mangroves have increased dramatically in recent years, with many countries losing 50-80% of the mangrove cover in 50 years. The food supply and livelihood of many local coastal communities have been lessened or lost because of the removal or degradation of mangrove ecosystems.

Mangrove-associated aquaculture has worldwide importance in providing subsistence-level food and income, as well as commercial benefits, for a wide range of stakeholders. Unfortunately, some aquaculture development has also resulted in severe environmental degradation and socioeconomic problems, due to poor management practices and lack of enforcement of environmental regulations. There is a need to adopt better aquaculture practices that are compatible with mangrove ecosystem management.

Mangrove loss has stemmed from failures in policy, management, and enforcement of protection measures. Mangrove conservation can succeed only through appropriate policies and action, and only with due consideration of the problems of people and production. Mangrove conservation and rehabilitation policies must increase livelihood options for local communities. On the other hand, forestry, fisheries, aquaculture, and other production sectors must use the best practices that promote conservation of mangrove biodiversity.

Fortunately, society has begun to appreciate the value of mangroves far beyond the land, the fuel wood, the fish, and other goods. Mangroves have begun to be valued for their many ecological functions, such as providing protection against waves and storms, habitats for biodiversity, erosion control, silt entrapment, nursery and feeding grounds for fishery species, and subsistence livelihoods for coastal residents. Governments, non-government organizations (NGOs), and local communities around the world have stepped up efforts to conserve, sustainably use and manage, and rehabilitate mangroves.

World Bank, ISME, cenTER Aarhus (2005). *Principles for a Code of Conduct for the Management and Sustainable Use of Mangrove Ecosystems*. (Version 10 March 2005). 106 pages. Work in Progress: http://mit.biology.au.dk/cenTER/MCB_Files/2005_MCB_Code_March.pdf

Scale of the threats to mangroves in tropical Asia and Africa

Threat	South and Southeast Asia	Africa Central and South
Natural disasters	Low-High <i>Increasing</i>	Medium <i>Increasing</i>
Population pressure	High <i>Increasing</i>	High <i>Increasing</i>
Overexploitation by traditional users	High <i>Increasing</i>	Medium <i>Increasing</i>
Forestry	High <i>Stable</i>	Medium <i>Increasing</i>
Agriculture	High <i>Decreasing</i>	High <i>Increasing</i>
Aquaculture	High <i>Increasing</i>	Low <i>Increasing</i>
Salt Production	High <i>Decreasing</i>	High <i>Stable</i>
Urban and industrial development	High <i>Increasing</i>	Low <i>Increasing</i>
Tourism	Low-Medium <i>Increasing</i>	Low <i>Increasing</i>
Hydrological diversions, e.g. dams	Medium-High <i>Increasing</i>	Localised medium-high <i>Increasing</i>
Coastal pollution	Medium-High <i>Increasing</i>	Medium-High <i>Increasing</i>
Mining	Low-Medium <i>Decreasing</i>	Medium <i>Increasing</i>
Management shortcomings	Medium-High <i>Decreasing</i>	High <i>Stable</i>

From World Bank et al. (2005)

Causes of loss of mangrove forests

Direct human action: drainage for agriculture and mosquito control, dredging and flood protection, cutting for fuelwood and wood chips, conversion to shrimp and fish ponds and salt pans, mining, oil pollution, construction of roads, sea walls, dikes, and tourist facilities

Indirect human action: sediment diversion due to dams and floods, change in waterways due to construction of canals and roads, increased soil salinity by changes in freshwater runoff

Natural causes: sea level rise, drought, typhoons, soil erosion

Responsible Aquaculture

Aquaculture means the farming of aquatic organisms including fish, mollusks, crustaceans, echinoderms, and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding and protection from predators. Farming also implies individual or corporate ownership of or rights resulting from contractual arrangements to, the stock being cultivated primarily for livelihood and business activities. For statistical purposes, aquatic organisms harvested by an individual or corporation, which has owned them throughout their rearing period contribute to aquaculture, whereas aquatic organisms exploited by the public as a common property resource, with or without appropriate licenses, are the harvest of fisheries.

Responsible aquaculture encompasses use of appropriate and efficient farming technologies and practices that are not harmful to ecosystems and resources, and post-harvest handling, processing, and marketing that produce healthy and wholesome products for consumers. Responsible aquaculture makes efficient use of land and water and also conserves ecologically sensitive habitats and ecosystem functions.

Several global and national guidelines now exist for responsible aquaculture, including:

- *FAO Code of Conduct for Responsible Fisheries* (1995)
- *Environment Code of Practice for Australian Prawn Farmers* (1998)
- *Thailand Operating Guidelines for Shrimp Farms* (2000)
- *SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia – Responsible Aquaculture* (2001, 2005)
- *Global Aquaculture Alliance Codes of Practice for Responsible Shrimp Farming* (1999)
- *Philippine Code of Practice for Sustainable Shrimp Farming* (2001)



Regional Guidelines for Responsible Aquaculture

In 2000, the Southeast Asian Fisheries Development Center (SEAFDEC) initiated a program to 'regionalize' the global *FAO Code of Conduct for Responsible Fisheries*, and the Aquaculture Department eventually produced the *Regional Guidelines for Responsible Fisheries in Southeast Asia – Responsible Aquaculture* in 2001. The *Regional Guidelines* includes the following articles relevant to responsible aquaculture in mangrove ecosystems:

Article 9.1.1.4.

States should establish the legal framework for the use of non-land based aquaculture, emphasizing the integration of aquaculture into coastal area management.

Article 9.1.3.3.

States and the region should adopt an integrated approach to the development, maintenance, preservation, and sustainable use of aquaculture areas including lakes, rivers, mangroves, and other aquatic ecosystems.

Article 9.1.3.4.

Given the importance of mangroves, States and regional institutions should prepare regional guidelines for the responsible use of mangroves for aquaculture. States should ensure coordination among departments, agencies, and other units that have jurisdiction and stake in mangroves.

Article 9.1.3.5.

States should ensure that abandoned and unutilized aquaculture facilities are rehabilitated as far as possible to an ecologically sustainable system.

The *Regional Guidelines for Responsible Fisheries in Southeast Asia – Responsible Aquaculture* was adopted during the ASEAN-SEAFDEC Millennium Conference in Bangkok in October 2001. At that time, it was agreed that a regional *Code of Practice for Responsible Aquaculture in Mangrove Ecosystems in Southeast Asia* be formulated through the ASEAN-SEAFDEC Mangrove-Friendly Aquaculture Program

FAO Code of Conduct for Responsible Fisheries

The Code sets out principles and international standards of behavior for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The Code recognizes the nutritional, economic, social, environmental and cultural importance of fisheries and the interests of those involved in the fishery sector. The Code is global in scope and is directed towards members and non-members of FAO, fishing entities and organizations, and all persons concerned with the conservation of fishery resources and management and development of fisheries, such as fishers, those engaged in processing and marketing of fish and fishery products and other users of the aquatic environment in relation to fisheries.

The Code was endorsed by the FAO Committee on Fisheries and adopted by the 28th session of the FAO Conference on 31 October 1995. The Code is voluntary but is based entirely on international law especially the United Nations Convention on the Law of the Seas. The

Responsible fisheries

Use or harvest of aquatic resources in harmony with the environment – a concept encompassing capture (fishing) and culture (farming) methods and practices that are not harmful to ecosystems and resources, transformation processes that add value to the products and meet the required sanitary standards, and commercial practices that provide consumers good quality products.

ASEAN-SEAFDEC Mangrove-Friendly Aquaculture Program

The ASEAN-SEAFDEC Program on the Promotion of Mangrove-Friendly Aquaculture in Southeast Asia was approved for implementation in 1999 with AQD as Lead Department and Thailand as Lead Country for the ASEAN. The initial five-year program was planned to cover culture of various organisms that could have effects on mangroves. Upon the recommendation of the 22nd SEAFDEC Program Committee, the program was revised to focus on the effects of shrimp culture on mangroves. Thus, the Mangrove-Friendly Shrimp Culture Program was carried out starting in 2001.

The Program aimed to develop sustainable shrimp farming by means of technology packages that are non-destructive or ‘friendly’ to mangroves and the environment, and to disseminate such packages to the region through actual demonstration, training, conferences, and extension manuals. To refine the technology packages, research was conducted to understand the (1) effects of shrimp pond effluents on mangrove trees, (2) feeds and nutrient dynamics in shrimp ponds, (3) mechanisms of action of probiotics, and (4) mechanisms of action of ‘green water.’

Under the Program, technology verification and pilot demonstration were conducted in Thailand, the Philippines, Vietnam, Myanmar, and Malaysia. Skills development sessions were conducted at the pilot project sites. To hasten the transfer of developed technologies, training sessions were conducted formally at AQD and on-site in the Member Countries, such as Vietnam and Cambodia. The training sessions included lectures, but mostly practical work in shrimp ponds and field visits to successful shrimp farms.

Information dissemination was also an important component of the Program. A mangrove web site www.mangroveweb.net was put up in 2001 to carry information about the Program, mangroves, and shrimp farming.



Extension manuals and other information materials were published and sent out to the Member Countries. The manual *Best Management Practices for Mangrove-Friendly Shrimp Farming* was published in 2002 and has been translated into Filipino, Bahasa Indonesia, and Burmese (translations into Thai, Vietnamese, and Khmer are ongoing). To assess Program implementation, seminar-workshops were convened and the reports of these were sent to the Member Countries.

Preparation of the regional *Code of Practice for Responsible Aquaculture in Mangrove Ecosystems in Southeast Asia* was started during the Regional Seminar-Workshop on Mangrove-Friendly Shrimp Aquaculture in June 2003. Initial inputs were gathered from the Country Representatives and the initial list of Core Experts was put together.



The Regional Technical Consultation held in Bohol, Philippines on 25-27 August 2004 produced a Code of Practice for the Sustainable Use of Mangroves in Aquaculture in Southeast Asia

Regional Technical Consultation on the Code of Practice

In early 2004, the SEAFDEC Aquaculture Department drafted a regional *Code of Practice for Responsible Aquaculture in Mangrove Ecosystems in Southeast Asia* for discussion during the Regional Technical Consultation. For this draft Code, the *Principles for a Code of Conduct for the Management and Sustainable Use of Mangrove Ecosystems* (2005) was used as the main source book of concepts, policy statements, explanations, and examples.

The Regional Technical Consultation for the Development of the Regional Code of Practice for Responsible Aquaculture in Mangrove Ecosystems was convened by AQD in Tagbilaran, Bohol, Philippines from 25 to 27 August 2004. It was attended by 40 Core Experts and representatives from the SEAFDEC-ASEAN Member Countries, and from AQD, UNESCO, JIRCAS, and non-government organizations.

The SEAFDEC/AQD draft of the *Code of Practice* was submitted to the RTC for review, discussion, and revision. The RTC produced a second draft, retitled *Code of Practice for the Sustainable Use of Mangrove Ecosystems in Aquaculture in Southeast Asia*.



The Core Experts and Country Representatives took the second draft *Code* home to be discussed with their respective governments, fish farmers, and other stakeholders. Inputs were later collated and incorporated in a third draft *Code* that was presented during the 27th SEAFDEC Program Committee Meeting in November 2004, and also during the 7th ASEAN-SEAFDEC Fisheries Consultative Group Meeting and the 37th SEAFDEC Council Meeting in April 2005. More annotations and examples were later added, and a lay-out was prepared and distributed to the Member Countries for final review.



Felizardo Guerrero, Jr., 15 years old

Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia

Objectives of the Code of Practice

- To define principles, guidelines, and best practices for responsible aquaculture in mangrove ecosystems in Southeast Asia
- To provide a tool to guide States, non-government organizations, research and academic institutions, aquaculture practitioners, mangrove managers, local communities, global and regional aid and financial institutions, and other stakeholders concerned with both responsible aquaculture *and* the conservation and sustainable use of mangrove ecosystems
- To recommend key legislation and enforcement mechanisms to ensure both responsible aquaculture *and* the conservation and sustainable use of mangroves

What's in the title?

Code of Practice

A set of concepts, principles, or policy statements that prescribe preferred ways of doing and acting to achieve standard or desired results

Sustainable use

The introduction and application of methods and processes for the use of biodiversity, at the same time maintaining its potential to meet current and future human needs and aspirations.

Article 10 of the Convention on Biological Diversity sets the sustainable use agenda as follows:

- Integrate consideration of the conservation and sustainable use of biological resources into national decision-making.
- Adopt measures relating to the use of biological resources to avoid or minimize adverse impacts on biological diversity.
- Protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements.
- Support local populations to develop and implement remedial action in degraded areas where biological diversity has been reduced.
- Encourage cooperation between its governmental authorities and its private sector in developing methods for sustainable use of biological resources.

Mangrove ecosystems

Tide-influenced wetlands consisting of mangrove forests, estuaries, lagoons, and associated habitats along the coasts and around islands in the tropics and subtropics. The mangrove forest consists of seawater-adapted plants, and the swamps are inhabited by a variety of fishes, invertebrates, reptiles, birds, and other wildlife.

Aquaculture

Farming of fish, mollusks, crustaceans, echinoderms, and aquatic plants, in different enclosures in fresh, brackish, or marine waters, for food, livelihood, and business. Farming implies some form of intervention to enhance production, such as regular stocking, feeding, and protection from predators. Farming also implies individual or corporate ownership of the farmed stock.

Southeast Asia

The *Code* was prepared taking into account the diversity of social, economic, cultural, ecological, and institutional contexts of the 10 Member Countries of the ASEAN (Association of Southeast Asian Nations) and SEAFDEC (Southeast Asian Fisheries Development Center), particularly in terms of the development and management of mangroves and aquaculture.

Southeast Asia is largely tropical and monsoonal, and its ecosystems and the component flora and fauna are highly diverse. Except Lao PDR, the ASEAN countries have some of the richest mangrove ecosystems in the world. Ecosystem diversity makes possible the diversity of fisheries and aquaculture in the region. The complexity of mangroves and other ecosystems also makes the introduction of exotic or non-native species more dangerous and harder to predict.

Although the traditions and cultures of the 10 ASEAN-SEAFDEC Member Countries are varied, two things stand out in common. First, fish is part of the daily diet and is a major if not main source of animal protein. Second, aquaculture is already part of daily life and products of aquaculture already contribute to meal tables. Due to the long tradition, the aquaculture industry in the region is very heterogeneous in terms of the species being farmed, the farm sites, and the scales of operation.

Article 1. Recognize mangrove ecosystems as provider of vital ecological services and valuable goods to coastal areas and communities.

- 1.1. States should recognize, and promote public awareness of, the fact that mangrove ecosystems provide a variety of goods (fuel wood, timber, fish, mollusks, crustaceans, and other products that can be priced in the market), and also vital ecological services that are not usually 'priced' or accounted for, such as coastal protection, nutrient cycling, erosion control, silt entrapment, and provision of habitats for biodiversity, and nursery and feeding grounds for fishery species.
- 1.2. States should recognize that many forms of subsistence fishing and fish farming in mangrove areas provide vital economic support to coastal communities worldwide.

Article 2. Protect and conserve mangroves to sustain vital ecological services and goods.

- 2.1. States should protect and conserve large areas of mangroves to safeguard their ecological functions and to ensure that goods and products can continue to be harvested from them indefinitely.
- 2.2. States should recognize that loss of mangrove areas means the loss of these ecological services and goods, all to the detriment of coastal areas, human communities, and economic enterprises including aquaculture, fisheries, agriculture, and forestry.

Article 3. Improve governance over mangrove conservation and sustainable use, such as for aquaculture.

- 3.1. States should review and rationalize inconsistent policies and legislation pertaining to mangrove conservation and sustainable use, such as for aquaculture.
- 3.2. States should improve enforcement of existing laws and regulations related to mangrove conservation and sustainable use.
- 3.3. States should ensure effective coordination and linkages among the various government agencies involved in mangrove conservation and sustainable use.

Article 4. Integrate aquaculture and mangrove conservation in coastal zone management.

- 4.1. States should work towards integrated coastal zone and watershed management, where the needs of local communities and the various economic sectors (aquaculture, fisheries, forestry, agriculture, industry, transportation, tourism) are coordinated and harmonized.
- 4.2. States should establish appropriate zones for use of aquaculture and the various other economic sectors, in agreement with local communities and other stakeholders.
- 4.3. States should base planning and management decisions on biophysical and ecological data on mangroves and aquatic ecosystems (inventories, maps), their current uses and users, economic costs and benefits, appropriate technologies, and local requirements for education, recreation, and aesthetics.
- 4.4. States should establish systems for monitoring of mangrove ecosystems, evaluation of economic enterprises, and early detection of adverse effects.

Article 5. Assess and classify existing mangrove ecosystems for proper disposition.

- 5.1. States should conduct periodic inventory and ecological assessment of the mangrove areas within their territory. Ecological quality of mangrove areas may be defined based on geomorphology, water flows, mangrove cover, forest structure, sediment quality, and plant and animal biodiversity.
- 5.2. States may classify mangrove areas in terms of ecological quality and present use, and allocate or use them as recommended below:

<i>Ecological quality</i>	<i>Present use and status</i>	<i>Recommended disposition</i>
Excellent	not yet used, pristine	full protection, non-use, ‘no touch’
Good	slightly used	conservation, sustainable use
Poor	fully converted, damaged	optimum use, rehabilitation

Article 6. Retain a mangrove greenbelt or buffer zone along coasts and rivers where mangroves naturally occur, and where replanting is technically feasible.

- 6.1. States should retain or replant a mangrove greenbelt or buffer zone along the coasts and rivers for protection from erosion, waves, and storms.
- 6.2. States should enact the necessary greenbelt laws, or enforce existing greenbelt laws.
- 6.3. States should ensure that aquaculture farms in mangrove areas maintain a greenbelt for protection of the dikes and for treatment of farm effluents.

Article 7. Locate aquaculture farms outside of pristine mangroves, coral reefs, and seagrass beds.

- 7.1. States should encourage aquafarmers to find suitable farm sites outside of pristine mangrove ecosystems, and also outside of coral reefs and seagrass beds. Mangrove areas often have peat soils or potential acid sulfate soils not good for farms. Coral reefs and seagrass beds are damaged by siltation from farm effluents or sediments.
- 7.2. States should prohibit or minimize large-scale aquaculture in UNESCO Biosphere Reserves and other marine protected areas.

Article 8. Prohibit conversion of pristine mangrove ecosystems into shrimp aquaculture farms and other uses.

States should prohibit conversion of pristine mangrove ecosystems and associated tidal flats for shrimp farming and other uses that require clear-felling of forests and draining of swamps.

Article 9. If large-scale aquaculture farms must be built in mangroves, then require a full environmental impact assessment.

States should develop and implement procedures for a full, independent, and public Environmental Impact Assessment (EIA), or an equivalent procedure, for large-scale aquaculture farms to be located in mangroves. The EIA includes determination of the impact of the farm on the mangrove ecosystem and on the food supply and livelihoods of local communities. The EIA also provides for a management plan, mitigating measures, and periodic monitoring and evaluation of farm operations.

Article 10. Promote small-scale integrated aquaculture in sustainable-use mangrove areas.

States should promote small-scale integrated mangrove-aquaculture systems that are non-destructive, sustainable, and beneficial to fishing communities.

Article 11. Make available to aquafarmers appropriate technologies and information on best management practices for aquaculture in mangrove ecosystems.

States should make available to farmers appropriate technologies and information on the best management practices for different aquaculture systems in mangrove areas.

Article 12. Follow national and regional guidelines and codes of conduct for responsible aquaculture.

- 12.1. States should ensure that aquaculture farmers adopt codes of practice based on the *Regional Guidelines for Responsible Fisheries in Southeast Asia – Responsible Aquaculture* drawn up by the SEAFDEC and ASEAN Member Countries.
- 12.2. States should also help farmers adopt more sustainable farming practices and technologies so they can comply with the codes of conduct.

Article 13. Apply appropriate incentives and disincentives to encourage good farming practices.

States should establish a system of appropriate licenses, permits, and fees for use of land and water, penalties for violations of aquaculture regulations, and other incentives and disincentives to ensure that farms use mangrove-friendly technologies and management practices.

Article 14. Require optimum production in aquaculture farms located in mangrove areas.

- 14.1. States should ensure that aquaculture farms in mangrove areas are fully developed for the optimum production of fish, crustaceans, mollusks, or seaweeds.
- 14.2. States should not allow farmers to use the aquaculture permit to hold lease on the mangrove land for other purposes. Underutilized aquaculture farms must be brought to full use or have their permits or lease revoked.

Article 15. Establish land and water quality criteria for aquaculture.

States should establish land and water quality criteria for allowing farming operations in mangrove ecosystems and other aquaculture sites.

Article 16. Prevent pollution, disease contamination, and hydrological alterations in mangrove ecosystems.

States should establish regulations to prevent severe pollution and disease contamination of mangrove areas from aquaculture effluents, by means of appropriate water management and effluent treatment. Construction of the farms must also not adversely alter the waterways and water flows in mangrove areas.

Article 17. Regulate introduction of exotic species for aquaculture.

States should strictly regulate the introduction of exotic species for aquaculture as these exotics may escape from farms into and through mangrove waterways, often with adverse effects. Mangrove ecosystems are open systems with extensive water exchange and animal movements between adjacent freshwater and marine habitats.

Article 18. Minimize collection from mangrove ecosystems of wild broodstock, seedstock, and feedstuff for aquaculture.

States should conserve animal biodiversity in the mangrove waterways. Thus, States should regulate or prevent the collection from mangrove areas of broodstock for hatcheries, larvae and juveniles for grow-out farms, and juvenile fish and other feedstuff for farmed fishes and crustaceans.

Article 19. Rehabilitate abandoned aquaculture ponds back to mangroves.

States should promote the rehabilitation of abandoned fish and shrimp ponds back to mangroves with the support and cooperation of local communities. Rehabilitation can be achieved by breaking the dikes to restore the water flow and recolonization, or by planting propagules or seedlings from the wild or from the nursery.

Article 20. Consider product labeling and certification for mangrove-friendly aquaculture and fishery products.

States should consider product labeling and certification for mangrove-friendly aquaculture and fishery products to raise consumer awareness about mangrove-friendly aquaculture and fishery technologies and practices.

Article 21. Support research, training, and education about mangroves and mangrove-friendly aquaculture.

States should actively support research, technology transfer, training, information dissemination, communication, and widespread public education about mangrove conservation and mangrove-friendly aquaculture.

Article 22. Resolve conflicts between aquaculture and other users of mangrove ecosystems.

States should establish mechanisms for conflict resolution among the various stakeholders in mangrove areas, including compensation schemes for the adverse effects of aquaculture on local communities.

Definitions, explanations, and examples

In the following pages, the articles of the *Code* are annotated with definitions, explanations, and many examples. The book *Principles for a Code of Conduct for the Management and Sustainable Use of Mangrove Ecosystems* was used as the source book, in the spirit of unity of principles and purpose.

Sustainable development

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987)

“Management and conservation of the natural resource base and the orientation of technological change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable” (FAO 1988)

World Bank, ISME, cenTER Aarhus (2005). *Principles for a Code of Conduct for the Management and Sustainable Use of Mangrove Ecosystems*. (Version 10 March 2005). 106 pages. Work in Progress: http://mit.biology.au.dk/cenTER/MCB_Files/2005_MCB_Code_March.pdf

Precautionary approach

A decision to take action, based on the possibility of significant environmental damage, even before there is conclusive, scientific evidence, that the damage will occur.

Principle 15 of the Rio Declaration on Environment and Development states that: *“In order to protect the environment, the precautionary approach shall be widely applied by the States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”*

The Precautionary Principle acknowledges that:

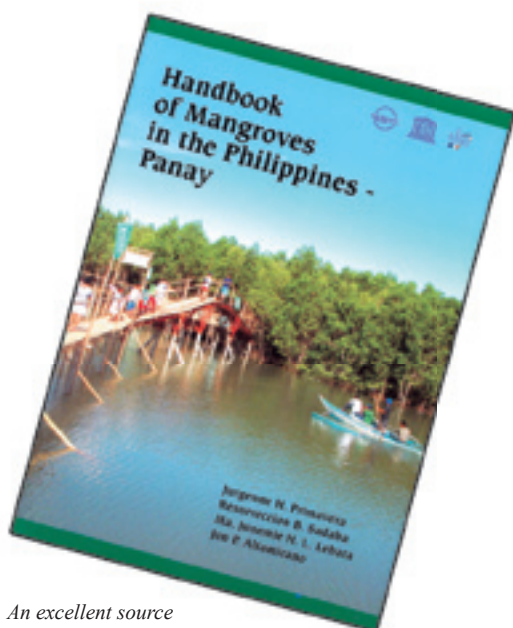
- People have a duty to take anticipatory action to prevent harm.
- The burden of proof of harmlessness of a new technology, process or activity lies with the proponents, not with the general public.
- Before introducing a new technology, process, or starting a new activity, people have an obligation to examine ‘a full range of alternatives’ including the alternative of doing nothing
- Decisions applying the precautionary principle must be open, informed, and democratic and must include all affected parties.
- It is easier and more effective to avoid harm than to restore damaged ecosystems.

Article 1. Recognize mangrove ecosystems as provider of vital ecological services and valuable goods to coastal areas and communities.

- 1.1. States should recognize, and promote public awareness of, the fact that mangrove ecosystems provide a variety of goods (fuel wood, timber, fish, mollusks, crustaceans, genetic resources, and other products that can be priced in the market), and also vital ecological services that are not usually ‘priced’ or accounted for, such as coastal protection, nutrient cycling, erosion control, silt entrapment, and provision of habitats for biodiversity, and nursery and feeding grounds for fishery species.
- 1.2. States should recognize that many forms of subsistence fishing and fish farming in mangrove areas provide basic food security and vital economic support to coastal communities around the world.

Article 2. Protect and conserve mangroves to sustain vital ecological services and goods.

- 2.1. States should protect and conserve large areas of mangroves to safeguard their ecological functions and to ensure that goods and products can continue to be harvested from them indefinitely.
- 2.2. States should recognize that loss of mangrove areas means the loss of these ecological services and goods, all to the detriment of coastal areas, human communities, and economic enterprises including aquaculture, fisheries, agriculture, and forestry.



An excellent source of information on mangroves

Valuation of mangroves

Analysis of a mangrove system in Thailand revealed that conversion for aquaculture made sense in terms of short-term private benefits, but not once external cost were factored in. The global benefits of sequestration were considered to be similar in intact and degraded systems. However, the substantial social benefits associated with the original mangrove cover — from timber, charcoal, non-traditional forest products, offshore fisheries, and storm protection — fell to almost zero following conversion. Summing all measured goods and services, the total economic value of intact mangroves exceeded that of shrimp farming by around 70% (about US\$60,4000 compared with \$16,700 per hectare). (Balmford et al. 2002)

State

National government, or any level government in charge of development and regulation

The State provides the legal and administrative framework (agencies, authorities, and the appropriate laws, regulations, orders, agreements, including codes of practice) for the development, promotion, regulation, and management of ecosystems and economic activities

Food security

The situation that exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life

Biological diversity or biodiversity

The variety and variability of life on earth, comprising ecosystems, species, and genes in given geographic areas

Ecosystems

Ecological systems such as mangroves, coral reefs, seagrass beds, lakes, rivers, etc. containing different habitats, the species that live therein, and the processes and interactions that take place within and with adjoining systems

Species

A group of interbreeding individuals that share the same gene pool and usually (but not always) the same body form

Gene pool

The variation within a given species, measured in terms of the differences in genes (DNA or amino acid sequences) as well as breeds, strains, or populations

Genetic resources

The genetic material of plants, animals, and microorganisms that are of actual or potential value as a resource for future social, economic, or environmental purposes

Ecosystem goods

Ecosystem products — fish, wood, medicines, etc. — harvested for household use or for sale

Ecosystem functions

The processes of production and the dynamics of energy and resources (organic matter, nutrients, biomass, elements) through ecological systems

Ecological or ecosystem services

Important services provided by large intact ecosystems — coastal protection, nutrient cycling, erosion control, silt entrapment, and provision of habitats for biodiversity and nursery and feeding grounds for fishery species

Ecosystem integrity

Maintenance of the natural biological diversity, interactions, connections, and functions of ecosystems

Economic value

The value of a good or service placed by an individual or society through his willingness to pay using market price or other indicators

Valuation

The process of placing monetary value on goods and services (such as biodiversity) that do not have accepted market prices

Direct use value

The productive or consumptive values derived from direct use or interaction with a biological resource that may or may not be marketed

Indirect use value

The value of an environment's ecological functions which support or protect the life forms dependent on that environment

Existence value

The benefit an individual or society receives from merely knowing that a good or service exists; can be measured as society's willingness to pay towards the conservation of biological resources for their own sake regardless of their current or optional uses

Article 3. Improve governance over mangrove conservation and sustainable use, such as for aquaculture.

- 3.1. States should review and rationalize inconsistent policies and legislation pertaining to mangrove conservation and sustainable use, such as for aquaculture.
- 3.2. States should improve enforcement of existing laws and regulations related to mangrove conservation and sustainable use.
- 3.3. States should ensure effective coordination and linkages among the various government agencies involved in mangrove conservation and sustainable use.

Examples of the policy and legal framework for mangroves

Thailand has about 170,000 hectares of mangrove forest (as of 2002). The national policy is to increase this area to 200,000 ha by 2006. Institutional responsibility for mangrove conservation has recently been assigned to the Office of Mangrove Conservation under the Department of Marine and Coastal Resources, which is a department under the new Ministry of Natural Resources and Environment.

Vietnam has enacted a zoning plan for the Lower Mekong Delta featuring a Full Protection Zone (FPZ) for coastal protection, a Buffer Zone for controlled economic activities (40% by area), but retaining 60% forest cover, and an Economic Zone where there are no forest conservation restrictions. The FPZ is demarcated with clear signs and written information.

Examples of measures to promote compliance with the legal framework for mangroves

In Peam Krasop Wildlife Sanctuary in Koh Kong, **Cambodia**, illegal charcoal kilns were destroyed from 1995 by the Department of Environment as they were the cause of large-scale cutting of some of Cambodia's best mangroves. This action was also backed by existing legislation prohibiting the cutting of mangrove wood for charcoal production and a Royal Decree on Protected Areas Management in Cambodia. The DoE operated with the support of an inter-agency committee set up by the Provincial Authority against charcoal production. In 1999, the Provincial Authority declared the buying or selling of mangrove charcoal to be illegal, thereby targeting the powerful middlemen in the charcoal trade for the first time, as well as the producers.

In the Philippines, local ordinances prohibiting the sale of mangrove fuelwood to bakeries in Bais, Negros Occidental and outside the towns of Candijay and Mabini in Bohol proved more effective in halting illegal cutting than the mangrove ban itself.

Example of inter-agency consultations on mangrove management issues

Inter-agency stakeholder consultation and licensing practices have been established for the Matang Mangrove Forest Reserve in Peninsular **Malaysia**. The licensing of charcoal kilns and wood harvesting is done by the Forestry Department and fish cage licensing by the Fisheries Department. Preservation of a bird sanctuary and archaeological sites were also agreed after consultation with the Wildlife Department and the National Museum, respectively

Use of mangrove swamps for aquaculture

Background

- Long history in Indonesia and Philippines
- Used primarily for milkfish culture
- Only in recent years (1980s) with strong Japanese market for shrimps were milkfish farms and mangrove swamps converted to shrimp farms.

Why mangrove swamps were used for traditional fish ponds

- Swamps could not be used for agriculture or for habitation.
- Nobody seemed to own them.
- Swamps were regularly watered at high tide, and drained at low tide.
- Swamps could be developed by simply clearing the trees and putting a dike around an area with little excavation.

Why mangroves are not the best site for modern aquaculture

- New technologies require deeper ponds and more excavation.
- Once excavated and exposed, soil with high iron sulfide content becomes acidic.
- At high stocking density and high feeding rate, higher water exchange rate is required, and cannot be provided by tidal action.

Later...

People realized that mangrove swamps are not wastelands, but rather very productive ecosystems. Governments began to craft or change policies and regulations giving due recognition to the ecological importance of mangroves but also seeking to use mangroves sustainably, for aquaculture and for other economic activities.

Examples of provisions related to mangroves and aquaculture

Philippine Fisheries Code (1998)

Public lands such as tidal swamps, mangroves, marshes, foreshore lands, and ponds suitable for aquaculture shall not be privatized. The Department of Agriculture-Bureau of Fisheries and Aquatic Resources and the Department of Environment and Natural Resources shall determine areas or portions of available public lands suitable for fish pond purposes, or to be declared as fish reserve or sanctuary for conservation and ecological purposes.

Lease of public lands (mostly mangroves) for fish ponds shall be according to Fishpond Lease Agreements (FLAs) subject to the following conditions:

- FLA holders: only Filipino citizens
- Preferred FLA grantees: fisherfolk cooperatives/associations or small and medium enterprises
- FLA area: up to 50 ha for individuals and 250 ha for fisherfolk organizations
- Lease period: 25 years, renewable for another 25 years
- Lease rates: shall be set at levels that reflect resource rent accruing from the use of the pond resources and shall be determined by DA-BFAR

Pond development shall begin within 6 months or the FLA is cancelled. Ponds shall be commercially productive within 3 years. Ponds not fully producing within 5 years shall revert to the public domain for reforestation.

Reforestation shall be done by FLA grantee of 50 m wide strip of seashore or river bank fronting the fish pond.

Abandoned, underdeveloped, or unused fishponds covered by FLAs shall be identified by DA-BFAR, DENR, and the local government, and shall be restored to the original mangrove state.

Article 4. Integrate aquaculture *and* mangrove conservation in coastal zone management

- 4.1. States should work towards integrated coastal zone and watershed management, where the needs of local communities and the various economic sectors (aquaculture, fisheries, forestry, agriculture, industry, transportation, tourism) are coordinated and harmonized.
- 4.2. States should establish appropriate zones for use of aquaculture and the various other economic sectors, in agreement with local communities and other stakeholders.
- 4.3. States should base planning and management decisions on biophysical and ecological data on mangroves and aquatic ecosystems (inventories, maps), their current uses and users, economic costs and benefits, appropriate technologies, and local requirements for education, recreation, and aesthetics.
- 4.4. States should establish systems for monitoring of mangrove ecosystems, evaluation of economic enterprises, and early detection of adverse effects.



Artwork by JH Primavera, IT Tendencia and E Ledesma

An idealized coastal zone integrating mangrove conservation, aquaculture, fisheries, and other land and water uses

Integrated coastal zone management

Development, sustainable use, and conservation of coastal ecosystems and resources according to an integrated plan prepared and implemented through a continuous and dynamic process that unites government and the community, sectoral and public interests, and the tools of science and management

Conservation

Protection (from change, loss or damage), management, and care of valuable natural and cultural resources

Management

The methods and practice of handling, administering, supervising, or controlling entities, resources, and activities

Integrated ecosystem approach

The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It is based on a collaboratively developed vision that integrates ecological, economic and social factors. It is applied within a geographic framework defined by ecological boundaries. It recognizes that humans, with their cultural diversity, are an integral component of ecosystems. It is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompasses the essential processes, functions and interactions among organisms and their environment. The approach provides the framework that draws together national, local and community-based management practices to achieve the ultimate goal of a healthy and sustainable environment.

Adopted by the Conference of the Parties of the Convention of Biological Diversity, at its Fifth Meeting in Nairobi, 2000, as the primary framework for action under the Convention, under 12 Principles:

1. The objectives of the management of land, water and living resources are a matter of societal choices.
2. Management must be decentralized to the lowest appropriate level.
3. Ecosystem managers must consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
4. Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem management program should reduce market distortions that adversely affect biological diversity, align incentives to promote biodiversity conservation and sustainable use, and internalize costs and benefits to the extent feasible.
5. The priority target is the conservation of ecosystem structure and function, in order to maintain ecosystem services.
6. Ecosystems must be managed within the limits of their functioning.
7. Ecosystem management must be undertaken at the appropriate spatial and temporal scales.
8. Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management must be set for the long term.
9. Management must recognize that change is inevitable.
10. There must be appropriate balance between, and integration of, conservation and use of biological diversity.
11. All forms of relevant information must be considered— scientific data, indigenous and local knowledge, innovations and practices.
12. All relevant sectors of society and scientific disciplines must be involved.

Zoning of mangrove areas

Designation of particular areas in the mangrove ecosystem for either full protection, conservation, sustainable use, full conversion, or rehabilitation and reforestation

Aquaculture zones

State-designated areas for aquaculture farms, especially fish pens and cages, mollusk rafts and stakes, and seaweed longlines

Watershed

A large area (encompassing lowlands, forests, lakes, coasts, towns, farms) surrounded by highlands that are drained by several streams that empty into a common river leading out to the sea; may include several ecosystems and geographic and political units within its boundaries but considered also a single unit for management purposes

Article 5. Assess and classify existing mangrove ecosystems for proper disposition.

- 5.1. States should conduct periodic inventory and ecological assessment of the mangrove areas within their territory. Ecological quality of mangrove areas may be defined based on geomorphology, water flows, mangrove cover, forest structure, sediment quality, and plant and animal biodiversity.
- 5.2. States may classify mangrove areas in terms of ecological quality and present use, and allocate or use them as recommended below:

<i>Ecological quality</i>	<i>Present use and status</i>	<i>Recommended disposition</i>
Excellent	not yet used, pristine	full protection, non-use, ‘no touch’
Good	slightly used	conservation, sustainable use
Poor	fully converted, damaged	optimum use, rehabilitation

Zoning of mangrove areas

Mangrove areas should be clearly zoned, with the function and conservation status of each zone identified and legally defined. Restrictions must be set for the use of land, water and waterways, and the biological resources. Zoning is a practical means to help implement conservation and other management objectives, and should be part of the overall coastal zone management plan.

Ecological assessment

Identification of the status of, and threats to, mangroves and other ecosystems, as a basis for monitoring and evaluation, or for planning, development, and management

Inventory

Systematic counting, measuring, and recording of ecosystem statistics—including species diversity, population and community structures, habitats, users, products, etc.

Monitoring

Collection of specific information about ecosystems, populations, and economic activities for management purposes

Geomorphology

Lay-out of the land and water bodies; geography and topography

Ecological footprint

The total ecosystem area required to support a unit area of farm in terms of the resource inputs and ecological services.

All human activities, including aquaculture, each has an ecological footprint that must be accounted for. Aquaculture farms have ecological footprints that are many times larger than the size of the farm. Farms in mangrove areas require ecosystem support in terms of water, seed and feed, nutrient cycling, and primary production. But these farms require also inputs from marine ecosystems (in fish meal) and agricultural farms (in other feedstuff).

This requirement for ecosystem support that makes it very important for aquaculture farms to help ensure that mangrove areas and other marine ecosystems are maintained in good condition. Whereas some coastal ecosystems can be used for economic activities, a larger proportion should be left intact.

The ecological footprint concept illustrates the fundamental role of marine and coastal ecosystems in sustaining seafood consumption by a growing human population. (Kautsky et al. 1997)

Article 6. Retain a mangrove greenbelt or buffer zone along coasts and rivers where mangroves naturally occur, and where replanting is technically feasible.

- 6.1. States should retain or replant a mangrove greenbelt or buffer zone along the coasts and rivers for protection from erosion, waves, and storms.
- 6.2. States should enact the necessary greenbelt laws, or enforce existing greenbelt laws.
- 6.3. States should ensure that aquaculture farms in mangrove areas maintain a greenbelt for protection of the dikes and for treatment of farm effluents.

Greenbelt or buffer zone

A wide strip of mangrove forest (*Rhizophora*, *Avicennia*, *Sonneratia*, etc.) but also beach forest made of sturdy shrubs and trees such as *Pandanus*, *Terminalia*, *Acacia*, and *Cocos*, that when retained and maintained, help protect coastal areas from erosion, strong waves and winds, storm surges, and even tsunamis

Engineers estimate that an earthen sea dike with rock facing will last about 5 years before it requires repair due to wave damage. However, the same sea dike with a 100 meter wide mangroves greenbelt in front, will last 50 years.



Banacon Island has a mangrove greenbelt around it that protects the residents against the waves and winds

Width of Greenbelt or Buffer Zone

Indonesia

- 200-540 m (maximum 1,000 m)
- Width = 130x mean spring tide range

Brunei Darussalam

The Land Act states that 50 yards from river banks should be preserved for protection.

Vietnam

- Enacted a 500-1000 m wide green belt (full protection zone) along the Mekong Delta coastline for storm and flood protection
- The 1-km wide mangrove protection belt of *Kandelia candel* planted in the Red River Delta has greatly improved coastal protection against typhoons.

Philippines

- 20 m strip along creeks, rivers excluded from pond development (PD 705)
- 20 m strip to be retained or replanted by pond or mangrove lease holders (PD 953)
- 20 m along river banks, 50 m fronting seas, oceans (DENR AO 76, 1987)
- 50-100 m along shorelines and 20-50 m along riverbanks in storm surge areas(MNR AO 42, 1986)

Planting of mangroves as a component of the municipal fish sanctuary must be incorporated in the ordinances of coastal towns.

Article 7. Locate aquaculture farms outside of pristine mangroves, coral reefs, and seagrass beds.

- 7.1. States should encourage aquafarmers to find suitable farm sites outside of pristine mangrove areas, and also outside of coral reefs and seagrass beds. Mangrove areas often have peat soils or potential acid sulfate soils that require time and effort to neutralize. Coral reefs and seagrass beds are damaged by siltation from farm effluents or sediments.
- 7.2. States should prohibit or minimize large-scale aquaculture in UNESCO Biosphere Reserves and other marine protected areas.

Biosphere Reserves

Biosphere Reserves (BRs) were established under UNESCO's Man and the Biosphere (MAB) Program in 1970. BRs are high-diversity terrestrial and coastal ecosystems—a series of protected areas linked in a global network. Through appropriate zoning and management mechanisms, BRs are intended to fulfill three complementary functions:

- Conservation — preserve genetic resources, species, ecosystems, landscapes
- Development — foster sustainable economic and human development
- Logistic — support demonstration projects, environmental education, training, research, and monitoring related to local, national and global issues of conservation and sustainable development

To carry out both nature conservation and sustainable use of natural resources, BRs are organized into three zones:

- Core area, legally established and sufficiently large to meet the conservation objectives
- Buffer zone, clearly delineated and surrounding the core area. Buffer zones protect the core areas and have land use controls and allow only activities compatible with conservation, such as research, education, recreation, and tourism
- Transition zone extending outwards; may include a variety of agricultural activities, human settlements, and other uses

Marine Protected Areas

The International Union for the Conservation of Nature (IUCN) defines marine protected area (MPA) as “any area of intertidal and subtidal terrain, together with its overlying water and associated flora and fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment.” In 1986, IUCN began promoting the establishment and management of a global system of representative MPAs.



Photos by B Lasam

Article 8. Prohibit conversion of pristine mangrove ecosystems into shrimp aquaculture farms and other uses.

States should prohibit conversion of pristine mangrove ecosystems and associated tidal flats for shrimp farming and other uses that require clear-felling of forests and draining of swamps.

Article 9. If large-scale aquaculture farms must be built in mangroves or other ecosystems, then require a full environmental impact assessment.

States should develop and implement procedures for a full, independent, and public Environmental Impact Assessment (EIA), or an equivalent procedure, for large-scale aquaculture farms to be located in mangroves. The EIA includes determination of the impact of the farm on the mangrove ecosystem and on the food supply and livelihoods of local communities. The EIA also provides for a management plan, the necessary mitigating measures, and periodic monitoring and evaluation of the farm operations.

Environmental Impact Assessment

EIA, a method of analysis which attempts to predict the likely repercussions of a proposed major development upon the social and physical environment of the surrounding area

All proposed development projects that adversely affect mangroves must be subjected to a comprehensive and independent EIA. The EIA includes socioeconomic valuations (e.g. cost-effectiveness and social impact) that reflect the true social, economic and cultural costs and benefits of the planned development. The findings of the EIA should be made available at a public hearing to debate the proposed development project.

Risk analysis

A process consisting of risk assessment, risk management, and risk communication

Risk assessment is a scientific process of hazard identification and characterization, exposure assessment, and risk characterization. Risk management is the process of weighing policy alternatives in the light of the results of risk assessment and if required, selecting and implementing appropriate control options, including regulatory measures. Risk communication is the interactive exchange of information and opinions concerning risk among risk assessors, risk managers, consumers, and other interested parties.

Examples of impacts from aquaculture development in mangrove areas

Positive impact from aquaculture development in **Malaysia** – the cockle farming industry at Kuala Selangor (a mangrove fringed estuary with extensive intertidal and subtidal mudflats) has helped to promote awareness of the need for sound environmental management along the Selangor coast, as the quality of the cockles, e.g. their growth rate, condition factor and level of *E. coli* contamination, are very sensitive indicators of environmental change.

Negative impact from aquaculture development in **the Philippines** – more than 100,000 hectares of mangroves have been converted into milkfish and shrimp ponds over the last 75 years. Poor coastal communities have lost a free source of fuel wood, fish, and many other products.

Article 10. Promote small-scale integrated aquaculture in sustainable-use mangrove areas.

States should promote small-scale integrated mangrove-aquaculture systems that are non-destructive, sustainable, and beneficial to fishing communities.

Article 11. Make available to aquafarmers appropriate technologies and information on the best management practices for aquaculture in mangrove ecosystems.

States should make available to aquafarmers appropriate technologies and information on the best management practices for different aquaculture systems in mangrove areas.

Small-scale aquaculture

Farming and husbandry of aquatic organisms to augment nutrition or income. The operation uses limited capital and household labor

Integrated aquaculture

Farming of aquatic plants and animals together with land crops and livestock, where water is shared and nutrients and other resources are recycled



Oyster farm in mangrove river

Small-scale aquaculture technologies appropriate in mangrove areas

- Oyster and mussel rafts in mangrove waterways
- Seaweed longlines in the mangrove waterways
- Mudcrab fattening in pens and cages in the mangrove forest
- Mudcrab grow-out in pens and cages in the mangrove forest
- Mudcrab—fish polyculture in mangrove pens
- Small-scale fish cages in mangrove estuaries and lagoons
- Cockle beds in mangrove tidal flats
- Production of soft-shell crabs in floating cages in mangrove estuaries
- Silvofisheries or *tambak tumpang sari* and *empang parit* (Indonesia)
- Brush park, rock piles, miracle holes or *amatong* (Philippines)



Seaweeds farmed in the mangroves



Mud crabs fattened or grown out in mangrove pens

Examples of sustainable integrated mangrove aquaculture systems

Integrated mangrove-aquaculture systems, or silvo-fisheries, have a long tradition dating back many centuries to mangrove fishponds known as *tambak* in Indonesia. Different forms of silvo-fisheries continue to operate on a large scale today in many countries, especially in Indonesia, Philippines, and Vietnam. Some of the farming systems in operation are still based on traditional methods; others feature significant advances in design and operation.

A well known traditional example is the *empang parit* farm in Indonesia. This farm features a pond with a raised central platform planted with mangroves, surrounded by a deeper canal usually 3-5m wide that provides the permanent water area for fish, shrimps, and crabs. The central platform is flooded intermittently as the pond water level changes with the tidal cycle, giving the mangroves trees successive periods of inundation and exposure to air. When inundated, the mangrove platform also provides valuable additional habitat for the farmed stock; mangrove crabs in particular like to use the platform in this manner. The farm lay-out can be varied to meet local conditions and production needs. The ratio of mangrove forest to pond area can be varied, or the density of trees can be adjusted. This in turn affects many processes in the pond — light penetration and algal productivity, litter production and water circulation.

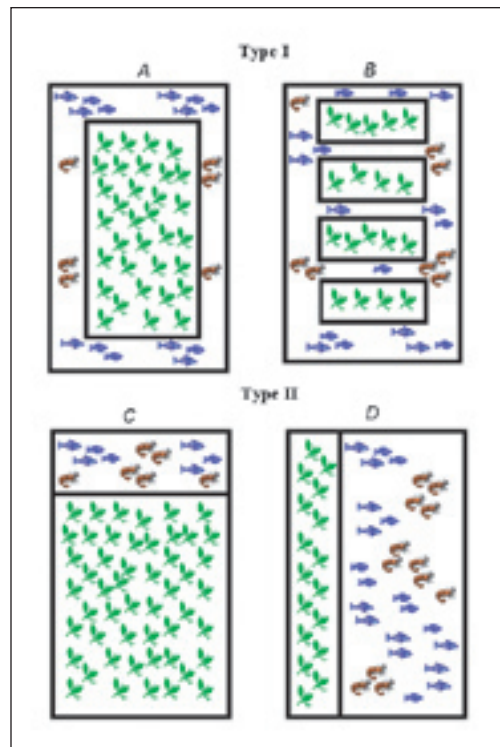
Integrated farming of milkfish

In brackishwater ponds, milkfish may be raised, simultaneously or in rotation, with other fishes, shrimps, mud crabs, seaweeds, mollusks, and mangroves. Stocking milkfish during the peak fry season and other species like mullets and rabbitfishes during slack periods may also be feasible.

Small family-type milkfish cages can be set up in clean, free-flowing water in mangrove areas and bays, and the stocks can be fed brown mussels, snail meat, or other protein source not otherwise used by people.

Downstream from these fish cages can be set up mussel and oyster beds that can remove particulate wastes from the fish cages. Further downstream can also be set up longlines for seaweeds that can absorb the nutrients from both fish cages and oyster and mussel beds.

Such aquafarming systems, integrated at the coastal community level, can also establish linkages with agricultural farms and with capture fisheries, which can both provide some unused by-products.



Models of silvofisheries. In type I, the mangroves are maintained in the middle of the pond. In type II, the ponds and the mangroves are in adjacent lots.

Article 12. Follow national and regional guidelines and codes of conduct for responsible aquaculture.

- 12.1. States should ensure that aquaculture farmers adopt codes of practice based on the *Regional Guidelines for Responsible Fisheries in Southeast Asia – Responsible Aquaculture* drawn up by the SEAFDEC and ASEAN Member Countries.
- 12.2. States should also help farmers adopt more sustainable farming practices and technologies so they can comply with the codes of conduct.

Article 13. Apply appropriate incentives and disincentives to encourage good farming practices.

States should establish a system of appropriate licenses, permits, and fees for use of land and water, penalties for violations of aquaculture regulations, and other incentives and disincentives to ensure that farms use mangrove-friendly technologies and practices.

Article 14. Require optimum production in aquaculture farms located in mangrove areas.

- 14.1. States should ensure that aquaculture farms in mangrove areas are fully developed for the optimum production of fish, crustaceans, mollusks, or seaweeds at near the carrying capacity.
- 14.2. States should not allow farmers to use the aquaculture permit to hold lease on the mangrove land for other purposes. Underutilized aquaculture farms must be brought to full use or have their permits or lease revoked.

Incentives

Policies, regulations, financial assistance, and other ways to encourage good farm practices or use of better technologies

Disincentives

Policies, regulations, effluent charges, user fees, negotiable permits, fines, and other ways to discourage bad farm practices and use of inefficient or destructive technologies

Good (Best) management practices

Farm practices that are practical and effective in preventing or reducing environmental and social impacts

A system of GMPs is usually required to address a problem. GMPs may be structural, biological, technological, or management-oriented approaches or solutions. GMPs vary by species, farm facility, phase, or method of production.

Carrying capacity

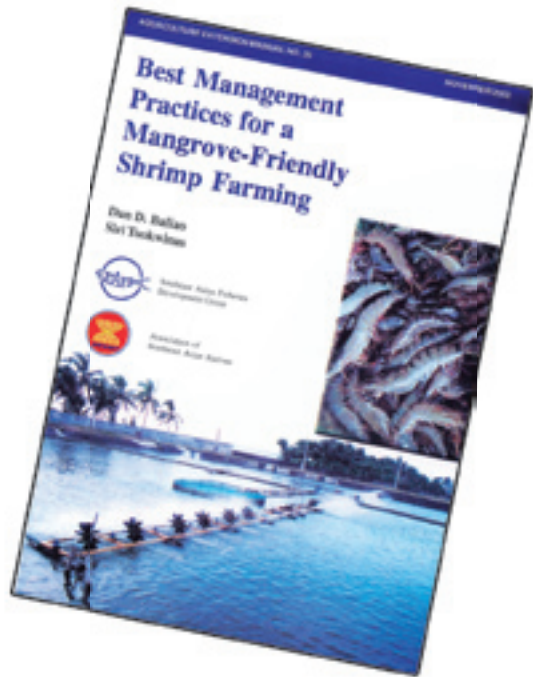
The maximum number of individuals of a defined species that a given environment can support over the long term, or the ability of an environment to sustain the resource demands of a species or a community without losing its ability to regenerate the resource

The carrying capacity of a given area for a certain type of use can be defined as the capacity to provide space, resources, and environmental conditions in a sustainable manner. Also the “capacity of an ecosystem to support healthy organisms while maintaining its productivity, adaptability, and capability of renewal” according to the IUCN, the United Nations Environment Program, and the World Wild Fund.

Promoting responsible practices and attitudes

The trends within many countries toward the use of more intensive aquaculture systems and higher value species, often in sensitive areas could increase the potential for environmental damage and put additional stress on the socioeconomic structure of local communities. Therefore it is essential that the aquaculture industry and all stakeholders adopt a strong commitment for cooperation and self-regulation.

It is the responsibility of States to support individual farmers and the aquaculture industry in general to develop its own standards for responsible aquaculture practices. Consultations on possible incentives may be held with, and training on regulatory aspects of aquaculture may be provided to, aquafarmers and their associations, to enable them to participate in the formulation and improvement of aquaculture-specific legislations.
(FAO 1997)



Philippine Code of Practice for Sustainable Shrimp Farming (2001)

- Protect mangroves from adverse aquaculture impacts
- No new shrimp ponds in mangroves
- No net loss of mangroves, given that some mangroves are removed for canals
- Continue environmental assessment in operating farms to recognize and mitigate negative impacts on mangroves
- Dispose waste water and sediments in ways not detrimental to mangroves
- Conduct mangrove restoration when old farms in former mangrove areas stop operations.

Thailand Operating Guidelines for Shrimp Farms (2000)

- Site selection – involve all stakeholders in zoning areas for shrimp farms; determine carrying capacity
- Pond management – predator control that does not destroy ecologically important species in receiving waters
- Health management – disinfect pond before discharging water
- Chemical use – discharge in nontoxic forms
- Waste management – prevent water contamination by safe storage and treatment before discharging, dispose sediment responsibly
- Social responsibility – shrimp farm associations to communicate with community, accommodate traditional uses, encourage mangrove replanting

Article 15. Establish land and water quality criteria for aquaculture.

States should establish land and water quality criteria for allowing farming operations in mangrove ecosystems and other aquaculture sites.

Article 16. Prevent pollution, disease contamination, and hydrological alterations in mangrove ecosystems.

States should establish regulations to prevent severe pollution and disease contamination of mangrove areas from aquaculture effluents, by means of appropriate water management and effluent treatment. Construction of the farms must also not adversely alter the water ways and water flows in mangrove areas.

Effluents

Waste water from fish and shrimp grow-out ponds and tanks; the water contains silt, uneaten feeds, feces, dead organisms, molted exoskeleton, dissolved nutrients, and other waste products of metabolism and environmental processes

Wastewater or effluent treatment

Process of cleaning up effluents or wastewater by passing it through a series of facilities and processes including settling and biofiltration

Settling ponds

Earthen ponds or concrete tanks where effluents from fish ponds are passed through or held for some time long enough for particulate materials (uneaten feeds, feces, plankton, silt) to settle out from the water

Biofiltration

Removal of suspended particles and dissolved nutrients by passing the effluents through a population of filter feeders (oysters and mussels), seaweeds and microalgae, and a sand filter with ammonia- and nitrite-oxidizing bacteria

Effluent standards

Water quality criteria applied to effluents from fish and shrimp farms

Mangroves as filters

As plants, mangroves are nutrient absorbers, and can be integrated in a waste treatment facility for intensive shrimp and fish farms. Studies have shown that 3-9 hectares of mangroves are needed to absorb or process the nitrogen wastes from one hectare of semi-intensive to intensive shrimp pond. This fact also argues for retention of a mangrove greenbelt to absorb heavy nutrient loads and prevent serious water pollution.

Example of effluent quality criteria

Under the Environment Act (1992), marine shrimp farms in Thailand must maintain the water quality criteria below:

pH	6.5-9.0
Total nitrogen	< 4.0 mg/L
Total ammonia nitrogen	< 1.1 mg/L
Total phosphorus	< 0.4 mg/L
Total suspended solids	< 70 mg/L
Hydrogen sulfide	< 0.01 mg/L
Biochemical oxygen demand	
5 days	< 20 mg/L
20 days	< 20 mg/L

Pollution

Dumping, release, or spread of unwanted byproducts of human activities— including garbage, sewage, oil and industrial effluents, and solid and toxic wastes

Pollution is a major threat to mangrove ecosystems, particularly in stagnant mangrove channels where oxygen can be depleted and cause fish kills or plant kills. Therefore, waste disposal from urban, industrial, agriculture, or aquaculture sources should be carefully regulated. The inputs of organic matter, nitrogen and phosphorus compounds into coastal waters should be minimized through adequate treatment or cleanup before discharge.

Appropriate practices to eliminate, minimize or mitigate pollution should be formulated. Existing regulations to control pollution in coastal areas must be effectively enforced.

Guidelines on pollution from farms

- States should establish guidelines and regulations to ensure proper disposal of wastes from aquaculture facilities – sludge, diseased or contaminated fish, offal, excess veterinary drugs and other hazardous inputs.
- States should define standards for effluents especially those from intensive aquaculture farms and hatcheries.
- States should require large-scale farms and assist groups of small-scale farms to include wastewater treatment (e.g., by means of settling ponds or biofiltration by seaweeds, mangroves, and filter feeding mollusks) and recycling in the farming system. Compliance may be required for the issuance of licenses and permits.
- States should institute a system for communication and cooperation among aquafarmers and other users of water resources and potential users of sludge and other farm byproducts.

Example of regulations to control pollution in coastal areas

Environmental regulations for shrimp farming in **Thailand** (Department of Fisheries):

- Shrimp farms and hatcheries must be registered.
- The biochemical oxygen demand of effluent water must be below 10 mg/l, and the Secchi disc transparency more than 60 cm.
- On farms larger than 50 rai (8 hectares), effluent water must be treated in settlement ponds before being discharged into canals or river.
- It is forbidden to release salt water into freshwater bodies, or to discharge silt and sediment into public water bodies or onto public land.

Example of upstream activities affecting mangrove ecosystems

In **India**, water and sediments from the Ganges River have been diverted through a dam since 1974. This diversion has adversely affected **Bangladesh** downstream — its agriculture, navigation, irrigation, fisheries, forestry, and industries — and has caused coastal erosion, submergence, siltation, and salt intrusion into rivers and ground water. All these together with agricultural and industrial pollution have adversely affected the Sundarbans mangrove ecosystem in the Bay of Bengal.

Article 17. Regulate introduction of exotic species for aquaculture.

States should strictly regulate the introduction of exotic species for aquaculture as these exotics may escape from farms into and through mangrove waterways, often with adverse effects. Mangrove ecosystems are open systems with extensive water exchange and animal movements between adjacent freshwater and marine habitats.

Article 18. Minimize collection from mangrove ecosystems of wild broodstock, seedstock, and feedstuff for aquaculture.

States should conserve animal biodiversity in the mangrove waterways. Thus, States should regulate or prevent the collection from mangrove areas of broodstock for hatcheries, larvae and juveniles for grow-out farms, and small fish and other feedstuff for farmed fishes and crustaceans.

Introductions and transfers of species

Intentional or accidental transport, import, release, and dispersal of a species into an environment outside its natural or present geographic range

Exotic or alien species

Species occurring in an ecosystem or biogeographic area outside of its historically known natural range as a result of intentional or accidental dispersal by human activities

Indigenous or native species

Species naturally occurring in a local ecosystem and that may also be found elsewhere in the same country or contiguous ecosystem

Endemic species

Species occurring only in a specific region or locality, usually over a relatively small area

Endangered species

Species in danger of extinction throughout all or a significant portion of its range. A species is considered endangered when the factors that make them vulnerable or cause their decline exist and continue to operate

Invasive species

Introduced species that establish themselves, invade, outcompete natives, and take over the

Broodstock

Aquatic animals grown to sexual maturity for breeding purposes, or wild adults captured for the same purpose

Seedstock

Young or early stages or smaller sizes of farmed aquatic plants and animals, either harvested from the wild or produced in the hatchery. Includes eggs, larvae, postlarvae, fry, fingerlings or juveniles, mollusk spats, and seaweed cuttings. Seedstock are stocked in aquaculture facilities or environments and grown to larger and higher value sizes.

Incidental catch or by-catch

Animals that also caught by fishing methods and gears that target other species; often killed instead of being released alive

Feedstuff

Small fish, crustaceans, mollusks, worms, and other materials used directly as food for farmed animals, or as ingredients and sources of protein, fats, and other nutrients in the manufacture of formulated feeds for farmed fish and livestock

Fish meal

Dried and powdered fish used as the main protein source in the manufacture of feeds for farmed fish and livestock

Guideline on Alien or Exotic Species (Convention on Biological Diversity)

Prevent the introduction of, control, or eradicate those alien species which threaten ecosystems, habitats, or species.

Intentional introductions include species for aquaculture or forestry. Accidental introductions include organisms accompanying those introduced for economic purposes (viruses, parasites); escapees from aquaria, zoos and other scientific facilities or through fouling of ship hulls or ballast waters. The threat to biodiversity due to introduction of alien species is considered second only to that of habitat loss.

Introduction of *Penaeus vannamei* into brackishwater farms in Southeast Asia

Many countries in Southeast Asia have imported the South American tropical white shrimp *Penaeus vannamei* for farming in brackishwater and freshwater ponds.

There is much concern that this exotic shrimp might be released, or escape, and establish itself in mangrove ecosystems, with adverse effects.



Examples of introduction of alien or exotic species into mangrove ecosystems

Tilapias introduced (from 1946 on) to **Asia** from **Africa** for stock enhancement and aquaculture have now colonized extensive brackishwater areas with mangroves even though they are a freshwater group of fishes.

The nipa palm *Nypa fruticans*, a mangrove species native to Southeast Asia, was brought from **Singapore** to eastern **Nigeria** in 1906 to control erosion. However, the nipa palm spread westwards and invaded extensive areas and displaced valuable indigenous mangrove species such as *Rhizophora* and the important palm *Raphia*. Nipa also invaded fish nursery and feeding grounds. Contrary to the situation in Southeast Asia, nipa is not used by the local people of **Nigeria**. The government has launched a program to control the spread of the invasive nipa.

Example of destructive fishing methods in mangrove ecosystems

Mangrove-associated penaeid shrimps (e.g. *Penaeus monodon*, *P. merguensis*) are collected heavily for broodstock and seedstock especially in **Bangladesh**. The unfortunate result is high mortality of non-target species of shrimp and fish that are caught incidentally. Collection of seedstock for grow-out ponds need not be banned, but should be regulated, and the use of captive broodstock from hatcheries should be promoted as an alternative source of seed production.

Women and children collect shrimp larvae in the Sundarbans mangrove ecosystem, **Bangladesh**, using very fine nets. This fishery is now banned in the mangroves, but still continues in the river system. It is not feasible to ban this activity completely until alternative livelihoods for these local families can be developed.

Article 19. Rehabilitate abandoned aquaculture ponds back to mangroves.

States should promote the reforestation of mangroves in abandoned fish and shrimp ponds with the support and cooperation of local communities. Reforestation can be achieved by breaking the dikes to restore the water flow and allowing natural recolonization, or by planting propagules or seedlings from the wild or from the nursery.

Rehabilitation

Putting in place a functioning system, but not necessarily what was there before. An example is the reforestation of mangroves in abandoned ponds by breaching the dikes and by replanting

Restoration

Bringing an ecosystem back into its original condition, as nearly as possible, renewing it, or bringing it back into use

There are various ways by which the legal system can support restoration of degraded wetlands. One is through the establishment of a system of environmental performance bonds. Legislation may also provide for the making of environmental restoration orders. This type of order may be issued where individual wetlands are damaged or destroyed by the actions of a legal person and the damage is detected and the responsible party is identified. Breach of these laws would constitute a criminal offence subject to financial or other penalties.

Reforestation

Restoring denuded forests by replanting the various species that were removed (harvested) and those lost secondarily

Recolonization

Natural seeding by mangroves of abandoned ponds or other coastal areas left open to water currents and flows; succeeds given the following factors:

- Proximity to natural sources of seeds, propagules, and seedlings
- Suitable elevation for given species
- Moderate waves or currents
- Suitable soil type and water quality
- Low salinity
- Moderate ground surface temperature
- No flotsam, no smothering by seaweed or green algae
- No diseases, isopods, or barnacles
- No grazing by livestock or disturbance by people



An abandoned fish pond reverts to mangroves



The award-winning mangrove reforestation project in Kalibo, Aklan, Philippines is now an ecotourism site

Article 20. Consider product labeling and certification for mangrove-friendly aquaculture and fishery products.

States should consider product labeling and certification for mangrove-friendly aquaculture and fishery products to raise consumer awareness about mangrove-friendly aquaculture and fishery technologies and practices.

Green labeling

Attaching descriptions to processes and products that are environment-friendly, thus, 'green'. Green labels include 'organic', 'dolphin-safe' and 'sustainably produced.'

Certification

The process of identifying, verifying, and documenting processes, products and producers that conform to particular standards, such as ISO and HACCP, which are internationally agreed and recognized

HACCP

Hazard Analysis Critical Control Points: a system that identifies, evaluates, and controls hazards significant for food safety

A good quality food product can only come from clean natural sources and from clean farms that implement proper management throughout the entire production cycle.

ISO

International Standards Organization is the world's largest developer of standards. ISO standards contribute to making the development, manufacturing, and supply of products and services more efficient, safer and cleaner. They make trade between countries easier and fairer. They provide governments with a technical bases for health, safety, and environmental legislation. They aid in transferring technology to developing countries. ISO standards also serve to safeguard consumers and users of products and services - as well as make their lives simpler.

CITES

Convention on International Trade in Endangered Species of Wild Flora and Fauna

Adopted in Washington DC March 1973 and came into force July 1975. Regulates international trade of animals and plants (dead, alive, or any recognizable parts or derivatives thereof) that are threatened or endangered in the wild through a system of permits and controls

Examples of green labeling of mangrove products

Mangrove charcoal from the Matang Mangrove Forest Reserve in **Malaysia** is marketed in Japan as a product from 'sustainably managed forests.'

In Ranong, **Thailand**, poor villagers produce 'kapi', a shrimp paste made from dried and salted *Acetes* shrimp, which are caught from the mangrove waterways. This is a sustainably produced traditional product, which the producers used to sell very cheaply to local middlemen. With assistance from the management of the Ranong Biosphere Reserve where the villagers live, this mangrove product is now being better packaged to enable direct selling by the producers to local hotels, shops, and other retail outlets. Traditionally produced 'kapi' will be promoted with a green label.

Article 21. Support research, training, and education about mangroves and mangrove-friendly aquaculture.

States should actively support research, technology transfer, training, information dissemination, communication, and widespread public education about mangrove conservation and mangrove-friendly aquaculture.

Examples of research needs in mangrove ecology

- Critical size of mangrove habitats that must be retained to maintain their ecological functions
- Nursery functions of mangroves and other mangrove-fisheries interactions
- Fate and pathways of nutrients and particulates in the mangrove ecosystem, including nutrients generated from aquaculture
- The importance of mangroves as habitat for biodiversity
- The value of mangroves as an important feature of coastal protection
- The role of mangroves as sinks and sources of carbon, nitrogen, and phosphorus, etc.
- Productivity studies on mangroves
- Impacts of global climate change and sea level rise on mangrove ecosystems
- Economic benefits from mangrove ecosystems, including fisheries and aquaculture
- Natural recruitment and colonization by different mangrove species
- Restoration and rehabilitation of abandoned aquaculture ponds and other degraded mangroves

Examples of research on the sustainable use of mangroves

In **Vietnam**, mud crabs and mudskippers have been collected traditionally for food. Mud crab and mudskipper farming in mangrove ponds is now developing rapidly, particularly among poor farmers. Research leading to the breeding of mud crabs and mudskippers in hatcheries and nurseries is now underway. Successful production of mudcrab and mudskipper seedstock would greatly enhance the potential to culture these mangrove-associated species.

In the **Philippines**, cooperatives in Alicia, Zamboanga, Mindanao have adopted the SEAFDEC/AQD technology of growing mud crabs in pens in the mangroves. SEAFDEC/AQD researchers are refining the hatchery production of mudcrab seed and the formulation of low-cost pellets to help the cooperatives reduce the use of ‘trash’ fish to feed the mud crabs.

GLOMIS

The Global Mangrove Database and Information System is a project of the International Society of Mangrove Ecosystems based in Okinawa, Japan. The project puts emphasis on the exchange of information and cooperation among scientists, governments, and coastal stakeholders for the conservation, rational use, and management of the mangroves of the world. ISME coordinates information provided by regional centers in Brazil, Fiji, Ghana, and India.

Examples of existing educational program on mangroves

In **Thailand**, students of Bangtaboon School, situated in the mangrove forest of Petchaburi Province, receive practical teaching in mangrove research, rehabilitation and protection, with the active support of the Ministry of Education.

In the Red River Delta, **Vietnam**, the teachers use a Big Book illustrating the role of mangroves for coastal protection. School children also participate in innovative learning activities such as theater, puppetry, dance, painting, school competitions, videos, and CD-ROM to promote the conservation and sustainable use of mangroves and related ecosystems. in basic law, organization, and management.

In Iloilo, **Philippines**, SEAFDEC FishWorld, the museum and visitor center of the SEAFDEC Aquaculture Department, conducts painting contests under the theme “Mangroves are important to me and my community”. School children 7-12 years of age study about mangroves together with their teachers (coaches) and parents. The mangrove painting contest is conducted as one of nine contests during Aquaculture Week, held in July. The winning paintings are submitted to the Mangrove Action Project (Washington, USA), which produces an international mangrove calendar every year. Many paintings produced by Filipino children at FishWorld have appeared in the calendar. Six mangrove paintings from Aquaculture Week 2005 appear on the inside back cover.

Examples of community training in mangrove resource management

In **Vietnam**, training courses are conducted regularly for farmers in Ca Mau, Lower Mekong Delta by the Division of Forestry, Department of Agriculture and Rural Development. The farmers are from both the State-managed Forest and Fishery Enterprises and from private farms. The planting and maintenance techniques that they learn are put in to practice on their farms with good success.

In **Thailand**, the community of Pled Nai Village in Trad Province have been trained in mangrove rehabilitation, maintenance, and protection, through the efforts and strong commitment of Yad Fon Association, a non-government organization that helped to mobilize government and public support for the poor coastal community.

In the **Philippines**, the 70-hectare mangrove plantation in New Buswang, Kalibo, is an example of a successful project initiated by the local government, implemented by the people’s association, Kalibo Save the Mangroves Association, together with the non-government organization Us wag. The 27 original member families planted 50 ha of river delta to *Rhizophora* species and *Nypa fruticans*. Aside from site preparation and planting, the responsibilities of the families included regular maintenance (removal of debris, pruning of damaged branches and stands, replacement of dead plants), protection, and record keeping for 3 years. Us wag also trained local community leaders in basic law, organization, and management.

Examples of information dissemination about mangrove management policies

In the Lower Mekong Delta of **Vietnam**, leaflets were distributed to local residents explaining the allowed and disallowed activities in the full protection zone and the buffer zone.

Article 22. Resolve conflicts between aquaculture and other users of mangrove ecosystems.

States should establish mechanisms for conflict resolution among the various stakeholders in mangrove areas, including compensation schemes for the adverse effects of aquaculture on local communities.



Crab fishing in the mangroves of Banacon, Bohol



The local residents in Maribojoc, Bohol protect and manage their own mangroves

Examples of improved livelihood opportunities for mangrove dwellers

The Coastal Wetlands Protection and Development Project in the Lower Mekong Delta, **Vietnam** is helping the Government of Vietnam to resettle people from the mangrove Full Protection Zone to the more landward Buffer Zone and prevent others from migrating into the protected zone. The resettled people act as local forest guards to protect the mangroves. In addition to receiving land and a new house, training is being given in engine mechanics, tailoring, aquaculture and agriculture to improve their livelihood prospects and make them less dependent on mangrove resources.

In Koh Kong Province, **Cambodia**, mangrove charcoal kilns were destroyed to protect the remaining mangrove forest, so alternative livelihoods were supported by the Ministry of Environment and external donors; for example, animal husbandry and home gardens, mangrove plantations. A model village was also developed to relocate former charcoal producing families.

... The true Principles for a Code of Conduct will not come from a World Bank under-funded or even well funded study, nor from scientific papers written by erudite academics. It will only come from the hearts and the minds and the will of the indigenous peoples and local communities who live with and depend upon the mangroves for their lives and livelihoods. It is these coastal dwellers who are the real stakeholders and consequently should be more intricately involved in drawing up a more appropriate Code of Conduct that they can really abide by and enforce, and that we can all live with—one which truly adheres to the principles of sustainable development which involve effective conservation, equitable resource use, and resource tenure rights for those coastal dwellers living in the mangrove areas.

For the mangroves and mangrove communities,
Alfredo Quarto, Mangrove Action Project

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Annex 1

Charter for Mangroves

The International Society for Mangrove Ecosystems (ISME) has adopted a Charter for Mangroves in Bangkok, Thailand, in November 1991. The Charter for Mangroves complements the World Charter for Nature that the General Assembly of the United Nations proclaimed on 28th October 1982 affirming that nature shall be respected, genetic viability on earth shall not be compromised, conservation shall be practiced, sustainable management shall be practised by man, and nature shall be secured against degradation.

ISME being aware that:

- Mangrove forests are unique intertidal ecosystems that occur primarily in tropical regions of the world.
- The total worldwide mangrove area is estimated at not less than 170,000 km² and there are some sixty species of trees and shrubs that are exclusive to the mangrove habitat.
- Mangroves support genetically diverse communities of terrestrial and aquatic fauna and flora of direct and indirect environmental, economic, and social value to human societies throughout the world.
- Sustainable development of mangrove ecosystem implies the maintenance and rational use of the natural resource to ensure ecological resilience and economic opportunities for present and future generations.
- Mangroves must be conserved in various parts of the world to prevent the occurrence of degraded coastal lands.

Convinced that:

- Destruction and degradation of mangrove forests are worldwide phenomena as a result of activities related to the non-sustainable use and overexploitation.
- The value of mangrove lands is consistently underestimated when the areas are converted for non-sustainable purposes
- The sustainable use of mangrove ecosystems would provide a better use of the resource.
- There is an urgent need to restore degraded mangrove ecosystems for economic, social and conservation reasons.

Persuaded that:

- Mangroves are a valuable natural resource with distinctive genetic diversity, high intrinsic natural productivity and unique habitat value.
- Mangroves sustain important economic and ecological values in adjacent terrestrial and marine systems.
- Mangroves play an important role in the economic and social resources available to subsistence coastal dwellers in the tropics.
- Mangroves play an important role in coastal protection and in the reduction of coastal erosion.
- Mangroves buffer coastal waters from undesirable land-based influences, such as sediment, contaminant or nutrient runoff.

Reaffirming that people must acquire the knowledge to use natural resources in a manner which ensures the protection and enhancement of species and ecosystems for their intrinsic values and for the benefit of present and future generations.

Convinced of the need for appropriate measures at individual, collective and national levels to manage, conserve and promote understanding of the mangrove ecosystem.

Convinced also of the need to foster the sharing of information and understanding at an international level and cooperation in all aspects of management and study of mangrove ecosystems.

Adopts, to these ends, a Charter which proclaims the following principles for the utilization of mangrove ecosystems.

General Principles

1. Mangrove ecosystems shall be respected and their intrinsic characteristics shall be preserved wherever possible.
2. The genetic diversity inherent in mangrove ecosystems shall be safeguarded and the necessary habitats must be preserved.
3. Mangrove ecosystems that are utilized by people shall be managed to achieve and maintain sustainable productivity without degrading the integrity of other ecosystems with which they coexist.
4. Mangrove ecosystems shall be secured against indiscriminate destruction, natural hazards, pollution and damage resulting from disturbance of surrounding areas.
5. The sustainable utilization of mangrove ecosystems by traditional users shall be recognized and provided for to improve the welfare of the indigenous people.
6. The acquisition and dissemination of knowledge with respect to structure, function, and management of pristine and disturbed mangrove ecosystems shall be encouraged by all means, including international research and technical cooperation.

Management of Mangroves

1. The decisions affecting the management of mangrove ecosystems shall be made only in the light of best existing knowledge and an understanding of the specific location.
2. Decisions on how to manage a mangrove ecosystem shall be informed by data on:
 - The biological components and the physical characteristics of the area under consideration by means of inventories, maps and the collection of physical and biological data
 - The needs of people in relation to sustainable uses of the resource while ensuring adequate reserves for preservation purposes
 - The national and international significance of the resource as a habitat and as a genetic reservoir
 - The national and international significance of the site for coastal stability and fisheries production
 - The local requirements for education, recreation and aesthetic values
 - The requirements that must be satisfied for non-sustainable uses of the resource
 - The extent to which rehabilitation and compensation mechanisms can be used to mitigate the impact of non-sustainable use
3. The information in (2) shall be used to define the areas necessary for preservation; to define strategies for the management, restoration; and preservation of the resource, or to define areas necessary for sustainable use.
4. Decisions on the use of mangrove ecosystems shall consider the guidelines:
 - Utilize the mangrove resources so that their natural productivity is preserved
 - Avoid degradation of mangrove ecosystems
 - Rehabilitate degraded mangrove areas
 - Avoid overexploitation of the natural resources produced by the mangrove ecosystems
 - Avoid negative impacts on neighboring ecosystems
 - Recognize the social and economic welfare of indigenous mangrove dwellers
 - Control and restrict non-sustainable uses so that long term productivity and benefits of the mangrove ecosystems are not lost
 - Introduce regulatory measures for the wise use of mangrove ecosystems

5. Activities that might impact on mangrove ecosystems shall be controlled by appropriate national, regional and international laws and agreement.
6. Activities which are likely to pose a risk to a mangrove ecosystem shall be subjected to an exhaustive examination prior to decisions being made. Only after it has been publicly demonstrated that the potential advantages outweigh the potential damage should the activity be allowed to commence.
7. Mangrove ecosystems degraded by human activities shall be rehabilitated for purposes in accord with their natural potential and compatible with the well-being of the affected people.
6. Resources, programs, and administrative structures necessary to achieve sustainable use of mangrove ecosystems should be provided.
7. The status of mangrove ecosystems should be monitored nationally and internationally to ensure evaluation of current practices and to enable early detection of adverse effects.
8. States should establish specific statutory provisions or regulations for the protection and management of mangroves and mangrove ecosystems.
9. States, public authorities and international organizations, non-government organizations, individuals, groups, and corporations should:
 - Cooperate in the task of managing mangrove ecosystems for sustainable purposes
 - Establish procedures and methodologies for assessing the status of mangrove ecosystems and for managing them
 - Ensure that activities within their jurisdiction do not cause unnecessary damage to mangrove ecosystems within or beyond their jurisdiction
 - Implement national and international legal provisions for the protection and conservation of mangrove ecosystems

Implementation of the Charter

1. The principles set forth in the present Charter should where possible be reflected in the law and practice of each State, as well as at the international level.
2. Knowledge of the structure, function and importance of mangrove ecosystems should be communicated by all possible means at local, national and international levels.
3. Knowledge of the structure, function and management of pristine and disturbed mangrove ecosystems should be enhanced.
4. Educational programs and regional centers should be provided to train scientists, planners, managers and the general public and to encourage an awareness of the importance of mangrove ecosystems.
5. All planning should include the establishment of biological, physical and socioeconomic inventories of the mangrove ecosystems under consideration, and assessments of the effects of the proposed activities on the ecosystems and their surroundings. All such planning should be open to public scrutiny and comment prior to any decision.
10. Each State should where possible support the provisions of the present Charter through its component organs and in cooperation with other States.
11. All persons should have the opportunity to participate, individually or collectively, in the formation of decisions of direct concern to the conservation and sustainable use of mangrove ecosystems.
12. Affected people should have means of redress when their mangrove ecosystems have suffered damage.
13. Each member of ISME has the duty to act in accordance with the provisions of the present Charter, individually, in association with others, or through a political process. Each member shall strive to ensure that the objectives and requirements of the Charter are met.

Annex 2

Convention on Biological Diversity

This Convention is the first global, comprehensive binding agreement to address all aspects of biological diversity: genetic resources, species and ecosystems. It requires countries to develop and implement strategies for sustainable use and protection of biodiversity and provides a forum for continuing dialogue on biodiversity-related issues through the annual Conference of the Parties.

Adopted in Rio de Janeiro, Brazil, June 1992 and came into force December 1993. Signed by over 150 countries. Legally binding agreement with three key objectives:

- Biodiversity conservation
- Sustainable use of biodiversity
- Fair and equitable sharing of the resulting benefits

Jakarta Mandate on Marine and Coastal Biological Diversity

This program was adopted in 1995 at the Second meeting of the Conference of the Parties of the Convention on Biological Diversity in Jakarta, Indonesia. Five key thematic issues were identified with work objectives:

Integrated marine and coastal area management (IMCAM)

- Review existing instruments related to IMCAM
- Promote the implementation of IMCAM at the local, national, and regional level
- Develop guidelines and indicators for ecosystem evaluation and assessment

Marine and coastal living resources

- Promote ecosystem approaches to the sustainable use of marine and coastal living resources
- Make available to the Parties information on marine and coastal gene resources, including bioprospecting

Marine and coastal protected areas

- Facilitate research and monitoring activities on the value and effect of marine and coastal protected areas or similarly restricted areas on sustainable use of marine and coastal living resources
- Develop criteria for the establishment and management of marine and coastal protected areas

Mariculture

- Assess the consequences of mariculture for marine and coastal biological diversity and promote techniques to minimize adverse impacts

Alien species and genotypes

- Understand better the causes and impacts of introductions of alien species and genotypes
- Identify gaps in existing or proposed legal instruments, guidelines and procedures and collect information on national and international actions
- Establish a list of incidental introductions

Annex 3

Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat

This Convention was adopted in Ramsar, Iran, in February 1971 and came into force December 1975. Legally binding agreement now signed by over 110 countries with the following objectives:

- To promote the wise use and conservation of wetlands
- To make environmental assessments before transforming wetlands
- To establish nature reserves on wetlands
- To increase waterfowl populations in appropriate wetlands through management

Ramsar Resolution VII.21, San José, Costa Rica, 10-18 May 1999

Recognizes the critical economic, social and environmental values of intertidal wetlands, including tidal flats, salt marsh, mangroves, and seagrass beds for fisheries, biodiversity, coastal protection, recreation, education, and water quality.

Recognizes that the livelihood of substantial numbers of people around the world depend on the productivity of intertidal wetlands and that a large proportion of these wetlands are being lost to reclamation, unsustainable aquaculture, and pollution, and that, in some regions, the scale of reclamation is increasing.

Notes the growing scientific evidence of, and awareness by local communities, of the productivity of intertidal wetlands, particularly tidal flats.

Notes that the expertise in dealing with the conservation and wise use of intertidal wetlands at local and national levels is rapidly increasing but that there are no adequate mechanisms at the global level to share and benefit from these experiences and expertise.

Urges all Contracting Parties to suspend the promotion, creation of new facilities, and expansion of unsustainable aquaculture activities harmful to coastal wetlands until such time as assessments of the environmental and social impact of such activities, together with appropriate studies, identify measures aimed at establishing a sustainable system of aquaculture that is in harmony both with the environment and with local communities.



Mangroves are important to me and my community

Paintings done by children from elementary schools in Iloilo, Philippines during Aquaculture Week 2005 at SEAFDEC FishWorld



Reian Faith Karnele Sollesta, 11 years old



Tegyd Lampasa, 12 years old



Christine Joy Ramos, 12 years old



Cathrina Bagarinao, 11 years old



Hannah Jane Yap,
11 years old

Karl Brian Gascon,
11 years old





The Southeast Asian Fisheries Development Center (SEAFDEC) is a regional treaty organization established in December 1967 to promote fisheries development in the region. The Member Countries are Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The policy-making body of SEAFDEC is the Council of Directors, made up of representatives of the Member Countries.

SEAFDEC conducts research on fisheries problems; generates appropriate fisheries technologies; trains researchers, technicians, fishers and aquafarmers, and managers; disseminates information on fisheries science and technologies; and recommends policies pertaining to the fisheries sector.

SEAFDEC has four Departments that focus on different aspects of fisheries development:

- The Training Department (TD) in Samut Prakan, Thailand for training in marine capture fisheries
- The Marine Fisheries Research Department (MFRD) in Singapore for post-harvest technologies
- The Aquaculture Department (AQD) in Tigbauan, Iloilo, Philippines for aquaculture research and development
- The Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia for the development and management of fishery resources in the exclusive economic zones of SEAFDEC Member Countries

SEAFDEC/AQD is mandated to:

- Conduct scientific research to generate aquaculture technologies appropriate for Southeast Asia
- Develop managerial, technical, and skilled manpower for the aquaculture sector
- Disseminate and exchange aquaculture information
- Conduct other activities as assigned by the SEAFDEC Council

The Aquaculture Department in the Philippines maintains four stations: the Tigbauan Main Station and Dumangas Brackishwater Station in Iloilo; the Igang Marine Station in Guimaras; and the Binangonan Freshwater Station in Rizal.