FISH for the PEOPLE

A Special Publication for the Promotion of Sustainable Fisheries for Food Security in the ASEAN Region

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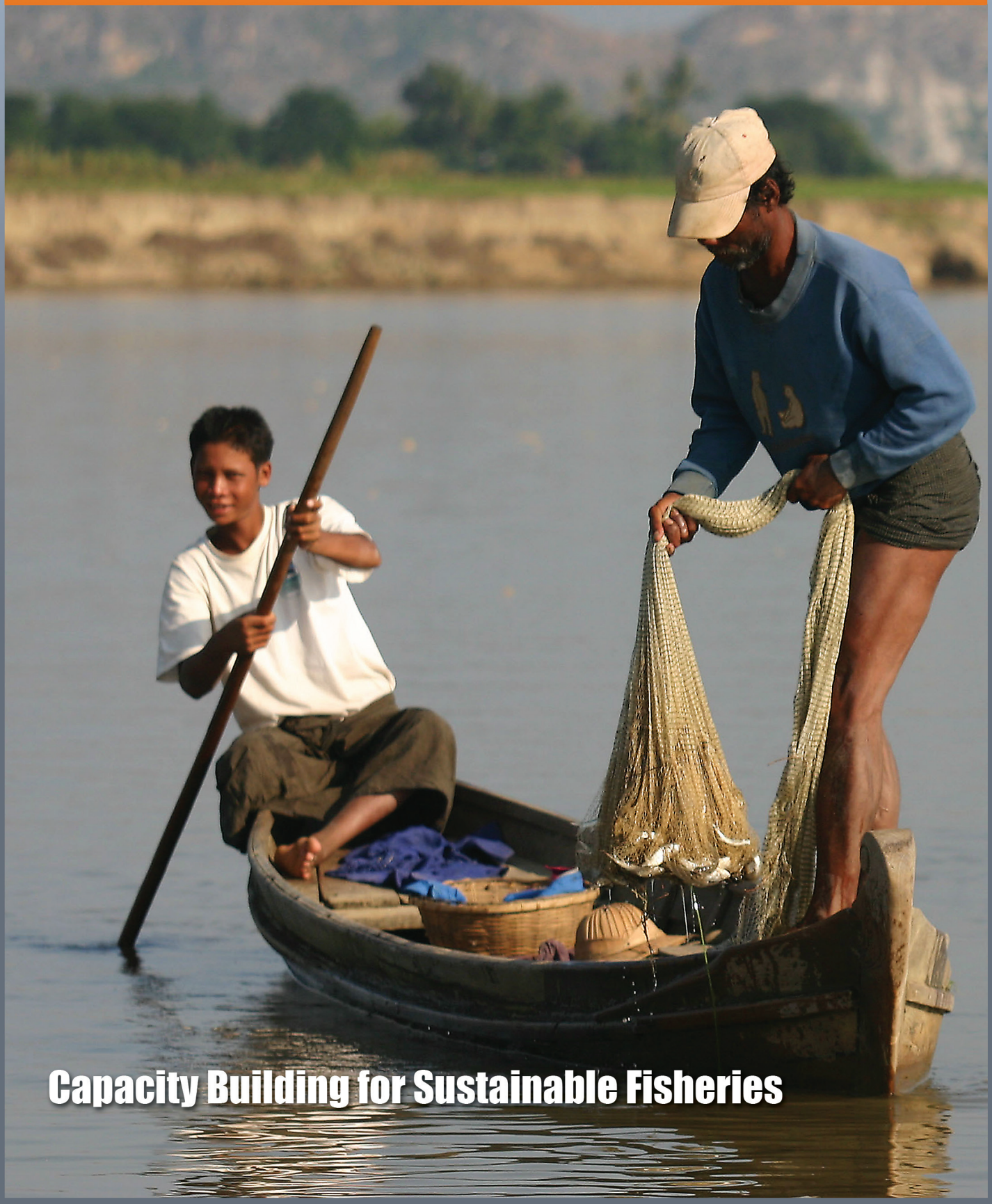

Capacity Building for Sustainable Fisheries

Southeast Asian Fisheries Development Center

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Editorial

SEAFDEC and the Margarita Liz□rraga Medal Award 2006-2007

It is indeed very timely that as SEAFDEC approaches its 40th anniversary in December 2007, it is the recipient of the Margarita Liz□rraga Medal Award for the biennium 2006-2007 given by the Food and Agriculture Organization (FAO) of the United Nations. This award is for the efforts of SEAFDEC in promoting the adoption of the Code of Conduct for Responsible Fisheries (CCRF) in the ASEAN Region. Established by FAO in 1997, the Margarita Liz□rraga Medal Award is given biennially in memory of the late Dr. Margarita Liz□rraga, FAO Senior Fishery Liaison Officer for her "decisive role in promoting the CCRF and for her productive work in the field of fisheries particularly in developing countries for almost 40 years". SEAFDEC received the Medal Award for 2006-2007 at the FAO Headquarters in Rome, Italy during the 34th Session of the FAO Conference, 17-24 November 2007.

Formulated by FAO, the global CCRF was adopted during the FAO Conference in 1995, providing general principles and international standards for responsible fishery practices worldwide. Recognizing that the implementation of the CCRF is very important in ensuring sustainable fisheries in Southeast Asia, SEAFDEC for almost ten years now, has sustained its campaign for the implementation of the CCRF in the region. In order for the ASEAN countries to adopt the CCRF, it was necessary for SEAFDEC to provide clarification with regards to the regional specific situation. The different fishing scenarios and issues that exist within the region, especially those related to the multi-species, multi-gear and small-scale nature of fisheries are rather dominant. It is quite unfortunate that these issues were only superficially covered by the global CCRF, thus it was deemed important for SEAFDEC to address such specific fisheries at the regional level. Careful investigation of the CCRF and where required, clarification and addition of specific guidelines considering the regional fisheries specificities were therefore carried out. This was conveniently facilitated through the SEAFDEC Program on the Regionalization of the CCRF (RCCRF) with funding support from the Government of Japan Trust Fund Program.

Generally aimed at sufficiently investigating the necessary requirements to promote the implementation of the CCRF in the region, the RCCRF was carried out through several series of regional consultations. Specifically, the RCCRF was mainly aimed at formulating regional policies for the implementation of the CCRF and facilitating the development of national codes of practice for responsible fisheries by the ASEAN Member Countries.

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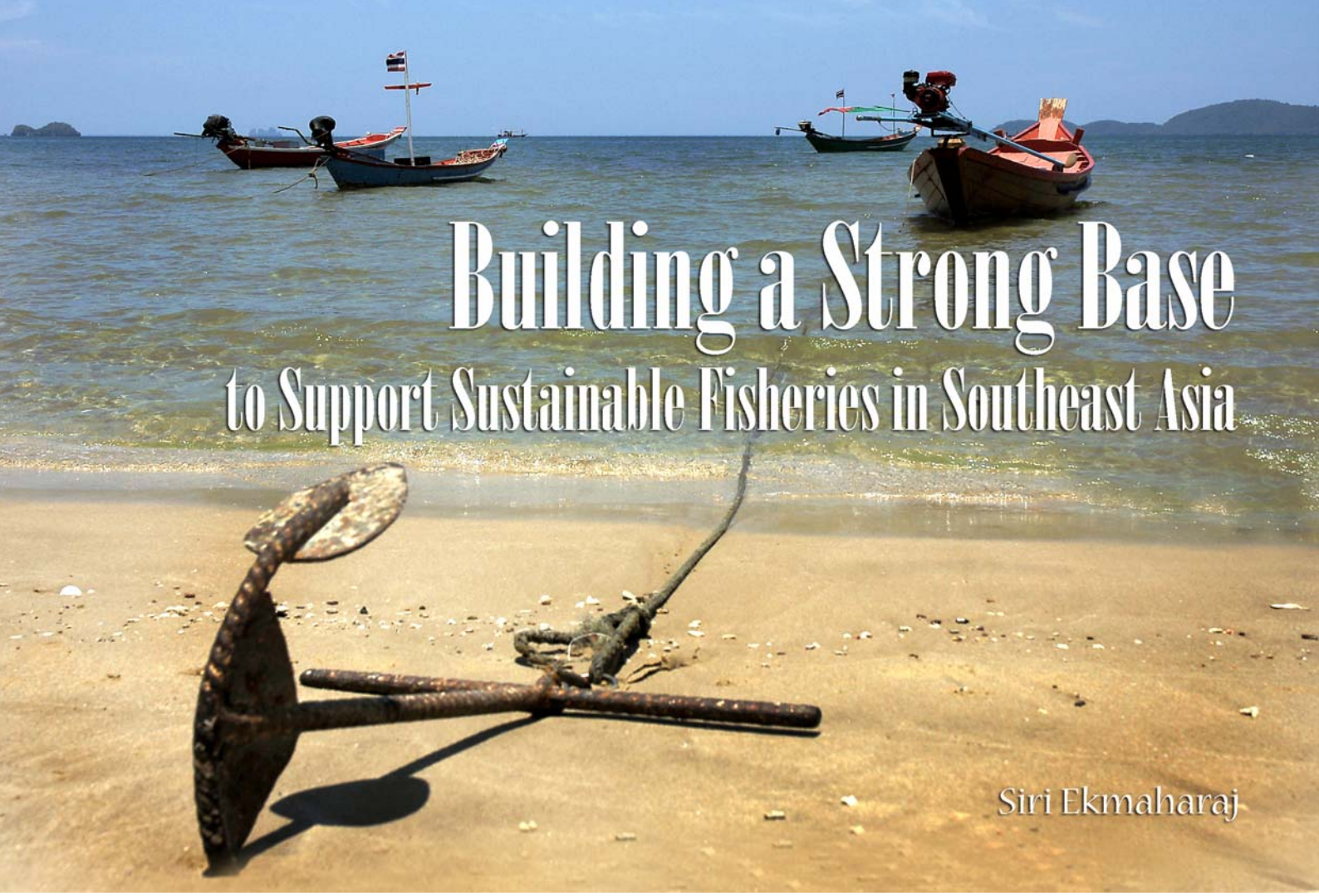
CONTENTS

As a commitment of SEAFDEC to provide assistance to the ASEAN in the implementation of the CCRF at national levels, the RCCRF was initiated in 1998 under the ASEAN-SEAFDEC Fisheries Consultative Group mechanism. The major outcomes of the RCCRF include four regional technical guidelines, namely: (1) Responsible Fishing Operations (supporting Article 8 of the CCRF); (2) Responsible Aquaculture (providing supplementary guidance to Article 9 of the CCRF); (3) Responsible Fisheries Management (to support Article 7 of the CCRF); and (4) Responsible Post-Harvest Practices and Trade (to clarify Article 11 of the CCRF). In addition, the Supplementary Guidelines on Co-management Using Group User Rights, Fishery Statistics, Indicators and Fisheries *Refugia* was also developed. Although prepared for the ASEAN Member Countries, SEAFDEC hopes that these Regional Technical Guidelines would also be useful by any country in Asia sharing the same specific fisheries circumstances as the ASEAN Member Countries.

In order to sustain adoption of the regional guidelines in the ASEAN, SEAFDEC collaborated with the Swedish Board of Fisheries for the development of the region's human resource capacity in implementing the CCRF. The regional Seminar on the Implementation of CCRF in Southeast Asia which SEAFDEC convened in October 2007 assessed the extent of implementation of the CCRF at national and local levels, and identified the issues and problems that the ASEAN countries encountered in the process. The outcome of the Seminar serves as basis for the planning of SEAFDEC future activities to address such issues and constraints as well as to follow up and closely monitor the development of sustainable fisheries in the region based on the framework of the CCRF. The initiatives and the progress made by the ASEAN countries in putting into effect the principles towards ensuring food security as provided in the regional guidelines will be included in the forthcoming issues of this magazine.

FISH for the PEOPLE is a special publication produced by the Southeast Asian Fisheries Development Center (SEAFDEC) to promote sustainable fisheries for food security in the ASEAN region.



The basic structure that SEAFDEC molded into a strong support to promote sustainable fisheries in Southeast Asia makes SEAFDEC the deserving recipient of the of the most prestigious Margarita Liz□rraga Medal Award for the biennium 2006-2007. Given biennially by the Food and Agriculture Organization (FAO) of the United Nations, this award recognizes the efforts of SEAFDEC in promoting the adoption of the Code of Conduct for Responsible Fisheries (CCRF) in the ASEAN Region. The Margarita Liz□rraga Medal Award is given biennially in honor of the late Dr. Margarita Liz□rraga, FAO Senior Fishery Liaison Officer for her „decisive role in promoting the CCRF and for her productive work in the field of fisheries particularly in developing countries for almost 40 years‰. The announcement that Margarita Liz□rraga Medal Award for the biennium 2006-2007 goes to SEAFDEC, came at the most appropriate time as SEAFDEC celebrates its 40th anniversary in December 2007.

Making the global CCRF comprehensible for the Southeast Asian fisherfolk

After the adoption of the global CCRF in October of 1995, SEAFDEC initiated a program on the Regionalization of the Code of Conduct for Responsible Fisheries (RCCRF) starting in 1998. The RCCRF took into consideration the Southeast Asian regionÊs specific context, encompassing its culture, its fisheries structure, and the regionÊs fishery ecosystems and came up with regional guidelines accommodating the specific regional concerns that the global CCRF might have failed to highlight and where the issues of particular importance to Southeast Asia are amplified and elaborated on under the framework of the global CCRF. From the formulation of the regional guidelines on responsible fisheries (**Box 1**) until their dissemination, the RCCRF has been financially supported by the Government of Japan through its Trust Fund from 1998 to 2004. A follow up activity on human resource development to support the implementation of the regional guidelines in the Southeast Asian region has since then been advanced with the support of the Government of Sweden through its Swedish National Board of Fisheries from 2003 to 2006.

While adhering to its objectives (**Box 2**), the RCCRF has been able to bridge the gaps between the internationally adopted initiatives and the actual implementation of the CCRF at regional, national and local levels as the regional guidelines were promoted to a wide range of stakeholders from the high-level policy-makers, managers, scientists/ researchers, technicians, the private sector down to the fishers. Since the RCCRF was initiated and reviewed through the SEAFDEC and ASEAN collaborative mechanism, the full mobilization of the competence of these two organizations made the implementation of the CCRF

Box 1: Regional Guidelines for Responsible Fisheries in Southeast Asia

Responsible Fishing Operations: supports the implementation of Article 8 (Fishing Operations) of the CCRF

Responsible Aquaculture: provides supplementary guidance to Article 9 of the CCRF

Responsible Fisheries Management: supports the implementation of Article 7 (Fisheries Management) of the CCRF

Responsible Post-harvest Practices and Trade: serves as reference in identifying directions and priority actions for the implementation of Article 11 (Post-harvest Practices and Trade) of the CCRF

Supplementary Guidelines for Responsible Fisheries in Southeast Asia: substantiating the Regional Guidelines for Responsible Fisheries Management, comprises: (1) Co-management Using Group User Rights for Small-scale Fisheries; (2) Fishery Statistics for Capture Fisheries; (3) Use of Indicators for Sustainable Development and Management of Capture Fisheries; and (4) Use of Fisheries *Refugia* for Capture Fisheries Management

in the region possible putting the actual implementation of the CCRF in the Southeast Asian region in its proper perspective. In addition to the changes of their respective national policies and programs based on the RCCRF, the impact of the CCRF in the region has been multiplied through human resource development and awareness building activities conducted by SEAFDEC leading to sustained promotion of responsible fisheries in the ASEAN member countries.

The set of Regional Guidelines for Responsible Fisheries in Southeast Asia

Box 2: Objectives of the Regionalization of the CCRF by SEAFDEC

- To clarify the requirements of the Code of Conduct for Responsible Fisheries
- To identify and prioritize the required actions
- To identify the issues that require special consideration from the regional point of view
- To formulate regional policies that would help the ASEAN member countries in implementing the global Code of Conduct for Responsible Fisheries
- To facilitate the formulation and implementation by the ASEAN member countries of national codes of practices for responsible fishing operations, fisheries management, aquaculture, and post-harvest practices and trade

Beyond Winning the Margarita Liz□rraga Medal Award

Receiving the Margarita Liz□rraga Medal Award for the biennium 2006-2007 is indeed one of the most colorful events in the history of SEAFDEC. Building an ongoing base of support for the development of sustainable fisheries remains an ultimate goal, and SEAFDEC is not resting on its laurels nor hanging its anchor as it continues to sail towards achieving responsible fisheries development in the region.

It is towards this objective that SEAFDEC convened the Regional Seminar on the Implementation of the CCRF in Bangkok, Thailand on 22 October 2007. While considering the recommendations made at the Regional Seminar (**Box 3**), SEAFDEC will continue to conduct activities that would strengthen the base that it has started to mold to fully support the promotion of responsible fisheries in the Southeast Asian region.

Acknowledgment

SEAFDEC is very grateful to all those who have worked relentlessly for the promotion of the CCRF especially in Southeast Asia. To the SEAFDEC Member Countries for embracing the regional guidelines under the global CCRF framework and for their efforts in formulating national plans of action making the regional guidelines implementable at the national and local levels; to the SEAFDEC Secretariat and the technical Departments for coming up with the regional guidelines after thorough consultations with the Member Countries; to the Government of Japan for providing assistance in the production and dissemination of the regional guidelines through its Trust Fund Program; to the Government of Sweden for their support in developing the regionÊs human resource capability in adopting the CCRF

Box 3: Box 3. Future Activities to Promote the CCRF in Southeast Asia

(Recommendations made at the Regional Seminar on the Implementation of the Code of Conduct for Responsible Fisheries (CCRF), Bangkok, Thailand, 22 October 2007)

(1) Conduct of an in-depth study to identify the common areas of concerns in the Member Countries related to the implementation of CCRF;

(2) Integrate human resource development (HRD) requirements in the SEAFDEC programs and develop regional package to support the implementation of the CCRF at local and grassroots levels;

(3) Further promote fisheries management through the Regional Scientific Advisory Committee for Fisheries Management in Southeast Asia (RSAC) serving as a forum where SEAFDEC could provide support to the Member Countries;

(4) Carry-out regular evaluation of the compliance by the Member Countries with the CCRF by developing Key Performance Indicators (with quantitative measurements); and

(5) Further develop information packages on the principles and importance of CCRF for promotion at national and local levels, specifically targeting the high ranking policy and political levels to ensure policy support in the national implementation of the CCRF.

through the Swedish National Board of Fisheries; and finally to the peoples of Southeast Asia for their faith and confidence in the CCRF viewing it as beneficial not only to their own livelihoods but also to those of their childrenÊs children.

Winning the Medal Award gives SEAFDEC more inspiration and aspiration to set higher sights in promoting responsible fisheries in the Southeast Asian region. Just like the late Margarita Liz□rraga who incessantly promoted the adoption of the CCRF and who dedicated 40 years of her life to fisheries service in developing countries, SEAFDEC in thanking the FAO for the Medal Award, assures FAO and other sponsors that SEAFDEC will persistently continue to promote responsible fisheries in the Southeast Asian region under the framework of the CCRF.

About The Author

Siri Ekmaharaj, Ph.D. is the Secretary-General of SEAFDEC. He received the Margarita Liz□rraga Medal Award for the biennium 2006-2007 on behalf of SEAFDEC and its Member Countries, at the FAO Headquarters in Rome, Italy in November 2007.

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CALL FOR ARTICLES

Several issues of Fish for the People were already published from 2003 to 2006 and the Publication is now on its Fifth Volume. We are inviting in-house writers who are interested in promoting the activities of SEAFDEC in the Southeast Asian region as well as writers from the SEAFDEC Member Countries, to contribute articles for the Publication.

Fish for the People takes several sections, such as: Special Feature (usually giving a theme to the issue), Fisheries Management, Aquaculture, Fish Trade and Post-harvest Technology, Announcements on important SEAFDEC events, and the Event Calendar.

Fish for the People is currently a free publication. It receives a generous support from the Government of Japan's Trust Fund. The Publication primarily intends to make known the activities of SEAFDEC as well as other relevant fisheries issues from the SEAFDEC Member Countries. While the focus is on promoting fishery issues in the Southeast Asian region, we also welcome articles on important fishery issues from other regions external to SEAFDEC.

An Editorial Team for the Publication was organized in 2006 comprising the editor-representatives from the SEAFDEC Departments. Writers from the Departments are therefore, requested to contact their respective Editor-Representatives or they can also communicate directly to the Secretariat-based Editors (*fish@seafdec.org*).

The Publication is policy-orientated. It is not a forum for research findings and it is not also intended to provide detailed technical information. In other words, the Publication does not contain typical scientific papers but instead articles that are in popular or layman language and easy to read papers especially to all our stakeholders. Popular and readable articles that address the various issues discussed at the ASEAN-SEAFDEC Millennium Conference will be most desired. The articles could also discuss newly emerging issues relevant to the sustainable development of fisheries in the Southeast Asian region.

Beyond Regionalizing the Code of Conduct for Responsible Fisheries:

ASEAN-SEAFDEC Human Resource Development Initiative

Worawit Wanchana

For almost 40 years since its creation in 1967, SEAFDEC has continued to work towards the development of fisheries in the Southeast Asian region. Several regional programs in support of the development of sustainable fisheries have been carried out using SEAFDECÊs technical expertise, including the promotion for the adoption of the global Code of Conduct for Responsible Fisheries (CCRF). During the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium: „Fish for the People‰ organized in 2001, the Resolution and Plan of Action on Sustainable Fisheries for Food Security was adopted based on the CCRFÊs guiding principles and thematic issues, and have been considered common regional policy frameworks and used as guidelines in promoting sustainable fisheries and in ensuring food security in the ASEAN region.

The Regionalization of the Code of Conduct for Responsible Fisheries

The program on the Regionalization of the Code of Conduct for Responsible Fisheries (RCCRF) which SEAFDEC carried out starting in 1998 consisted of two main components: (I) formulation and dissemination of the regional guidelines on responsible fisheries, and (II) human resources development (HRD) with emphasis on sustainable fisheries management. The regionalization program, which was financially supported by the Government of Japan through its Trust Fund Program from 1998 to 2004 (Component I) and Component II on HRD by the Government of Sweden through the Swedish Board of Fisheries (2003-2006), produced five regional technical guidelines.

Responsible Fishing Operations

The Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Fishing Operations was developed to support the implementation of Article 8 (Fishing Operations) of the global CCRF in the ASEAN region, considering current situation of the regionÊs fishing operations and practices. Since the inland fisheries sector

and its activities is of great economic importance for the countries of Southeast Asia, the Guidelines also include issues relevant to the sustainable development of this sub-sector. The development of the Guidelines, through a series of consultations with experts on fishing technology and fishing gears from the SEAFDEC Member Countries, was coordinated by the SEAFDEC Training Department (TD).

Responsible Aquaculture

Recognizing that irresponsible farming practices destroy the ecosystems, decrease biodiversity, and cause social conflicts in pursuit of short-term gains, the Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Aquaculture therefore, aims to mitigate such negative effects of aquaculture. The Guidelines provide supplementary guidance to Article 9 of the CCRF, accommodating regional requirements to promote the implementation of responsible aquaculture in marine, brackish, and freshwater environments, e.g., lakes, reservoirs, estuaries, rivers etc. The Guidelines also provide guidance on efficient use of inputs, e.g., fry, broodstock, feeds, etc., to improve production and facilitate responsible culture practices. The first edition of the Guidelines, published in 2001 was updated in 2005 to consider relevant factors resulting from the fast development of aquaculture in the region. The inputs for the Guidelines, collated by the SEAFDEC Aquaculture Department (AQD), took into consideration the outcome of a series of consultations with aquaculture experts from the region.

Responsible Fisheries Management

The Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Fisheries Management support the implementation of Article 7 (Fisheries Management) of the CCRF and provide suggestions for the improvement of fisheries management with emphasis on human capacity enhancement for all levels of stakeholders involved in inland, coastal and marine fisheries. The Guidelines also incorporates relevant provisions of the Resolution and Plan of Action for Food Security for the ASEAN Region. Directions for management of fishing capacity are focused and problems on open access fisheries are addressed through the introduction of ecosystem-based, rights-based/ decentralized fisheries management.

Moreover, the Guidelines also promote the understanding of the status and trend of shared stocks, strengthening fishery statistical systems, development of indicators for multi-species, and expansion of fisheries to include under-utilized resources. Consisting of two parts, the guidelines for industrial fisheries were compiled by the SEAFDEC Marine Fisheries Resources Development and Management Department (MFRDMD) and the coastal fisheries by SEAFDEC/TD. The Guidelines was formulated from the outcomes of consultations as well as relevant technical recommendations including those from Regional Technical Meetings in the promotion of the Resolution and Plan of Action.

Responsible Post-harvest Practices and Trade

The Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Post-Harvest Practices and Trade, serves as reference in identifying directions and priority actions for the implementation of Article 11 (Post-harvest Practices and Trade) of the CCRF. Considering that traditional fish products in the ASEAN region still represent a significantly high amount of total fish utilization, the Guidelines also aimed to address this concern under its three main topics: responsible fish utilization, responsible international trade, and laws and regulations related to fish trade. The Guidelines also incorporated relevant provisions of the Resolution and Plan of Action for Food Security for the ASEAN Region. Coordinated by the SEAFDEC Marine Fisheries Department (MFRD), the Guidelines was prepared after a series of consultations with core experts from SEAFDEC and ASEAN Member Countries. It aims to achieve food security and promote trade in domestic, intra-regional and international markets, considering that only few countries in the region have the capability to develop food safety and quality assurance in their fish products especially those intended for the foreign markets.

Supplementary Guidelines for Responsible Fisheries in Southeast Asia

In order to substantiate the Regional Guidelines for Responsible Fisheries: Responsible Fisheries Management, Supplementary Guidelines was published comprising four parts: (1) Co-management Using Group User Rights for Small-scale Fisheries in Southeast Asia; (2) Fishery Statistics for Capture Fisheries in Southeast Asia; (3) Use of Indicators for Sustainable Development and Management of Capture Fisheries in Southeast Asia; and (4) Use of Fisheries *Refugia* for Capture Fisheries Management in Southeast Asia.

Beyond Production of the Regional Guidelines

After the production of the Regional Guidelines, follow-up actions have been made by SEAFDEC and ASEAN especially at the national level to secure that the Guidelines would be fully understood and implemented by the Member Countries, and eventually developing their respective national frameworks for the implementation of the global CCRF. SEAFDEC with financial support from the Swedish International Development and Cooperation Agency (Sida) through technical cooperation with the Swedish Board of Fisheries launched a four-year project on Human Resource

Development (HRD) for Fisheries Management in the ASEAN Region (2003-2006). The project, which comprised Component II of the RCCRF focused on human resource development to specifically support the implementation in the ASEAN region of the CCRF: Fisheries Management. This project aimed to support the implementation of the CCRF through awareness building and training activities, specifically with respect to the priority issues contained in the Regional Guidelines for Responsible Fisheries in Southeast Asia: Fisheries Management as well as on the issues related to the reduction of „fishing capacity‰ to achieve sustainable fisheries in the region. In order to set directions and priorities, a process-oriented (step-by-step) approach is being adopted, seeking consensus and recommendations from the Member Countries through a series of regional consultations and meetings as well as other related initiatives.

Recognizing that „*HRD in fisheries is specific to the national situation*‰, the development of a „*pilot process*‰ in a representative set of ASEAN member countries is necessary to enhance the management of fishery resources through effective implementation and regional application of the CCRF and the RCCRF. Thus, the pilot process was implemented in representative countries, i.e., Cambodia, Indonesia, Thailand and Vietnam that were chosen during a series of meetings, workshops and on-site training sessions conducted to address fisheries management and fishing capacity issues. At these fora, the discussions highlighted on the fact that in the ASEAN region *the major issue regarding fisheries management relates to management of fishing capacity and reduction of over-capacity*. Based on the need to integrate social, legal and environmental aspects, three „thematic‰ priorities for HRD were developed and are being promoted: (1) management of over fishing capacity; (2) strengthening of local fisheries management; and (3) integrating fisheries management into habitat management.

HRD strategy for fisheries

Consonant with the implementation of the CCRF and the RCCRF, the Strategy for HRD in Fisheries in the ASEAN Region promotes the packaging of outputs from the capacity building and HRD programs with the aim of improving planning and management capabilities in coastal fisheries.

Box 1: Fisheries *refugia* in Southeast Asia

In Southeast Asia, fisheries *refugia* is the "spatially and geographically defined marine or coastal areas in which specific management measures are applied to sustain important species (fisheries resources) during the critical stages of their lifecycle, for their sustainable use".

Box 2: Human Capacity Building in Support of the Establishment of Fisheries *Refugia* in Southeast Asia

Establishment of fisheries *refugia* in the Thailand-Cambodia-Vietnam areas, include three main concerns:

- Processes for the establishment of fisheries *refugia*
  - Establish criteria for selection/establishment of fisheries *refugia*
  - Motivate people to establish fisheries *refugia*
  - Establish the fisheries *refugia*
  - Manage the fisheries *refugia*
- Activities for other countries to establish and manage fisheries *refugia*
  - Cooperation between Cambodia-Thailand (Koh Kong and Trad Provinces)
  - Cooperation between Cambodia-Vietnam (Kampot and Kien Giang Provinces)
- Mechanisms for the establishment of fisheries *refugia*
  - Establishment of provincial working groups
  - Establishment of technical working groups

The outputs could include policy and technical advice as well as awareness building in fisheries management including management of fishing capacity for the policy makers/high level officials. The process of awareness building and human resource development includes a key set of thematic indicators on the integration of social, environmental, and legal aspects. Moreover, collaboration with the UNEP/GEF South China Sea Project (fisheries component) was forged to introduce the concept of *refugia* (**Box 1**) and HRD for fisheries *refugia* for commercially-important fish stocks and endangered species in the ASEAN region.

In response to the recommendation to integrate fisheries management into habitat management, consultations to promote management and conservation of habitat and transboundary resources were initiated. The concept of establishing „fisheries *refugia*‰ as a marine protected area with regulated fishing was therefore considered. Thus, human capacity building in support of the establishment of fisheries *refugia* in Southeast Asia (**Box 2**) is being carried out in collaboration with concerned institutions, i.e. the Ministry of Fisheries (Vietnam), Department of Fisheries (Cambodia), Ministry of Environment (Cambodia), UNEP/GEF South China Sea Program, and IUCN/MPA (Vietnam). Consultations with the local/provincial offices on management of the coastal habitats and fisheries were deemed necessary to promote the concept and design for the „Fisheries *Refugia*‰ while the link of „Fisheries *Refugia*‰ with coastal resource management was clarified, and the capacity building needs and activities including HRD materials in support of the „Fisheries *Refugia*‰, have been identified.

Box 3: HRD materials and regional database developed for this project

1. HRD "packages" based on a the information and materials used during training workshops and on-site training
2. "*Regional Inventory, Database and Network for Information Collection on Human Resource Development in Fisheries*" (RIDNIC-HRD), which could also be accessed through the internet
3. A description and implementation approach to representative types of management situations:
   - Development of local organizations and fisheries management in three areas (Lombok in Indonesia, Satun in Thailand and Koh Kong in Cambodia)
   - Management of anchovy fishery in two locations (Thailand and Vietnam)
   - Establishment of MPA and marine fisheries resources protection areas in Vietnam

HRD Materials

A common pool of learning experiences from various sources was used to develop a series of „packages‰, documenting the knowledge and information shared during the pilot process and on-site training. Four sets of „packages‰, one each for Cambodia, Indonesia, Thailand and Vietnam have been developed, while the HRD materials and regional reference database were established (**Box 3**).

HRD for fisheries management and management of fishing capacity

Recognizing that HRD only on „technical issues are not sufficient‰, HRD in fisheries management and management of fishing capacity should be developed at all levels taking into consideration three important aspects:

- *Legislations, laws and regulations* – implication of international initiatives and conventions, structure/rules of local management, co-management approaches, functions of rights-based fisheries and rights of resource users, institutional role and responsibility;
- *Socio-economics* – implications of limiting access, reducing and managing fishing capacity, facilitating exits from fisheries, supplementary/alternative livelihoods, co-management concepts, survey/research techniques including consultation and participations; and
- *Environment* – habitats and reproduction areas, migratory routes and interconnectivity, supplementary/alternative livelihoods, necessity to maintain coastal features.

For this project, „isolated‰ process in developing human resources for management of fishing capacity has been avoided. Thus, HRD for the management of fishing capacity is incorporated within the context of fishery management otherwise having another parallel process would not put the project funds to optimal use. From the point of view of fisheries management, addressing fisheries management would lead to addressing also fishing capacity.

The ASEAN-SEAFDEC Member Countries at the Regional Technical Consultation on Management of Fishing Capacity and HRD in Support of Fisheries Management held in Phuket in 2006, recommended the establishment of "Regional Fisheries Management Body"

Direct results from the pilot processes and on-site training

Monitoring the impacts, effects and activities as well as assessing direct or indirect results from the implementation of the activities are closely followed up. Based on the report of the review mission (March 2007) and the reports provided by counterparts from the four pilot countries, the project has already achieved direct results (**Box 4**).

Box 4: Direct results from the implementation of project activities

- Fishermen in Trad Province, Thailand, organized themselves using the experience gained from on-site training in Satun Province, including improved management of crab fisheries
- Plans were developed for the establishment of a fisheries resources conservation area/MPA in Quang Binh Province, Vietnam, based on lessons learnt from on-site training in Phu Quoc
- In Indonesia, the MAFF planned to build up on the "district models" based on traditional practices, such as the *Awig-Awig* model that was used as a reference during the project event in Lombok
- In Koh Kong Province, Cambodia, cooperation across the border with Thailand on fisheries and habitat management has been confirmed as a priority by the Director-General of the Fisheries Administration of Cambodia, as a cooperative effort between Vietnam and Kampot Province
- A senior official of the Department of Fisheries of Thailand, after recognizing the need for Provincial Fishery Officers improve their skills in conflict resolution, facilitation and planning, in addition to technical subjects, and made provision in the next year's departmental (national) budget for such skills training

Box 5: Major collaboration fostered among the countries

1. **Moving towards a regional fisheries management mechanism**
   The recommendation of the ASEAN-SEAFDEC Member Countries during the 2006 Consultation in Phuket, Thailand on the establishment of a **"Regional Fisheries Management Body"** as a major long-term policy issue or area for collaboration, gained impetus upon its approval by the 39th Meeting of the Council Meeting in 2007 Siem Reap, Cambodia.
2. **Willingness to cooperate in bordering (or trans-boundary) water areas**
   A consensus to promote cooperation between neighbouring countries on the integration of habitat and fisheries management (*Refugia)* was reached under a common management mechanism. The areas recommended include the Gulf of Thailand, Andaman Sea, South China Sea and Sulu/Sulawesi Sea. With the cooperation of Cambodia, Vietnam and Thailand, the project successfully initiated the process in two locations:
   - Trad – Koh Kong (Thailand – Cambodia)
   - Kampot – Phu Quoc (Cambodia – Vietnam)
3. **Management of Fishing Capacity in Southeast Asia**
   Since management of fishing capacity is considered *the* fisheries management issue and considering the regional nature of fishing operation and migration of fish workers, regional cooperation could be attained upon addressing the following issues:
   - As there is no aggregate data on fishing capacity at national or regional level and that available information is more site-specific and relates to projects rather than statistical information, the lack of "statistics" with respect to fishing capacity especially at small-scale level remains a critical problem
   - Fishing capacity of large-scale fisheries to be addressed in parallel with small-scale fisheries
   - The need for alternative, supplementary income opportunities to facilitate exit from fishery
   - Transboundary and regional aspects of Illegal, Unregistered and Unreported fishing (IUU)
   - Social aspects of reduction and management of fishing capacity
4. **Successful promotion of cooperation and innovative approaches to management**
   Establishing cooperation with other institutions and projects is crucial to seek broad cooperation even beyond the sphere of fisheries agencies for long-term results. Such cooperation is important in addressing the social, environmental, economical and legal aspects in order to develop innovative approaches for improved regional cooperation. Thus, the project has been instrumental in:
   - Promoting integration of fisheries management into habitat management
   - Initiating activities on providing incentives to fishermen that are fishing in a sustainable way (eco-labelling)
   - Improving coordination between fisheries, environmental and other agencies, including involvement of NGO's at various levels
   - Introducing adaptive management through dialogue among projects and institutions

Promotion of regional cooperation in fisheries management and management of fishing capacity

It will take time for the objective of „aiming for a drastic change in the course of action‰ together with the philosophy of building consensus among ASEAN-SEAFDEC member countries in close collaboration with and among ASEAN countries to be realized. But after such time, the countries in the region shall have already built up their means and mechanisms for cooperation. Nevertheless, the projectÊs „process oriented results‰ helped pave the way for regional cooperation (**Box 5**) in terms of fisheries management and the management of fishing capacity.

A sequence of activities to promote the cooperation in bordering waters included the Training/Workshop on Development of Community-based Fisheries Management in Coastal Areas of Cambodia, held in Kampot, Cambodia in 2005

Thus, the pro-active interaction with other projects and programs has been a useful mechanism not only in getting inputs to the project process but also in disseminating information and recommendation based on project results.

About The Author

Worawit Wanchana, Ph.D. is currently the SEAFDEC-Sida Project Manager and also works with the SEAFDEC Secretariat Policy and Program Coordination Office as Program Manager. Before joining the Secretariat in 2004, he served as Instructor in Fishing Gear Technology at SEAFDEC Training Department for 14 years.

Capacity Building in Fisheries Information: SEAFDEC Initiatives

Pouchamarn Wongsanga

SEAFDEC was established in December 1967 for the purpose of promoting sustainable fisheries development in the Southeast Asian region through research, training and information dissemination. As incorporated in its mandate, SEAFDEC is specifically tasked to support its Member Countries in strengthening their capacities to steer their fisheries towards responsible and sustainable development.

For almost 40 years, SEAFDEC accomplished major achievements in capacity building in the various aspects of sustainable fisheries development. The most significant of which is the promotion of the global Code of Conduct for Responsible Fisheries (CCRF) in the region through the development starting in 1998 of regional technical guidelines that cover responsible fishing operations, fisheries management, aquaculture and post-harvest practices and trade. The adoption of the SEAFDEC Strategic Plan in 1998 also enabled SEAFDEC to embark on new challenges to support the Member Countries in complying with new fisheries instruments and requirements at international, regional and national levels. Later, the „Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region‰ adopted during the 2001 ASEAN-SEAFDEC Conference on Sustainable Fisheries in the New Millennium: „Fish for the People‰, provided SEAFDEC with the regional policy frameworks in order to attain sustainable fisheries in the region under the guiding principles of the CCRF. These accomplishments were materialized through the capacity building initiatives that SEAFDEC has been pursuing in the region for the past 40 years.

Capacity building, as defined by UNDP is the process of strengthening abilities in a sustainable manner to improve competence. A process which is over and beyond training, capacity building involves the task of developing humans as well as institutions specifically encompassing the development of human resources, organizational structures, and institutional and legal frameworks. The basic components of capacity building have been put together by SEAFDEC in its overall objective of promoting sustainable fisheries development in the region. One very important endeavor initiated by SEAFDEC in order to attain its objectives is capacity building in fisheries information.

Fisheries Information in the ASEAN

The regionÊs current fisheries information is collected in a fragmented manner because the objectives for data and information collection including fisheries statistics are rather vague. Collection of information on the status and trend of fisheries and aquaculture either at regional or national level should therefore be intensified in order to aptly illustrate the fisheries situation of a country in particular and the region in general. In addition, from the actual situation, data and information gaps particularly for management purposes should be identified in order to prioritize efforts and allocation of resources to fill up such gaps. Specifically targeting also the ASEAN region, the need to collect information has been emphasized in the CCRF (**Box 1**).

Considering therefore, that the promotion of effective information and communication has become increasingly important for planning as well as management purposes, and in order to address concerns spelled out in the global CCRF and supplemented by the directives in the Resolution and Plan of Action adopted in 2001, SEAFDEC intensified its efforts in capacity building in fisheries information. Such efforts come in the form of collecting and processing information, and exchanging and sharing such information with all the stakeholders. Moreover, in the formulation of communication and information policies for the region, efforts to enhance the visibility of the SEAFDEC have been emphasized to raise public awareness on SEAFDECÊs roles and its contributions to the development of sustainable fisheries in region.

Box 1: Related provisions on the need to collect fisheries information (CCRF)

"*States should assign priority to undertake research and data collection in order to improve scientific and technical knowledge of fisheries including their interaction with the ecosystem*" (Article 6.4); and that "*The absence of adequate scientific information should not be used as a reason for postponing or failing to take measures to conserve target species, associated or dependent species and non-target species and their environment*" (Article 6.5). Moreover, the CCRF also emphasized that "*States should ensure that timely, complete and reliable statistics on catch and fishing effort are collected and maintained in accordance with applicable international standards and practices …*"; and that "*States should compile and disseminate such data in a manner consistent with any applicable confidentiality requirements*" (Article 7.4.4). The CCRF also indicated that "*Subregional or regional fisheries management organizations … should compile data and make them available, … in a timely manner and in an agreed format to all members … in accordance with agreed procedures*" (Article 7.4.7).

SEAFDEC Initiatives in Developing Fisheries Information Systems and Management

One of the most significant activities that SEAFDEC had sustained through the years is on the improvement of fishery statistics and information for planning and management of fisheries in the ASEAN region. Through this activity, SEAFDEC assists the Member Countries in achieving sustainable fisheries based on sound fisheries policies and management strategies derived from quality statistics, data and information. Thus, SEAFDEC continues to improve the collection and usage of statistics, data and information at national level; identify and establish linkages among all sources of available data and information; and enhance the quality, reliability, availability and timeliness of statistics.

Since fishery statistics is one of the very important tools that can be used to facilitate fisheries development planning and management, SEAFDEC continues to compile fishery statistics not only for use at the national level but also for regional and international purposes to enable a broader exchange of fishery statistics and information. The information collected by SEAFDEC through the regionÊs national fishery statistics systems has been compiled in the Fishery Statistical Bulletin for the South China Sea Area which SEAFDEC published annually since 1978.

SEAFDEC also published in 2006 the Regional Guidelines on Fishery Statistics in the ASEAN Region as part of the Supplementary Guidelines on Responsible Fisheries Management to provide regional reference or checklist for countries in the region interested in reviewing and improving their respective national fishery statistical system. Although the Regional Guidelines on Fishery Statistics in the ASEAN Region focused on improving fishery statistics for capture fisheries in the region, the Handbook on Collecting Fishery Statistics for Inland and Coastal Fisheries published by SEAFDEC in 2004 could be used as guide in dealing with inland and coastal fishery statistics.

The Fishery Statistical Bulletin (left); and Handbook on Collecting Fishery Statistics for Inland and Coastal Fisheries (right)

Regional Workshop on Improvement of Fishery Statistics and Information (15-18 February 2005, Indonesia)

Human Resource Development

Human resource development (HRD) aims to equip individuals with the necessary skills and technologies and providing them access to information. Since HRD is one of the original mandates of SEAFDEC, it has continued during the past 40 years to conduct training courses on the various aspects of fisheries at its four departments: the Training Department (TD) in Thailand for marine capture fisheries; Aquaculture Department (AQD) in the Philippines for farming of aquatic species; Marine Fisheries Research Department (MFRD) in Singapore for fish post-harvest technology; and the Marine Fishery Resources Development and Management Department (MFRDMD) in Malaysia for marine fishery resources conservation and management, while the SEAFDEC Secretariat implements HRD in fisheries information as well as HRD to promote the implementation of the CCRF in the region.

In a bid to improve the human resource capability of the region, SEAFDEC implements the Information and Communication Strategies which include various approaches, viz: (1) production of relevant, timely and useful information materials meeting the requirements of the target audience; (2) capacity development of information staff and workers at all levels; (3) improving the accessibility of SEAFDEC information to target groups; (4) strengthening of the cooperation and networking with other relevant organizations; (5) enhancing communication and information sharing; and (6) regular monitoring and evaluation of regional information activities.

Organizational Management Structure Development

SEAFDEC continues to assist the member countries in the development of their fisheries organizational management structure through the promotion of sustainable fisheries management strategies and collaborating with international organizations concerned with sustainable fisheries management. One such linkage is with the Fishery Resources Monitoring System (FIRMS) sustained since 2004 which has facilitated the collection of fisheries status and trend information, as important tools to support planning and management of fisheries in the ASEAN region.

It was through its partnership arrangement with FIRMS that enabled SEAFDEC to pursue related activities including the case study on development of a test inventory of shark fisheries in Southeast Asian countries based on data/ information from a SEAFDEC program on „Management of Fisheries and Utilization of Shark in Southeast Asia‰. Thus, the Fisheries Module on Shark of Thailand which was submitted to FIRMS Database and Module Development has already been presented in the fact sheet. The Fisheries Module on Shark of the other ASEAN countries that are still being developed will also be submitted by SEAFDEC to FIRMS, and it is expected that all these efforts will greatly benefit the Member Countries.

Institutional and Legal Framework Development

SEAFDEC has been assisting the ASEAN countries in the implementation of the CCRF not only through human resource development but also through organizational as well as legal framework development. Specifically, SEAFDEC collaborates with the Coordinating Working Party on Fisheries Statistics (CWP) of FAO in order to strengthen the capacity of the Member Countries in implementing activities related to statistics compilation, paving the way for the improved quality of the regionÊs fishery statistics as enhanced through the development and harmonization of common definitions, classifications and standards.

SEAFDEC also implemented the three-year project „Towards Better Utilization and Harmonized Information for Fisheries Management in Southeast Asia‰ from 2007 to 2009, which will be used as basis for collaborative activities with CWP, FAO and other regional fisheries bodies (RFBs) on issues related to fishery statistics and information. Besides, ASEAN and SEAFDEC convened the Regional Technical Consultation on Management of Fishing Capacity and Human Resource Development in Support of Fisheries Management in Southeast Asia‰ in Thailand in 2006 to discuss among others, the usefulness of the regional mechanism to regulate fishing capacity at sub-regional level (Gulf of Thailand, Malacca Strait, Andaman Sea, South China Sea and Sulu or Celebes Sea) as well as the need for improving fisheries management particularly addressing issues such as fishing capacity and Illegal, Unreported and Unregulated (IUU) fishing.

The ASEAN-SEAFDEC „Experts Meeting on Fisheries Statistics, Information and Indicators‰ held in Thailand also in 2006 has initially considered the establishment of the Regional Scientific Advisory Committee on Information for Fisheries Management to enhance information collection for fisheries management. However, this is still in the process of thorough discussion by concerned authorities in the region.

Conclusion and Way Forward

During the adoption of Code of Conduct for Responsible Fisheries since 1995 and the UN Fish Stock Agreement since 1994, the Regional Fisheries Management Organizations (RFMOs) have focused their main roles and functions on fisheries management for certain identified fisheries stocks in the region (semi-enclosed areas) and high sea fisheries. Since there has been clamors to develop new RFMOs to work on the gaps for areas/stocks not covered by existing arrangements and since the Southeast Asian region has been recognized as one of the few vacuum regions that do not currently fall under competent management areas of any RFMO, the need to investigate appropriate collaborative mechanism/arrangement for regional fisheries management in this region was deemed necessary. The Southeast Asian region has very limited high sea areas and its fisheries management has been critically constrained by the ineffective control of fishing capacity and other activities within national waters particularly fishing vessels encroaching into the EEZs of other countries putting much pressure on the already degraded fisheries resources. The mobility of capacity between jurisdictions leads to regular fishery conflicts between the large and small-scale fisheries and between fishing nations. Therefore more effective governance in fisheries, which is the goal of several regional organizations and countries in the region, should be put in its proper perspective and should be considered with utmost importance.

The relatively scarce information on the status of the fishery resources and the degree of fishing capacity in the regionÊs waters also constrain any further management action. Although there may be information now available to trigger the necessary action, this apparent uncertainty continues

to limit effective decision making on the management of fishing capacity especially the IUU fishing. The domestic situation in many countries of the region and inadequate human capacity and resources to deal with these issues requires a systematic regional approach.

Towards this end, there is a need to develop appropriate regional mechanism reflecting the regionÊs efforts in promoting sustainable fisheries. This means that regional fisheries management issues should be considered an urgent agenda for SEAFDEC to push through. Since there is a growing concern on the sustainable fisheries issues in the international arena, increasing pressures in achieving sustainable fisheries will soon become very apparent for the Southeast Asian region. This is therefore a very appropriate time for the region to think about a mechanism that would expedite the required fisheries management actions through collective regional efforts.

The Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region adopted in 2001 provide regional policy framework and priority actions including those of fisheries management. In addition, the Regional Guidelines for Responsible Fisheries Management in Southeast Asia and the Supplementary Guidelines (containing regional guidelines for co-management using group user rights for small-scale fisheries, fishery statistics, use of indicators for management of marine capture fisheries, and fisheries *refugia*) also provide standards to improve fisheries management under the framework of the CCRF. Considering these structures, the promotion of sustainable fisheries management in the Southeast Asian region could be enhanced through regional collaborative efforts for fisheries management taking into consideration the need to address the following major issues:

- Clearly defined fishery data and information needs for the formulation of management policies and programs;
- Close linkage between research activities and data collection on one hand and fisheries management policy, programs and actions on the other; and
- Clearly defined and harmonized fisheries management methodologies and approaches as well as maintaining dialogues among stakeholders particularly at the regional level on implementation of such methodologies and approaches.

Although there has been no appropriate forum to specifically discuss about fisheries management issues in the region based on the understanding that fisheries management issues are prerogatives of the respective national fisheries-related authority of the countries, SEAFDEC will continue to promote a regional framework on fisheries management through capacity building in fisheries information that can be complementary to the national fisheries management actions, and coordinate such actions within the countries in the region.

About The Author

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Advocating HRD in Aquatic Tagging:
A Demonstration for Economically Important Small Pelagic Fishes

Yoshinobu Konishi, Somboon Siriraksophon and Virgilia T. Sulit

Aquatic resources have been valuable sources of protein for most people in the Southeast Asian region. High fishing pressure and environmental impacts due to fast growing human population have however put much stress on the regionÊs aquatic resources. In order to assure sustainability of these resources, responsible fisheries management has been actively promoted in the region. Recognizing that responsible fisheries management requires knowledge on fish behavior and habitat use as well as other biological information such as growth and reproductive ecology, SEAFDEC has been conducting studies aimed at collecting data and information on commercially important pelagic fishes of the region with a view of promoting sustainable fisheries management and conservation.

As early as 1998, SEAFDEC has implemented the regionalization of the global Code of Conduct for Responsible Fisheries (CCRF) and came up with regional guidelines on responsible fishing operations, responsible aquaculture, responsible fisheries management, and post-harvest practices and trade. The preparation of the Regional Guidelines for Responsible Fisheries Management, which covers industrial as well as coastal fisheries, was coordinated by the SEAFDEC Marine Fisheries Resources Development and Management Department (MFRDMD) and Training Department (TD).

Information Collection for Fisheries Management

Keeping abreast with the provisions in the Regional Guidelines for Responsible Fisheries Management, MFRDMD and TD conducted a study on „Information Collection for Sustainable Pelagic Fisheries in the South China Sea‰ from 2002 to 2006 (Phase I of Japanese Trust Fund Project). Focusing on two groups of commercially important pelagic fishes, namely, the Indian mackerels and roundscads, the study was aimed at collecting information on fishery status and fishing gear operation as well as catch and biological data for pelagic fishery management purposes. Two basic methods were used in assessing the subpopulation of the targeted pelagic fishes, i.e., mtDNA and morphometry, the results however, were not very conclusive.

The movement behavior and migration routes of small pelagic fishes are useful information in determining their subpopulation. Since tagging is an effective method to determine such movements, a five-year regional tagging project for small pelagic fishes (Phase II) was initiated by SEAFDEC in 2007 which mainly aims to complement the results of the subpopulation study under Phase I and covers the Andaman Sea as well as the South China Sea targeting

on the small pelagic fishes and small tunas. The outcome from this tagging project is expected contribute to the regionÊs efforts in improving the management of the targeted pelagic fish resources.

Tagging of Economically Important Small Pelagic Fishes

Many research institutions and organizations have been promoting the use of telemetry to study the characteristics of fishes with a view to increase benefits while maintaining a balance between exploitation and conservation. As an important technology for measuring biological variables including information on biology and behavior of aquatic species, telemetry is therefore considered one of the most important tools in fisheries management. However, there are no available transmitters of telemetry and data loggers suitable for the targeted small pelagic fishes with about 20 cm in body length. Thus, a traditional tagging method using simple tags is being adopted in Phase II of the project in order to obtain information on fish behavior and migration patterns of small pelagic fishes.

Since many pelagic fishes seems to consist of a mixture of individuals originating from different populations and fishes of different genetic background are likely to be found in the same waters, studies on the behavior of fish from mixed and shared stocks require information on genetic background of individual fishes. Thus, genetic analysis combined with tagging could be useful tools in studying the migration pattern of fishes.

Tagging practice using fresh fish (left); and actual tagging of live fish (right)

Tagging Experiences

SEAFDEC and some countries in the region have had experiences in tagging of fishes (**Box 1** and **Box 2**). Specifically, Thailand has long history of tagging activities for small pelagic fish dating as far back as the 50s. Indonesia also conducted tagging activities for three species of tuna in the North Sulawesi waters from 1996 to 2000. MFRDMD conducted tagging of small tuna in the South China Sea

Box 1: National Experiences in Fish Tagging

THAILAND

Fish tagged: Indo-Pacific Mackerel collected from bamboo stake traps

Releasing Area: Gulf of Thailand (1962-1975) and Andaman Sea (1981-1984)

Activity Duration: 1960s to 1980s

Objectives:

1. To establish the migratory route of the fish and the speed of migration
2. To establish mortality rate of the fish
3. To establish other biological parameters
4. To stabilize the maximum sustainable yield of mackerel resources exploited in the Gulf of Thailand

Tag used: Red Dart Tags

Results:

1. From 1960 to 1965, total of fish tagged and released was 26,864 with 4,191 recaptured (15.6%)
2. From 1970 to 1975, total of 12,971 fishes were tagged and released in the Gulf of Thailand, only 6.57% was recovered
3. In the Gulf of Thailand, the longest recovery period was after 240 days while the maximum distance traveled by the tagged fish was 300 nautical miles at the rate of 1.2 nmiles/day

INDONESIA

Fish tagged: skipjack, yellowfin and big-eye tuna

Releasing Area: North Sulawesi waters (Eastern part of Indonesia)

Activity Duration: 1996-2000

Objectives:

1. To establish the migration route and behavior of the three tuna species
2. To establish biological parameters

Tag used: Tip pointed dart tags

Results:

1. From a total of 16,217 tunas tagged and released, 833 were recovered (5.74%)
2. Many of the tagged fishes were recovered near the FAD areas, therefore small pelagic fishes should be tagged in FAD areas but released outside FAD areas in order to maximize gathering of information as regards fish movements and migration patters
3. Distance of movement (yellowfin tuna): <10 miles - 68.27% with maximum distance of 1784 nautical miles (caught in the Pacific Ocean)
4. Distance of movement (skipjack tuna): <10 miles - 46.36%, 10-30 miles - 19.10%
5. Duration of capture (yellowfin tuna): <30 days - 78.23%
6. Duration of capture (skipjack tuna): <30 days - 94.24%

Box 2: Regional Experiences in Fish Tagging

SEAFDEC/MFRDMD

Fish tagged: small tuna species (*Euthynnus affinis* and *Thunnus tonggol*)
Releasing Area: South China Sea
Activity Duration: 1990-1998
Objectives:

1. To understand the migration patterns of the neritic tuna species in the South China Sea
2. To estimate the biological parameters of the small tuna species

Tag used: Tip pointed dart tags
Results:

1. About 74.9% of E. affinis tagged and released were recaptured, and 56.0% of T. tonngol tagged and released were recaptured
2. 25.1% E. affinis were tagged as free swimming school while T. tonggol was 44.0%
3. 1,044 tags were returned (4.39%)
4. Recoveries from offshore area was 94.06%
5. A total of 882 (86.1%) tagged E. affinis were recaptured within the first month after release
6. About 3.2% were recaptured on the same day the fishes were released
7. About 1.3% was recovered after one year of time at liberty
8. E. affinis migrates towards the north from November to May, and also towards north from January to March opposite the water surface current direction
9. T. tonggol migrates towards the Gulf of Thailand during the end of the year
10. Distance traveled for E.affinis in nautical miles: <250 g - 12.1±0.6; 250-300 g - 14.9±0.8; >300 g - 59.3±3.5
11. Distance traveled for *T. tonggol* in nautical miles: ave 48.5±11.3

SEAFDEC/TD

Fish tagged: tuna
Releasing Area: Eastern Indian Ocean
Activity Duration: 22 October 2003-8 January 2004
Objectives:

1. To assist IOTC in their Tuna Tagging Program
2. To assist IOTC in recapturing the tagged tuna
3. To provide tagging data to the IOTC Database System

Tag used: IOTC Standard Dart Tags
Results:

1. Distance traveled: 390.6 nautical miles

from 1990 to 1998, while TD conducted tagging of tuna from 2003 to 2004 in the Eastern Indian Ocean as part of SEAFDECÊs commitment to assist in the Tuna Tagging Program of the Indian Ocean Tuna Commission (IOTC).

Tuna tagging by Indonesian researcher

Tagging Demonstration

As the first component of the five-year regional tagging project, tagging demonstration for the Indo-Pacific mackerel was conducted by SEAFDEC on 1 May 2007 at Samut Songkram Province, Thailand. A tagging technique was introduced in order to develop the capability of the member countries in improving fisheries management as well as in evaluating shared stock population and determining strategies for managing such population. Coordinated by MFRDMD and TD, the tagging demonstration was participated in by representatives from the member countries, namely, Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Vietnam. In addition to human resource development, the said Tagging Demonstration also served as prerequisite for the implementation of the Regional Tagging Project (Phase II) in the SEAFDEC Member Countries for the period 2008-2011 which receives funding support from the Government of JapanÊs Trust Fund Program (JTF).

Proper handling of fish for tagging: in fishing boat (inset) and in acclimation tanks (above) emphasized during the May 2007 Tagging Demonstration

With the guidance of the tagging experts from Thailand and also from MFRDMD and TD who had considerable experience in fish tagging, providing useful information during the May 2007 Tagging Demonstration, the representatives from the other member countries were able to conduct actual tagging of fishes ensuring that the tagged fishes that were released are alive. After the tagging demonstration, the country representatives became confident in initiating tagging activities of important small pelagic fish species in their respective countries.

Tagging procedure advocated by Dr. Yoshinobu Konishi (extreme left) is tried by participants onboard a fishing vessel

ThailandÊs experience in fish tagging also includes valuable developed techniques on handling and transport of fishes used in tagging activities. Considering that proper handling and transport of fish ensures the success of tagging activities, the Department of Fisheries of Thailand also promotes the guidelines that it has developed for the collection and handling of small pelagic fishes used in tagging (**Box 3**). Introduced during the May 2007 Tagging Demonstration, the guidelines also include effective transport of fish from the collection area to land-based holding facilities.

Way Forward

The May 2007 Tagging Demonstration served as an introductory activity for the Regional Tagging Project for Small Pelagic Fishes in the South China Sea and Andaman Sea to be carried out from 2008 to 2011 under the JTF Program. The participating member countries submitted their respective National Tagging Activity proposals under the five-year project. Considering financial availability, four pelagic species will be used in the tagging activities: two species of mackerel (*Rastrelliger kanagurta* and *R. brachysoma*) and two species of scads (*Decapterus macrosoma* and *D. maruadsi*).

The expected outcomes of the regional tagging project include: information on migratory patterns and migration routes; and information on short-term growth patterns for the targeted small pelagic fishes in the South China Sea and Andaman Sea. The project is also expected to provide recommendations and suggestions on management plan for purse seine fisheries in the South China Sea with reference to the information and outcomes obtained from Phase I of the JTF project.

About The Authors

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Box 3: Guidelines in handling live Indo-Pacific mackerel for tagging (DOF, Thailand)

Pla too (Indo-Pacific mackerel), the most popular pelagic fish in the Gulf of Thailand, is very sensitive and will immediately die when caught. In the open sea, pelagic fishes swim in big schools as defense mechanism. Their eyes sharply detect every motion near by even tiny movements of unknown object. All the schools immediately respond in the same way to escape from predator or retreat from their prey, feeling safe when darting left, right, back and fort in the open waters. Their glittering silvery skin and their fantastic schooling motions act as their idealistic shelter.

The fishes form a condense circular shape when fishing net engulfs their school, become alert and dart to any direction in an attempt to escape when the net is pulled up. Their snout and belly are seriously injured from pushing and rubbing the net. When their scales are rubbed out of their skin, the flapping fish on the deck would not survive they are pushed back to the water. Nevertheless, Indo-pacific mackerel is a very tough fish and can easily adapt to captive environment. They can be easily trained to feed on pellet feeds and also with automatic feeding machines. The only problem is how to transport them live to land-based aquaculture facilities in order to be useful in the tagging activities.

Collection and transport methods

Bamboo stake trap, used to collect Indo-Pacific mackerel live specimen, is usually installed in shallow waters not far from sea shore, in such a way that a return trip back to a village fishing pier should not take more than 2 hours by fishing boat. Seine (around 20-30 meters in diameter) is used to collect the trapped fish in the bamboo stake trap everyday, at the lowest tide period but before the coming up tide. The catch amount per trip is not much, so it is quite simple to handle. The bamboo stake trap catches a variety of pelagic fishes and the fishermen are asked when there is small school of the target fish homogeneously trapped in their fishing gear.

A knotless seine net (small mesh) is recommended because sometimes a bulk of small size Anchovy species are also trapped, and big knot net will injure the fish causing high mortality rate. Catching can be done day or night and will be very appropriate when the sea is calm.

Scoop net made of soft net or towel cloth is required. Although towel cloth is soft enough it does not allow water to easily flow through, so there is a need to cut a number of small holes. The length of the handle should be around 1.5 m or long enough to reach the fish in the net depending on the boat height from water level. The diameter of the scoop net should be around 30 cm and depth of about 40 cm.

Lining the bowl with towel or sponge sheet is necessary to prevent the fish from bumping with the bowl. The bowl should contain water volume of around 20 liters, not too heavy to be carried by one person.
A dark color round tank (1 m diameter) is needed to transport the fish on board, containing water 60-80 cm deep and covered with net to prevent the fish from jumping out. A 12 volt DC air pump is convenient to provide power supply from the engine of the fishing boat. Strong air bubbles (approximately 3 air stones) can supply enough oxygen for 150 medium size Indo-Pacific mackerel in the transport tank. The same equipment can be used to transport the fish from fishing boat to the truck at the landing spot and to the land-based aquaculture facility.

The fisherman should stop hauling their net when the fish school is condensed, scooping small numbers of the fish each time and pushing them in the bowl lining with towel as fast as possible. The bowl should already contain water around 15 cm in depth. The bowl should be carried immediately to the transportation tank and into the tank, where the target fishes are gently selected by hand. The only key to successful selection is the shortest time out of the water and not injuring the target fishes.

Fresh sea water exchange may be done if necessary while traveling back to the fishing pier. Transferring the fish from the transport tank onboard the boat to transport tank in truck and to holding tank should make use of soft scoop net and bowl lined with towel cloth.

Land-based aquaculture facilities

Holding tank can be any shape but have to be wide enough so that the fishes can swim in circle and adapt rapidly to captive environment. If the tank is too small, the fish will show signs of stress. Clean disinfected seawater is also necessary in the first holding tank to prevent infection of the injured fish. Chemical treatment must be done to get rid of external parasite, i.e. *Argurus* sp. which can be treated using 0.25 ppm dipterex or 50 ppm formalin. The seriously injured fish should be kept in separate tank and treated with antibiotic. Daily exchange of water using clean disinfected sea water should be done in order that injured fish could easily recover. It takes around 2 to 5 days for less injured fish to recover while the seriously injured could take around 2 to 3 weeks to recover.

Live zooplankton is the most accepted feed for Indo-Pacific mackerel and adult Artemia as the first feed can stay alive for a long time in the fish holding tank without spoiling the water quality. Live adult Artemia is used as feed for one week after which they can be weaned to pellet feed. When the fish already adapts to captive environment and accept supplementary feed, they are easy to handle, transfer and do anything with them including tagging or even displaying in an aquarium. With good sanitation and husbandry, *Pla too* can be placed in rearing tank for years.

Science and Environment Education: Aquaculture in Focus

Teodora U. Bagarinao

SEAFDEC has always recognized the need for enhanced human resource capabilities at all levels and greater involvement by stakeholders to achieve sustainable fisheries development. As one of the mandates of SEAFDEC, human resource development (HRD) has been the focus of its training and extension efforts for 40 years. In the Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region, adopted during the Millennium Conference in November 2001, HRD was emphasized in the policy documents strengthening the efforts of SEAFDEC, viz: *"Acknowledge the need for enhanced human resource capabilities at all levels and encourage greater involvement by stakeholders to facilitate consensus and compliance in achieving sustainable fisheries (**Resolution 3**)"*.

The Aquaculture Department (AQD) for example, since its establishment in 1973, has conducted various training courses about different aspects of aquaculture and has ÂgraduatedÊ more than 5000 fisheries officers, aquafarmers, trainors, and students. With aquaculture being an important industry in the Philippines, a unique HRD activity was developed at AQD teaching aquaculture to children while they are still young, and this has been carried out through the SEAFDEC FishWorld at AQDÊs Main Station in Tigbauan, Iloilo, Philippines.

SEAFDEC FishWorld

The SEAFDEC FishWorld program spawned when in the 1990s, groups of schoolchildren started visiting AQD year after year, and it soon became obvious that AQD had a separate clientele to serve · the general public. In 1998, then AQD Chief Dr. Rolando Platon committed funds and broke ground for a facility that would highlight the work of

Box 1: Objectives of SEAFDEC FishWorld

- To provide a venue for visitors to learn about SEAFDEC's research, training, and technology transfer programs for responsible aquaculture
- To inform the general public about aquatic ecosystems and biodiversity, responsible aquaculture and fisheries, biodiversity conservation, environment protection, and sustainable development.
- To operate a museum of aquatic biodiversity and provide taxonomic identification service
- To conduct aquatic biodiversity research and train students, teachers, and researchers in systematics
- To help strengthen science and environment education in schools and inspire students into careers in the aquatic sciences
- To build among citizens a deeper knowledge, understanding, and sense of stewardship towards the oceans, and the environment in general

Box 2: HRD Opportunities in aquaculture and environmental sciences

- **Aquaculture Week**
  Sci-Art Competitions for High School Students
  - Teaching aquaculture in High School
  - Ecology and aquaculture quiz
  - Proposals for High School Aquaculture Projects
  - Biodiversity for livelihood
  - Collect and document biodiversity
  - Install a FishWorld Exhibit
  - Seafood dish
  - T-shirt design

  Sci-Art Competitions for High School Students and Elementary School Pupils
  - Easy writing
  - Painting

  Sci-Art Competitions for Elementary School Pupils
  - Collect, Show and Tell
  - Bring, Show and Tell
  - Write a Fish Story
  - Write and recite a Fish Poem
  - Nutrition and aquaculture quiz
  - Aquarium quiz
- **International Coastal Cleanup and Fish Conservation Week**
- **R&D Internships**
- **FishWorld Ecology Camp**
- **Visitor Services**

SEAFDEC and the importance of aquatic ecosystems, fisheries, and aquaculture. Thus was established the SEAFDEC FishWorld, a museum-aquarium-visitor center dedicated to science and environment education of the general public , children, adults, students, teachers, researchers, public officials, tourists, local residents, etc. The SEAFDEC FishWorld was opened to the public on 7 July 2000 during the 27th anniversary of AQD. Its objectives (**Box 1**) slowly crystallized over the past six years as various projects and activities were carried out.

The SEAFDEC FishWorld has since then been proudly working with schools, students, and teachers in the Philippines to enhance their science and environment education. This article therefore describes SEAFDEC FishWorldÊs initiatives and experiences in providing various HRD opportunities (**Box 2**) through informal education in environment sciences. The science and art competitions are held during AQD Aquaculture Week every July. A large number of schools, students, and teachers in the towns and cities neighboring AQD have participated and benefited from the various FishWorld events and competitions. In addition to the annual celebration of the Aquaculture Week, other activities include participation in International Coastal Cleanup and Fish Conservation Week, conduct of R&D Internships, arranging FishWorld Ecology Camp, and offering visitorsÊ services, etc. The experiences at SEAFDEC FishWorld could offer examples of projects and activities to other HRD workers around Southeast Asia as to be included in their own educational programs.

Aquaculture Week

FishWorldÊs science and environment education program includes several science and art contests during Aquaculture Week in July as part of AQDÊs anniversary celebration. The sci-art competitions seek to build understanding and appreciation among students and teachers of the importance of aquatic ecosystems and biodiversity, and of responsible aquaculture and fisheries to food security and sustainable development. The contests require students to study and learn by themselves and with coaches and parents the specified topics and themes (aquaculture, fisheries, environment, biodiversity, etc.), to demonstrate special skills (painting, writing, speaking, quiz, field work, handicraft, cooking, etc.), and to produce some output (photojournalism posters, installations, research proposals, specimen collections, biodiversity reports, shell products, seafood entrees, etc.).

Opening of Aquaculture Week (above); and high school teams preparing their biodiversity collections (right)

The Sci-Art Contests

The Aquaculture Week competitions started in 1995 and since then has expanded over the years. On average, 350 students and teacher-coaches from 35 schools participate with tremendous spirit every year. All participants and coaches receive Certificates of Participation. Winners and their coaches get Certificates of Merit and cash prizes (ranging from US$6 to $14). Certificates from FishWorld are much sought-after by students and teachers who use them to improve their resumes for higher grades and higher pay, respectively. To get FishWorld Certificates, contestants study about aquaculture, fisheries and the aquatic sciences, and display that knowledge and understanding through some output at the SEAFDEC FishWorld.

Teaching Aquaculture in High School

Given the importance of aquaculture to the Philippines, it should be taught earlier than in fisheries colleges,it should be taught in science or technology classes in high school, and even introduced in elementary school. This contest challenges teachers of science, technology, work education, home economics, and livelihood to learn the fundamentals of aquaculture and teach these to high school students. Teachers study the aquaculture production cycle, from choosing the seafood species and farm site, producing the seedstock in the hatchery, growing out the seafood in farms (ponds, pens, cages, or tanks), until harvest and marketing. They prepare a 30-minute lecture with appropriate and effective audio-visual aids. On contest day, they deliver their lecture to about 30 high school students from different schools and a group of AQD researchers. Teachers are scored for research done (20%), comprehension and elaboration of the topics (20%), audio-visual aids (20%), clarity of speech (10%), logic and order of presentation (10%), ability to answer questions (10%), and assessment by the students (10%).

Ecology and Aquaculture Quiz

This multiple-choice quiz for high school students includes questions about aquatic ecology, aquaculture, fisheries, and conservation. Contestants study and learn that natural ecosystems and their proper functioning support all human economic activities, including fisheries and aquaculture. They learn about responsible and sustainable aquaculture, in which resources are used carefully and adverse impacts on the environment and on local communities are prevented. They gain a working familiarity with the species and products from fisheries and aquaculture, including some main statistics.

Proposals for High School Aquaculture Projects

This contest is intended to train high schools to engage in small-scale fish farming projects and also encourage them to conduct research projects on aquatic ecosystems and biodiversity, aquaculture and fisheries, and related aquatic sciences. This familiarizes students with the practice and methods of science, develop the studentsÊ creativity and analytical mind, and help disseminate science and technology and their applications in daily life. For this contest, students with their research advisers prepare proposals for school-based projects in aquaculture. First, contestants learn the basics of aquaculture, that is, that fish are bred and reared in hatcheries (or the larvae may be collected from beaches), grown to market size in water farms (ponds, pens, or cages), then harvested, taken to market, bought by consumers, and eaten at home, in restaurants, etc. Second, they figure out what aquaculture project can be done in school and they make a good plan. Third, they write a three-page proposal. Fourth, they prepare Powerpoint slides (maximum 10 slides) about the proposed project.

The proposals should explain the why, how, and when the project will be undertaken, who will do it, and how much it will cost. Contestants write a three-page proposal following the prescribed format shown in **Box 3**: On contest day, copies of the written proposals are submitted to SEAFDEC

Box 3: Format of Proposal for High School Aquaculture Projects

- Title (must be descriptive, 10 selected words or less)
- Proponents (2 students, 1 adviser)
- High School name and address (where the project will be based or located)
- Rationale for the Project (why do the project? cite two scientific papers from journals)
- Methodology (how is project to be carried out? cite two scientific papers from journals)
- References (what S&T work has been done before? List the four selected and relevant scientific papers)
- Schedule of work (what will be done when?)
- Budget (cost equipment, materials, supplies, transportation, computer work, analysis, etc.)

Presentation of Project Proposal

FishWorld for evaluation by AQD aquaculture specialists. Each team is allowed 20 minutes for slide presentation. The proposals are scored for research done (20%), written proposal (30%), oral presentation (30%), and do-ability and capacity to meet the studentsÊ interest and intellectual needs (20%).

Biodiversity for Livelihood

Teams of high school students go to beaches or markets and collect good-looking unbroken shells of mollusks, clean them, and put together in a collection of at least 20 species excluding oysters and endangered species. The shells are identified by English or local names and by scientific names. To determine the scientific names, contestants bring their collections to SEAFDEC FishWorld for careful comparison with reference collections. A list of species in the collection is submitted to SEAFDEC FishWorld with the specimens on contest day.

Contestants then process, value-add, and package the shells for sale. Processing and value-adding can take many forms, as seen at several handicrafts stores. The shells are cleaned and presented in their natural form with no paint or varnish. Contestants bring the processed and packaged shells to SEAFDEC FishWorld for sale. Teams are scored for set of at least 20 different species (20%), printed list of correct scientific names (20%), printed description of the methods of collection, processing, value-adding, and packaging (20%), quality of the processed and packaged shells (20%), and sales after eight hours (20%).

Collect and Document Biodiversity

This contest for high school students involves biological collection for the school and to deposit some important specimens at SEAFDEC FishWorld. Contestants survey aquatic habitats, collect as many species (at least 10) of resident plants and animals, preserve and identify the specimens, and present the collection at SEAFDEC FishWorld. Teams prepare biodiversity reports that contain information and are scored (**Box 4**).

Box 4: Contents of Biodiversity Report

- Locality and date of collection
- Aquatic habitat type, description, and photos (20 points)
- Sampling method and processing of specimens (20 points)
- Research done, taxonomic references used (20 points)
- Table of species collected (common names, scientific names, classification) (5 points per species correctly identified)

Value-adding and packaging of shells

Photojournalism Contest

High school students prepare photo-posters about aquaculture as an important producer of seafood, provider of jobs and income, and contributor to the economy. Contestants do research to prepare for the photo essay by learning first which species are produced from aquaculture, as opposed to those from capture fisheries.

The contestants are expected to learn the basics of aquaculture, i.e, that fish is bred and reared in hatcheries (or the larvae may be collected from beaches), grown to market size in water farms (ponds, pens, or cages), then harvested, taken to market, bought by consumers, and eaten at home, in restaurants, etc. They also learn about the grow-out process: farm preparation, stocking, feeding, water change, and growth monitoring. They visit aquaculture farms and take pictures, and then write a short story or perspective.

On contest day, contestants bring their loose photos, printed story and captions, and other materials to SEAFDEC FishWorld, which provides 75 cm x 100 cm illustration boards and glue to set up the posters. Contestants lay out their best photos on the board and view the whole poster for quality of graphics and impact of story. The photo-posters are scored for story and perspective (20%), research done (20%), writing style (20%), quality of photos (20%), and overall visual impact of poster (20%).

Install a FishWorld Exhibit

For this contest, high school students are invited to conceptualize and install hands-on or interactive exhibits demonstrating the idea that marine biodiversity is important to people. The science installation includes an explanatory poster and a set of activities, or plants and animals, or devices, or artwork, or similar such items that can be manipulated to facilitate teaching and learning.

High school students preparing posters for exhibit

The teams first learn about the plants and animals that live in the sea and how they provide goods and services to people. Each team is allowed a 1 m x 2 m floor space and a whole day to install exhibits, and these are scored for theme or storyline (20%), research done (20%), quality of explanatory poster (20%), workability of hands-on and interactive items (20%), and overall teaching-learning impact (20%).

Seafood Dish Contest

This contest is open to student cooks from high schools, where a prospective cook may enter one main dish (not appetizers or salads) made with farmed seafood in the competition. The cooks prepare at school or at home a plate of each dish entry enough for several judges and other test tasters. The cooks type and print the recipe (listing ingredients and describing how to cook) on a 5"x 8" board and bring it with the dish. Entries are prepared for lunch and judging by 5-10 AQD researchers and staff. Entries are scored for printed recipe (10%), farmed species used (10%), sufficient quantity (10%), freshness (10%), health value (10%), presentation (10%), novelty (20%), and taste (20%).

T-Shirt Design Contest

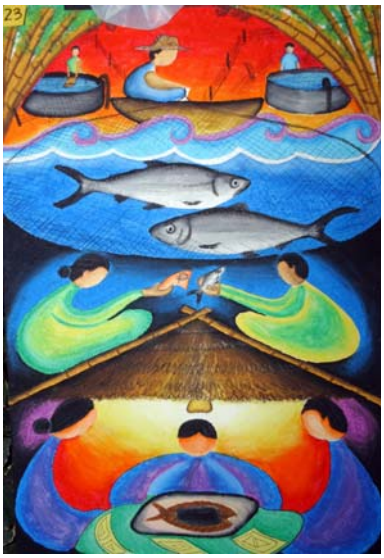
This is a variation of the painting contest for high school students. Contestants draw simple but striking story-telling T-shirt designs (two designs for front and back, each 30 cm x 20 cm in size) depicting the importance of aquaculture, fisheries, and aquatic biodiversity. Designs are scored for the same criteria as the paintings.

Essay Contest

Separate essay contests are conducted among elementary school and high school students. The contestants do background research, interview SEAFDEC/AQD scientists, and then write perspectives about aquatic ecosystems and biodiversity, responsible aquaculture, fish conservation, and food security. Essays are in English, about 2-5 handwritten pages long, and are scored for research done (20%), information content (20%), organization and logic of arguments (30%), and grammar and writing style (30%).

Painting Contest

Separate painting contests are held for high school and elementary school students. Contestants paint in full color the importance of aquaculture to Filipinos as producer of seafood, provider of jobs and income, and generator of arts and traditions. In preparation for the contest, the contestants read about aquaculture and how it contributes to food security, economic development, and the arts and culture in the Philippines. They also learn the appearance, behavior, habitat, and other characteristics of farmed aquatic organisms and depict them accurately in the painting. In July 2001, FishWorld conducted the ASEAN-SEAFDEC



Among the winning seafood entrees (above); and some of the winning paintings (right)

Drawing Contest: Fish and the Filipino Culture and selected one student, Alex Ordoyo, who produced the painting that became part of the art exhibition during the ASEAN-SEAFDEC Millennium Conference ÂFish for the People‰ in Bangkok in November 2001. FishWorld has also conducted contests to select mangrove paintings for the International ChildrenÊs Art Calendar produced by the Mangrove Action Project in Seattle, USA.

The painting size is 45 cm x 30 cm among elementary school pupils and 56 cm x 76 cm among high school students. Illustration boards, drawing paper, pencils, and pentel pens are provided by FishWorld, but contestants bring coloring and other materials they want to use. Contestants are allowed 4-8 hours to paint their entries and submit them with titles and short descriptions. Paintings are scored for research done (20%), context and message or story value (30%), details and accuracy (20%), and style, color, and visual impact (30%).

Collect, Show and Tell

This is a biodiversity contest among elementary school pupils, where contestants and coaches go to beaches near them and collect shells of mollusks, select good-looking unbroken shells, clean them, and put together a collection of at least 20 species. The specimens must NOT be endangered species. The shells in the collection are identified by English or local names and by scientific names. To determine the scientific names, contestants bring their collections to FishWorld for careful comparison with the reference collections. The specimens are then labeled and arranged on illustration board, or in some box or glass container, for display and presentation. The shell collection is donated to the school to become part of their Learning Resource Center or their biology collection. The teams then prepare a 10-minute oral presentation about the particular shells in the collection.

On contest day, teams bring their collections to FishWorld, show them to the public for one hour, and then tell the audience about the natural history of shells in 10 minutes. Presentations are scored for collection of at least 20 different species (20%), quality of specimens (20%), research done for correct identification and labeling (20%), packaging for show and display (20%), public speaking and showmanship (20%).

Bring, Show and Tell

This contest among elementary school pupils intends to encourage children to learn about the plants and animals that live in aquatic habitats, particularly those harvested by fisheries and aquaculture. When contestants find interesting plants and animals, they bring them to FishWorld preferably alive and healthy, show them to an audience, and tell their natural history. Endangered species are excluded. Contestants record the collection information: locality, date, and means of collection, specimen name, size, what plants and animals were found with it, and collectorÊs name and address. Contestants do research on the selected species and compose a short (one page long) factual story about them.

To determine the scientific names, contestants bring specimens to FishWorld for identification by taxonomic books. Each team is allowed 10 minutes for show-and-tell during which the contestants talk like enthusiastic science teachers to a group of pupils. Presentations are scored for research done (20%), story line (20%), interest value of the species and quality of the specimens (30%), and public speaking and showmanship (30%).

In a rather popular variation of this contest, elementary school students find three seafood species, identify them,

Bring, show and tell (top); and T-shirt design (above)

write a story about them, cook them, and bring them to FishWorld for show-and-tell. Presentations are scored three correctly identified species (20%), natural history and story line (20%), cooking and presentation of the seafood (20%), pictures and other visual aids for show and display (20%), and public speaking (20%).

Write a Fish Story

Elementary school pupils learn which fishes and invertebrates are produced from aquaculture. Then they write stories about aquafarm animals and their encounters with them in farms, in the market, in the kitchen, or the dinner table. Stories are scored for research done (20%), storyline (30%), grammar and writing style (30%), emotional impact (20%).

Write and Recite a Fish Poem

Elementary school pupils learn about fish, mangroves, other coastal ecosystems, marine debris and pollution, and fish conservation. They compose poems about what they learned and on contest day, they write the poems down and recite them out loud. Poems are scored for research done (20%), storyline (20%), writing style (30%), and recitation and showmanship (30%).

Nutrition and Aquaculture Quiz

AQDÊs Aquaculture Week fits right with the Philippine Department of EducationÊs Nutrition Month activities in July when elementary schools hold a Nutrition Quiz. About 30-40 Grade V and VI pupils join the FishWorld quiz. The contestants learn the basic concepts in nutrition, and coaches help them study the fundamentals of agriculture, fisheries, and aquaculture and their importance to food security. Contestants also learn to recognize good food items, including different species of fish and other aquatic products.

Aquarium Quiz

Grade V and VI pupils join this quiz where contestants learn about the plants and animals that live in the sea, particularly those harvested by fisheries and aquaculture. They also come to FishWorld and observe and become familiar with the animals in aquaria, which are provided information labels. During the quiz, contestants go around the FishWorld aquaria and answer the multiple-choice questions, including local or common names, scientific names, morphology, habitats, feeding habits, whether it is fished or farmed, and about fish conservation.

International Coastal Cleanup and Fish Conservation Week

The International Coastal Cleanup (ICC) is a yearly event every third Saturday of September in over a hundred countries where volunteers work for the reduction of marine debris and pollution and for the conservation of the oceanÊs biodiversity, beauty, and productivity. AQD has participated in the ICC since 1998 and FishWorld coordinates with schools, local government units, and other organizations to conduct ICC events in several localities in Iloilo.

The SEAFDEC FishWorld also organizes competitions among ICC volunteers from schools where the students learned that fish conservation is the sustainable use of fishery resources through the protection of aquatic habitats (natural ecosystems like coral reefs, mangroves, seagrass-seaweed beds, rivers, lakes) and through the regulation of human activities and marine pollution. The FishWorld competitions built awareness and understanding of the importance of fish conservation to food security and the contribution of aquaculture to both.

International Coastal Cleanup collection (left) and R&D Internship participants (above)

R&D Internships

Since 2003, FishWorld has offered a 20-day internship course in research and development for high school science students during the April-May school break in the Philippines. Students learn aquatic biodiversity, ecology, aquaculture, and fisheries through hands-on demonstrations, field trips, and some lectures from AQD scientists.

Already 60 students from the Philippine Science High School Western Visayas and the University of the Philippines High School in Iloilo have spent their summer internships at FishWorld. The internships seek to inspire and guide students into research projects, college degrees, and careers in fisheries, aquaculture, and the aquatic sciences.

FishWorld Ecology Camp

Empowerment of people through leadership training is an important step towards generating positive action for environment protection and sustainable development. Since April 2002, FishWorld has conducted 3-day live-in Ecology Camps that enables high school students and teachers to gain knowledge, understanding, and appreciation of the situation of the environment in the Philippines; marine ecosystems and biodiversity; responsible aquaculture and fisheries; ecological waste management, the greening of schools; and what individuals and schools can do to achieve environment protection and sustainable development.

Visitor Services

In its six years of active commitment, FishWorld has added value to SEAFDEC and to AQD. FishWorld receives about 10,000 visitors a year, mostly students from schools all over Panay and the neighboring islands. Indeed, FishWorld has become an Iloilo landmark in itself and many tourists now come to visit. The FishWorld tour includes a briefing or video about SEAFDEC and the Aquaculture Department, going around the visitor center and museum, and visiting the hatcheries and laboratories. Visitors also drop by the Sea Store to buy aquaculture publications and a variety of sea-inspired souvenirs.

About The Author

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Promoting GMP/SSOP for SMEs in Fish Processing: Indonesia's Perspective

Hendarni Mulyani and Suhartika Idawati

Fish fillet production in Indonesia

This article is based on the paper presented by the authors during the Regional Planning Meeting of the Project on Quality Assurance Systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries, 20-21 June 2007, Singapore.

The fish processing industry of Indonesia comprises mainly the domestic-based traditional fish products factories commonly operated by small to medium-scale processors catering mostly to the domestic market. Fish processing establishments are spread out in all the provinces in Indonesia most particularly in Java Island where almost 60% of the total industries are situated. About 40% of the countryÊs total fish catch of 4.71 million mt is utilized by the processing establishments, which are engaged in fish curing such as salting-drying (85%), salting-boiling (11%), smoking (3%), and fermentation (1%). About 50% of the total fish catch is marketed fresh and the other 10% is processed by large-scale fish processors in the form of frozen fish, canned fish, etc. The most important fish products of Indonesia are the salted-dried fish, salted-boiled fish (*pindang*), fish paste, fermented fish (*peda*), fish sauce, smoked fish, etc. The countryÊs total production of fish products was about 1.50 million mt in 2004 but this decreased to about 1.46 million mt in 2005 (**Table 1**).

Issues and Constraints

In order that IndonesiaÊs traditional fish products meet the safety and hygiene requirements, various issues and concerns such as the need for adequate infrastructure and equipment, adequate supply of potable and clean water and sufficient quantity of ice, and availability of clean handling and processing areas, etc. should be addressed. Since the countryÊs fish processing industry is dominated by small and medium-sized establishments (SMEs), efforts are being made to encourage the SMEs to improve their knowledge and skills on processing technology especially on the adoption of good manufacturing practices (GMP) and standard sanitation operating procedures (SSOP). Adequate knowledge on these aspects of fish processing as well as having sufficient and clean processing facilities will assure the country of fish products that are of high quality and safe for human consumption not only for the domestic market but also for the competitive export market as well. In order to be able to address the abovementioned issues and concerns, Indonesia through the Directorate of Fisheries

Table 1. Indonesia's production of fish products (mt)

Product type	2000	2001	2002	2003	2004	2005
Salted-dried fish	611,662	584,394	571,577	598,235	568,323	478,360
Salted-boiled fish (*pindang*)	66,457	134,071	124,826	121,491	122,807	95,776
Fish paste	16,581	21,607	7,251	9,342	9,809	13,911
Fermented fish (*peda*)	7,950	13,442	4,996	4,911	4,665	6,452
Fish sauce	76	524	2	6	10	71
Smoked fish	37,641	36,561	53,905	56,574	59,403	86,690
Frozen fish	305,923	307,235	319,237	573,911	633,200	699,224
Canned fish	21,227	25,299	36,913	28,415	31,945	49,211
Fish meal	1,640	12,204	16,612	8,635	7,339	7,251
Others	9,195	30,158	53,645	53,355	65,443	28,012
TOTAL	**1,078,352**	**1,165,495**	**1,188,964**	**1,454,875**	**1,502,944**	**1,464,958**

Product Processing, Directorate General of Fisheries Product Processing and Marketing of the Ministry of Marine Affairs and Fisheries, is actively participating in the SEAFDEC Program on Quality Assurance Systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries under the Government of JapanÊs Trust Fund Program (JTF). Through the countryÊs participation in this SEAFDEC Program, the implementation of GMP/SSOP in the SMEs in Fish Processing could be promoted for the quality and safety of its fish products.

The Fish Processing Establishments in Indonesia

As in most countries in the ASEAN region, the SMEs engaged in fish processing in Indonesia also comprise the pre-processing and traditional product processing establishments. The pre-processing establishments (PPEs) produce mainly fish fillets as semi-processed raw materials for large-size establishments producing surimi or surimi-based products or fish jelly products.

Pindang processing in Indonesia

The production capacity of the countryÊs PPEs is from 500 to 3,000 mt. The processing of fish fillets requires washing of the deboned and trimmed fish with cool clean water and packing the product with ice. However, in most cases the infrastructure, materials and equipment are not adequate. In addition, there has been scarce supply of good materials for fish filleting because large quantity of fresh raw materials is exported. Most PPEs also lack awareness on hygiene requirements and this resulted to not very good quality of the products from handling to processing thus distribution is localized only in the domestic market. Moreover, the locations of the PPEs are spread in the whole country making it difficult for concerned government agencies to monitor and conduct surveillance on the performance of the PPEs.

On the other hand, the traditional product processing establishments (TPEs) in Indonesia are predominantly engaged in fish curing producing such products as salted-dried fish, smoked fish, salted-boiled fish, and fermented fish. One of the most important cured fish in Indonesia is the salted-boiled fish locally called „pindang‰, which plays an important role as source of nutritious and low-cost food in the Indonesian diet. However, in recent years, production of „pindang‰ has decreased brought about by the short shell-life and storage triggered by poor sanitation and hygiene during its processing. „Pindang‰ is prepared in two different ways, i.e. through dried-salted boiling and brine boiling, the latter being most popularly practiced at present. The major species of fish used are scads (*Rastrelliger* spp.) and little tuna or sometimes milkfish. The processing of „pindang‰ involves washing the cleaned fish with clean water and arranging them in bamboo baskets. Granular or rock salt is sprinkled on the fish (15-25% of fish weight) then 10-12 baskets are tied together for boiling in a big container (with 25% salt) for 15-30 minutes. The baskets are washed with hot brine and after each basket is drained and cooled, the fish is packed for distribution.

As in the PPEs, the TPEs are also constrained with inadequate infrastructure, materials and equipment as well as antiquated technology based only on inherited techniques. The inadequate knowledge on hygiene practices resulted to the distribution of „pindang‰ only in the local markets. The participation of Indonesia in the SEAFDEC Program is expected to raise the status of „pindang‰ as a nutritious fish product not only for domestic consumption but also for export.

GMP/SSOP for SMEs Fish Processing Establishments

The Directorate of Fisheries Product Processing under the Directorate General of Fisheries Product Processing and Marketing of the Ministry of Marine Affairs and Fisheries conducted a survey on the real situation of the countryÊs PPEs and TPEs. In an effort to improve the safety and quality of the countryÊs fish products through the adoption of GMP and SSOP by the PPEs and TPEs and in order to comply with quality assurance requirements, initial SSOP guidelines have been formulated by the Directorate of Fisheries Product Processing and being promoted for adoption by the countryÊs SMEs. Although based on IndonesiaÊs perspective, other countries in the ASEAN region could refer to the draft guidelines (**Box 1**) for the development of their own SSOP guidelines for PPEs and TPEs.

Plan of Action

With the participation of Indonesia in the SEAFDEC Program on Quality Assurance Systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries, pilot projects will be conducted from 2007 to 2011 to develop and disseminate GMP/SSOP for fish fillet production as well as for salted-boiled fish (*pindang*) production. The specific activities for the PPEs will include:

1. development of GMP/SSOP for PPEs (using the draft guidelines as reference)
2. dissemination of GMP/SSOP to fish fillet processors
3. actual introduction of GMP/SSOP for fish fillet production in Tegal, Central Java
4. preparation of manual on GMP/SSOP for fish fillet production

For the TPEs, the specific activities include:

1. development of GMP/SSOP for TPEs (using the draft guidelines as reference)
2. dissemination of GMP/SSOP to salted-boiled fish processors
3. actual introduction of GMP/SSOP for on salted-boiled fish processing in Bali
4. preparation of manual on GMP/SSOP for salted-boiled fish production

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Box 1: Guidelines on SSOP for PPEs and TPEs (Indonesia's Perspective)

1.	Plant Construction and Layout	
1.1	**General Considerations** The plant and surrounding area should be such that these can be kept reasonably free from contamination. The buildings should be sufficient in size without crowding of equipment or personnel, well constructed and with good maintenance. The plant and surrounding area should be designed and constructed so as to prevent the entrance and harboring of insects, birds or other vermin, but to permit ready and frequent cleaning.	**Specific Guidelines** • The location of the processing plant, its design, layout, construction and equipment should be planned in detail with considerable emphasis on the hygienic aspect, sanitation and quality control. • Where new premises are constructed or when existing buildings are modified, the local authorities should always be consulted in regard to building codes, hygienic requirements of the operation, and sanitary disposal of sewage and plant wastes. The food handling area should be completely separate from any parts of the premises used as living quarters.
1.2	**Specifications** Floors should be hard surface, non-absorbent and adequately drained	**Specific Guidelines** • Floors should be constructed using durable, waterproof, non-toxic, non-absorbent materials which is easy to clean and disinfect. The materials should be non-slip and without crevices and should slope evenly and sufficiently for liquids to drain into trapped outlets fitted with removable grills. • Junctions between the floors and walls should be impervious to water and should be coved and rounded for ease of cleaning.

Box 1: Guidelines on SSOP for PPEs and TPEs (Indonesia's Perspective) (Cont'd)		
	Drains should be of adequate size, suitable type, equipped with traps and with removable gratings to permit cleaning	• Suitable and adequate drainage facilities are essential for removal of liquid and semi-liquid wastes from the plant. There should be no floor area where stagnant water might collect in pools. Drains should be constructed from smooth and impervious materials and should be designed to cope with maximum flow of liquid without any overflowing and flooding. Each drainage inlet should be provided with a deep seal trap which is appropriately located and easy to clean.
	Internal walls should be smooth, waterproof, resistant to fracture, light colored and readily cleanable	• Acceptable materials for wall finishing should have adequate impact resistance, desirable surface qualities and easily repairable. • All joints should be sealed with compound resistant to hot water and cover strips should be applied where necessary. • Wall-to-wall and wall-to-floor junctions should be coved or rounded to facilitate cleaning. Walls should be free from projections and all pipes and cables should be sunk flush within the wall surface or neatly boxed in.
	Windows should be kept to a minimum size, sloped towards the processing area	• Window sills and frames should be made of smooth waterproof materials, and if of wood, should be kept well painted. Internal window sills should be sloped to prevent storage of miscellaneous materials or accumulation of dust and should be constructed so as to facilitate cleaning. • Windows should be filled with whole panes and those which open should be screened. The screens should be constructed so as to be easily removable for cleaning and should be made from suitable corrosion-resistant material.
	All doors, through which fish are moved, should be sufficiently wide, well constructed of suitable material, and should be of a self-closing type	• Doors, through which fish are moved, should be either sheeted with or made of a corrosion-resistant metal or other suitable material with adequate impact resistant and, unless provided with an effective air screen, should be of a self-closing type. Both doors and frames of the doorways should have smooth and readily cleanable surface. • Doors, through which the product is not moved, such as those providing staff access, should be appropriately surfaced, at least on the processing area side, to allow ease of cleaning.
	Ceilings should be designed and constructed to prevent accumulation of dirt and condensation and should be easy to clean	• Ceilings should be free from cracks and open joints and should be of smooth, waterproof and light coloured finish, which do not permit the growth of mould
	Premises should be well ventilated to prevent excessive heat, condensation and contamination with odours, dust, vapour or smoke	• The air flow in the premises should be from the more hygienic areas to the less hygienic ones. Good ventilation is important to prevent condensation and growth of moulds in overhead structures. • Ventilation opening should be screened and, if required, equipped with proper air filters. Windows which open for ventilation purposes should be screened. The screens should be made easily removable for cleaning and should be made from suitable corrosion-resistant material.
	Adequate lighting in the processing room and should be covered	• Light bulbs over the working areas where fish are handled at any stage of preparation should be of the safety type, or otherwise protected to prevent food contamination in case of breakage.
1.3	**Hygiene Facilities** Areas where fish are received or stored should be separated from areas in which product preparations or packaging are conducted so as to prevent contamination of the finished product	**Specific Guidelines** • Well-defined areas of adequate size, preferably separate rooms, should be provided for receiving and storing raw materials and for operations like washing, filleting or other processing and packaging. • Manufacture or handling of edible products should be entirely separate and distinct from the areas used for inedible materials. • Receiving and storage areas should be clean and readily capable of being maintained in clean condition and should provide protection of raw materials from deterioration and contamination.
	Separate refuse room should be provided on the premises	• If refuse is to be collected and held before removal, adequate precautions should be taken to protect it against rodents, birds, insects and exposure to warm temperatures.
	An adequate supply of potable water and/or clean sea water, under adequate pressure, should be available at numerous points throughout the premises at all times during working hours	• All water available for use in various parts of the establishments where fish are received, held, processed, packaged and stored, should be potable water or clan sea water.

Box 1: Guidelines on SSOP for PPEs and TPEs (Indonesia's Perspective) (Cont'd)	
When in-plant chlorination of water is used, the residual content of free chlorine should be maintained at not more than the minimum effective level for the use intended	• Chlorination systems should not be relied on to solve all hygiene problems. The indiscriminate use of chlorine can not compensate for non-hygienic conditions in a processing plant. • Ice used in the operation of the fish processing establishment should be made from water of potable quality. Care must be taken to ensure that ice used to chill fish does not contaminate the fish.
Where non-potable auxiliary water supply is used, the water should be stored in separate tanks and carried in separate lines, identified by contrasting colours and labeled, and with no cross connections or back-siphonage with the lines carrying potable water	• Non-potable water may be used for such purposes as producing steam, cooling heat exchangers and fire protection. • It is very important that the systems of storage and distribution of potable and non-potable water are entirely separate and there is no possibility for cross-connection or for inadvertent usage of non-potable water in the fish processing areas. • The same requirement for separation systems would apply for clean sea water when it is used in processing.
Proper facilities for washing and disinfection of equipment should be provided	• Facilities should be present in every processing establishment for cleaning and disinfection of utensils, containers and other equipment. • Any containers and equipment used for offal or contaminated materials should not be washed in the same area.
Adequate and conveniently located toilet facilities should be provided	• Toilet rooms should have walls and ceilings, with smooth washable light coloured surface and floors constructed of impervious and readily cleanable materials. Toilet facilities should be well-lit, ventilated and kept in a hygienic condition at all times. Adequate supply of toilet paper should be available in each toilet cubicle. • The doors leading to the facilities should be of self-closing type and should not open directly into the fish processing areas. • Hand-washing facilities of a type not requiring operation by hand, with an adequate supply of potable water or clean seawater, with liquid or powdered soap and with suitable hygienic means of drying the hands, should be provided adjacent to the toilets and in such position that the employee must pass them when returning to the processing room. Where paper towels are used, a sufficient number of receptacles for used towels should be provided. • Notices should be posted directing personnel to wash their hands after using the toilets. • The following formula could be used as a guideline in assessing the adequacy of toilet facilities in relation to the number of employees: 1-9 employees = 1 toilet 10-24 employees = 2 toilets 25-49 employees = 3 toilets 50-100 employees = 5 toilets For every 30 employees over 100 = 1 toilet
Facilities should be available in the processing areas for employees to wash and dry their hands and for disinfection of protective hand coverings	• In addition to hand-washing facilities available in toilet rooms, a number of wash basins with an adequate supply of potable water or clean seawater and liquid or powdered soap should be provided whenever the process demands. These should be located at all employee entrances in full view of the processing floor and should be of a type not requiring operation by hand or should be fed by continuous flow of potable water or clean seawater. Single-use paper towels are recommended and the facilities should be kept in a hygienic condition at all times.
Staff facilities consisting of lunchrooms, changing rooms or rooms containing shower or washing facilities should be provided	• Where workers of both sexes are employed, separate facilities should be present for each except the lunchrooms which could be shared. As a general guideline, the lunchrooms should provide seating accommodation for all employees and the changing rooms should provide enough space for lockers or some alternative facilities for each employee without causing undue congestion. • Clothing and footwear not worn during working hours must not be kept in the processing areas.
Storage facilities should be available for proper dry storage of packaging materials	• Separate facilities for the storage of cartons, wrappings or other packaging materials should be provided in order to protect them against moisture, dust or other contamination.
If poisonous or harmful materials, including cleaning agents, disinfectants, sanitizers and pesticides are stored, these should be kept in a separate room designed or marked specifically for this purpose	• All such materials must be prominently and distinctly labeled so that these can be easily identified. The room should be kept locked and the materials contained in it should be handled only by personnel trained on their use.

Box 1: Guidelines on SSOP for PPEs and TPEs (Indonesia's Perspective) (Cont'd)

1.4	**Equipment and Utensils** All work surfaces and all containers, trays, tanks or other equipment used for processing should be of smooth, impervious, non-toxic material which is corrosion-resistant. Such equipment and utensils should be designed and constructed to prevent hygienic hazards and permit easy and thorough cleaning. In general, the use of wood for this purpose is not recommended	**Specific Guidelines** • Contamination of fish product during processing can be caused by contact with unsatisfactory surfaces. All food contact surfaces should be smooth, free from pits, crevices and loose scales, substances harmful to man, or other ingredients used and capable of withstanding repeated cleaning and disinfection. • Equipment should be so designed that they can be easily dismantled to facilitate thorough cleaning and disinfection. • Containers used for holding fish products should preferably be constructed of plastic or corrosion-resistant metal and, if of wood, these should be treated to prevent entry of moisture and coated with a durable, non-toxic paint or other surface coating that is smooth and readily washable. • Equipment and utensils used for inedible or contaminated materials should be identified as such and should not be used for handling fish products intended for human consumption.
	Surfaces on which fish product are processed shall be made of suitable corrosion-resistant material, other than wood, and all joints on such surfaces should be smooth and watertight	• It is important that all surfaces be of non-absorbent and crevice-free material so that these will not become saturated with juices containing micro-organisms which would give rise to off odours and become source of contamination. Corrosive materials are objectionable because the product of corrosion may contaminate the products.
	Tables should be so constructed that these, and the areas beneath, can be readily cleaned	• Tables should be constructed so that there will be no inaccessible points which may be omitted in establishment clean-up. Stands for workers along the processing lines should be constructed of metal, should be well maintained and should be movable or so constructed that the stands and the floor beneath can be properly cleaned.
	Transport vehicles should be designed to protect fish product (especially fish fillet) from warming during transport and should be of such material and construction as to permit easy and thorough cleaning	• Vehicles used for transporting fish products (especially fish fillet) should be designed to provide some means of refrigeration and constructed to ensure constant protection against contamination by dust, and the drying effect of sun and wind. Even where ice is very cheap and travel times or distances are relatively short, the use of an insulated vehicle provides an additional insurance against inadequate icing or unforeseen delays. • For the purpose of cleaning, the transport vehicle should have wall, floor and roof linings made of suitable corrosion-resistant material with smooth and non-absorbent surface. Floors should be adequately drained.
	Removal of solid, semi-solid or liquid wastes from fish product unloading, holding and processing areas should be on a continuous basis so that these areas are kept clean and there is no danger of contaminating the product	• All waste materials, resulting from the operation of a processing plant, should be disposed of as soon as possible in a way that they can not be used for human food and in a manner that they can not contaminate food and water supplies or offer harborage or breeding places of rodents, insects or other vermin. • Containers, flumes, conveyors, bins or storage bays used for removal, collection or storage of offal and other waste should be cleaned frequently with potable water or clean seawater containing an appropriate amount of free chlorine. • All waste materials from containers and vehicles should be removed in such a way as not to cause any contamination and not to create any nuisance. • Arrangements or the disposal of trade refuse and inedible waste should be approved by appropriate official agencies having the jurisdiction.
	Effective measures should be taken to protect against the entrance into the premises, especially storage areas, and the harborage on the premises of insects, rodents, birds or other vermin	• An effective and continuous programme for the control of insects, rodents, birds or other vermin within the establishment should be maintained. • All rodenticides, fumigants, insecticides or other harmful substances should be of an approved type and should be stored in separate locked rooms or cabinets and handled only by properly trained personnel.
	Dogs, cats and other animals should be excluded from areas where fish products are received, handled, processed or stored	• Dogs, cats and other animals are potential carriers of diseases and they should not be allowed to enter or live in rooms or areas where fish and products are handled, processed or stored.
	All persons working in fish processing plant should maintain high degree of personal cleanliness while on duty and should take all necessary precautions to prevent the contamination of the products with any foreign substance	• All employees should wear, appropriate to the nature of their work, clean and protective clothing including footwear and a covering for the hair or beard where required, all of which should be either washable or disposable. The use of waterproof aprons where appropriate is recommended. • Any behaviour which can potentially contaminate the fish products such as eating, smoking, chewing of tobacco and other materials and spitting should be prohibited in any part of the product handling areas.
	No person who is known to be suffering from, or who is a carrier of any communicable disease, or has an infected wound or open lesion should be engaged in the preparation, handling or transporting the fish and fish products	• Plant management should require that any person afflicted with any illness, should immediately report to management. • Management should not allow any person known to be affected with disease capable of being transmitted through food or known to be a carrier of such disease, to work in any area of a plant in a capacity in which there is a likelihood of such person contaminating the fish products with disease-causing micro-organisms.

Advancing Improved Fish Processing Technology in Lao PDR

Pachone Bounma

This article is based on the paper presented by the author during the Regional Planning Meeting of the Project on Quality Assurance Systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries, 20-21 June 2007, Singapore.

The Government of Lao PDR has always emphasized on the importance of economic growth based on agriculture and food production to promote rural development as a key part of its national framework for poverty reduction. During the past decade, fish and fishery products played an important role in the countryÊs economy, being source of income and employment for rural men and women, and contributing a large share of the peopleÊs food consumption. In 2004, the countryÊs fisheries sector produced approximately 94,700 mt of fish (**Table 1**) and production is expected to increase at around 3-5% per year (as reported production was about 97,400 in 2006).

Due to the abundance of its fishery resource, capture fisheries and collection of aquatic animals are important activities of the country especially during the rainy season. Fish supply is derived mainly from the countryÊs natural freshwater resources such as the Mekong River, its tributaries and reservoirs (40%), ponds, swamps, wetlands, flood plains (26%), rice fields (32%), and cage culture (2%). In 2004, Lao PDR imported about 3,000 mt of food fish and fishery products valued at about USD 3.0 million (FAO FishStat Plus 2006) comprising mainly canned sardines, frozen squids, mackerels, tunas, etc. Its export of freshwater fishes was valued at USD 64,000 in 2001 but decreased to USD 12,000 in 2004 (FAO FishStat Plus 2006).

Although the supply of fish and fishery products is expected to increase annually, the countryÊs high demand for food fish makes its production usually ending up only for domestic consumption. The per capita supply of fish in Lao PDR in 2004 was about 17 kg/person for a population of 5.62 million reported in March 2005 by the National Statistics Centre of Lao PDR. Sugiyama *et al* (2004) reported that the average per capita consumption of fish in Lao PDR is about 15-25 kg/year.

Any surplus from the countryÊs fish production especially during the rainy season is preserved in a variety of ways based on cultural preference and prevailing local conditions. Usually, fish is processed in small scale by traditional domestic manufactories, which are established mostly by traditional fish processing families or traditional fish processing communities. The most common form of traditional fishery products are: fish sauce, fermented fish, pickled, dried or smoked fish. The preserved fishery products are then utilized during the dry season when fresh fish is relatively scarce.

In the food processing industry, the Lao PDR Government strongly supports the establishment of small and medium enterprises, to ensure that there is sufficient food for domestic consumption and also for export. However, the fish processing industry in Lao PDR has not yet been established *per se*, despite the efforts of its Government to invest in this fisheries sub-sector.

Problems and challenges

The fish processing industry in Lao PDR mainly adopts the traditional processing system and management thus, is still underdeveloped. The dearth of knowledge and

Table 1. Fish production of Lao PDR (mt)

Species	2000	2001	2002	2003	2004
Bighead carp	2,466	2,931	3,500	3,804	3,804
Catla	685	814	972	1,056	1,056
Common carp	10,517	12,500	14,926	16,225	16,225
Cyprinids nei	4,400	4,650	5,000	4,500	4,500
Freshwater fishes nei	26,953	28,850	31,426	28,545	28,545
Grass carp(=White amur)	1,379	1,639	1,957	2,127	2,127
Mrigal carp	1,761	2,093	2,500	2,717	2,717
Nile tilapia	18,928	22,499	26,872	29,205	29,205
Roho labeo	1,761	2,093	2,500	2,717	2,717
Silver carp	2,466	2,931	3,500	3,804	3,804
TOTAL	**71,316**	**81,000**	**93,153**	**94,700**	**94,700**

Source: FAO FishStat Plus 2006

Fermented fish common in the ASEAN countries

understanding by the processors and consumers about food quality and safety continues to have negative impact on the countryÊs public health and economic development. Public awareness of serious health risks from food contamination by both consumers and processors is also very limited. The outbreak of intoxication and some incidence of food-borne infections and diseases that occurred recently prompted the government to exert efforts in improving the countryÊs fish processing industry. At present, the necessary regulatory tools are not yet available although some regulations and decrees related to food control are in place but these needs improvement in order to be able to effectively address food safety problems. The governmentÊs fisheries sector has no special laboratory for fish quality and control. At present, the sector shares the facilities of the animal disease laboratory at the National Animal Health Center of the Department of Livestock and Fisheries that performs tests for animal parasites and diseases, and certifies the safety of meat products. It is therefore, necessary to establish or improve the countryÊs institutional infrastructure and especially the human resource in order to be able to develop proper certification for the quality and safety of its fishery products.

The absence of trained manpower in the processing industry and inadequate qualified food inspectors in the fisheries sector also constitute the countryÊs major concerns. Most of the government personnel have limited capacity in food analysis and quality assurance, while essential and more specialized equipment are either inadequate or not available at all. Thus, the governmentÊs capacity to test for pesticide residues and mycotoxins for example, as well as to test and monitor chemical contamination of food products is rather inadequate. Added to this is the countryÊs difficult terrain and absence of proper communication systems making it difficult to monitor the quality and safety of the fishery products processed by the small manufactories. Summing up, all these are brought about by inadequate operational funds.

Advancing improved fish processing through capacity building

The countryÊs National Food and Drug Committee and National Codex Committee (inter-ministerial committee) chaired by the Ministry of Health of Lao PDR has developed a Food Safety Policy to address food safety along the food production chain, food regulations, standardization of food and control. The countryÊs Ministry of Agriculture and Forestry through the Department of Livestock and Fisheries on the other hand, plans to conduct activities aimed at helping the countryÊs fish processing industry especially in the application of GMP and SSOP through capacity building of the institution as well as the human resource. This is intended to enhance quality improvement of the countryÊs fishery products. This effort will be pursued initially through the implementation of two important approaches, i.e. the development of GMP/SSOP in the TPEs together with intensified human resource development.

Plan of Action

Unlike in other ASEAN countries, Lao PDR has no pre-processing establishments (PPEs) although the government is promoting the production of semi-processed raw materials from freshwater fishes for the fish processing industries. Lao PDR is optimistic that with its participation in the SEAFDEC Program on Quality Assurance Systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries (under the Government of Japan Trust Fund Program), would steer the country towards improving its fishery products for human consumption and improve its economy. Thus, under the SEAFDEC Program, Lao PDR aims to conduct pilot projects for the development of good manufacturing practices (GMP) and standard sanitation operating procedures (SSOP) especially in the traditional fish product processing establishments (TPEs) for the production of fermented fish and dried fish, which are the countryÊs most popular fishery products.

With possible technical assistance from regional/international organizations, Lao PDR also intends to conduct training courses for the TPEs in the country in order to upgrade their capabilities and be competitive in the fish processing industry. Eventually, this will lead to the development of the countryÊs quality assurance systems such as GMP and SSOP leading to the implementation of HACCP, and help the TPEs meet the safety and quality assurance requirements of its fish products for the welfare of the consumers.

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Efforts to Preserve a Fishery Cultural Heritage in Myanmar: The "cooperative fishing" with Irrawaddy Dolphins

Mya Than Tun

Isn't it not wonderful to see river dolphins practically helping fishermen make bountiful fish catch? This is only through "cooperative fishing" in the Ayeyarwady River of Myanmar. So, if you are looking for a good fish catch from the Ayeyarwady River why not ask help from the Irrawaddy Dolphins.

The "cooperative fishing" by cast-net fishermen and the Irrawaddy Dolphins in Ayeyarwady River

Cooperative fishing between the Ayeyarwady dolphins (also known as Irrawaddy Dolphins) and cast-net fishermen in the Ayeyarwady River of Myanmar is a form of traditional fishing that has never been described in any world fisheries record. The Irrawaddy Dolphins, which are respected by the fishermen living in the shores of Ayeyarwaddy River, help them in their cast-net fishing in a cooperative way.

For the fishermen in the Ayeyarwady River, the key to a bountiful dayÊs catch is not the bait used or their effort but it is the help they get from the Irrawaddy Dolphins. In the morning, a group of dolphins could be seen swimming downstream or upstream and upon reaching near the junction of the riverÊs sand bar, the lead dolphin is seen hopping and searching for fishing canoes. The dolphins jump up from the water and make whole body twist (360 degrees turn) searching the horizon. The fishermen while still ashore, call the dolphins by sending acoustic and audio signals (i.e., tapping the sides of their canoes) using a conical wooden pin or sometimes using lead weights, paddle or by making guttural sounds through their mouths. Usually, the dolphins respond positively to these calls through visual signals, communicating back through their body and several positions of their tail flukes. Some dolphins turn around near the canoes while lifting their flukes and waving left and right to the surface of the water. Slapping the water surface with their flukes, signals the desire of the dolphins to help the fishermen.

Upon seeing the dolphins swimming along the river, the fishermen follow the dolphins with their fishing canoes. If the dolphins can not find fish in one area, they show their fluke up and down to the surface very slowly and swim to another place. The fishermen understand that they are supposed to follow the swimming direction of the dolphins with their canoes. Upon finding an area and sensing that fish is abundant in that place, the dolphins show a signal for the fishermen to row their canoes back and forth especially when the dolphins show their flukes up the water surface pointing straight to the sky. This means that the fishermen should stop their canoes and wait for another signal for the proper time to throw their nets.

The understanding and cooperation between the Irrawaddy Dolphins and the cast-net fishermen in this cooperative fishing is a very unique and perhaps a very fascinating

culture. One lead dolphin swims in semi-circles driving the fish towards a certain direction while the other dolphins guard the fish from escaping the imaginary corrals made by the lead dolphins. Then the lead dolphins drive the herded concentrated mass of fish towards the direction of the fishing canoes and waving their half-submerged flukes signals the need for the fishermen to cast their nets. The fishermen then throw their nets timely and orderly to the school of fish.

Through this cooperative form of fishing, the fishermen said they could catch more fish with the help of the dolphins than without them.

Sometimes in one day, the fishermen could catch about 40 to 80 kg of fish. In fact some fishermen were saying that they could already live well for almost a month even without doing anything if they get such a good catch. Through this cooperative fishing, the dolphins herd fish to the fishermen, and the fishermen to the people. Cooperative fishing in the Ayeyarwady River of Myanmar is a mutually beneficial technique for both the fishermen and the dolphins and it has been passed on culturally through generations of humans and dolphins for a very long time.

The Irrawaddy Dolphins

The Irrawaddy Dolphin (*Orcaella brevirostris*) is a species of dolphin found near the coasts and in estuaries in some parts of Southeast Asia. It is usually 1.0 m long weighing about 10 kg at birth and about 2.3 m long at full maturity. An adult can weigh more than 130 kg and its life span is about 26-30 years. The Irrawaddy Dolphins are slow swimmers and surface the waters in a rolling motion. They lift their tail flukes clear of the water for a deep dive and spit streams of water through their mouths while spy-hopping. Although sometimes called Irrawaddy River Dolphin, it is rather more of an oceanic dolphin that lives near the coasts and enters the rivers including the Ayeyarwaddy River (known before as Irrawaddy River, thatÊs how the dolphin got its name) of Myanmar.

Commonly called „La Bine‰ in Myanmar, the Irrawaddy Dolphins eat the fish that are either stunned or darted away from the sinking cast-nets or from the mesh aperture of the nets. The dolphins always eat fishes entangled or half-protruding from the cast-net. When a dolphin bites the fish and the fish stretches its spine, the dolphin drops the fish and swims away. Dolphins never eat fish from the head and never eat spiny fish, they eat only the tail section of the fish. Since the benefit in terms of fish catch is shared among the dolphins and the fishermen, this form of fishing has always been known as „cooperative fishing.‰

Fishermen in the Ayeyarwady River reported that the dolphins sometimes spy-hopped to check the surroundings of the nets while these are being lifted. It is therefore necessary that the nets should be pulled carefully and slowly while the dolphins are swimming slowly and checking the nets. The fishermen explained that the dolphins will never cooperate with them again if not enough time is given for them to check the nets. The fishermen said that it is necessary to keep the dolphins preoccupied in a certain way until the termination of the cooperative fishing. Making mostly guttural sounds during the fishing operation with their hands busy lifting the nets and rowing their canoes, is one way of making the dolphins engrossed in their activity.

Two fishermen operate the cast-net canoe for fishing, one rowing the boat from the back while the other stands in front observing the signal given by the dolphins. The dolphins could herd the fish for the fishermen for a few hours or sometimes for half day or even sometimes for one whole day. When fishing operation is over, the dolphins swim

Irrawaddy Dolphin (above); and fishermen following the response and direction given by the Irrawaddy Dolphin (right)

downstream or upstream and the fishermen let them swim away freely. There are however mornings when some dolphins are not interested to cooperate by not replying when some fishermen send signal to them because these dolphins may have been fishing the night before with some other fishermen. The fishermen also observed that some dolphins are willing to fish only at night time. The fishermen explained that they could already recognize each individual dolphin, the day-fishing dolphin or night-fishing dolphin, or some dolphins fishing day and night. The fishermen gave names to some individual dolphins, such as „Gote Htit Ma‰ or dolphin with bigger head which could be more than 40 years old. Another dolphin is called „La Bine Nyi Naung‰ or the dolphinÊs brother and another „Bay Kyar Ma‰ or dolphin with stripe on its side.

The Ayeyarwady River of Myanmar

Myanmar is one of the largest mainland countries in Southeast Asia with a land area of 656,577 km^2 and population of about 54 million (estimated) as of 2007. The country owes the richness of its fisheries to the extensive big river systems, such as the Ayeyarwady (2170 km long) and its tributaries, Chindwin (960 km), Sittaung (298 km), and Thanlwin (1274 km), originating from Mainland China. As the longest river in Myanmar, Ayeyarwady River traverses the entire length of the country from north to south to the Andaman Sea. The Ayeyarwady River is famous for its traditional cooperative fishing between the dolphins and local fishermen. Here, the fishermen and the dolphins maintain this practice of mutualism from generation to generation.

In the Ayeyarwady River of Myanmar, Irrawaddy Dolphins were first reported by John Anderson (1879) to inhabit no farther downstream than Pyay (Prome) during the low-water season and Yenangoung (about 450 km from the sea) during the high-water season. The earliest reference to the Irrawaddy Dolphin in Myanmar was in the NewÊs TÊang History (Chinese Text from „about 800 A.D‰ as cited by Luce (1966)) that mentioned about traffic by „river-pigs‰ among the ancient Pyu culture of Myanmar.

Dwindling Population of the Irrawaddy Dolphins of Myanmar

The Irrawaddy Dolphin population in Myanmar was reported to be decreasing and threatened by many environmental and human-created factors. It was feared that its decreasing population could result to the disappearance of the countryÊs culturally and economically important traditional cooperative fishing where „inter-species relationship‰ between the dolphins and humans is strongly demonstrated. During the surveys conducted in 2002 and 2004 by the Whale and Dolphin Conservation Society (WDCS) of the United Kingdom and the Wildlife Conservation Society (WCS), respectively, in conjunction with the Department of Fisheries of Myanmar, it was revealed that the dolphin population decreased by about 60% from its last known records and that only 37 individuals remained in a river area that stretches 1000 km from the sea. Based on such findings, the World Conservation Union (ICUN) in 2004 designated the Irrawaddy Dolphin population as „critically endangered‰. As a result, during the Thirteenth Meeting of the Conference of Parties (COP13) held in Bangkok, Thailand in October 2004, the Irrawaddy Dolphin was up-listed from the CITES Appendix II (list of species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled) to the CITES Appendix I (list of species that are most endangered among the CITES-listed animals and plants).

The most important factors that affect the dwindling population of the Irrawaddy Dolphins include mortality from irresponsible fishing gears such as the gill nets that entangle the dolphins. The preference of fishermen for gill nets anchored at the riverbeds over the traditional cast-nets indiscriminately trap the fishes, dolphins and other aquatic animals that swim into them. Furthermore, some destructive fishing practices such as the use of electricity have become rampant in the river areas without proper law enforcement. The high voltage used in electric fishing kills everything within range. With dead fishes floating in water surface, it is easy for the fishermen to collect their catch. The countryÊs lucrative gold mining industry in riverbeds has also contributed to the Irrawaddy DolphinÊs declining population. Mercury which is used to extract gold from the ores leaches into the river system slowly polluting the water and eventually poisoning the aquatic species including the dolphins. The gold mining operations in the riverbeds also resulted to loss of habitats of the animals as major changes in the geomorphic and hydrologic features of the river channels take place.

Operations in the gold mines are very noisy distracting the echo sounds that the dolphins used to detect and catch their prey as well as to communicate with the fishermen. The very noisy operations largely contributed to the extinction of the species as this interferes with their ability to catch their food. Nevertheless, the countryÊs local communities depend solely on the fishery resources for their livelihoods so it is not easy to immediately enforce the banning of gill nets and other fishing practices or even stopping the mining of gold as it contributes to the countryÊs economy and religious practice. But efforts are now being initiated by the Government of Myanmar to make the people understand

the need to implement conservation and management measures especially for the threatened Irrawaddy Dolphins and also to preserve the „cooperative fishing‰ activity.

Efforts to conserve the Irrawaddy Dolphins and preserve "cooperative fishing"

The Department of Fisheries (DOF) of Myanmar has been designated to carry out the responsibility of promoting the conservation and management of the Irrawaddy Dolphins. Recognizing that the fishermen and the villagers love the dolphins as they provide them with economic benefits, but that the dolphin population has been critically endangered, the DOF considers it a challenge to implement effective conservation and management measures. Thus, in order to achieve its goal, the DOF collaborated with Wild Life Conservation Society (WCS) to protect and conserve the Irrawaddy Dolphins and the cast-net fishermen. In December 2005, the DOF and WCS established a protected area, about a 72 km segment of the Ayeyarwady River between Mingun and Kyaukmyaung, for the benefit of the Irrawaddy Dolphins and the cast-net fishermen. In this area, gill net fishing and gold mine operations are prohibited, while illegal fishing practices was completely banned. Since cooperative fishing occurs only in this 72-km stretch of the Ayeyarwady River and this area also supports about 22 to 32% of the total dolphin population in the river, this Mingun-Kyaukmyaung segment was the first area to be considered a protected area.

The conservation and management plan for the protected area includes regular consultation with the local people and stakeholders by the DOF officers and concerned authorities in order to raise the publicÊs awareness about the program. The DOF also asks the help of the monks to disseminate the information, as monks play a crucial role in the behavior of the people especially at the village level. The DOF Dolphin Conservation Team has been tasked to regularly conduct monitoring and surveillance as well as training the fishers and other people living along the river on sustainable fishing methods. Printed banners on the need to preserve the „cooperative fishing‰ practice have been put up for the peopleÊs awareness while pamphlets about the program were distributed to the local communities. Another measure being implemented is the dolphin-based ecotourism, where tourists are treated to a first-hand experience of the traditional cooperative fishing. This is conducted in the Myay Zun Village in Mandalay Division. The cast-net fishermen are poor so by conducting the dolphin-based ecotourism showing their skills in cooperative fishing, they can generate certain income. But the dolphin-fishermen demonstration activity has been carefully managed to ensure that the dolphins are not harmed by harassment or collision with tourist boats, and that a significant portion of the economic benefits goes directly to the participating fishermen.

The ultimate goal of the management and conservation plan is to develop the cast-net fishing while conserving the Irrawaddy Dolphins thus, preserving the cultural heritage of cooperative fishing at the Ayeyarwady River of Myanmar. The DOF will exert more efforts to preserve the traditional cooperative fishing for the future generations. In order to sustain the implementation of the management and conservation plan, the DOF is inviting international and regional organizations to also collaborate in their efforts, especially in the monitoring of the dolphin stocks and in training the local fishers about sustainable fishing practices especially the people living near the protected area.

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Quantifying Benefits of an Improvement to the Environment: The Economics of Environment-Friendly Shrimp Farming in Mangrove Areas

Giselle PB. Samonte-Tan and Philip S. Cruz

There is a way of measuring the benefits of an improvement to the environment, and comparing these with the costs of implementing such improvement is revealed from the results of this study

This study which focuses on the Experiences and Insights from the Philippines, was conducted as part of the activities of the AQD Project on the Promotion of Mangrove-Friendly Shrimp Aquaculture in Southeast Asia, which received funding from the Government of Japan through its Trust Fund Program.

Intensive shrimp farmers now employ a variety of progressive technologies and practices. Among the most notable are the reduction of stocking density, extended pond bottom preparation, crop rotation, feed quality improvement, stocking of good quality fry, use of green water and bioremediators, use of probiotics, and increased aeration. Recent practices include the screening of fry for White Spot Syndrome Virus (WSSV), the use of settling ponds and the adoption of biosecurity measures. This benefit-cost analysis study was conducted in order to measure the environment-related benefits of water quality improvements from environment-friendly shrimp farming practices.

The results of the study, which was conducted in the Philippines in 2005, indicated that the average annual investment in pollution management of the shrimp farming industry constitutes a significant portion of around 9% of the annual production costs. The opportunity cost of not utilizing this technology is estimated at Ph₱740,000.00/ha and Ph₱44,000.00 (Ph₱50.00 = USD 1.00), in terms of pollution damage to the fisheries and human health, respectively. Thus, environment-friendly shrimp farming practices generate net economic benefits for the Philippine economy as a whole and the society. In fact, the use of environment-friendly shrimp farming practices increases the economic value attributed to the role of mangrove habitats in supporting fisheries.

This study has shown that, in effect, shrimp pond culture has contributed to the multiple use and benefit of mangroves. The estimated net present benefits of environment-friendly shrimp farming as shown in this study could provide governments and stakeholders, including the private sector, the necessary baseline information on economic costs and benefits of appropriate technologies for non-destructive shrimp farming in mangrove areas. By providing guidelines on sustainable shrimp farming, it is expected that appropriate legislation and enforcement mechanisms could be developed to ensure responsible aquaculture, as well as the conservation and sustainable use of mangroves in Southeast Asia.

Shrimp Farming and Mangrove Conservation

Effective coastal management stresses the importance of integrating responsible shrimp farming in mangrove conservation. The task of conserving mangrove ecosystems is shared among the coastal dwellers and users, including aquaculture entrepreneurs, through responsible aquaculture practices. Responsible aquaculture encompasses the use of appropriate and efficient farming technologies and practices, which are not harmful to ecosystems and resources (SEAFDEC 2001, 2005). The Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia (SEAFDEC, 2005a) also provides the guidelines for responsible aquaculture in mangrove areas.

Successful technology packages developed by SEAFDEC and other ASEAN countries have focused on the management of pond effluents (Baliao and Tookwinas, 2002). However, research is still lacking on the economic assessment of these technology options and the impacts of these technologies on mangrove ecosystems. Some research projects, however, have focused on the economic

Polyculture of tilapia (in net cages) in shrimp ponds to feed on organic wastes and plankton

valuation of mangroves (Barbier and Strand, 1998) or on the profitability of shrimp farming to the private sector. For example, Sathirathai (1998) presented the private sectorÊs benefits of shrimp farming in Thailand. Other studies have focused on the assessment of technology (effective microorganisms) in terms of total economic development value (Aquilar and Tabora, 2003).

In the Philippines, the farming of the black tiger shrimp (*Penaeus monodon*) as a secondary crop in milkfish pond culture is a centuries-old tradition. Large-scale monoculture of the species, however, is a fairly recent development that took off only in the 1970s. Shrimp farming has benefited greatly from advances in milkfish culture technology. As recent as the early 1980s, Philippine black tiger shrimp production was less than 2000 mt, which suggests that no greater than 6000 ha of brackishwater fishponds then was devoted to the culture of this species. The Philippines, therefore, is one of the worldÊs few shrimp farming nations which has extensively converted the mangrove resources into fishponds prior to the popularization of shrimp aquaculture.

Because of its vast developed brackishwater pond area, the Philippines rapidly became a leader in world black tiger shrimp production in the 1980s and up to the early 1990s. At a period when shrimp farming investments were fueled by quick profits rather than long-term enterprise development, the Philippines inevitably became one of the first victims of unsustainable shrimp farming practices. Within 15 years from being the worldÊs top black tiger shrimp producer, Philippine shrimp farmers found themselves in a high-risk venture threatened by serious disease and water pollution problems.

Many lessons and technologies have since been learned throughout the region from the experience of the Philippines, and the other countries that were similarly hit by shrimp diseases in the years that followed. TodayÊs shrimp farming technology centers on the concept of being environment-friendly, as evidence from the large investment that farmers now take to improve environmental conditions in the pond, as well as in the quality of inputs, such as seeds and feeds. To a large extent, the current shrimp farming industry does not deserve its image of the past, which was often depicted negatively in its economic and social contribution in relation to its use of the mangrove ecosystem.

This study looked at the economic value as a basis of determining the net benefits of the current environment-friendly shrimp farming technologies relative to past farming practices. While the data and computations presented were based on Philippine conditions, most of the environment-friendly technologies presented are also similarly employed (or can be similarly employed) in other countries. Hence, this study may provide a good basis for comparative analysis. The study also specifically reflected on the potential benefits from shrimp farming.

Economic Importance of Shrimp in Aquaculture

Shrimps, given their large demand for export, are the most valuable crop in brackishwater aquaculture. At its peak in 1991, the Philippines attained its highest export volume of 26,607 mt valued at US$269.4 million (**Fig. 1**). In the last eight years, however, the collapse of shrimp farming in the country due to unsustainable practices and diseases has effectively curtailed the growth of the aquaculture industry (**Fig. 2**). As a result, the PhilippinesÊ world ranking was brought down from the 5th place in 1991 to 11th in 2004 (by volume, all species excluding seaweeds).

On the contrary, neighboring countries such as Thailand, Indonesia, Vietnam, and Malaysia, which have managed to

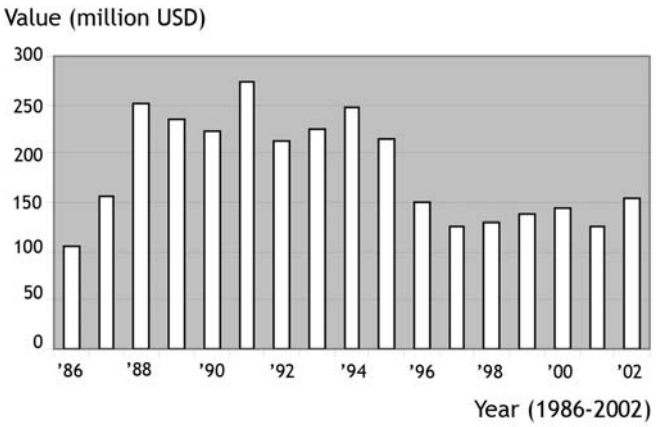


Figure 1. Philippine export of shrimps and shrimp products (Million USD) Source: FAO FishStat Plus 2006

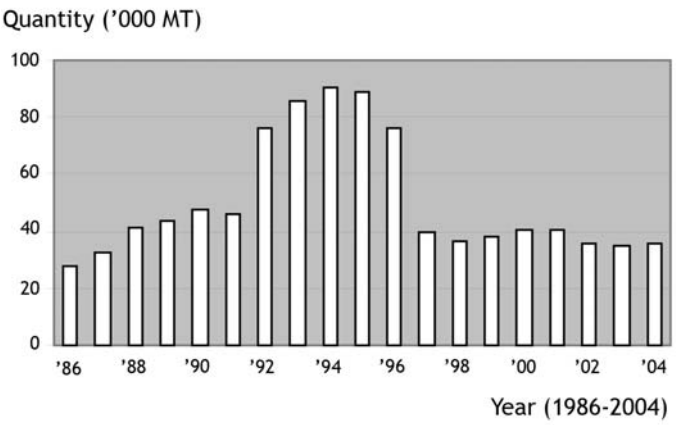


Figure 2. Philippine production of giant tiger shrimps ('000 mt) Source: FAO FishStat Plus 2006

sustain their shrimp culture industries, have either maintained or advanced their aquaculture standings. The reality is that the farming of shrimps, which demands a high level of technology and management, has become an instrument for the advancement of the aquaculture industry as a whole. It provides a catalytic role by putting valuable experience, progressive farming techniques, modern equipment, and key support industries in place for other sectors to tap. Shrimp farming in particular is credited for having rapidly advanced the technologies for intensive culture techniques, feed milling, hatchery management, and value adding. Interestingly, through shrimp farming, it is to note that many countries in Latin America, Africa, and the Middle East, which had no aquatic farming tradition in the past, have become empowered to join the league of aquaculture nations in just a span of few years.

Benefits from Mangroves

Mangroves are highly productive ecosystems which are not only able to provide a range of valuable forest products, but also maintain estuarine water quality and play crucial roles in the life cycle of many commercially-important species of fish and shrimps. The traditional uses of the mangroves, as modified ecosystems, include firewood gathering, thatch materials (*Nypa* species) for homes and mangrove poles for lumber and construction materials, and nursery grounds for the small-scale and commercial marine fishery resources.

Thirty-five per cent of the total 18 million ha of mangrove forests are found in Southeast Asian countries of Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam. Indonesia alone has 4.5 million ha of mangroves. Human activities, however, including aquaculture, have put these mangroves at risk. In the last three decades, mangrove loss has ranged from 25% in Malaysia to 50% in Thailand. In the Philippines, the mangrove cover of 418,990 ha in 1967 has been reduced to only about 100,000 ha now (Primavera, 2005). This reduction was mainly caused by charcoal and firewood utilization followed by the expansion of agricultural areas, fishponds, urban and industrial development, harbor construction, mining, and housing projects.

Mangroves also reduce coastal erosion, as they serve to dampen storm surges and to a minor extent high winds. Both events are associated with tropical and subtropical storms. The mangrove resource, where it occupies flood plains, performs a flood reduction function which may be lost if the trees are felled and the area is converted to other uses. Mangroves lining the banks of rivers also help prevent erosion of the riverbanks, which in turn helps protect adjacent property.

The mangrove area is the spawning and nursery area for many species of fish and crustaceans. The particles of vegetation (detritus) and nutrients exported out of the mangrove ecosystem from the food base of the complex marine organisms, support valuable estuarine and near-shore fisheries (finfish, shellfish and crustaceans). Those whose livelihood depends on fishing have long recognized the interconnection between mangroves and fisheries, but the values have only been slowly considered in planning processes where decisions on allocations of intertidal lands are being made.

Mangroves are not only of significance to local communities, but to the shrimp culture industry as well (Primavera, 2005). Revenues from mangrove fisheries, tourism and timber result in an annual benefit to the community of USD315.00/ha/yr (Walton, et al, 2006). This figure is likely to be considerably more if the contribution of the mangrove to the coastal catch of mangrove-associated species is included. This estimate only includes direct benefits to the community from mangroves, and not intangible benefits such as coastal protection, which paradoxically is perceived by the community as one of the most important functions. More than 90% of all fishers, regardless of where they fished, thought the mangroves provided protection from storms and typhoons and acted as a nursery site and should be protected. Annual net revenue from mangroves was estimated at USD 1000.00/ha/yr (Samonte-Tan, et al., 2007).

Mangrove resources are now under growing pressure as a result of population growth and economic development. Human activities and interventions within and near mangrove areas usually lead to the degradation of the mangroves and the coastal ecosystems as well. The demand for wood and wood products is increasing. Moreover, mangrove forests are being cleared for the construction of aquaculture ponds especially for shrimp and are likewise reclaimed for the cultivation of rice, coconuts or other agricultural crops.

But not all aquaculture requires clear-cutting of mangroves. Examples of mangrove-friendly aquaculture exist either in waterways (seaweeds; bivalves such as mussels, oysters and cockles; and cages for crab and fish) or land-based (ponds and pens for crabs, shrimps and fish). These technologies, particularly mangrove ponds and pens (also called aquasilviculture or silvofisheries) integrate the utilization of mangroves for both forestry and aquaculture production.

Environment-Friendly Shrimp Farming Practices

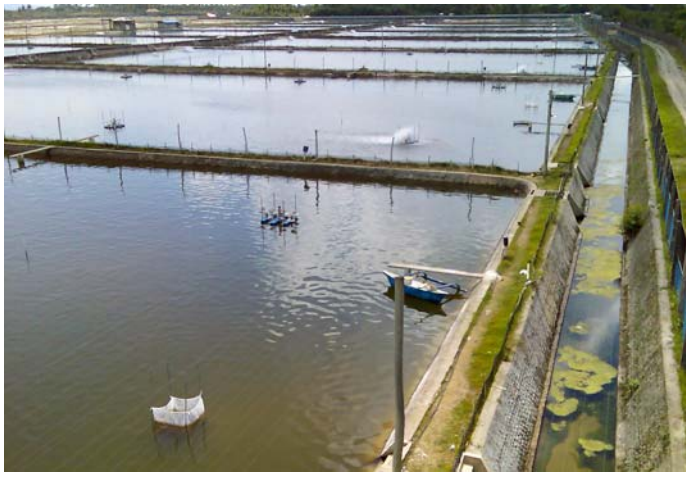
Early attempts to revive the Philippine shrimp industry in the late 1990s started with the lowering of stocking densities, as this was seen to be the major culprit behind the rampant disease problems. From the usual 25-40/m^2 stocking rate, densities were reduced to 10-15/m^2, bringing down yields from the usual 7-10 mt/ha/crop to 5-8 mt/ha/crop or a volume reduction of around 20-30%.

Farmers also improved on their pond bottom management. During pond preparation, the soil was tilled more thoroughly to enhance the oxidation process. Some farmers also adopt polyculture of tilapia in net cages along the center of the pond to feed on the sludge and unconsumed feeds as well as on suspended organic matters, bacterial floc and plankton. A net biomass gain of approximately 500 kg of fish is harvested per hectare of shrimp pond, with the fish feeding on natural food and organic wastes alone. Through these practices, waste accumulation in ponds was significantly reduced. It is interesting to note that in the 1980s, it was not uncommon for farmers to dispose of accumulated sludge along the riverbanks.

Complementing pond bottom management is the practice of crop rotation where shrimps are cultured during the summer months, while fish (usually tilapia or milkfish) are cultured during the remaining months of the year. Intercropping fish under extensive culture with no feeding has been found to reduce organic matter load in the sediment, as the accumulated wastes are allowed to be consumed in the fishÊ detrital food web or are decomposed more thoroughly. High organic matter in the soil favors the proliferation of pathogenic bacteria, particularly *Vibrio harveyii* or more commonly known as luminous bacteria.

Starting in 2003, the practice of crop rotation has become essentially mandatory as studies have indicated that WSSV disease is mostly prevalent when temperatures drop during the cool months of the year. A single summer crop per year has since led to a dramatic reduction in the occurrence of the WSSV disease in shrimps.

An important shift in the health management strategy of shrimp farmers in recent years is the attention given to proper nutrition and feed quality. In the past, price competitiveness was the major consideration in choosing a feed. Understandably, this has discouraged feed manufacturers from working with higher quality formulations as well as from investing on better processing technology that would enhance digestibility, reduce fines and improve hydrostability. In improving nutrition, farmers have also adopted on-farm supplementation with vitamins (especially vitamin C), minerals, marine lipids and immune enhancers. The obvious benefits from these practices are the improvement in feed conversion efficiency and reduction in waste, both of which have positive impacts to water quality and the environment.



Top: Aquafarm in Negros Occidental with drain water fully recirculated through tilapia ponds; Left: Pond undergoing thorough plowing using a tractor; Above: Handwash, footdip and barrier fence for biosecurity

While fry quality selection has long been adopted by progressive shrimp farmers (Cruz, 1993), the screening of the fry for possible infection by WSSV or *Vibrio harveyii* is relatively new. This practice is widely regarded to have improved markedly the survival rates. Moreover, it reduces disease outbreaks, which readily spread from pond to pond and farm to farm, and conceivably also to the surrounding environment.

Luminous bacteria was thought to be responsible for the large mortalities associated with the „30-day‰ syndrome, and „60-day‰ syndrome in 1996. The discovery by shrimp farmers from Negros Island (central Philippines) in the late 1990s of the effectiveness of green algae-rich effluent from fish farms in improving water quality, and in inhibiting luminous bacteria disease, was a breakthrough. This practice became known later as the „greenwater‰ technology. The technology as it is practiced today involves allocating 25-50% of the farm area for use as reservoir, where tilapia is raised at an ideal biomass load of 3 mt/ha. Water used for the shrimp ponds is exclusively taken from this reservoir. Results of studies by SEAFDEC/AQD indicated that tilapia promotes the bloom of green algae, particularly *Chlorella*, which has a suppressing effect on the proliferation of *Vibrio harveyii* and other pathogenic bacteria. Ammonia levels in the water were also found to be lower with the use of greenwater as a result of the algae assimilating it. Through the use of greenwater, the farmers are able to extend their first water exchange from the usual 30 days to 60-70 days, reducing the risks of water borne disease vectors and eggs of noxious fish entering the pond early during the crop.

As a standard practice, farmers try to maintain a plankton profile of at least 80% green algae and diatoms, with the population of non-beneficial blue-greens and dinoflagellates not exceeding 20%. Comparisons of ammonia readings and luminous bacteria population in shrimp ponds versus its water source, almost always show that water quality conditions in the culture environment are better.

The use of probiotics is a key aspect in the recent success of environment-friendly shrimp culture. Probiotics provided farmers a sound alternative to antibiotics, which were widely used in the 1980s. A stabilized mixture of naturally-occurring beneficial bacteria and enzymes, probiotics are mainly applied to: inhibit the growth of pathogenic bacteria by boosting the population of „good‰ or beneficial species; and improve the water quality by enhancing the natural decomposition process. These twin actions are now well recognized by farmers to effectively create a healthier environment. To a lesser extent, probiotics are used as on-farm feed additive to improve shrimp gut flora and improve food assimilation. The application of probiotics in the Philippines is actually not new, dating back to the late 1980s. Lack of understanding on its proper use, however, resulted to inconsistent results eventually forcing most early users to abandon it.

Complementing the use of probiotics is the increased use of aeration. This is the direct result of a higher oxygen demand from the enhanced decomposition of wastes. As a general rule, farmers today target a minimum dissolved oxygen (DO) level of 5 ppm as compared to 3-4 ppm in the past. Typically, the increased aeration requires the doubling of horsepower per hectare. It is through the combined use of probiotics and increased aeration that water use and effluent production have been dramatically reduced. In the past, water was changed 10-20% daily and this was increased to 30-40%/day during the high tide. Now, water change averages only 5-10% daily with very little water use during the first 60 days. Hence, the higher aeration cost is partly reduced by the lower pumping expense.

Experience in the past has taught farmers that organic waste coming from effluents inevitably pollutes the receiving waters. To reduce organic load of wastewater, a growing number of farmers have now adopted the use of settling ponds or settling canals. As such, a series of baffles reduce the water velocity and allow the settling of suspended wastes. The collected sludge are eventually removed and allowed to decompose aerobically on dry land. The extent of removal of suspended wastes under such facilities is yet to be studied but is believed to be significant.

The widespread occurrence of WSSV disease nowadays is the single biggest threat to shrimp farming. Even by stocking WSSV-free fry, numerous potential vectors for infection could still remain such as copepods, small shrimps, crabs, birds, feral animals, and even humans. The risk of bringing WSSV carriers is therefore naturally highest when new water is pumped in. Hence, as a biosecurity measure, farmers have capitalized on the use of probiotics in conjunction with increased aeration to cut down water exchange by at least 50%. Effluent production from the adoption of this practice has consequently been cut to at least half.

Other biosecurity measures include strict protocols on personal hygiene and movement of materials, use of bird scaring devices and crab fences, use of fine-meshed nets in screening incoming water, and sanitizing pond waters with readily degradable products such as Virkon-A™ or chlorine to rid the pond of WSSV or its potential carriers. A summary of the environmentally-friendly shrimp farming practices with information on the cost of adopting such practices to the farmer and the perceived benefits to the environment is shown in **Box 1**.

Table 1. Cost and returns analysis (PhP/ha)

Harvest Data	Traditional practices (average of 3 ponds)	Traditional practices (average of 6 ponds)	Use of probiotics (average of 7 ponds)	Use of *Tilapia* greenwater (average of 3 ponds)	Low water discharge technique (average of 2 ponds)		Combined environment-friendly methods (average of 2 ponds)	
- Stocking density (pcs/m²)	29	33	30	19/*4*		30	13	23
- Days of culture	183	126	323		143	147	137	113
- Average body weight (g)	36.1	32	30	33/*200*	37	26	32	25
- Biomass (kg)	8057	7208	7792	4421/ *5600*	7784	5825	3883	3653
- Survival rate (%)	72.6%	70.0%	85.0%	*70.0%*	105	77.1%	94.0%	75.5%
- Feed conversion ratio	2.09	1.58	1.33	1.60/*1.50*	1.8		1.55	2.1
- Biomass (tons/ha)	8.06	7.21	7.79	4.42/*5.60*	7.8	5.82	3.88	3.7
Production Cost (Php)								
- Pond preparation		22,083	32,250	24,999	48,565	17,341	10,000	11,264
- Fertilizer, lime			812			9,404		
- Probiotics/ biomanipulators			34,069		63,036	21,274	19,175	5,638
- Water culture					4,920			
- Fry/Fingerlings	102,083	82,084	92,717	101,099	39,975	78,999	40,899	50,459
- Feeds	677,151	606,763	423,932	537,353	603,294	416,646	297,183	350,205
- Supplementary feeds			89,381	135,930	51,913		43,513	14,167
- Conditioners, chemicals	187,399		9,679			12,890	13,497	10,167
- Sludge collectors, cages						13,357		
- Gen./Admin	80,854	208,333	76,605					
- Fuel/Oil	114,202	41,667		91,718	47,220	11,219	36,883	174,487
- Power			239,601	84,693	258,689	194,537	61,856	15,839
- Direct labor	13,851	83,333	124,812	122,585	61,909	103,256	16,665	17,074
- Lab fees	2,787		62,357	17,406	19,175	2,827	36,641	30,490
- Repairs and maintenance	16,788		2,855	10,789	10,699	68,753		14,019
- Security services			13,271		8,233	6,501		
- Other direct expenses	10,101		4,279	12,184	37,639	49,827	6,189	
Total (Php)	1,205,216	1,044,263	1,206,620	1,138,756	1,255,267	1,006,831	582,501	693,809
- Cost to produce 1.0 kg	149.53	144.84	154.89	257.64	161.34	173.00	150.13	190.08
- Selling price	294.28	325.00	377.62	325.45/ 55.00	425.85	286.55	325.00	325.00
- Gross Sales	2,363,463	2,342,708	2,931,119	1,746,540	3,314,640	1,661,547	1,261,812	1,187,159
Net returns (Php)	1,158,247	1,298,445	1,724,499	607,784	2,059,373	654,716	679,311	513,350

Net Benefits from Environment-Friendly Shrimp Farming

A comparison of the costs and benefits derived from using traditional shrimp farming methods, without environment-friendly practices, are presented in **Table 1**. Producer Surplus was computed for shrimp pond farming, where producer surplus is the excess of the revenue over costs received by the shrimp farmers. Gross revenue included the value of shrimp generated from shrimp farming. Total cost consisted of variable costs (materials, supplies, labor) and fixed costs (overhead, maintenance).

Since shrimp farming provides a stream of valuable services to society over time, the economic benefits derived from shrimp farming were calculated as the sum of the present value of the stream of revenues over a 15-year period (assumed lifespan of shrimp ponds). In essence, these shrimp farms generated positive private net benefits ranging from Php607,000 to Php2.0 million per hectare for using traditional and environment-friendly shrimp farming practices, as summarized in **Table 2**. Over a 15-year period, environment-friendly shrimp farming practices are estimated to generate net revenues of up to Php8.5 million. This value is almost 40% more than the net present value benefits for traditional shrimp farming.

The defensive treatment expenditures of shrimp farmers provide a minimum value of the benefits of clean water. These values represent the willingness-to-pay of shrimp farmers to restore or maintain the water sources in their unpolluted state. On an incremental basis, a shrimp farmersÊ investment to the environment is Php24.00/kg. This means that for every kg of shrimp produced, Php24.00 is an additional investment for the environment. The average annual investment in pollution management of the shrimp farming industry constitutes a 9% of the annual production costs.

Management Implications

Surrounding waterways are the primary sources as well as recipients of pollutants and pathogens. Hence, the developments of production systems with these characteristics are the cornerstones of mangrove-friendly shrimp culture operations: (1) lower organic matter load,

Table 2. Economic benefits of environment-friendly shrimp farming

Economic Benefits	Farms employing traditional shrimp farming practices		Environment-friendly shrimp farming					
			Probiotics	Green water	Low-discharge		Use of combined Methods	
Production (mt/ha/year)	8.06	7.21	7.79	4.42	7.78	5.82	3.88	3.65
Private benefits								
- Costs per ha	1,205,216	1,044,263	1,206,620	1,138,756	1,255,267	1,006,831	582,501	693,809
- Net returns per ha	1,158,247	1,298,445	1,724,499	607,784	2,059,373	654,716	679,311	513,350
- Cost to produce 1 kg	149.53	144.84	154.89	257.64	161.34	173.00	150.13	190.08

(2) lower effluent production, and (3) lower water exchange rate. The widespread disease problems that have tremendously affected shrimp farmers in the Philippines confirmed that many aspects of intensive shrimp farming were indeed not sustainable.

While Philippine shrimp production continues to be threatened by luminescent *Vibrio* and WSSV disease, the recent developments have been encouraging in that many shrimp farmers have already adopted major changes in their culture technologies consistent with Âbest management practicesÊ for mangrove-friendly shrimp farming. As described by Baliao and Tookwinas (2002), these include: (1) lowering of stocking density; (2) improvement of pond bottom management; (3) crop rotation; (4) improvement in feed quality; (5) stocking of laboratory-screened fry; (6) use of „greenwater‰ technology; (7) use of probiotics; (8) increase in aeration; (9) use of settling ponds; and (10) employment of biosecurity measures. Compared to intensive shrimp farms in the past, most existing shrimp ponds in the Philippines today are able to maintain the necessary water quality standards or requirements for producing healthy shrimps up to harvest.

The quality of water in the mangroves is essential to sustain ecological or life-support benefits for associated species for coastal and fisheries livelihood activities. In general, no cost is attributed to discharges from shrimp ponds because, with the environment-friendly production techniques, effluents are not expected to result in significant negative impacts on water quality.

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Box 1: Summary of costs-benefits of environment-friendly shrimp culture practices

Feature/Description	Cost to Farmer	Benefits to Farmer	Benefits to Environment
Lowering of stocking density			
• Decrease in stocking density from 25-40/m^2 to 15-30/m^2 resulting to drop in harvest biomass from 7-10 mt/ha/crop to 5-8 mt/ha/crop	• Decrease in harvest volume by around 20-30%	• Increased harvest value by 8-10% due to bigger and better quality shrimps • Improved feed conversion • Reduced opportunistic diseases	• Reduced feed use (hence nutrient load) by at least 20%
Improvement of pond bottom management			
• Increased frequency and depth of tilling to allow better soil oxidation during drying period • Concentration of sludge along pond center where caged fish feed on waste	• Increase plowing/tilling cost by ₱5000.00-7000.00/ha/yr • Additional ₱12,000/ha for net cages (to be depreciated in 2 years) and ₱5000/ha/yr for tilapia fingerlings (note: cost is recovered from sale of fish)	• Improved bacterial profile of sediment and reduced count of pathogenic *Vibrio*, resulting to healthier shrimps and reduced risk of opportunistic diseases	• Improved effluent quality, with lower levels of nutrients (*i.e.* N and P) and suspended solids
Crop rotation			
• Culture of tilapia or milkfish at low density for 2-4 months, alternate with shrimp crop, to fallow pond bottom and reduce OM load	• Cost of ₱25,000-35,000/ha/yr for fish culture inputs (e.g. fry, feeds, etc.) and labor (note: cost is recovered from sale of fish) • Loss of 1 shrimp crop per year	• Improved bacterial profile and reduced pathogenic *Vibrio* in sediment (healthier shrimp) • Significantly reduced risk of WSSV disease as virus is active only during cold months	• Reduced organic load in receiving waters during fish culture period enhancing breakdown of accumulated waste
Improvement in feed quality			
• Improved formulation with higher micronutrients and use of immune enhancers • Reduced fines and increase hydrostability • Enhanced nutrition through on-farm supplementation of Vitamin C, immune enhancers, and other nutrients	• Increase in commercial feed cost by ₱3-4/kg and additional cost of around ₱2/kg feed for farm level nutritional supplements; equivalent to a ₱30,000-60,000/ha/crop increase in feed cost	• Better growth, health, and appearance of shrimps • Reduced feed use by 10-15% based on improved FCR; partly due also to enhanced natural food productivity (*i.e.* from heterotrophic food web) resulting from use of probiotics and the increased aeration	• Improved effluent quality, with lower levels of nutrients (*i.e.* N and P) and suspended solids
Stocking of laboratory-screened fry			
• Screening of fry for infection of WSSV (through PCR) and *Vibrio harveyii*; in addition to standard tests for physical health, and infection from MBV and other opportunistic bacteria and fungi	• Higher fry cost, from ₱0.12-0.16/pc to ₱0.25-0.30/pc, increasing seed expense by around ₱40,000/ha/crop • Additional fry screening expenses of ₱2,000/ha/crop • 3-4 weeks delay in stocking	• Reduced risk of WSSV disease and pathogenic *Vibrio* infection • Improved growth performance and survival of stocks	• Minimized risk of spreading diseases to receiving waters
Use of "greenwater" technology			
• Culture of milkfish or tilapia in reservoir, and in net cages inside shrimp grow-out pond to stabilize plankton bloom and to discourage growth of pathogenic bacteria	• Reduced grow-out area by 25-50% due to bigger reservoir • Fish culture inputs of ₱25,000-35,000/ha/yr in reservoir (*e.g.* fry, feeds, labor, etc.) but may be recovered from fish sale • Modification of water supply channel and acquisition of transfer pump at ₱5,000-10,000/ha (depreciation in 3 years)	• More stable water quality which reduces stress to cultured animals • Suppressed growth of pathogenic bacteria, particularly *Vibrio harveyii*, minimizing risk of disease and premature harvest	• Reduced water use and effluent volume • Reduced load of pathogenic *Vibrio* in effluent water
Use of probiotics in water and feed			
• Suppressed growth of pathogenic bacteria through domination of beneficial bacteria • Hastened degradation of organic waste and oxidation of noxious gases (*e.g.* ammonia and hydrogen sulfide) • Improved gut flora and hence lower disease incidence and increased food assimilation	• Total cost of ₱20,000-40,000/ha/crop, depending on type of probiotics and dosage	• Production of antibiotic-free shrimp • Control of pathogenic *Vibrio*, minimizing risk of disease and premature harvest • Improved water quality and lower sludge accumulation, reducing stress and opportunistic diseases • Reduced water exchange (*i.e.* lower pumping cost)	• Reduced risk of more virulent antibiotic-resistant strains of bacteria • Lower nutrients (*i.e.* N and P) and suspended solids in effluents • Reduced load of pathogenic *Vibrio* in effluent water

Box 1: Summary of costs-benefits of environment-friendly shrimp culture practices (Cont'd)

Feature/Description	Cost to Farmer	Benefits to Farmer	Benefits to Environment
Increase in aeration			
• 1 HP/400-500 kg biomass (from 1 HP/800 kg) raising minimum DO levels from 4 ppm to 5 ppm • Addition of long-arm paddle-wheels or diffuser-type aerators for water circulation and development of bacterial floc • Enhances probiotic efficacy	• Additional fixed cost for aerators and electrical distribution/generation system amounting to ₱150,000-200,000/ha (to be depreciated in 3 years) • Increase in power consumption by 50-60%	• Faster growth, improved feed conversion, better physical quality, and reduced risk of opportunistic diseases • Reduced water exchange (*i.e.* lower pumping cost) • More stable plankton (*i.e.* less plankton crash) and hence lesser water exchange	• Increased DO level in effluent (from 4 ppm to 5 ppm) and reduced level of noxious metabolites, especially ammonia and hydrogen sulfide • Lower water exchange and effluent volume
Use of settling pond			
• Modification of canal system for dual use as drainage and effluent settling pond to reduce suspended solids	• Cost of ₱2500-5000/ha/yr for construction and maintenance of baffles and bamboo support, and removal of settled waste	• Improved water quality in receiving waters	• Reduced suspended solids in effluent and sediment build-up in receiving waters
Employment of biosecurity measures			
• Application of chlorine (15-20 ppm) or Vikron-A™ to sanitize the pond of WSSV or its potential carriers • Setting up of crab fence and bird scaring devices • Filtering new water thru 150-300µ net to screen out potential virus carriers • Proper sanitation of workers, visitors, equipment, facilities • Reduced water use to 5-10%/day (from 10-20%), with zero exchange during 1st 60 days	• Additional cost of ₱15,000-20,000/ha/yr for pond sanitation, carrier exclusion devices, filters, and worker hygiene	• Significantly reduced risk of introducing viral diseases, particularly WSSV	• Reduced water usage and effluent volume by 60-70% • Minimized risk of spreading diseases in receiving waters

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Philip S. Cruz, M.Sc. in Fisheries, is a progressive aquafarm operator and President of Cruz Aquaculture Corporation in Bacolod City, Philippines. He was one of the Philippines' Ten Outstanding Young Men (TOYM) Awardees for Aquaculture in 2005 and is a member of the Philippine Fisheries and Aquaculture Board. He is also a board member of the World Aquaculture Society Asia-Pacific Chapter.

Events Calendar

Date	Venue	Events	Organizer
		2007	
16-17 October	Philippines	Technology Forum for ABOT (agree-build-operate-transfer) AquaBusiness	SEAFDEC/AQD
22 October	Bangkok, Thailand	SEAFDEC Seminar on Implementation of the Code of Conduct for Responsible Fisheries (CCRF) in Southeast Asia	SEAFDEC/ Secretariat
23-25 October	Bangkok, Thailand	2nd ASEAN-SEAFDEC Regional Expert Consultation on Future Roles of SEAFDEC in Fisheries Management in Southeast Asia	SEAFDEC/ Secretariat
25-26 October	Bangkok, Thailand	SEAFDEC Department Chiefs' Meeting	SEAFDEC/ Secretariat
25-26 October	Chiang Rai, Thailand	Mekong River Commission (MRC) Fisheries Programme Fourteenth Annual Meeting	MRC
26-28 October	Philippines	AQD at the AgriLink-FoodLink-AquaLink 2007 exhibition	SEAFDEC/AQD
29 Oct-2 Nov	Bangkok, Thailand	29th Meeting for ASEAN Ministers on Agriculture and Forestry Plus Three	ASEAN
5-7 November	Rome, Italy	FAO Technical Consultation on Technical Guidelines on Responsible Fish Trade	FAO
6-8 November	Bangkok, Thailand	Workshop on the Concept for the Establishment of an ASEAN Fisheries Development and ASEAN Fisheries Management Mechanism	SEAFDEC/ Secretariat
13-15 November	Malaysia	8th Meeting of the SEAFDEC Information Staff Exchange Program (ISEP)	MFRDMD
17-24 November	Rome, Italy	34th Session of the FAO Conference	FAO
19 November	Thailand	FAO Expert Meeting on Sea Cucumber	FAO
26-28 November	Philippines	30th Meeting of SEAFDEC Program Committee Meeting	SEAFDEC
26-30 November	Queenstown, New Zealand	25th Conference of the OIE Regional Commission for Asia the Far East Oceania	OIE
28-30 November	Bangkok, Thailand,	3rd Regional Scientific Conference of the UNEP/GEF Project: "Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand"	UNEP/GEF
29-30 November	Philippines	10th Meeting of the ASEAN-SEAFDEC Fisheries Consultative Group (FCG)	SEAFDEC
6-7 December	Bangkok, Thailand	International Workshop on Emerging Fish Diseases in Asia	SEAFDEC/AQD
12-14 December	Bangkok, Thailand	Regional Technical Consultation on Fishery Statistics and Information in Southeast Asia	SEAFDEC/ Secretariat
12-14 December	Rayong Province, Thailand	Regional workshop on " Set-Net Fishing Technology Transfer for Sustainable Coastal Fisheries Management in Southeast Asia"	SEAFDEC/TD
18-20 December	Chiang Rai Province, Thailand	Regional Workshops on Demersal Resources as Surimi Raw Materials in Southeast Asia Waters and New-findings from M.V. SEAFDEC 2	SEAFDEC/TD

Southeast Asian Fisheries Development Center (SEAFDEC)

What is SEAFDEC?
SEAFDEC is an autonomous intergovernmental body established as a regional treaty organization in 1967 to promote sustainable fisheries development in Southeast Asia.

Objectives
SEAFDEC aims specifically to develop fishery potentials in the region through training, research and information services in order to improve food supply through rational utilization of fisheries resources in the region.

Functions
To achieve its objectives the Center has the following functions:
1. To offer training courses, and to organize workshops and seminars, in fishing technology, marine engineering, extension methodology, post-harvest technology, and aquaculture;
2. To conduct research and development in fishing gear technology, fishing ground surveys, post-harvest technology and aquaculture, to examine problems related to the handling of fish at sea and quality control, and to undertake studies on the fisheries resources in the region; and
3. To arrange for the transfer of technology to the countries in the region and to make available the printed and non-printed media, which include the publication of statistical bulletins for the exchange and dissemination related to fisheries and aquaculture development.

Membership
SEAFDEC members are the ASEAN Member Countries (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam) and Japan.

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In the occasion of the Millennium Conference, a drawing contest was organized for the children among ASEAN-SEAFDEC Member Countries, on the theme of "*Fish and the Culture*". This is the second best drawing from Thailand.