

FISH for the PEOPLE

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**Beyond Ten Years
of Reinforcing ASEAN Fisheries Development:
The JFT ten-year saga in SEAFDEC**



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Editorial

The implementation by SEAFDEC of many regional projects addressing the various concerns and issues on the sustainable development of fisheries for the benefit of the ASEAN region has been supported by the Japanese Trust Fund (JTF) Program of the Fisheries Agency of the Government of Japan. Thus, during the ten-year period from 1998 to 2007, SEAFDEC has already amassed a large amount of information including many important findings and policies arising from the implementation of such regional projects. Specifically, the implementation of such projects which include capacity development activities, has also paved the way for the formulation of policies and strategies in achieving sustainable fisheries and ensuring food security in the ASEAN region.

In a span of ten years from 1998 to 2007, the technologies developed by SEAFDEC through the JTF projects have been transferred to the ASEAN region through intensified training and human resource development programs as well as through massive information dissemination activities. While acknowledging the benefits from such efforts, the ASEAN countries also recognized that the outcomes have greatly contributed to the sustainable development of the region's fisheries and created significant impacts on the livelihoods of the fisherfolk in the region.

As the JTF Program in SEAFDEC enters the 11th year of its continued support in advancing responsible fisheries development in the ASEAN region, additional projects have been lined up for future implementation. It is the wish of the JTF Program that the findings from the JTF projects be continued to be mainstreamed in the national policies of the countries in order to attain sustainable development of fisheries in the region. The opportunity is now with the hands of the ASEAN countries for them to make full use of the outcomes of the JTF projects and activities in order to improve the livelihoods of the region's small-scale fishers and uplift the socio-economic conditions of the region's fisheries communities.



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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.

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Boosting Responsible Fisheries Development in the ASEAN Region via the Japanese Trust Fund Program

Hideki Tsubata

Starting 1998, SEAFDEC has been implementing projects in the ASEAN region with the assistance of the Trust Fund Program of the Fisheries Agency of the Government of Japan. Through such assistance, SEAFDEC has been able to pursue the implementation of projects aimed at addressing the various concerns and issues on responsible fisheries development for food security in the ASEAN countries.

The Government of Japan through its Japanese Trust Fund (JTF) Program has been assisting SEAFDEC to heighten the development of responsible fisheries in the ASEAN region since 1998. Japan's financial assistance channeled through the JTF Program, has enabled SEAFDEC to continue implementing regional projects with the view to promoting the development of sustainable fisheries.

The implementation of fisheries projects under the JTF Program has been supported by a series of regional directives. Specifically, the implementation of regional projects in the ASEAN countries found a new light after the adoption of the SEAFDEC Strategic Plan in 1998 and also after the establishment of the ASEAN-SEAFDEC Fisheries Consultative Group (FCG) collaborative mechanism in the same year. This has also been intensified after the adoption of the Resolution and the Plan of Action on Sustainable Fisheries for the ASEAN Region in 2001, paving the way for the formulation of policies and strategies aimed at achieving sustainable fisheries and ensuring food security in the ASEAN region.

The program formulation strategy stipulated in the Resolution on the SEAFDEC Strategic Plan and Terms of Reference of the FCG have been used as basis by SEAFDEC in formulating regional programs more particularly the Regionalization of the Code of Conduct for Responsible Fisheries (RCCRF). Furthermore, the Resolution and the Plan of Action on Sustainable Fisheries for the ASEAN Region, which were developed following the guiding principles of the global CCRF, provided the framework and policy guidelines for SEAFDEC to promote the adoption of the CCRF in the ASEAN region. Thus, with financial support from the JTF Program, SEAFDEC continued to implement the RCCRF from 1998 to 2006 in order to consider certain specificities in the Southeast Asian fisheries structures as well as the region's cultural and socio-economic realities.

The JTF Program Implementation

Under the JTF Program, SEAFDEC has already implemented more than 45 wide-ranging activities in the ASEAN region from 1998 to 2007. The activities cover various areas in sustainable fisheries development, such as sustainable fisheries management, responsible marine fishing technologies, responsible and sustainable aquaculture, safe and wholesome fishery products, fisheries resources research, marine resources conservation, management and enhancement, etc. leading to the formulation of policies and development of technologies that have been disseminated and adopted in the region (**Box 1**).

Among the most significant achievements of SEAFDEC is the successful promotion of the CCRF in the ASEAN region. Through the RCCRF project, Regional Guidelines for Responsible Fisheries in Southeast Asia covering responsible fishing technology and practices,

Box 1. Advancements attained by SEAFDEC through the JTF Program

- Enhancement of the promotion of sustainable fisheries management in the region
- Improvement, verification and intensified dissemination of responsible coastal fishing technologies to the region
- Amplification of the development of responsible and sustainable aquaculture
- Augmentation of the promotion of safe and wholesome fishery products in the region
- Intensification of the conduct of fishery resources research
- Strengthening of the marine resources conservation, management and enhancement efforts
- Intensified utilization of harmonized information for fisheries management
- Establishment of forums for monitoring the region's common stand in responding to international fisheries related issues
- Intensified advocacy for the visibility and public awareness of SEAFDEC initiatives and efforts

aquaculture, post-harvest technology and trade, and fisheries management, were published and disseminated. The Regional Guidelines have been used by the ASEAN countries as frameworks for the promotion of responsible fisheries in their respective countries.

The sustained efforts of SEAFDEC in advancing the adoption of the Regional Guidelines in the ASEAN region have been globally recognized when SEAFDEC received in November 2007 the Margarita Lizárraga Medal Award for the biennium 2006-2007 from FAO, for having “served with distinction in the application of the Code of Conduct for Responsible Fisheries through the RCCRF”. This prestigious achievement is another milestone in the 40 years of SEAFDEC’s existence. Having assisted SEAFDEC in fostering responsible fisheries in the region through the RCCRF and in the dissemination of the Regional Guidelines, the JTF Program is committed to continue its support to SEAFDEC for the advancement of sustainable development of fisheries in the region.

Specifically, through the continuing efforts of SEAFDEC in promoting the adoption of the Regional Guidelines for Responsible Fisheries in the region, the ASEAN countries were also able to initiate activities and continue intensifying their efforts in implementing the CCRF. The countries also made use of the CCRF principles in revising and/or updating their national policies and legal documents such as fisheries laws as well as in their plans and programs on sustainable fisheries development. Thus, it could be assured that fisheries development in the region is harmonized with global initiatives as well as with the sustainable and responsible approaches. In order to further assess the progress of the ASEAN countries as well as identify their needs for the continued mainstreaming of the CCRF in their respective programs, the JTF Program also supported the conduct of the “Seminar on Implementation of the Code of Conduct for Responsible Fisheries in Southeast Asia” in October 2007. During the Seminar, SEAFDEC was specifically requested to continue providing support to the ASEAN countries to enable them to pursue further implementation of the CCRF.

Since fisheries in the Southeast Asian region are mainly small-scale, the JTF Program also supports SEAFDEC in implementing projects aimed to strengthen the development and management of the region’s small-scale fisheries. By introducing innovative management measures such as rights-based and co-management approaches, a stable fish supply and food security could be ensured as such approaches highlight the importance of improving the small-scale fishers’ livelihood and their fishing communities. The innovative measures and approaches have been concretized in the Regional Guidelines for Co-

management Using Group User Rights for Small-Scale Fisheries in Southeast Asia produced by SEAFDEC in 2006. Since then, SEAFDEC has been assisting the ASEAN countries in strengthening their management strategies for coastal and inland fisheries through the promotion of rights-based and co-management in fisheries, management of overcapacity in coastal areas, etc. The ASEAN countries on the other hand, continued to promote the mainstreaming of the Regional Guidelines into their respective national policies on small-scale fisheries.

The high demand for fish and fishery products as well as the fast modernization of fishing technology, led to the over-exploitation of the coastal fishery resources in the region. This situation makes the small-scale fishers vulnerable to the competition for limited fishing grounds with decreasing resources. Recognizing such concern, SEAFDEC with support from the JTF Program has promoted responsible fishing technologies through the adoption of selective fishing gears and practices. In addition, to minimize the catch of juveniles and trash fishes by trawlers, SEAFDEC developed the Juvenile and Trash Fish Excluder Devices (JTEDs) and collaborated with the ASEAN countries for the on-site demonstrations on the use of JTEDs. Currently, a number of fishing fleets in many ASEAN countries have been installed with JTEDs as possible means of selectively harvesting only the target fish species. Moreover, SEAFDEC also promoted set-net fisheries as a means of reducing the fishing pressure on coastal fisheries resources. Initially implemented in Thailand, the set-net fisheries technology has been disseminated to the ASEAN region through training and information dissemination.

Considering the potentials of aquaculture to fill the gap between supply and demand for fish and fishery products, the JTF Program has always been behind SEAFDEC in promoting aquaculture as a long-term strategy



Experiment and demonstration on the use of TEDs in Thai waters



for economic development by making aquaculture development technically feasible, economically viable, environment-friendly, and socially equitable. Since aquatic diseases have also threatened the region's sustainable aquaculture development, the JTF Program also backs SEAFDEC in facilitating the healthy and wholesome trading of aquaculture products from the region through the development of diagnostic methods of important viral diseases of aquatic animals as well as the establishment of disease surveillance system of aquatic diseases. SEAFDEC's continued efforts in promoting fish disease management in the region has prompted the countries to continue their endeavors in controlling aquatic diseases to safeguard the quality of their products which are meant not only for domestic consumption but also for the foreign markets to attain economic sufficiency.

With the full support of the JTF Program, SEAFDEC has also advanced the production of safe and wholesome fishery products by maximizing the utilization of fish catch and minimizing wastage of fish resources. The application of Hazard Analysis and Critical Control Point (HACCP), Good Manufacturing Practices (GMPs), and Standard Sanitation Operating Procedures (SSOPs), etc. has been promoted to ensure food safety and help the region's fish processing industries in meeting quality assurance requirements. Enhancing the understanding of all stakeholders on the

implications of chemical contaminants and drug residues in fish and fish products has also been continued. With the development of capacities to detect residues in fish and fish products, countries in the region are now able to take appropriate actions to manage the safety and quality of their fish and fish products for domestic consumption as well as for export.

The conservation of the marine turtles in the region has also been advanced by SEAFDEC through the JTF Program. This has been carried out through sustainable hatchery management, tagging experiments considering that sea turtles are highly migratory species, stock enhancement, mitigating the interaction between sea turtles and fisheries, and promoting the adoption of Turtle Excluder Devices (TEDs) to minimize sea turtle by-catch from trawl fisheries.

In consonance with the 1998 SEAFDEC Strategic Plan on Fisheries, the projects and activities conducted by SEAFDEC with support from the JTF Program are aimed to effectively safeguard the interests and welfare of the countries in the region from unfair treatment in order not to jeopardize the sustainability of the region's fisheries. SEAFDEC therefore continues to provide the platform for discussing and exchanging views on emerging issues related to fisheries that have serious implications to the

region's trading of fish and fishery products including the sustainability of the region's fishery resources. This has enabled the countries in the region to respond to various international initiatives and requirements related to fish trade and to develop common stand and policy options on such emerging issues.

Promotion of JTF Program Achievements

Promoting and transferring the technologies developed from the various JTF program activities to the ASEAN region has been sustained by SEAFDEC through intensified training and human resource development as well as through massive information dissemination. Regional workshops, training sessions, meetings, and conferences on relevant topics were regularly convened to transfer the technologies developed through the regional projects, gather feedback from the ASEAN countries on the adoption of the developed technologies as well as to secure the plans for the future programs of work and activities. Proceedings and reports of meetings and surveys have been published and disseminated to the region, while some technical reports emanating from the projects and activities have found their ways into various scientific journals and other publications, confirming the validity and applicability of the developed technologies.

Moreover, the many important findings and policies that have impacts on the development of sustainable fisheries in the region have been summarized in the publication "Celebrating Ten Years of Sustainable Fisheries Development in the ASEAN via the Japanese Trust Fund Program: JTF Achievement in SEAFDEC", which was published and launched in April 2008. The publication has been disseminated to its target clientele specifically to the peoples of Japan and the ASEAN region, to make them aware of the achievements attained from the regional activities that have been implemented by SEAFDEC with financial support from the JTF Program. This is also intended to increase the understanding of the peoples' from the ASEAN region on the need to properly manage fisheries for their own benefit and most of all for the benefit of the small-scale fishers in Southeast Asia.

The Special Publication Fish for the People has also played a vital role in enhancing public awareness on various regional activities and outcomes from the SEAFDEC programs and the implementation of the regional sustainable fisheries policies. With full support from the JTF Program, the initiatives of the SEAFDEC Member Countries in addressing various concerns on sustainable fisheries development with respect to the Resolution and the Plan of Action are also being promoted through the

Box 2. JTF Projects (2008-2012)

- Research and Stock Enhancement on Shared Stocks
- Exploration of New Resources and Fishing Grounds
- Effective Utilization of Under-utilized Resources
- Improvement of Post-harvest Practices
- Collection of Information and Public Relations about International Fisheries Issues

Special Publication thus, providing an opportunity for the issues relating to the practical improvement of the current status of local fisheries to be brought forward, attracting the attention and consideration of potential target groups. Moreover, with Fish for the People promoting the visibility of SEAFDEC as an important regional fisheries body, it could also evolve into a regional structure for the exchange of fisheries-related information in Southeast Asia.

Plan of Action

Beyond 2007, the JTF Program has committed to continue leading SEAFDEC towards the sustainable development of fisheries in the ASEAN region. As part of such continued commitment, the JTF Program in SEAFDEC convened a meeting in Bangkok, Thailand in June 2007 to deepen the understanding of the SEAFDEC Member Countries and the Departments on the JTF Policy as well as to seek inputs from the Member Countries for the programming of future projects and activities under the JTF Program. Thus, in addition to the continuing projects from 2007, a number of new projects (**Box 2**) would also be carried out by SEAFDEC with continued support from the JTF Program.

In brief, as the implementation of the activities pursued by SEAFDEC proceeds from 2008, the JTF Program envisaged that SEAFDEC would continue to foster the mainstreaming of the policies and findings that emanate from the regional activities by the countries in the region for the sustainable development of fisheries.

About the Author

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Following-up on the Conservation of Sea Turtles in Southeast Asia: DNA Study



**Hjh. Mahyam bte Mohd. Isa, Syed Abdullah bin Syed Abdul Kadir
and Wahidah bte Mohd. Arshaad**

Efforts in the conservation and management of sea turtles in Southeast Asia have been carried out by SEAFDEC through the MFRDMD from 1998 to the present, with funding support from the Japanese Trust Fund.

The increasing number of endangered aquatic species including the sea turtles has become a global concern knowing that the indiscriminate exploitation by man of the aquatic species' populations for commercial gains has led to the species' decreasing populations. Since the International Union for Conservation of Nature (IUCN) Red List of Threatened Animals of 1996 has indicated that all species of sea turtles are classified as endangered, SEAFDEC as a regional organization has been doing its part to conserve the endangered sea turtles. With funding support from the Japanese Trust Fund (JTF) Program of the Government of Japan through its Fisheries Agency, the SEAFDEC Marine Fishery Resources Development and Management Department (MFRDMD) based in Terengganu, Malaysia has implemented a program on the Conservation and Management of Sea Turtles initially from 1998 to 2004, and extended until 2008. The program was aimed at compiling information on the status of research, conservation and management activities of sea turtles in Southeast Asia, and establishing a mechanism for regional collaboration in the research and conservation of the sea turtles.

SEAFDEC Program on Conservation and Management of Sea Turtles

Spearheaded by MFRDMD and with the collaboration of the ASEAN Member Countries as well as the SEAFDEC Training Department (TD) in Samut Prakan, Thailand, various regional researches and development programs have been successfully conducted in the region in addressing the need to conserve the region's sea turtles species (**Table 1**). Parallel with the efforts of SEAFDEC, the ASEAN Member Countries have also been serious about strengthening their conservation measures on the sea turtles (Fish for the People, Vol. 1 No. 3: 2003). Turtle hatcheries have been set up in many countries as these are considered the most important conservation tools in order that sea turtle eggs have better chances of hatching. Considering that sea turtles are highly migratory, the ASEAN countries also collaborated with MFRDMD's sea turtle tagging activities where the results provided them with considerable ecological information, including information on geographical range and migratory path,

Table 1. SEAFDEC Program on Conservation and Management of Sea Turtles in Southeast Asia (1998-2004)

Project Activities/Objectives	Accomplishments
<p>Sea Turtle Hatchery Management To develop a common tool in conserving sea turtles through sustainable hatchery management focusing on the green turtle, <i>Chelonia mydas</i></p>	<p>Results were published in: <i>A Guide to Set and Manage Sea Turtle Hatcheries in the Southeast Asian Region</i>. The book provides useful information and guidelines in setting up and management of sea turtle hatcheries based on knowledge established on-site in Malaysia and experiences of other countries. Using this book as guide, turtle hatcheries in the region would be able to continuously produce hatchlings in order to enhance sea turtle conservation activities.</p>
<p>Tagging Survey To gather information on migration pattern, growth and mortality rates, reproduction and population estimates, etc.</p>	<p>Results of the survey were included in: <i>Conservation and Enhancement of Sea Turtles in the Southeast Asian Region</i>. The book highlights on the measures undertaken by the ASEAN countries in conserving and managing sea turtles including laws and enforcements on conservation, establishment of sea turtle sanctuaries and hatcheries, tagging and satellite telemetry, training and public awareness. <i>A Guide for Tagging Sea Turtles in the Southeast Asian Region</i> was also published to help the countries in the region in standardizing their own turtle tagging activities.</p>
<p>Development of Turtle Excluder Devices To develop Turtle Excluder Devices (TEDs) suitable for the ASEAN countries in response to the US embargo on shrimps caught by gear not equipped with means to prevent sea turtle by-catch, which was also imposed on the Southeast Asian countries posing threat to the livelihood of the fishers in the region.</p>	<p>Awareness by the region's fishermen on TEDs was promoted through a series of demonstrations conducted in Thailand, Malaysia, Philippines, Brunei Darussalam, Indonesia, Myanmar, Cambodia, and Vietnam. The use of TEDs has already been advanced by many countries in the region.</p>
<p>Collaboration and Partnership To enhance regional collaboration and partnerships in sea turtle conservation and management</p>	<p>MOU on ASEAN Sea Turtles Conservation and Protection was adopted at the 9th AMAF Meeting in 1997 The ASEAN Network on Sea Turtles was established as a regional taskforce in the promotion of conservation and management of sea turtles in the region Development of Turtle Research Database System promoted by Western Pacific Regional Fisheries Management Council in collaboration with Department of Fisheries Malaysia Cooperation with SEASTAR2000 finalized for the satellite tracking of sea turtles</p>

breeding and inter-nesting frequencies, growth rates and population size, etc.

Stock Enhancement of Sea Turtles

Recognizing the need to broaden regional activities into an integrated management approach for future efforts in the conservation of sea turtles, SEAFDEC with support from the JTF Program, pursued further its efforts in the conservation and management of the sea turtles by implementing the Program on Stock Enhancement of Sea Turtles in the Southeast Asian Region from 2005 to 2008 (Table 2). Conducted by MFRDMD and TD in collaboration with the SEAFDEC Member Countries, the program aims to advance the conservation and management of sea turtles by incorporating all possible approaches through collaborative efforts of the ASEAN countries in order to make the conservation effort of the sea turtles a “regional success story” and to ensure the long-term survival of these endangered species.

Determining Population Structure of Sea Turtles through DNA Study

Identification of the stock/population of sea turtles is a very essential ecological aspect to promote their conservation. Enhancement of the sea turtle resources requires ecological and physiological knowledge throughout the sea turtles' life. Sea turtle conservation and enhancement could be promoted by determining their subpopulations because the resources-protect schemes should correlate to each population unit. Understanding the discreteness of sea turtle stocks and on how the stocks relate to each other is therefore important for the conservation of the sea turtle resources.

In the DNA study conducted by MFRDMD, the population genetics of the green and hawksbill turtles were analyzed using mitochondria (mt) DNA. Using the 300 samples of green turtles collected from 16 sampling sites throughout the Southeast Asian Region, initial results indicated that

Table 2. SEAFDEC Research Projects on Stock Enhancement of Sea Turtles in Southeast Asia (2005-2008)

Project Activities/Objectives	Progress of the Activities as of 2007
<p>Tagging and Satellite Telemetry To enhance the sea turtle migration studies in the region, specifically in countries where turtle rookeries are concentrated.</p>	<p>Tagging of sea turtles (green turtles, hawksbill and Olive Ridley), using inconel tags was conducted in participating ASEAN countries. Posters highlighting the SEAFDEC tagging program were distributed for public awareness. Initial reports indicated that sea turtles are sharing resources and their foraging has been confirmed in certain areas in the Southeast Asian region.</p>
<p>Head Starting Technique To collect information and conduct analysis on head-starting, a technique for raising sea turtles in captivity for release later to improve survival during their early years, which is still relatively new in the region.</p>	<p>Information collection on head starting programs in the region and other countries outside Southeast Asia was initiated.</p>
<p>Sea turtles - Fisheries Interactions To mitigate interaction between sea turtles and fisheries and minimize mortalities of sea turtle from fishing operations.</p>	<p>Assessment/evaluation of lessons learned from the introduction and promotion of TEDs in shrimp trawls was carried out taking into account the 2004 FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations. Collection of information on sea turtle interaction with fishing operations in Southeast Asia was initiated.</p> <p>Result of the comparative study on the efficiency of the Circle hook and the J-hook in pelagic and bottom longlines indicated that the use of Circle hook (with larger hook width which the sea turtles could not swallow) was the most suitable device for the conservation of sea turtles.</p> <p><i>Mitigation of Fishery-Sea Turtles Interactions: Efficiency of the Circle Hook in Comparison with J-hook in Longline Fishery</i> was published containing the outcomes of the studies on mitigation of sea turtles and fisheries interaction. When sea turtles are caught by the Circle hook, hooking position is only around their jaws thus the hook could be easily removed. Results also showed that sea turtles caught by the Circle hook have no serious injuries and could be released safely back to the sea.</p>
<p>DNA Study To identify stock/population of sea turtles from the ASEAN region and detect multiple paternities for estimation of stock size of male sea turtles.</p>	<p>The Standard Operating Procedure: Sampling Tissue of Sea Turtles in the Southeast Asian Region to guide the countries in collecting tissue samples was published. Based on this guideline, many tissue samples of green turtles from selected nesting sites in participating ASEAN countries were collected. Tissue samples of green turtle hatchlings are being analyzed to determine multiple paternities through microsatellite markers.</p> <p>Symposium on Cloning of Sea Turtles was convened in March 2006 in collaboration with DOF Malaysia to discuss and compile methodologies and techniques for cloning sea turtles.</p> <p>The <i>Conceptual Framework on Cloning of Sea Turtles and Master Plan: Cloning of Sea Turtles</i> were published. The Master Plan describes the establishment of advanced reproductive biotechnology and captive breeding for the sustainable management of sea turtles.</p>
<p>Sea Turtle Information Dissemination To enhance awareness, knowledge and understanding of the public on sea turtles and spread awareness on the need to protect and conserve the sea turtles as well as the environment as a whole.</p>	<p>Five volumes of <i>Sea Turtle Information Kit</i> were published in 2006: Volume 1: Sea Turtle Evolution and Biology Volume 2: Sea Turtle Distribution Volume 3: Sea Turtle Hatchery Volume 4: Conservation Genetics of Sea Turtle Volume 5: Public Awareness on Sea Turtles</p>

green turtles from Southeast Asia have few sub-populations or Management Units (MUs). The analysis of the hawksbill samples is still in progress.

Nonetheless, the preliminary results also showed that several sub-populations of nesting green turtles were present in Thamee Hla Island-Coco Island (Myanmar), Khram Island-Huyong Island (Thailand), Redang Island

(Malaysia), Sarawak Turtle Island (Malaysia), Philippine and Sabah Turtle Island (Malaysia and Philippines) and Derawan Archipelago (Indonesia). For the hawksbill turtles, samples were also collected from 15 selected sampling sites. However, only the 100 tissue samples from two sampling sites: Melaka (Malaysia) and Segamat/Belitung (Indonesia) had been analyzed so far.



Collecting tissue samples from sea turtles at nesting locations

Issues and Concerns

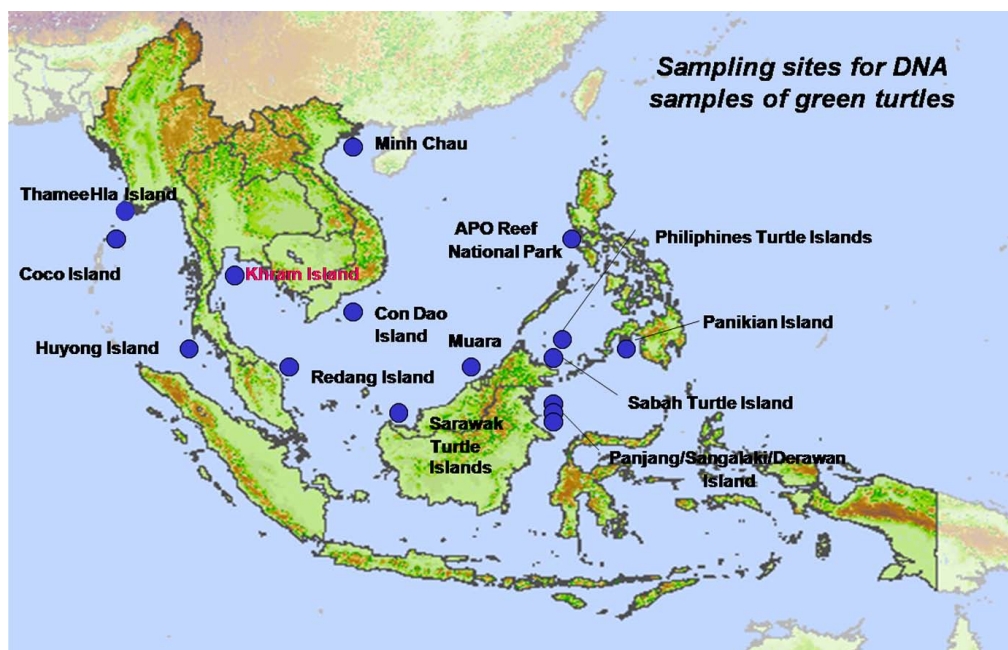
Since six of seven species of living sea turtles in the world are commonly found in the Southeast Asian waters, it is most appropriate to conduct research to conserve and enhance the sea turtles populations in these waters with a view of maintaining their biodiversity. Since sea turtles are highly migratory and share the waters of the region, regional cooperation among the Southeast Asian countries is vital to ensure their survival. Within the Southeast Asian region, conservation efforts of one country could be jeopardized by fisheries-related activities of another country. Thus, it is crucial that conservation efforts should be done in a concerted regional manner.

Generally, the population sizes of sea turtles are investigated only for adult females landing on the beach for nesting since the adult males do not land on the beach and their natural habitats have always been the sea throughout their life. Since it is also known that the adult males of sea turtles have bigamic relationships with the nesting females, multiple paternities would be determined to estimate the stock size of male sea turtles in a pilot nesting beach.

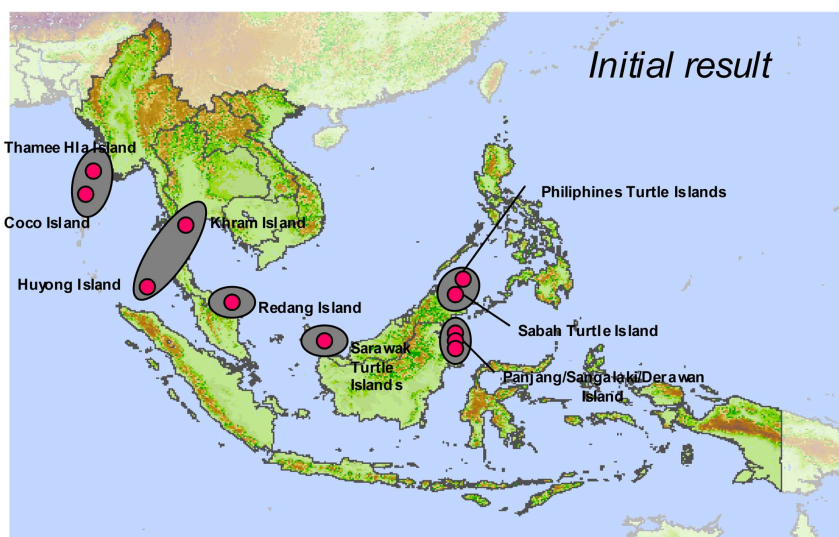
Considering the Mak Kepit Beach in Redang Island of Terengganu, Malaysia as the pilot nesting area, 300 tissue samples of hatchling green turtles from 10 nesters were analyzed. The initial findings showed that most of the females mate with only one adult male green turtle. The microsatellite DNA marker was used to identify each male individual that mates with the nesting females during the nesting season.

Conservation and enhancement of sea turtle resources requires ecological and physiological knowledge of their life and their living behavior and conditions. Since conservation and enhancement efforts should be based on scientific evidence, molecular genetic analyses are used to investigate the population genetic structure of the green and hawksbill sea turtles of Southeast Asia. During the series of consultations conducted prior to the implementation of the project activity, it was recognized that understanding sea turtle stocks and on how the stock relates to each other is crucial for the regional management of sea turtles.

Molecular biological study on DNA fingerprint was therefore pursued to determine the stock population/sub-population of sea turtles in the Southeast Asian region and to come up with guidelines for the genetic study of sea turtle management in the region. Starting with the green turtles, results showed that their frequency distributions indicated eight (8) genetically distinct breeding stocks (Management



Selected sampling sites for collecting tissue samples of green turtles in the Southeast Asian region



Several sub-populations of nesting green turtles were found in the Southeast Asian region based on DNA profiling

Units, MUs). Significant genetic differentiations in mtDNA haplotype frequencies among rookeries support the hypothesis of natal homing. This means that the female adult green turtles that lay eggs at particular nesting beaches is unique and belong to one sub-population. Several sub-populations of female green turtles have been observed in the Southeast Asian region.

Since it has also been well observed that nesting females come back to the same beach in the next nesting season at intervals of seven years, it is therefore necessary that a good number of individual tissues of females are collected from each of the focused nesting places in the region complying with the standardized sampling method used in many DNA studies. Being highly migratory species, the environmental threats occurring in the region's waters may also jeopardize the population of the sea turtles at particular nesting beaches.

What should be done to address the concerns?

Most of the female adult green turtle populations are isolated according to their nesting beaches, and since they are highly migratory, they could migrate beyond the transboundary waters. Therefore regional collaboration is very essential on any action aims to protect sea turtles. Moreover, reducing the mortality of sea turtles caused by man-induced or fishing activities is vital for enhancing the population of sea turtles in the region. Intensive education and awareness program on conservation of sea turtles as well as on maintaining environmental and ecological integrity should therefore be conducted at all levels especially in the fishing communities in the region.

Plan of Action

The observations collected from the various conservation activities make it more vital for SEAFDEC to intensify its regional program on the conservation and management of sea turtles to protect the sea turtle resource. Under the Japanese Trust Fund IV Program, regional tagging and satellite tracking activities are also being conducted by the MFRDMD. These activities aim to determine the migration routes, foraging habitat and as well as mitigate the impacts from fishing activities occurring in particular areas of the region. Under the Japanese Trust Fund V Program, MFRDMD will conduct research on management and protection the foraging habitats of sea turtles in the region. Taken together, all these activities should be appropriately supported as these are mutually important for the success of the sea turtle conservation and enhancement efforts in the Southeast Asian region.



The DNA study of sea turtles

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Mitigating Interactions and Reducing Mortality of Sea Turtles due to Fishing: SEAFDEC Initiatives

Bundit Chokesanguan

The Southeast Asian region is home to one of the highest biodiversity and richest marine ecosystems in the world. Specifically, six of the seven species of living sea turtles in the world are commonly found in the marine waters of the region, these are the leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*) and flatback (*Natator depressus*).

The expansion of fishing activities in coastal areas and in the high seas over the past few decades has contributed to important changes in the marine ecosystems. This is not only in terms of the target fishery resources but also the other ecosystem components that are directly or indirectly affected by fishing activities. In response to such developments and concerns over the deteriorated status of the marine ecosystems, a number of global and regional initiatives have been initiated. These include the 1992 UN Conference on Environment and Development (UNCED), the 1995 FAO Code of Conduct for Responsible Fisheries, the 1995 UN Fish Stock Agreement, the 2001 Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem, and the 2001 ASEAN-SEAFDEC Resolution on Sustainable Fisheries for Food Security for the ASEAN Region. All of the abovementioned initiatives are pointing to a common concept, which is the “sustainable use of aquatic ecosystems”.

Sea turtles are highly migratory and share the waters of the Southeast Asian region. However, sea turtles are mostly affected by man-made interventions either fishing or non-fishing activities. In view of the importance to maintain the sea turtle biodiversity and the overall aquatic ecosystem balance, the SEAFDEC Member Countries have over the years been taking initiatives in promoting the conservation and management of sea turtles in the region.

Conservation and Management of Sea Turtles in Southeast Asia

In 1997, the Agriculture and Forestry Ministers of the ASEAN Member Countries endorsed the Memorandum of Understanding (MoU) on ASEAN Sea Turtle Conservation and Protection, aimed at promoting the protection, conservation, replenishing and recovery of sea turtles and their habitats based on the best available scientific evidence, taking into account the environment, socio-economic and cultural characteristics of the respective ASEAN countries.

The MoU has been initially supported by the ASEAN and SEAFDEC collaborative program on Conservation and Management of Sea Turtles in Southeast Asia from 1998 to 2004 (Managing Sea Turtles in Southeast Asia: Hatcheries and Tagging Activities, Fish for the People, Vol. 1 No. 3: 2003). The major achievements of the program, which was funded by the Japanese Trust Fund, are summarized briefly in **Box 1**. A follow-up program on Research for Stock Enhancement of Sea Turtles in the ASEAN Region



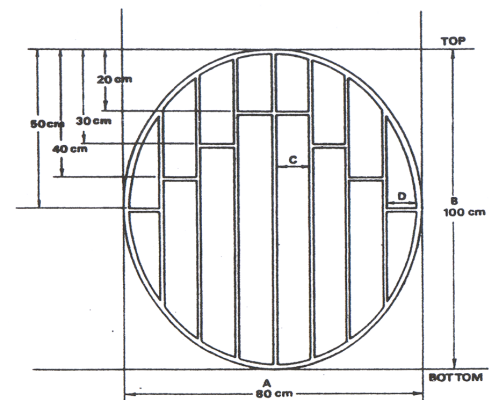
Sea turtle released from a fishing gear installed with a Turtle Excluder Device (TED)

Box 1. Achievements of the ASEAN-SEAFDEC Program on Conservation and Management of Sea Turtles

1. Establishment of the ASEAN-SEAFDEC Sea Turtle Research Network comprising national coordinators from the ASEAN countries and used as a regional forum for exchange of information on national programs and priorities on sea turtle research;
2. Organization of a number of regional conferences and workshops to exchange information and expertise as well as to develop a harmonized format for collecting data and information on sea turtles in the region;
3. Compilation and dissemination of information and research results on sea turtle conservation and management in the region in various forms of publications such as books/proceedings/technical and information papers among which two have been noted internationally, such as the Conservation and Enhancement of Sea Turtles in the Southeast Asian Region, and Guide to Set and Manage Sea Turtle Hatcheries in the Southeast Asian Region;
4. Distribution of 11,300 inconel tags and applicators to all Member Countries except Lao PDR and Singapore, used for the migratory study of sea turtles in the region; and
5. Development of turtle excluder device (TED) applicable for the regional situation and conduct of research and demonstration on TED in various ASEAN Member Countries in response to pressure of the US embargo on shrimp export starting in 1997.

Box 2. Research on Stock Enhancement of Sea Turtles in the ASEAN Region (2005-2008)

1. DNA study for the stock/population identification of sea turtles from the ASEAN region and detection of multiple paternities for estimation of stock size of male sea turtles;
2. Tagging and satellite telemetry study using inconel tags at established rookeries in the ASEAN countries, focusing on populations where no or very little information is available such as in Indonesia, Malaysia, Myanmar and Vietnam;
3. Feasibility study on head-starting (Sea Turtle Nursery) by reviewing the head-starting technique as a management tool for sea turtles and where global and regional attempts on the head-starting experiments are reviewed to find out whether they were successful or not; and
4. Interaction between sea turtles and fisheries
 - 4.1 information collection on sea turtle interaction with fishing operations in Southeast Asia
 - 4.2 comparative study on the efficiency of the Circle hook and the J-hook in pelagic and bottom longlines
 - 4.3 assessment/evaluation of lessons learned from the introduction and promotion of TEDs in shrimp trawls, taking into account the 2004 FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations.



The Thai Turtle Free Device (TTFD)

for 2005-2008 (**Box 2**), which is also supported by the Japanese Trust Fund, is being pursued to sustain the continuing efforts of the SEAFDEC Member Countries in the conservation and management of the sea turtles.

While noting that conservation and management of sea turtles are not easy tasks, the ASEAN countries have been determined to take bolder steps towards this endeavor. Their strong commitment was reaffirmed at the 13th Meeting of ASEAN Sectoral Working Group on Fisheries in May 2005. During that Meeting, the progress and achievements in the conservation and management of sea turtles in the region since 1998 were discussed, and their strong support to the initiatives and implementation of the activities on the Research for Stock Enhancement of Sea Turtles in the ASEAN Region as promoted by SEAFDEC, was reaffirmed.

Such commitment was further confirmed at the 38th Meeting of SEAFDEC Council in April 2006 in Brunei Darussalam, where the SEAFDEC Member Countries officially launched the “Year of Turtle” in the ASEAN region. This set the momentum for the regional campaign in building awareness and exchange of information and experiences among the SEAFDEC Member Countries at regional and national levels on the issue, and was also regarded as a SEAFDEC joint effort towards the 2006

Year of Turtle promoted by the Indian Ocean-Southeast Asian (IOSEA) Marine Turtle Secretariat.

Reducing the Interactions and Mortality of Sea Turtles due to Fishing

One factor that contributes to the success in sea turtle conservation and management in Southeast Asia lies on the importance of better understanding the interactions between sea turtles and fishing activities. Such understanding could not only improve sea turtle mortality from fishing in general but also help focus all efforts in improving other measures and initiatives for the conservation and management of sea turtles. Along this line, a number of activities and initiatives to reduce interactions and mortality of sea turtles from fishing has been undertaken by SEAFDEC over the past years. The summary results of such activities and initiatives are given in **Box 3**.

Future Directions

In taking progressive steps towards improved conservation and management of sea turtles in the region, the existing initiatives and collaboration would be continued and

Box 3. SEAFDEC Program on Reducing Interactions and Mortality of Sea Turtles from Fishing

1. Development and Application of Turtle Excluder Devices (TEDs) in Shrimp Trawls. In response to the US shrimp embargo in 1996, SEAFDEC in collaboration with Thailand, Malaysia, the Philippines, Brunei Darussalam and Indonesia conducted a regional collaborative program on the development and application of TEDs in shrimp trawls, with funding support from the JTF Program. The major activities included the design, development and implementation of the “Thai Turtle Free Device (TTFD) in shrimp trawl fisheries; experiments on various designs of TEDs, namely: Anthony Weedless, Supershooter, Bent Pipe, Georgia Jumper and Mexican models. The experience on the application of the various designs was further used to develop another Thai TED called the “Thai-KU”, which is tailored to the fisheries situation in the region. Since then, a series of on-site demonstration and training for government officials on the installation and use of TEDs were conducted in the region.

2. Mitigation of Fishery-Sea Turtles Interactions: Efficiency of the Circle Hook in Comparison with J-hook in Longline Fishery. As recommended in the FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations concluded during the FAO Technical Consultation on Sea Turtles Conservation and Fisheries in Bangkok, Thailand in December 2004, a comparative study between Circle hook and J-hook in longline fishing was initiated by SEAFDEC in 2005. Preliminary results of the experiments indicated that the Circle hook has higher catch rate of target species and lower by-catch, compared to the J-hook with the Circle hook also showing higher performance than the J-hook.

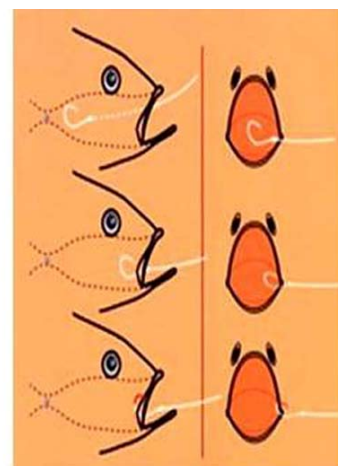
3. Regional Expert and Technical Consultations on Progress of Initiatives in Reducing Sea Turtles Mortality from Fishing. Based on the research results on the designs and experiments on TEDs in the region, a series of regional expert and technical workshops and consultations on the application of TEDs and initiatives to reduce sea turtle mortality from fishing have been organized since 1996. Experts and government officials working on the interactions between sea turtles and fishing have been meeting at least once a year under the SEAFDEC regional collaborative project on Responsible Fishing Technology and Practices to exchange information and experiences in addressing the issue. The outcomes from such workshops and consultations have been published and disseminated in the region and worldwide.

4. Information Packages and Awareness Building Campaigns on Conservation and Management of Sea Turtles. From the results of the research and experiments on TEDs as well as the regional workshops and consultations, a series of regional TED training courses have been conducted at national and regional levels. In addition, a wide range of promotional media for public awareness purposes (e.g., videos, posters, brochures, etc.) on the use and benefits of TEDs have been developed and disseminated targeting the fishers, the governments of the Member Countries, the coastal communities and researchers. The materials focused on the need to conserve sea turtles and the use of TEDs with an attempt to further improve fishers’ acceptance of the use of TEDs and compliance to related management measures.

to some extent intensified. Assessing the relationship between sea turtle mortality and fishing could reinforce the conservation and management interventions of the sea turtles (Refer to “Following-up on the Conservation of Sea Turtles in Southeast Asia: DNA Study,” this issue of Fish for the People). In this regard, SEAFDEC in collaboration with the Member Countries will continue to undertake a number of priority projects on turtle conservation beyond 2008 (**Box 4**).

Box 4. Forward Actions on Reducing Interactions and Mortality of Sea Turtles due to Fishing

1. Comprehensive assessment of the application of Turtle Excluder Devices (TEDs) in the region by clarifying the factors contributing to successes and failures in the application of such devices;
2. Expansion of the experiments and demonstrations on the comparative study on Circle and J-hooks, involving wide number fishers in the conduct of such experiments, to provide direct opportunity and first-hand experience to the fishers, which in return, could enhance their cooperation and compliance;
3. Intensification of efforts on awareness building through wider dissemination of information packages on the conservation and management of sea turtles particularly addressing the importance of reducing sea turtle mortality from fishing; and
4. Fostering and expansion of networking, collaboration and partnership with organizations at national, regional and international levels in conservation and management of sea turtles in the region in general as well as reduction of sea turtle mortality from fishing in particular.



The hooking mechanism: fish takes the bait until the hook is caught on the fish's jaw

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MANGROVES OR AQUACULTURE? Why not both?

Eva T. Aldon, Rolando R. Platon and V.T. Sulit

This article briefly summarizes the techniques developed, verified and/or refined during the implementation of the Project on the Promotion of Mangrove-Friendly Shrimp Aquaculture in Southeast Asia, which was implemented by the SEAFDEC Aquaculture Department from 2000 to 2005. Conducted under the ASEAN-SEAFDEC FCG collaborative mechanism, the project which received generous funding from the Government of Japan through its JTF Program, aimed to develop sustainable culture technology packages on shrimp farming that are friendly to mangroves and the environment.

We have always been told to “regulate the cutting of mangroves for aquaculture.” But why cut when mangroves and aquaculture can co-exist? In fact, aquaculture could be done right in mangrove areas, as what the SEAFDEC Aquaculture Department (AQD) has done at its Dumangas Brackishwater Station in Iloilo, Philippines, which has a flourishing crab culture facility within the mangroves (Baliao et al, 1999; Baliao et al, 1999a). The same technology was adopted by the Government of Palau, courtesy of technicians from AQD seconded by the Government of the Philippines to the Government of Palau. The Government of Palau is also promoting the culture of mud crab in mangroves with least impact to the environment and the pilot activity is proving great potentials for future development (FAO SOWA, 2006).

The Project on the Promotion of Mangrove-Friendly Aquaculture in Southeast Asian Countries: Mangrove-

Friendly Shrimp Culture was aimed at developing sustainable culture packages on shrimp farming that are friendly to mangroves and the environment, and disseminating such packages to the region through actual demonstration and training. Conducted by AQD with funding support from the Japanese Trust Fund (JTF) Program of the Fisheries Agency of Japan, verification and pilot demonstration of intensive shrimp culture techniques were implemented in Thailand and the Philippines; verification and pilot demonstration of semi-intensive shrimp culture techniques in Vietnam, Myanmar, Cambodia and Malaysia; research at AQD’s pond facilities on capacity of mangroves to absorb nutrients and on the evaluation of probiotics/waste digesters used in shrimp culture; and research on the economic benefits of mangrove-friendly aquaculture (Fish for the People, Vol. 5 No. 3: 2007).

Training was also a major component of the project where a number of sessions were conducted at AQD and

on-site in Vietnam, Myanmar and Cambodia. Various publications were produced from the results of the project's verification and R&D activities including a manual on Best Management Practices for Mangrove-Friendly Shrimp Farming, originally in English and translated into Bahasa Indonesia (Melayu), Filipino, Thai, Vietnamese and Burmese languages.

The results of a study conducted under the Project focusing on the mangroves' capacity to absorb nutrients, indicated that mangroves exhibited higher growth rates in the presence of aquaculture effluents than those with no adjacent aquaculture activities. Primavera (2004) confirmed that mangroves can indeed remove significant levels of nitrogen and solid wastes from shrimp pond effluents. In another study also under the project, it was concluded that "waste water from shrimp farms observing good management practices has no negative effect on natural mangrove areas" (Sangrungruang, 2004).

What to do?

Primavera (2004) established the following information for the effective co-existence of mangroves and aquaculture:

- Maintain mangroves at an estimated 1.4–1.6 ha to process wastes from one hectare of intensive or semi-intensive shrimp pond. These estimates cover only the waste assimilation function and are therefore minimum levels. Do not use antibiotics and other chemical or biological inputs that may be harmful to mangrove organisms.



Results of the study also showed that Bruguiera gymnorhiza (right) has the highest efficiency on the water treatment. On the other hand, Avicenia alba (left) has the highest efficiency on the treatment of high nutrient waste (Primavera, 2004).

- Hold shrimp pond effluents for 6h or more in the mangrove wetland to reduce levels of nitrogen and solid wastes before discharge into the creek.
- Harvest mangroves partially (as branches of Avicennia, Sonneratia and other non-Rhizophoraceae) or as the whole tree (for Rhizophorea, Ceriops and other Rhizophoraceae) with replanting of the latter. For ponds that border a waterway (creek, river or shore), the mangrove treatment area can also serve as the 20-m to 50-m greenbelt required by law.

Simple Water Recycling Treatments

The Manual on Best Management Practices in Shrimp Farming developed by the Department of Fisheries of Thailand features various good management practices as regards shrimp farming in mangrove areas. One of the most practiced is the use of integrated physical and biological technology as effluent treatment system for treated water, which can be recirculated using a reservoir (Songsangjinda, 2004). The strategy was developed to reduce the water consumption in shrimp ponds by recycling the water and re-using it for succeeding culture operations. The JTF Project corroborated the technique demonstrated through the Manual for the verification study on the effect of shrimp farm effluents on the mangrove ecosystem. The study confirmed that effluent from shrimp ponds, which is usually turbid and enriched with organic nutrients, can be cleaned using the integrated physical and biological treatment system. The treatment, consisting of filter boxes and biological filtration using bivalves, fishes and seaweeds, has proved to be effective and can be used extensively in the process of recycling the water in the shrimp farms.

As discussed by Songsangjinda (2004), the shrimp pond system usually consists of a grow-out pond (35x90 m²) and a treatment pond (30x27 m²). A third pond is required to serve as reservoir for new water during the initial filling and to compensate for losses due to evaporation and seepage. The grow-out pond and the treatment pond are connected in order to allow the water to circulate from one pond to the other. A 0.7-ton capacity filter box is installed in the treatment pond. The filter box is perforated at the sides and bottom, and filled with bags containing sand, shells or pieces of broken corals. The inlet of the water supply pump is set in the middle of the bags containing the filter media. The treated water is pumped through the filter box into the grow-out pond when refilling of the water is required. The treatment pond should be efficient so that sediment reduction and water quality improvement is at least 20-50% better than that of an untreated pond.

The use of biological treatments, such as seaweeds, tilapia and oysters, can reduce luminous bacteria (lum bac) levels from 7.5×10^2 cfu/ml in the water and 1.0×10^1 cfu/g in the sediments, to zero. Lum bac infection is caused by *Vibrio harveyi*, originally reported in cultured shrimp and are now also devastating crab larvae. Lumbac disease outbreaks in the shrimp industry showed that the shift in husbandry and feeding practices led to ecological imbalance in the culture system. The Total N and P concentrations in the culture water can also decrease from 33% to 9%. The technique established by Golez (2004) is to culture oysters at the mouth of shrimp effluent discharge pipes and stocking the settling pond with tilapia and seaweeds to “clean” and maintain good pond water-soil quality. Biological filtration improves the water quality of pond effluents by removing suspended matters especially the particulate organic matters. However, fecal pellets produced by bivalves accumulate and decompose on the pond bottom. Seaweeds are therefore used to absorb the excess nutrients in the water produced by the decomposition. Songsangjinda (2004) also added that integrating filter with the biological filter has the advantage of removing organic wastes and dissolved nutrients in the water. Therefore, the waste water from shrimp ponds that are released to the receiving mangrove ecosystems is free from undesirable elements and hence, has no adverse impact on the ecosystem.

Seawater irrigation system

The Royal Project in Kung Krabaen Bay, Thailand has developed a seawater irrigation system (SIS) with the objective of minimizing some obstacles in shrimp farming, e.g., diseases, environmental impact, etc., as well as in conserving the mangroves while operating shrimp culture farms. In discussing the SIS, Sangrungruang (2004) and Ekamaharaj (Tookwinas) (2002) confirmed that the seawater irrigation system of Thailand is applicable in intensive shrimp farming. The system has been tried in Kung Krabaen Bay shrimp farms but is yet to be tried in other areas in the region. SIS is parallel to the irrigation system in agriculture (i.e., rice irrigation or other crop irrigation system) where one farmer draws water from one source (in the case of shrimp farming from a treated water source) for his farms. The discharge of the water will also be through a common outlet canal, to make sure that the water is treated before it goes back to the mangrove ecosystem or to the sea, as the case may be. The seawater irrigation system of Thailand aims to clean shrimp pond effluents and provide quality water for shrimp culture. The system also includes a rest canal for rearing water released from the shrimp ponds, as the water undergoes treatment before being further released into the sea or in this case

Box 1. Detailed Information on Thailand’s Seawater Irrigation System (SIS)

The SIS consists of:

Seawater Conduit

- The facility has six rows of high pressure high density polyethylene (HDPE) conduits, each having a diameter of 1.0 m, and buried under the sea at a distance of about 350 m offshore. These conduits deliver seawater to the pumping station onshore.

Water pumping station

- This is used to pump seawater from the underground storage located about 11 m deep. This station can store water up to 4650 m³ and can continuously drain water using eight 200-Hp pumps, each having a drainage capacity of 1.25 m³ of water/sec. Water flows in through two 1.0-m diameter HPDE conduits, into a stocking pond, which can hold water up to 3000 m³.

Water inlet canal

- Running a distance of about 8820 m, the water inlet canal delivers seawater to the shrimp culture areas. This concrete canal stores seawater from the stocking pond, before the water is finally released into the shrimp ponds by gravity.

Sub-distributory canal

- About 5 m wide and approximately 580 m long, the sub-distributory canal is used to receive and distribute seawater to farmers in the lower areas.

Secondary canals

- Separated from the main canal, secondary canals are necessary for delivering water to shrimp ponds since the shrimp culture areas are usually large.

The SIS also includes a wastewater system, which is necessary to treat discharged water. This consists of:

- The sludge-pond where suspended solids settle so that clear water flows into the water treatment canal
- The water treatment canals are supplemented with physical and biological treatment systems, with an aeration system consisting of 24 units 5 Hp mechanical aerators along the canals. Oysters are hung in the treatment canals to enhance the efficiency of the wastewater treatment before passing the water to the sedimentation canals.
- Sedimentation canals comprise seven local canals, where both sides of the canals lay along the mangrove forest areas. The canals receive discharged water from the treatment canals.

to Kung Krabaen Bay, Thailand. More information on the SIS is shown in **Box 1**.

Ekamaharaj (2002) emphasized that the SIS ensures good water quality for shrimp farming and responsible release of pond effluents. From the results of the study conducted in Kung Krabaen Bay under the JTF Project, it was confirmed that the effluents from shrimp ponds using SIS do not have adverse effects on the receiving waters especially on the mangroves, and more particularly in this case the mangrove ecosystems of Kung Krabaen Bay.

Cost and benefits of environment-friendly shrimp farming

The low discharge and recirculating shrimp culture technologies, verified in different sites in the ASEAN region (Philippines, Vietnam, Myanmar, Cambodia, Malaysia) under different climatic conditions as part of the activities of the JTF Project, are capable of achieving high productivity and return on investment (ROI). Baliao (2004) has established the ideal stocking density for shrimp farming based on Philippine experience, using the low discharge and recirculating culture technologies. The average net profit/hectare was recorded to be highest with stocking densities around 25 pc/m². The net profit/hectare for 25 pc/m² was 1.8 M while for 15 pc/m² was PhP 1.1 M. In 40 pc/m² stocking density, the average was PhP 0.6 M/ha whereas in 5 pc/m², it was PhP 0.57 M/ha. The high net profit was attributed to the high quality and uniform sized shrimps harvested with average survival rate of 95%. (Note: 1.0 USD = PhP 50.0)

In the low discharge system, a small amount of water is discharged from the grow-out pond and released to the sea after passing through the settling pond. Water is pumped only once, from the head reservoir to the grow-out pond. In the recirculating system, effluents from the grow-out pond are reused after passing through the treatment pond. Water is fully recirculated by pumping twice, first from the head reservoir to the grow-out pond, and second from the treatment pond to the grow-out pond. Discharges from shrimp ponds using environment-friendly farming practices do not affect the quality of the receiving waters or mangrove wetlands, hence requires no cost (Ekmaharaj et. al, 2000). The average annual investment in pollution management of the shrimp farming industry constitutes a significant portion—around 9% of the annual production cost and only 3-4% of environmental benefits that the environment-friendly shrimp farming practices would generate (Samonte-Tan and Cruz, 2006).

Following the concept of environment-friendly shrimp farming which has been promoted by SEAFDEC, intensive shrimp farmers from the region now employ a variety of progressive technologies and practices without necessarily felling mangrove forests. Among the most recent improvements include reduced stocking density, proper pond preparation, crop rotation, feed quality improvement, stocking of good quality fry, use of bioremediators and increased aeration, use of settling ponds, and adoption of biosecurity measures (Samonte-Tan and Cruz, 2007). Such efforts are aimed at reducing the adverse impact of shrimp aquaculture on the environment, and effectively integrating responsible shrimp farming in mangrove conservation.

Samonte-Tan and Cruz (2006) further estimated that the opportunity cost for not utilizing environment-friendly shrimp farming practices in terms of pollution damage to the fisheries could be PhP740,000/ha and PhP44,000 to human health. On the other hand, the environment friendly shrimp farming practices generate net economic benefits to the economy as a whole for they increase the economic value of mangrove habitats in supporting fisheries.

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

Mangrove ecosystem has always been nature's best gift to the peoples of the ASEAN region. But in the past, peoples have regarded mangroves as wetlands to be converted into more useful and productive areas. Thus, large areas of mangrove forests in the region have been clear-felled and converted into many ways for food, fuel, timber and even for foreign exchange. The mangrove ecosystem has also been exploited for human and industrial settlements, infrastructure development as well as aquaculture as means of livelihood. It can not be denied that mangrove-associated aquaculture specifically shrimp culture, has provided economic benefits to a wide range of stakeholders in the ASEAN region. However, most of such aquaculture ventures have resulted in severe environmental degradation and socio-economic problems due to irresponsible and poor culture management practices and the lax enforcement of environmental regulations. Thus, the JTF Project has campaigned for the adoption of better aquaculture practices that are compatible with mangrove ecosystem conservation and management.

As an outcome of the JTF Project, AQD published in 2005 the "Regional Code of Practice for Sustainable Use of Mangrove Ecosystems for Aquaculture in Southeast Asia" to specifically address **Article 9.1.3.4** of the **Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Aquaculture** which states that "Given the importance of mangroves, States and regional institutions should prepare regional guidelines for the responsible use of mangroves for aquaculture." The Code also aims advance to the ASEAN region the need to "promote good farm management practices that reduce effluent pollution load and comply with relevant effluent standards through appropriate treatment" as specified in **Section B.3** Aquaculture of the **Plan of Action for Sustainable Fisheries for Food Security for the ASEAN Region** adopted in 2001.

Through the Code of Practice, SEAFDEC continues to enjoin the aquaculture sector and all other users of the mangrove ecosystem to be responsible stewards of this gift

of nature as the payback is food security and sustainable livelihoods. After all, mangrove ecosystem is like a “big bank account” containing big capital and earning big interests. As responsible recipients of this gift of nature, countries in the region are encouraged to adhere to the provisions in the Code of Practice by using only the “interest” (new growth of mangroves through reforestation) and leave the “capital” (the original mangrove ecosystem) in tact.

Way Forward

Shrimp aquaculture, which has always been associated with mangrove loss and destruction, has contributed much to the ASEAN region’s economy. Thus, shrimp farmers from the region have been steadily emboldened by the Code of Practice, for them to institute the sustainable use of mangroves including the operation of aquaculture systems integrated in more or less intact mangrove ecosystem in place of newly-felled mangrove forests. Moreover, with technologies already developed, refined and verified, shrimp aquaculture can after all be compatible with mangrove ecosystems provided better farm management practices are adopted.

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Assessing the Abundance of Demersal Fishery Resources in Southeast Asian Waters

Nakaret Yasook

Results of surveys conducted from 2004 to 2007 using the bottom vertical longline gear indicated that high value demersal fishery resources are abundant in the untrawlable waters of Southeast Asia. This article, which expounds on the results of the surveys, was based on the paper presented during the Regional Workshops on Information Collection of Demersal Resources as Surimi Raw Materials in Southeast Asian Waters and on the Findings of Demersal Resources from M.V. SEAFDEC 2 held in Chiang Rai, Thailand, 18-20 December 2007.

Funded by the Japanese Trust Fund (JTF) Program of the Government of Japan's Fisheries Agency, demersal fishery resources surveys were conducted by SEAFDEC with the collaboration of the Member Countries, to collect data on the relative abundance of demersal resources in the untrawlable waters of Southeast Asia. Specifically, the basic data and information on demersal fish species collected in 2004 to 2007 from four survey areas were used as basis to investigate the existing potential demersal fishery resources in the Southeast Asian waters. The four survey areas covered the untrawlable areas of the Andaman Sea of Thailand; West Coast of Borneo in the Waters of Brunei Darussalam, and Sabah and Sarawak of Malaysia; West Coast of Luzon and Sulu Sea of the Philippines; and the East Coast of Vietnam (Figure 1). A total of 105 fishing stations were surveyed on board the M.V. SEAFDEC 2.

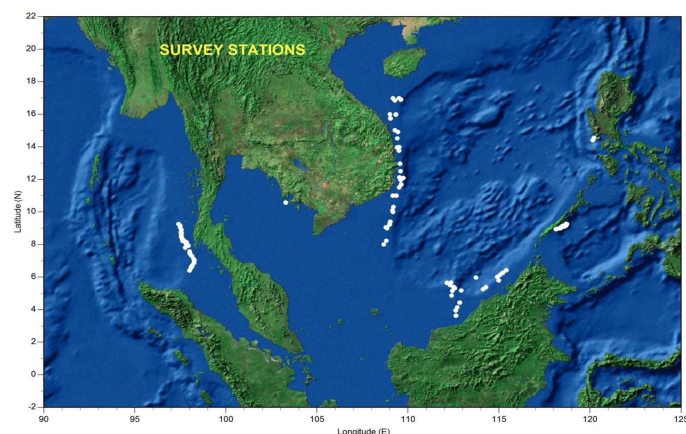


Figure 1. Bottom Vertical Longline fishing stations as survey areas in 2004-2007

The Bottom Vertical Longline

The bottom vertical longline gear was used to study the distribution and abundance of demersal fish species in the untrawlable areas of the Southeast Asian region. The fishing depths were between 38-300 m, and the fishing operation started in the early morning with 2-4 hours immersion time. The number of hooks used varied from 380 to 960 depending on the fishing ground. Squid was used as bait for the fishing operations using the bottom vertical longline gear (Figure 2).

CPUE and Average Catch

The highest CPUE per 1000 hooks in the fishing stations was 384.72 ind/1000 hooks in the Andaman Sea and the lowest was 1.19 ind/1000 hooks in the West Coast of Borneo in the Waters of Brunei Darussalam, and Sabah and Sarawak. The average CPUE in each survey areas and the average composition of the main catch, i.e. Serranidae, Lujanidae, Nemipteridae, other economic-value fishes, sharks and rays, and trash fishes are shown in Figure 3. The average catch in the Andaman Sea was the highest at 83.25 ind/haul/1000 hooks. However, 50% of the catch was considered discard species such as sharks and rays, and trash fish.

Distribution and Abundance

The data also showed that 19 species and one unidentified species of Serranidae were distributed in the survey areas. Areolate grouper, *Ephinephelus areolatus* was also distributed in all areas surveyed as well as 13 species and two unidentified species of Lutjanidae. Tang's snapper, *Lipochilus carnolabrum* was found in the Andaman Sea and East Coast of Vietnam only while goldbanded jobfish, *Pristipomoides multidens* was found in all areas. Five

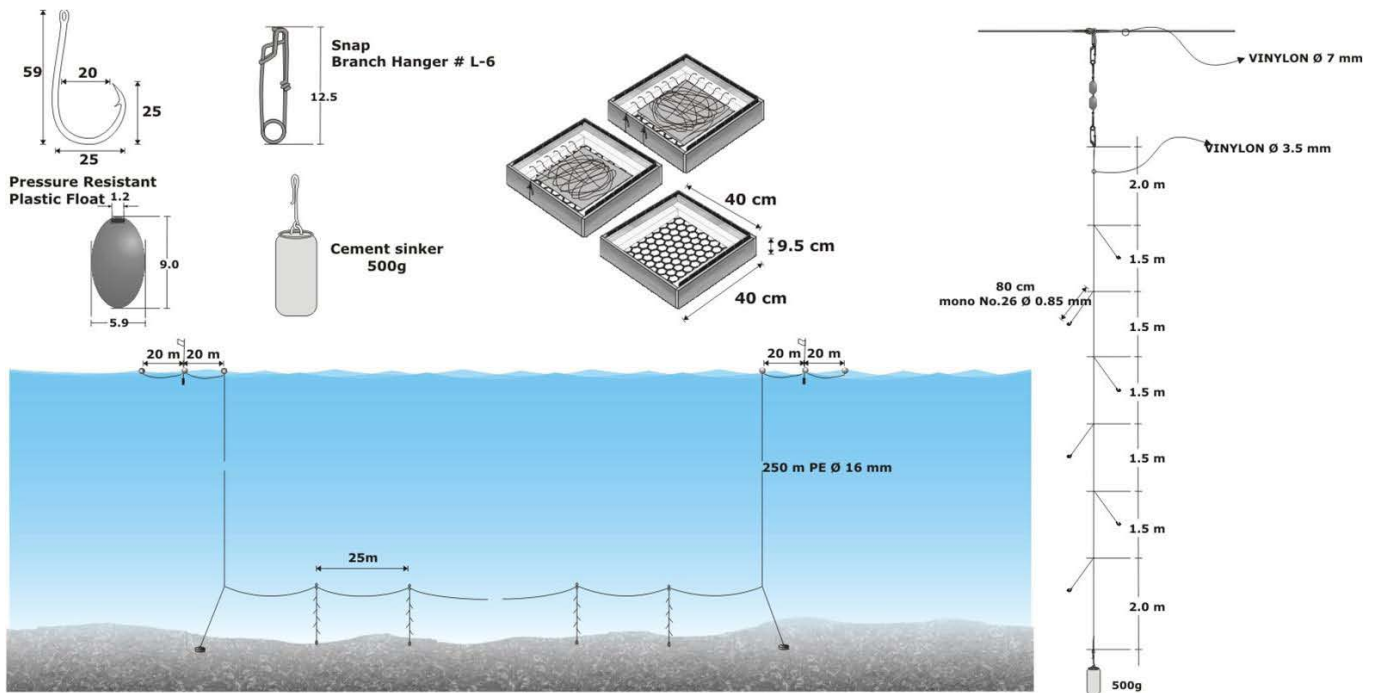


Figure 2. Bottom Vertical Longline used in the demersal fishery resources surveys

families of sharks were also caught using the bottom vertical longline, where dogfish shark (Family Squalidae) was dominant in all areas surveyed. The economic fishes caught from bottom vertical longline from each survey area, categorized by family, are shown in **Table 1**.

The data further indicated that the dominant family was different in each area. The cichlid fish (Family Cichlidae) for example was the highest family in the Andaman Sea (60.91%), the Emperor fish (Family Lethrinidae) in the West Coast of Borneo, and West Coast of Luzon and Sulu Sea (56.69% and 69.13%, respectively), and the lizard fishes (Family Synodontidae) in the East Coast of Vietnam (41.92%).

Non-target species were also caught by the bottom vertical longline from the survey areas, where the prominent group also differ in each area (**Table 2**). Gurnards, sea robins (Family Triglididae) was the highest in the Andaman Sea (57.14%), shark suckers (Family Echeneidae) in the West Coast of Borneo (77.57%), morays (Family Muraenidae) and threetooth puffer (Family Triodontidae) in the West Coast of Luzon and Sulu Sea (48% and 40%, respectively), and puffer (Family Tetradontidae) in the East Coast of Vietnam (41.09%).

Way Forward

The data from the bottom vertical longline gear surveys showed that high-value demersal fishery resources specifically the groupers and snappers are found in the untrawlable waters of Southeast Asia. There are 20 species of groupers and 15 species of snappers found although only some species such as *Ephinephelus areolatus* are distributed in each area surveyed. The highest CPUE was in the Andaman Sea, followed by West Coast of Borneo and East Coast of Vietnam. The lowest CPUE was in the West Coast of Luzon and Sulu Sea of the Philippines. However, about 50% of the catch comprised the discards that included sharks and rays as well as other non-target species such as morays and puffers.

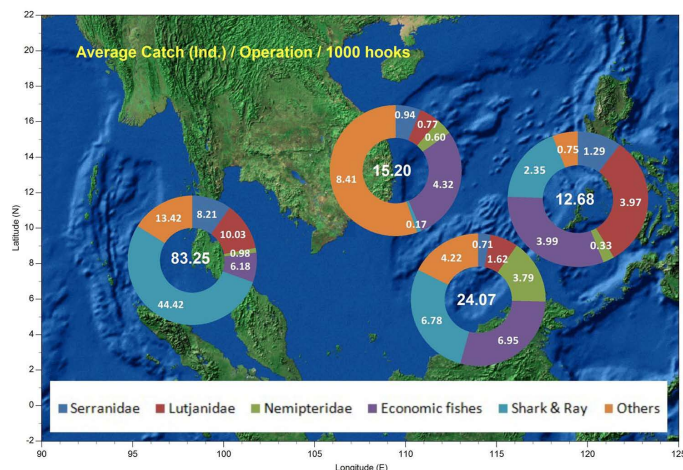


Figure 3. Average catch and group composition caught by Bottom Vertical Longline in each fishing area

Table 1. Individual catch/operation/1000 hooks by family group from Bottom Vertical Longline by survey area

Survey Area	Family	Ind/ operation/ 1000 hooks	%
Andaman Sea	Berycidae	1.38	0.60
	Bothidae	9.44	4.12
	Caesionidae	1.38	0.60
	Cichlidae	139.35	60.91
	Gempylidae	1.85	0.80
	Haemulidae	18.51	8.09
	Halocentridae	4.16	1.82
	Hapalogenyidae	8.33	3.64
	Lethrinidae	1.85	0.80
	Priacanthidae	7.29	3.18
	Sphyraenidae	1.38	0.60
West Coast of Borneo	Acropomatidae	5.20	3.56
	Ariidae	3.57	2.44
	Branchiostegidae	3.24	2.22
	Carangidae	2.38	1.63
	Haemulidae	1.38	0.95
	Halocentridae	7.29	4.99
	Lethrinidae	82.73	56.69
	Sparidae	32.07	21.98
	Scrombridae	1.19	0.81
	Sphyraenidae	1.19	0.81
Synodontidae	5.65	3.87	
West Coast of Luzon and Sulu Sea	Acropomatidae	1.04	2.06
	Carangidae	11.91	23.66
	Lethrinidae	34.82	69.13
	Polymixiidae	1.04	2.06
	Scrombridae	1.54	3.06
East Coast of Vietnam	Acropomatidae	1.08	0.76
	Branchiostegidae	5.87	4.12
	Carangidae	22.22	15.59
	Coryphaenidae	1.38	0.97
	Glaucosomatidae	12.15	8.52
	Halocentridae	8.44	5.93
	Sparidae	18.29	12.84
	Priacanthidae	11.41	8.01
	Terapontidae	1.85	1.29
	Synodontidae	59.72	41.92

The data seemed to indicate that the fishery resources in the untrawlable fishing grounds could be potential resources that could be utilized in deep sea fisheries. However, further study would still be necessary in order to reduce the catch of the discard species.

Table 2. Individual catch/operation/1000 hooks of trash fishes by family group from Bottom Vertical Longline by survey area

Survey Area	Family	Ind/ operation/ 1000 hooks	%
Andaman Sea	Chaetodontidae	1.38	0.28
	Dactylopteridae	1.38	0.28
	Berycidae	24.40	4.93
	Scorpaenidae	25.69	5.19
	Echeneidae	4.62	0.93
	Congridae	1.38	0.28
	Muraenidae	150.38	30.39
	Triglidae	282.75	57.14
	Tetraodontidae	1.38	0.28
	Triodontidae	1.38	0.28
West Coast of Borneo	Monacanthidae	1.38	1.49
	Scaridae	1.38	1.49
	Labridae	1.22	1.31
	Scorpaenidae	1.22	1.31
	Echeneidae	71.93	77.57
	Ophichthidae	1.19	1.28
	Muraenidae	1.04	1.12
	Ostraciidae	1.38	1.49
	Tetraodontidae	2.61	2.81
	Diodontidae	4.09	4.41
Triodontidae	5.24	5.66	
West Coast of Luzon and Sulu Sea	Labridae	1.04	12
	Muraenidae	4.16	48
	Triodontidae	3.47	40
East Coast of Vietnam	Dactylopteridae	1.85	0.64
	Berycidae	8.18	2.87
	Echeneidae	2.77	0.97
	Ophichthidae	6.82	2.39
	Congridae	38.88	13.63
	Muraenidae	103.51	36.29
	Ostraciidae	2.22	0.77
	Tetraodontidae	117.19	41.09
	Triodontidae	3.70	1.29

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Partnership for Higher Fisheries Education in Southeast Asia: Challenges, Directions and Opportunities

Pouchamarn Wongsanga and Suriyan Vichitlekarn

Southeast Asia encompasses a large expanse of rich and productive aquatic resources in inland as well as marine waters. The contribution of fisheries to the Southeast Asian region is well recognized as it provides a source of fish protein, employment and income opportunities, and generates trade that benefits the economies of the countries. Majority of fisheries in Southeast Asia is small-scale, operated in coastal areas and typically multi-species with most fishers relying on the harvest of different species for their livelihood but rarely on one particular target species. With the demand for fish increasing overtime, projections on fish supply indicated that such demand could not be met in spite of the aquaculture sub-sector producing more, because capture fish landings are declining.

Moreover, fisheries in Southeast Asia are generally conducted in an open-access regime resulting in excessive fishing capacity and overexploitation of the limited fisheries resources. Fishers have no other way out but to resort to using destructive fishing gear and practices creating conflicts of various users' interests. Coupled by the fact that there is lack of appropriate regulatory systems for fisheries, the situation provides impacts on the aggravation of poverty for the small-scale fisheries both in inland and inshore waters.

Initiatives towards Sustainable Development of Fisheries

Collective efforts have been exerted globally towards achieving the goals of sustainable development through the improvement of fisheries practices, management approaches and measures, governance, etc. The various instruments (**Box 1**) reflect the global concerns toward sustainable development goals through improved management practices.

The implementation of these instruments calls for greater attention by policy makers and managers to take progressive actions to ensure responsible and sustainable fisheries. However, it also poses logistical, administrative and legislative burdens for many countries particularly the developing countries, which are now experiencing

“implementation overload” due to lack of enabling resources and capacity.

Nonetheless, countries in Southeast Asia have over the years promoted regional cooperation to ensure sustainable development of fisheries. Specifically, under the framework of the ASEAN-SEAFDEC Fisheries Consultative Group (FCG), the regionalization of the global Code of Conduct for Responsible Fisheries (CCRF) exemplifies a very successful regional collective effort.

The Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region (2001) and the Strategic Plan of Action for ASEAN Cooperation in Food, Agriculture and Fisheries (2006-2010) are also examples of regional frameworks and initiatives developed by the countries in the region to ensure sustainable fisheries. Countries in the region have also been working on and committed to deepening and broadening its internal economic integration and linkages to realize the “ASEAN Economic Community by 2010” which is the end-goal of the ASEAN economic integration.

Fisheries have been identified as one of the Priority Sectors that would accelerate the region's economic integration by 2010. Roadmaps have been developed to ensure that the various measures are effectively and timely implemented to create an integrated production base and market for each sector. Fish trade within the ASEAN will be unified to promote more efficient distribution of fishery products among the countries. This is expected to create a niche for the ASEAN fishery products in the world market and increase competitiveness and potential foreign earnings. The unified market and production base will also afford the ASEAN fishers and fish farmers more leverage when trading with extra-ASEAN partners.

In order to work towards sustainable development in fisheries, it is necessary to critically understand the gaps of and the need for capacity development considering both human and institutional aspects. It is crucial that individuals and institutions involved in the fisheries sector should be able to translate policies and initiatives into actions considering the region's unique situation.

Box 1. Important Instruments Promoting Sustainable Development of Fisheries

- United Nations Convention on the Law of the Sea (UNCLOS, 1982)
- United Nations Conference on Environment and Development (UNCED, 1992)
- Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (FAO Compliance Agreement, 1993)
- FAO Code of Conduct for Responsible Fisheries (CCRF, 1995)
- Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN Fish Stocks Agreement, 1995)
- FAO International Plans of Action (IPOAs) for implementing various aspects of the CCRF, including national plans for (i) Management of Fishing Capacity (1999), (ii) Reducing Incidental Catch of Seabirds in Longline Fisheries (1999), (iii) Conservation and Management of Sharks (1999); and (iv) Prevent, Deter and Eliminate Illegal, Unreported and Unregulated (IUU) Fishing (2001)
- Reykjavik Declaration on Responsible Fisheries in Marine Ecosystems (2001)

Human Capacity Development in Fisheries

Human capacity development in fisheries has been increasingly recognized with high priority in order to achieve the objectives of sustainable development and the regional economic integration of the fisheries sector. The advancement of knowledge in improving management approaches and practices as well as the inclusive management processes considering the changes in the international development context would require high levels of human and institutional capacity.

Under the globalization, the region has been confronted with challenges threatening the sustainable development of fisheries resulting from irresponsible utilization of resources, ineffective fisheries management regime and measures, increases in trans-national and trans-sectoral issues, stiffer competitiveness of fish and fishery products in the world market as well as the more complex and dynamic international environment. In order to meet the challenges of globalization, it is necessary to set forth innovations and partnerships for human capacity development of fisheries personnel, particularly in higher education to enable the sector to continue maintaining its functions in the social, economic and eco-system dimensions.

Considering that the required levels of human and institutional capacities in the region vary considerably from one country to another, countries should tap the capacity building programs developed by various organizations in order to assist them in developing their national capacities

and address the difference gaps. Recognizing human capacity as a high priority for meeting the targets set by the World Summit on Sustainable Development, the FAO Advisory Committee on Fisheries Research (ACFR) has made changes on previous models in delivering such needs (i.e. formal training provided by experts from developed countries to developing countries) in order to accommodate the latest approaches on fisheries management. The approach is based on a more mutual learning process so that information and knowledge could be shared more efficiently and effectively by all concerned, and that capacity development should also be developed for management considering the needs of all stakeholders. Since the rather centralized and top-down approach has ignored or at least underestimated the importance of local knowledge, institutions and social capital in the process of economic and social development, the ACFR promotes the more recent trend towards merging the top-down and bottom-up approaches through co-management and other similar initiatives.

The countries in Southeast Asia through SEAFDEC have embarked on regional collaborative programs with the view to implement the Resolution and Plan of Action for Sustainable Fisheries for Food Security for the ASEAN Region. However, in the course of the programs implementation, it has become clear that the countries in the region should be supported through the enhancement and improvement of their technical capability. The existing differences in fishery related technology and human capacity development among the countries at various levels prevented such implementation from conforming with their national policies consonant with the Resolution and Plan of Action as well as the expected benefits from the implementation of the regional collaborative programs.

Human resources development in fisheries: A regional call

Recognizing that national human resource development programs in many countries have expanded, developed and become accessible in accordance with their general economic development, regional human resource development activities including training and higher education have also been evolved and modified considering the changes in the development of the fisheries sector. Under such circumstances, it has become necessary and timely to re-evaluate the impact of human resource development programs at both national and regional levels.

In an effort to address the above concern, the ASEAN-SEAFDEC Regional Workshop on Human Resources Development in Fisheries conducted in February 2004, reviewed the human resource development programs

conducted at regional level, demarcated national responsibility for similar programs, and identified areas of regional priority in human resource development as well as the strategies for mobilizing technical cooperation in human resource development among the ASEAN and SEAFDEC Member Countries.

Strategy for Human Resource Development in Fisheries in the ASEAN Region

“The Strategy for Human Resource Development in Fisheries in the ASEAN Region” (**Box 2**), adopted as the outcome of the 2004 Regional Workshop covers a wide range of HRD activities with particular emphasis on education, skills/competency training and research-based human capacity building. The Workshop also encouraged that government officials who are directly or indirectly implementing programs under the framework

of the Resolution and Plan of Action should be the target beneficiary of the “Strategy”, which highlights on the need to mobilize national capacity and resources for the promotion of HRD in fisheries as a primary a national concern.

As a follow-up action, discussion and clarification among countries in Southeast Asia have been conducted through a series of consultations on the need for human resources development in support of the implementation of the CCRF, particularly on areas related to fisheries management. During the consultations, the need to package policy and technical advices to raise awareness for policy makers/high level officials in HRD and particularly improving fisheries management was recognized. Suggestions were also made to promote community organizations and empowerment toward improved livelihood and capacity building, establish model areas and networking to support

Box 2. Strategy for Human Resource Development in Fisheries in the ASEAN Region

The “Strategy” is based on the following principle:

Promotion of human resource development (HRD) in fisheries is primarily a national concern, and national capacity and resources should be mobilized to maximize impact

Where there is insufficient capacity and/or resources available at the national level, support from bilateral and regional, and/or external sources should be sought

Regional HRD activities should be conducted considering the common needs to maximize the use of resources and benefits of the ASEAN member countries

Recommendations to ensure long-term support to HRD in fisheries in the ASEAN region:

- Regional collaboration should be strengthened to improve HRD activities at the national level
- Scope of HRD requirements including objectives, target groups/areas and levels to be identified in accordance with the Resolution and Plan of Action
- The development of HRD programs should not only be on technical issues but also integrating the social, environmental, legal, and other related issues as identified in the Resolution and Plan of Action
- The ASEAN member countries should conduct awareness building activities to obtain cooperation/compliance of private sector on the issues, including national requirements for sustainable fisheries
- The ASEAN member countries may conduct HRD activities to introduce new technologies to private sector, through consultation/collaboration with the target beneficiaries
- HRD activities directed towards competency/skill-based training relevant to the current fisheries situation and demands of industry can be promoted where resources and mechanisms are available
- Each ASEAN-SEAFDEC member country should conduct an inventory of programs for HRD in fisheries that contain essential and usable information from fisheries-related agencies and HRD programs operated by relevant institutions including the academe, and based on the result of the inventory, a regional database can be established and regularly updated to provide a basis for networking in HRD in fisheries
- The ASEAN-SEAFDEC member countries and international/regional organizations should use the inventory and networking to identify gaps, avoid duplication of effort and ensure complementarity of HRD activities
- Partnership and regional cooperation, including south-south cooperation, exchange of expertise at national and regional levels, international/regional organizations, among external funding agencies, government authorities and the academe should be developed by fully mobilizing the inventory and networking.
- Cost-sharing mechanisms (either cost-recovery or cost-sharing) should be encouraged to enhance the ownership and effectiveness of HRD programs in the ASEAN member Countries
- Regular monitoring and assessment of regional HRD activities should be conducted as part of the implementation of programs under the FCG mechanism

Follow-up actions to promote the implementation of the Strategy:

- ASEAN and SEAFDEC will jointly submit the “Strategy” to their higher authorities through the existing Fisheries Consultative Group (FCG) mechanism for their consideration and endorsement. In line with the existing ASEAN-SEAFDEC collaborative mechanism, SEAFDEC will be assigned as the coordinator for the implementation of the “Strategy”.
- Using the “Strategy” as the basis, and in collaboration with the ASEAN-SEAFDEC member countries and other fisheries-related institutions, SEAFDEC will formulate regional program(s) to promote HRD in fisheries. This can be an integral part of the second phase of the Special 5-year Program on Contribution of Sustainable Fisheries for Food Security for the ASEAN Region.
- SEAFDEC in collaboration with the ASEAN-SEAFDEC member countries will develop a standard format for the inventory.

capacity building, identify ways to sustain initiatives that go beyond projects' period, mainstream practices and enabling environment, and establish a regional network for HRD in fisheries.

Directions in Human Capacity Development for Fisheries

Human capacity development is defined as “*the process by which individuals, groups, organizations, institutions, and societies develop their abilities – both individually and collectively – to set and achieve objectives, perform functions, solve problems and to develop the means and conditions required to enable this process*”.

The ability of the world's fisheries resources to generate nutritional, social and economic benefits is firmly rooted in its collective 'capacity' to manage and regulate their use. This capacity was traditionally based on inter-generational knowledge of fishers and their forebears, but with rapidly increasing populations and the rising efficiency of fishing methods, many fisheries have become increasingly dependent on the ability of the research community, resource managers and policy makers to make decisions on their behalf. Much of the efforts in capacity development for resource management have therefore been directed over recent times (Jodice, Laura W., et. al., 2001). Since a significant shift in global thinking has influenced the ways in which fisheries and their underlying ecosystems are utilized and managed, and the role in which development partners interact in this process, various international and regional initiatives came up with the recommended directions for HRD in fisheries (**Box 3**).

Capacity development is also a process, whereby individual development becomes embedded in a sustainable shift in performance contributing to collective behaviour. In this recent period of rapid change, a review of past successes and failures of human capacity development in fisheries becomes necessary in order to identify the emerging needs and opportunities for improving the stewardship of the fisheries resources. Considering that past approaches to capacity development (both in fisheries and other sectors) focused primarily on technical support to individuals through skill-based training and institutional strengthening, more attention should also be given to non-sector specific knowledge and skills such as business management, socio-economics and good governance.

The FAO Strategic Framework for Human Capacity Development in Fisheries (FAO/ACFR 2004) was designed to cover capture fisheries and aquaculture in inland and marine waters, including industrial, artisanal, subsistence and recreational fisheries. As suggested under the FAO

Box 3. Recommended Directions for HRD in Fisheries

- Putting more emphasis on sustainability and the environment, as reflected in the targets set by the World Summit on Sustainable Development
- Pushing public management towards decentralization, strengthening relationships between government and civil society, privatization and deregulation
- Increasing emphasis on good governance - e.g. participation, accountability, transparency
- Wider recognition of the need for donor initiatives to be both cost-effective and demand-driven, with more emphasis on partnership
- Taking advantage of the information and communications revolution, with the internet transforming the way people and organisations can communicate and learn
- Increasing creativity and innovation from developing countries
- Promoting greater awareness of the need for a more integrated, holistic approach to development, rather than the historical emphasis on sectoral approaches

Strategic Framework (**Box 4**), capacity initiatives should take a holistic view of the overall context which can be equally applied to individuals, organizations, discrete and networked sectors as well as the wider enabling environment that represents the societal context in which development processes take place.

Partnership in Human Capacity Development for Fisheries in Southeast Asia: Challenges and Opportunities

There is a wide range of delivery mechanisms that can be used for capacity development, which can be categorized into face-to-face and remote mechanisms. Face-to-face mechanisms include: classroom-based training, seminars, conferences and workshops, research and exchange programs, demonstration trials, on-the-job training; while remote mechanisms include budget/program support, publications, manuals/training materials, radio and television, mentoring, distance-based training/learning, and mechanisms based on information and communication technology (ICT). Such mechanisms can be used in the fisheries sector, with increasing emphasis on remote, internet-based approaches. However, traditional mechanisms could remain vital although the way these are structured and delivered requires some changes, especially with regards to more active participation of the beneficiaries. It has also been increasingly recognized that a mixed use of the mechanisms may be appropriate, and that the mechanisms may have to be delivered through partnerships of service providers. Capacity development initiatives must therefore be participatory in design, implementation and monitoring, and must build on core-capacities through a two-way process of knowledge transfer. The key challenges and opportunities for more

effective human capacity development in fisheries are outlined in **Box 5**.

Way Forward

It is inevitable that capacity development in fisheries in both human and institutional aspects will continue to form an important integral part of development cooperation. Development of fisheries today has become more complex, considering the various emerging issues such as resource utilization, management, governance, market and trade, economic development and partnership, etc. Several issues encountered by the sector can no longer be addressed through a sectoral approach. Partnership and cooperation at all levels need to be reoriented recognizing this nature. SEAFDEC fully recognizes the fisheries situation in the region and the linkages between development and management of fisheries on one hand, and human capacity development on the other. Recognizing also that development and management, and human capacity development are processes that need to be converged, SEAFDEC will pursue the development and management of fisheries in partnership with other international/regional organizations, the academes, etc. and that partnership in human capacity development would also be enhanced. With regards to higher education, SEAFDEC believes in the complementarity between the academic broad-based knowledge, and hands-on and practical experience in the empirical situation. Guided by the above directions, concepts and opportunities, existing projects/programs could be venues for incorporating human capacity development aspects that could be explored further through partnership in a case-to-case basis.

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Box 4. FAO Strategic Framework for Human Capacity Development in Fisheries

Strategy 1: Capacity development focused at the appropriate level

Focus should be towards four levels: (i) individuals, (ii) institutions and organisations, (iii) sector-wide and (iv) at the enabling environment.

Strategy 2: Capacity development built upon, and widening the knowledge and skills of all stakeholders

Three groups of fisheries-related capacity needs should be addressed, i.e. (i) fisheries science and research, (ii) fisheries sector management and (iii) societal skills

Strategy 3: Development of regional capacity-development networks

To develop regional networks for addressing common issues and promoting self-reliance

Strategy 4: Identification and recognition of regional centres of excellence

To identify and recognize centres of excellence linked to regional networks for specific scientific and managerial skills and knowledge which could act as potential service providers, where the centres of excellence could be research facilities, academic institutions, private sector businesses or state sector management institutions.

Strategy 5: Establishment of improved cross-sectoral linkages and cooperation

To establish better cross-sectoral linkages, including horizontal links within the fisheries sector, e.g between researchers and policy makers or between fishers and researchers, and also better linkages between sectors to understand and manage the impacts of other sectors on fisheries

Strategy 6: Appropriate delivery mechanisms to suit local circumstances

To tailor delivery mechanisms through a participatory process to ensure they meet the particular needs, capabilities and funding of the recipients, with appropriate matching to service providers

Strategy 7: Sustainability of capacity-development initiatives

To establish long-term capacity-development initiatives where (i) individuals are encouraged, and able, to reinvest their new knowledge and skills in the fisheries sector and (ii) the capacity of institutions is strengthened to adapt to change

Strategy 8: Application of results-based management to capacity-development approaches

Improve the understanding of capacity-development 'success' and its measurability, to ensure that initiatives build upon prior experience and lessons learned.

Box 5. Key Challenges and Opportunities for More Effective Human Capacity Development

Human Capacity Development Objectives

- Capacity development approaches must take greater cognizance of the overall societal/political context in which initiatives operate
- Enhance coordination and cooperation between international institutions, national governments and local stakeholders to define and agree on capacity building objectives, ensure complementarity and avoid duplication
- Place greater emphasis on institution building at the national and regional levels
- Design programs that can support a process of continuous in-country capacity building that extends beyond the timeframe of the service provider's activities - i.e., build "sustainability" into the capacity building effort
- Clearly differentiate short, medium and long-term activities of capacity building programs
- Assist countries, particularly least developed countries, determine their capacity building needs and design activities and programs to meet their needs
- Build national networks of experts and institutions at different levels and in different sectors needed for policy development and implementation.
- Strengthen south-south cooperation, directly between national institutions, and by engaging relevant regional and sub-regional institutions
- Promote south-south cooperation in capacity building to build on ongoing south-south efforts that are already underway
- Ensure that research institutions are beneficiaries of capacity building, given that individuals often stay longer in posts in these institutions than in governments

Human Capacity Development Process

- Capacity building initiatives must provide for flexible and suitable learning pathways
- There is need for much better integration of initiatives based on regional/geographical, intra-sectoral, inter-sectoral, and vertical linkages
- Appropriate incentives must be built into capacity development initiatives
- When needed, assist developing countries prepare requests for assistance and project proposals
- Ensure programs are implemented based on accurate needs assessments
- Ensure that capacity building programs are flexible and adaptable, in order to meet evolving needs
- Develop active partnerships between service providers and beneficiaries to ensure that national needs and priorities are met by activities which also reflect national conditions
- Involve national experts and institutions, including from local communities, in the development, implementation, follow-up and evaluation of capacity building activities
- Place more emphasis on including civil society in capacity building activities
- Ensure all activities are based on a participatory process benefiting from multi-stakeholder ownership of national policy analysis, design and implementation
- Adopt a participatory approach in capacity building to promote good governance that is supportive of sustainable development
- Arrange back-to-back meetings at both regional and international levels to ensure a cost-effective method to enhance broad participation and promote policy integration
- Complement training and seminars with intensive and participatory, country-based, learning-by doing activities

Human Capacity Development Activities

- Develop more activities which assist countries with the complete policy cycle, including policy analysis, design and implementation
- Further develop activities to assist countries to comply with international obligations under multilateral trade and environment agreements
- Increase public awareness and understanding of environment, trade and development issues through educational programs
- Develop a global database on capacity building programs and activities being implemented in countries and regions to assist providers and beneficiaries in ensuring efficient provision of, and participation in, various activities
- Consider the effects of trade liberalization on monitoring and enforcement of MEAs
- Include a policy implementation phase in capacity building activities whenever possible
- Support additional research and case studies to clarify the relationship between poverty, development, management, trade and environment
- Those delivering capacity development may themselves require capacity development for effective delivery

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Pelagic Fisheries Management for Sustainable Development: Myanmar Initiative

Tun Than and Khin Ko Lay

This article was based on the paper presented during the Demonstration and Core Expert Meeting on Tagging Program for Economically Important Pelagic Species in the South China Sea and Andaman Sea convened by SEAFDEC TD and MFRDMD in Samut Sakhon, Thailand, 1-3 May 2007.

Myanmar has a land area of 676,577 km² with population of about 56 million as of 2007 (estimated). It is bordered by five countries: China on the northeast, India on the northwest, Lao PDR on the east, Bangladesh on the west, and Thailand on the southeast. It has a coastline of 2832 km with its coastal areas in Rakhine State along the Bay of Bengal, and in Ayeyarwaddy and Tanintharyi Divisions along the Andaman Sea. Such long coastline stretches along the coastal areas forming almost 228,781 km² of continental shelf where the water is so fertile and enriched with nutrients and planktons. The country's major economic sectors are agriculture, forestry and fisheries, and in 2007, the fish per capita consumption was reported to be 41.0 kg/year. The country's fish workers was reported to be over 2 million (2007, estimated).

The mission of the country's fishery sector is to promote all around development in order to increase fish production for domestic and foreign markets by responsible expansion of marine fisheries and aquaculture in order to upgrade the socio-economic status of the fishing communities. In carrying out this mission, the Department of Fisheries of Myanmar aims to: produce fish on sustainable basis; uplift the role of fisheries sector and fishing communities; produce sufficient amount of food for local consumption as well as for foreign markets; invite more investments, local and regional; avoid over-exploitation and destruction of fish stocks; develop sustainable aquaculture; safeguard

fishery resources and protect fish habitats; and develop technology on value-added fish products.

Myanmar is exerting efforts to manage and conserve its pelagic fish stocks in order to avert possible over-exploitation of the fishery resources. The country is specifically endowed with abundant pelagic and demersal fish resources. In terms of biomass, it has been estimated that there is close to 1.0 million mt of pelagic fishes and about 0.75 million mt of demersal fishes while the total annual maximum sustainable yield (MSY) is about 1.04 million mt (**Table 1**).

Myanmar's fishing grounds for pelagic fishes are generally the muddy-sandy bottom that is associated with rich plankton biomass. The coastal small pelagic fishes inhabit the nutrient-rich inshore neritic waters while the large pelagic fishes inhabit the offshore oceanic waters. The shallow-water fishing grounds are highly productive and account for the country's total pelagic fish catch. The small pelagic resources are exploited mostly by shallow-water purse seines, surface and mid-water gillnets, lift nets, and other surrounding nets while other pelagic fishes are caught by trawls, drift nets, long line, etc. In 2006-2007 there were about 1849 fishing gears exploiting the pelagic fishery resources of Myanmar (**Table 2**).

The major fish species that comprise the country's economically important pelagic fishery resources are

Table 1. Total fish biomass and MSY in Myanmar's marine waters (million mt)

Area	Biomass			MSY		
	Demersal	Pelagic	Total	Demersal	Pelagic	Total
Rakhine	0.194	0.175	0.369	0.160	0.087	0.248
Delta (Yangon, Ayeyarwaddy, Mon)	0.334	0.505	0.840	0.220	0.253	0.473
Tanintharyi	0.256	0.295	0.551	0.170	0.147	0.317
TOTAL	0.784	0.975	1.760	0.550	0.487	1.038

Table 2. Types and number of fishing gears used in pelagic fisheries of Myanmar (2006-2007)

State/Division	Trawl	Purse seine	Drift net	Long line	Stick-held falling net	Trap	Total
DOF Head Office	385	68	131	-	1	80	665
Rakhine	2	-	-	-	-	6	8
Tanintharyi	325	54	-	-	22	75	476
Ayeyarwady	-	-	526	2	-	-	528
Mon	-	-	172	-	-	-	172
Total	712	122	829	2	23	161	1849

the mackerels, sardines, round scads, big-eye scad, and carangids. Mackerels (*Rastrelliger kanagurta*, *Rastrelliger brachysoma*) are caught mainly by purse seines, encircling gill nets and occasionally by bottom trawls. Their fishing grounds extend widely from the inshore waters to the offshore waters of Myanmar's coastal areas.

The sardines found in Myanmar waters belong to the *Sardinella* spp., *Amblygaster* spp., *Dussumiera* spp., and *Herklotsichthys* spp. Among the most common are the goldstriped sardines (*Sardinella gibbosa*), fringescale sardines (*Sardinella fimbriata*) and spotted sardines (*Amblygaster* spp.). It should be noted that in the country's fisheries statistics reports, these are all grouped under *Sardinella* spp. Sardines are widely distributed in the country's coastal waters, and are mainly caught by purse seines, encircling gillnets and drift nets.

The most common round scads found in the waters of Myanmar are the *Decapterus marosoma* and *Decapterus marudsi*, which are widely distributed in its offshore waters. Round scads are mainly caught by purse seines. The country's catch of round scads are treated altogether as *Decapterus* spp. in the fisheries statistics reports. The big-eye scad (*Selar crumenophthalmus*) is also abundant and widely distributed in the offshore waters of Myanmar. This fish species is caught together with the round scads by purse seines as well as trawls. Other carangids are also abundant in Myanmar including about 39 species belonging to families Atule, Carangoides, Scombroides, Selar and Selaroides. These species are important in terms of the quantity landed, but are treated altogether as other carangids in the country's fisheries statistics reports due

to difficulties in the field identification of the various species.

Hilsa shad is another important pelagic fish resource in Myanmar, contributing much to the national economy through the small-scale fisheries industry. Hilsa is distributed widely in the entire coasts of the country as well as in inland waters. The fish takes an anadromous migration pattern during spawning through the country's river system, particularly the Ayeyarwaddy river complex.

There are two species of Hilsa in Myanmar. *Tenulosa toli* (Toli shad) is found in Tanintharyi area while *Tenulosa illisha* (Hilsa shad) is common in Ayeyarwaddy and Rakhine areas. Fishing season in the country's delta for the Hilsa shad is from September to March with peak seasons in August and September. While before encircling gillnets were used to catch the fish, during the last decade new fishing technology was introduced using the purse seine resulting in increased catch.

Issues and Constraints

The pelagic fishery resources are economically important to Myanmar. Although not specified separately by fish species, the marine fisheries production of Myanmar in 2004 was 1,091,740 mt (FAO FishStat Pus 2006). The country's total export in 2006-2007 was estimated at 343.43 thousand mt valued at USD 466.16 million (**Figure 1**), although this data comprises the freshwater and marine species. Considering that the country has an estimated 1.75 million mt of pelagic and demersal fish resources available for exploitation, much could still be done to improve the

country's production from its marine fishery resources through sustainable fisheries management.

However, the country lacks the appropriate technology as well as skilled manpower to conduct a complete survey of the pelagic fishery resources in a scientific and systematic way to be able to assess the stock and biology.

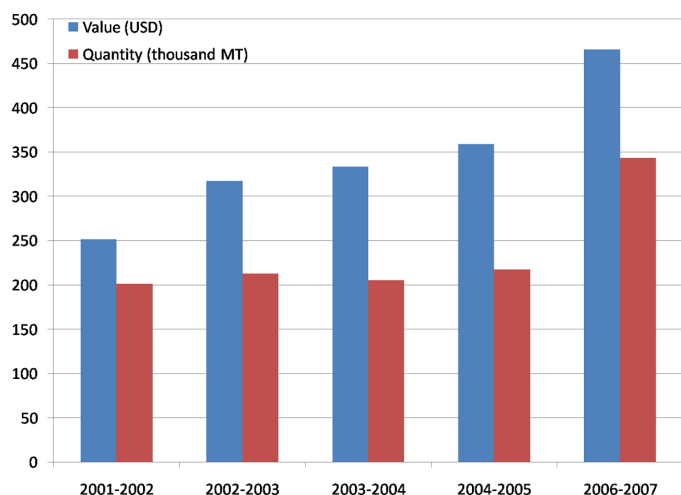


Figure 1. Trend of Myanmar's fish export
(Source: Department of Fisheries of Myanmar)

Way Forward

Meanwhile, in its effort to improve monitoring activities on this economically important fishery resource, Myanmar has committed itself to participate actively in the tagging program conducted by SEAFDEC in order to be able to gain knowledge in tagging small pelagic fishes as a way of knowing the movement and behavior as well as the migration routes of the small pelagic fishes. With information and data on the status and utilization of the country's pelagic fishery resources collected through the tagging activities, the Department of Fisheries of Myanmar would be able to promote the management of its pelagic fisheries while effectively utilizing the resources in a sustainable manner.

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Advancing the Development of GMP and SSOP for Small and Medium-Sized Fish Processing Establishments in the Philippines

Lilia L. Pelayo and Norma C. Borja

The strict implementation of quality assurance systems through GMP and SSOP application by small and medium-sized enterprises (SMEs) engaged in processing of traditional fish and fishery products is a vital component in the production of quality products that are safe for human consumption. In the Philippines, this ideal situation is a rather difficult pursuit for certain SMEs that are generally operating under budgetary constraints. Low-cost facilities are still commonly used such as drums for fish smoking, improvised trays for natural/solar drying, bench top retorts or pressure cookers, earthenware jars or concrete tanks for fermentation. The operations are mainly carried out manually, oftentimes under unfavorable sanitary conditions. This state of operations has to be corrected if competitiveness in international trade is to be achieved.

In the Philippines, the operational definition of "small and medium enterprise" is provided in Section 3 of the Magna Carta for Small Enterprises (Republic Act No. 6977, as amended by Republic Act No. 8289) which classifies them as "any business activity or enterprise engaged in industry, agribusiness and/or services, whether single proprietorship, cooperative partnership or corporation whose total assets, inclusive of those arising from loans, but exclusive of the land on which the particular business entity's office, plant and equipment are situated, must have values falling under categories shown in **Table 1**. In 2003, there were 1124 fish processing establishments in the Philippines, of which 963 were micro establishments (86%), 124 were small enterprises (11%), 25 were medium-sized (2%), and 12 were large enterprises (1%) (**Table 2**). Moreover, there were 67 GMP/SSOP certified establishments which were EU approved but this number decreased to only 33 in 2005 (**Table 3**).

Table 1. Classification of SMEs in the Philippines

Category	Based on Asset Value	Based on Employment Size
Micro	Less than PhP 1,500,001 (USD 32,608), USD 1.00 = PhP 46.00	1-9 employees
Small	PhP 1,500,001 to PhP 15,000,000 (USD 32,608-USD 326,086)	10-99 employees
Medium	PhP 15,000,001-PhP 100,000,000 (USD 326,086-USD 2.17 million)	100-199 employees

Table 2. Number of fish processing establishments in the Philippines as of 2003

Category	Based on Employment Size	
	Number	%
Micro	963	86
Small	124	11
Medium	25	2
Large	12	1
Total	1124	100

Source: National Statistics Office, Industry & Trade Department, Statistical Sampling & Operations Division

Table 3. GMP/SSOP Certified/EU Approved Fish Processing Establishments in the Philippines

Year	GMP/SSOP Certified/ EU Approved		Total Number of GMP/SSOP Certified Establishments
	Large	SME	
2000	14	31	45
2001	11	29	40
2002	10	29	39
2003	12	55	67
2004	11	47	58
2005	8	25	33

Source: Bureau of Fisheries & Aquatic Resources, Fish Inspection Unit

Issues and constraints on the development of GMP and SSOP

The decreasing number of certified/approved establishments adopting good manufacturing practices (GMP) and standard sanitation operating procedures (SSOP) as shown in Table 3 indicates the present need for the stricter implementation of food safety assurance program(s) by food manufacturers which are the emerging requirements of the regional and international markets. It is therefore imperative that the implementation of GMP/SSOP, especially by the pre-processing and traditional fish products processing establishments is strictly observed to ensure that the country's supply of processed fish is safe for human consumption and acceptable as export commodities.

Plan of Action

In order to address the issues confronting the country's fishery products, GMP/SSOP programs will be developed for selected small and medium-sized fish processing establishments (SMEs) engaged in the production of pre-processed as well as traditional fish and fishery products. Moreover, assistance will be provided for the implementation of the programs in these SMEs thereby assuring the quality and safety of the fish products produced in the Philippines.

During the selection of the SMEs for the SEAFDEC Program on Quality Assurance Systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries, producers of selected pre-processed and traditional fish and fishery products will be surveyed to assess their existing facilities and the general manufacturing practices employed. These facilities and practices will be evaluated in terms of their implementation of, and compliance to GMP/SSOP requirements. GMP/SSOP program(s) will then be developed for the identified SMEs with non-satisfactory operational conditions and practices. Visits to these SMEs will be conducted to assist them in the implementation of the developed GMP/SSOP programs. Eventually, handouts on GMP/SSOP will be provided for their guidance.

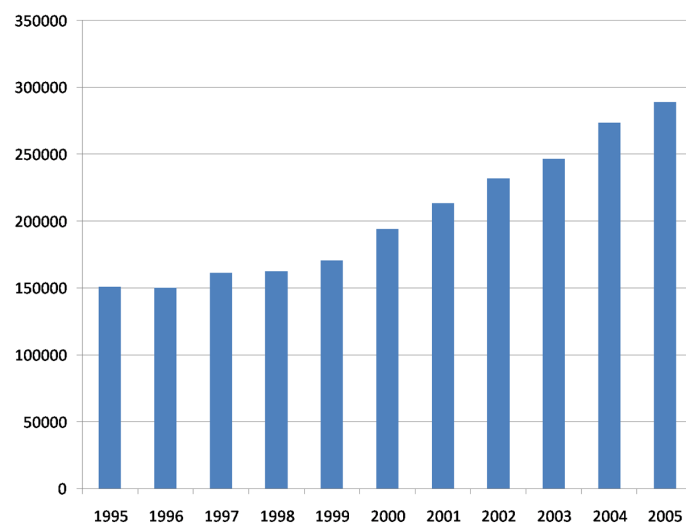
Thus, GMP/SSOP programs will be developed for the participating PPE producing pre-processed, salted shrimp which is the necessary raw material for shrimp paste production. Shrimp paste is popular and is part of almost every Filipino meal. It is also exported by the Philippines although at a limited degree. In 2004, the Philippines' export of shrimp paste was 625 mt valued at USD 1,595,000 (FAO FishStat Plus 2006).

In addition, GMP/SSOP programs for crab meat picking will also be developed, the crab meat being used for the country's crab meat canning industry. FAO FishStat Plus 2006 reported that the Philippines' export of canned crabmeat in 2004 was 1443 mt valued at USD 18,860,000. GMP/SSOP programs of traditional product processing establishments (TPEs) for the production of smoked fish and milkfish fillets (choice-cut belly) will also be developed under the SEAFDEC Program.

In 2004, the Philippines was reported to produce about 10,000 mt of smoked sardines and sprats (FAO FishStat Plus 2006), almost 90% is sold and consumed locally. The process of smoking fish involves arranging the fish in bamboo trays for sun drying after which the fish is cooked. Then the cooked fish is arranged in trays for smoking.

Moreover, milkfish is a very important fish for the Filipinos not only for food but also as an export commodity of the Philippines. In 2004 the Philippines produced 273,593 mt of milkfish (**Figure 1**) of which about 253,000 mt (about 92%) of fresh, chilled or frozen milkfish valued at USD 1,416,000 was exported (FAO FishStat Plus 2006). The Philippines is exporting milkfish in frozen, canned, dried, smoked or marinated forms to more than 30 countries. In the local front, domestic consumption of milkfish is estimated at 1.96 kg/capita/year. One of the most popular product forms from milkfish is the choice-cut belly because of the “melt-in-the-mouth” belly fat. The processing of the fish choice-cut belly is an industry in itself dominated by large-scale industries, e.g. Sarangani Boneless Bangus in Mindanao (south of the Philippines), and Bonuan Boneless Bangus in Dagupan City in northern Philippines.

The processing of the choice-cut milkfish belly involves cleaning, splitting, gutting and eviscerating the fish, then deboning it after which the belly is cut off. The belly parts are packed then quick frozen ready for the market. The trimmings are turned into other product forms such as “sisig”, rellenito, siomai, patties, nuggets, etc.



Source: BFAR

Figure 1. Philippine production of milkfish

Expected Results

Other SMEs engaged in the manufacture of pre-processed and traditional fish/fishery products can also have the opportunity to pursue similar activities to increase the country’s chances at the export market if given the right technical support. The participation therefore of the Philippines in the SEAFDEC Program on Quality Assurance Systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries, which is being funded by the Japanese Trust Fund Program is expected to enhance the development of GMP/SSOP programs for the country’s SMEs in fish processing. Specifically, the following outputs are expected to be achieved:

- Development of the appropriate GMP/SSOP Programs for the selected pre-processed and traditional products, enhanced by the publication of the respective manuals for use as guide in implementation.
- Pilot projects pursued to help fine-tune and improve their manufacturing operations, through monitoring and evaluation of the program implementation to help ensure the safety of the fish products being marketed for human consumption.

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Co-management for Reservoir/Lake Fisheries: Thailand Initiative

Napaporn Sriputinibondh and Siri Ekmaharaj

In Thailand, fish especially freshwater fish is the main source of cheap protein for the people in the countryside. Freshwater fish could come from aquaculture or capture fisheries in reservoirs and lakes. There are many man-made reservoirs and natural lakes in Thailand as well as in the Southeast Asian countries. However, these reservoirs are usually constructed as source of hydro-electricity and irrigation, with fisheries considered only partly for economic purposes.

Thailand has 26 reservoirs and three lakes with a total water volume of around 77,114 million m³. The total fish production from such bodies of waters is about 7,640 mt annually (Sripatprasite, 1966) valued at around USD 5,340,508 (**Table 1**). The Reservoir Fisheries Management Unit of the Department of Fisheries (DOF) of Thailand has implemented activities and monitored the fisheries production in reservoirs. Tookwinas (Ekmaharaj) (1974 and 1975) reported that the local people earned their incomes from catching fish in the reservoirs using simple fishing gear such as dip net, cast net, line and trap. The fish caught are mainly for their own consumption although some are sold to increase their incomes and improve their living conditions. After the application of the concept of co-management and rights-based in reservoir fisheries management, the fishermen have been able to earn additional incomes from reservoir fisheries and their livelihood could now be managed toward sustainability.

The Co-management Process Adopted by Thailand

Co-management using Group User Rights is a formal process of sharing the responsibility and authority between the government and organized groups in a decentralized approach to decision-making that can be replicated (Augustinous, 2002). Without co-management, decision-making could lead to top-down management that involves fewer users in fisheries management, and oftentimes resulting in communication barrier. Since the users have no clear ownership or responsibility to take care of the local fishery resources, they could choose to engage in illegal fishing, which is often the cause of conflict among users and between users and government officials.

Considering the fact that the increasing population and over-exploitation of the fishery resources have accelerated the decline of such resources causing negative impacts on the people's livelihood, co-management could therefore

Table 1. Fish Production from Reservoirs in Thailand (Sripatprasite, 1966)

Name of Reservoir	Volume (million m ³)	Total Catch (Tons)	Total Value (USD)
Reservoirs of the Electricity Generating Authority of Thailand			
Mae Chang Reservoir	108.55	12.37	12,400
Bhumipol Reservoir	13,462.00	22.92	30,000
Sirikit Reservoir	10,640.00	576.10	688,400
Ubol Ratana Reservoir	4,640.43	1,418.89	1,421,200
Chulabhorn Reservoir	188.00	398.51	56,400
Nam Pung Reservoir	165.48	115.22	130,800
Sirindhorn Reservoir	2,082.61	418.30	*365,176
Pak Mun Reservoir	630.00	-	-
Khao Laem Reservoir	11,860.00	460.92	402,400
Srinagarind Reservoir	18,770.00	275.45	219,200
Rajjaprapha Reservoir	5,640.00	236.20	25,085
Bang Lang Reservoir	1,404.00	182.55	200,400
Reservoirs of the Department of Fisheries			
Kwan Phayao Reservoir	11.20	220.50	*242,060
Bung Boraped Reservoir	212.50	162.20	*184,133
Nong Han Reservoir	64.00	103.17	*117,121
Reservoirs of the Royal Irrigation Department			
Mae Ngat Reservoir	325.00	15.30	*15,337
Mae Kuang Reservoir	410.00	-	-
Klew Lorn Reservoir	112.00	115.80	*131,458
Tuep Salao Reservoir	196.00	-	-
Khlong Pho Reservoir	101.00	-	-
Hual Luang Reservoir	113.00	161.34	*183,156
Lam Pao Reservoir	2,640.00	1,669.00	84,481
Nam Un Reservoir	520.00	164.40	15,249
Lam Takong Reservoir	445.00	58.90	*59,043
Lam Phar Ploeng Reservoir	220.00	131.70	*149,508
Lam Nang Rong Reservoir	218.00	-	-
Kra Sieo Reservoir	390.00	425.70	*371,653
Kang Kra Chan Reservoir	895.00	174.69	*198,312
Pran Buri Reservoir	650.00	120.00	37,536
Total	77,113.77	7,640.13	5,340,508

* Estimate Value

be a way out. In co-management, the responsibility, authority and roles of the co-management participants (users, community and government) are provided and/or enhanced. This strategy could therefore strengthen the efficiency of fisheries management.

Who is involved in co-management? **Figure 1** shows the participants in co-management and their roles and responsibilities in the management of the fisheries resources.

In Thailand, Co-management Using Group User Rights for reservoir and lake fisheries had been implemented for about 30-40 years. Tookwinas (Ekmaharaj) (1974) cited that the Reservoir Fisheries Management Unit under the Inland Fisheries Division of the DOF which was established in 1972 has been in charge of conducting technical surveys as well as fisheries enhancement and enforcement activities following the concept of co-management and rights-based fisheries. Such activities have been carried out in cooperation with fishermen groups/associations. The step by step process adopted by the Reservoir Fisheries Management Unit of the Inland Fisheries Division of DOF Thailand is described below:

Technical Services

Conducted as a concerted effort of various units under the DOF, i.e. Technical Unit, Reservoir Fisheries Management Unit, and Inland Fisheries Survey Unit, the implementation of a reservoir and lake fisheries management in newly man-made reservoirs usually starts with a hydro-bio-physicochemical properties survey in order to obtain the basic fisheries and related information. A series of data such as water volume, shore line development, water quality, primary production, benthic fauna, fish standing crop, fish species composition, fish landing statistics, etc., are regularly recorded (Chridchupunsari, 1979). This kind of survey is usually conducted two to three times a year based on the seasons in Thailand, i.e. summer, rainy and winter.

Creel census (counting and interviewing fishers to determine fishing effort and catch) and socio-economic surveys are also conducted by the DOF Units in order to obtain the basic information on fisheries, fishing effort and catch per unit effort (CPUE). As in any co-management and rights-based fisheries program, the information and data collected from such surveys are necessary (Pan-Aram and Apirakmewan, 1986) to ensure success in any fisheries management program.

To enhance the resources, releasing fish fingerlings and freshwater prawn fry into reservoirs/lakes is also promoted, taking into consideration the information on fish species composition obtained from the hydro-bio-physicochemical properties survey. For the purpose of fishery resources management, herbivorous fish species are preferred for restocking the reservoirs/lakes.

Establishment of Fishermen Groups/Associations

The formulation of fishermen groups/associations around the reservoirs/lakes is being encouraged. In order to improve the capability of the fishermen in Fisheries Co-

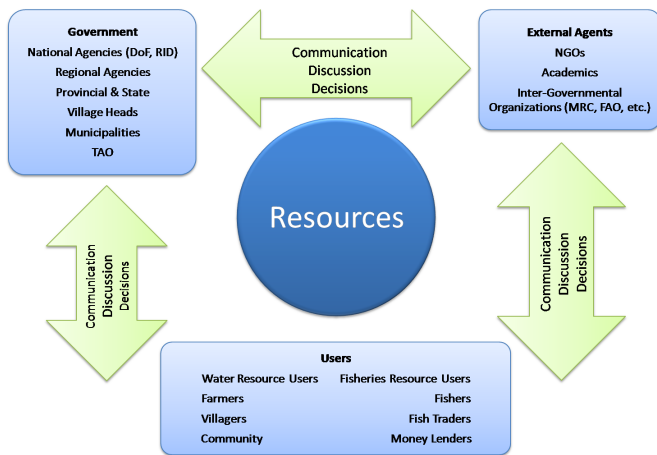


Figure 1. Roles of participants in the Co-management Using Group User Rights Process (After Augustinous, 2002)

management Using Group User Rights, training sessions, workshops and information services are conducted (Jaiyen, 2005 and Chatmalai, 2006) for the groups. After the capacity building sessions, fisheries group/association committees are elected by the fisher members of the respective groups/associations, where the elected

committees work closely with related government offices. A series of meetings for reservoir/lake fisheries are also conducted where regulations are developed by such groups/associations which should be in consonance to the Thai Fisheries Act. In the implementation process, the fisheries group/association committees would carry out the enforcement of the fisheries regulations that they have developed together with concerned government offices.

The regulations for reservoir/lake fisheries that the groups/associations set up could be reviewed from time to time depending on the results of the consultations conducted between the fisher groups/associations with concerned government offices. Based on the experience of Thailand, the efficiency of management for reservoir/lake fisheries depends largely on the efficiency of the fisher group/association committees. Therefore, the process of training the fishermen on co-management and rights-based fisheries has been considered very important for the capacity building of the fisher groups/associations.

Enforcement Process

In connection with the adoption of the concept of co-management, the established fisher groups/associations organize their respective Fisheries Enforcement Unit. This unit also conducts training and information services for their fishermen members to enable them to carry out enforcement activities under the guidance of their respective fisher groups/associations.

Setting-up of Fisheries Refugia

Setting-up of fisheries refugia is also conducted by convening the group committees for planning and



Restocking activities to enhance the resources

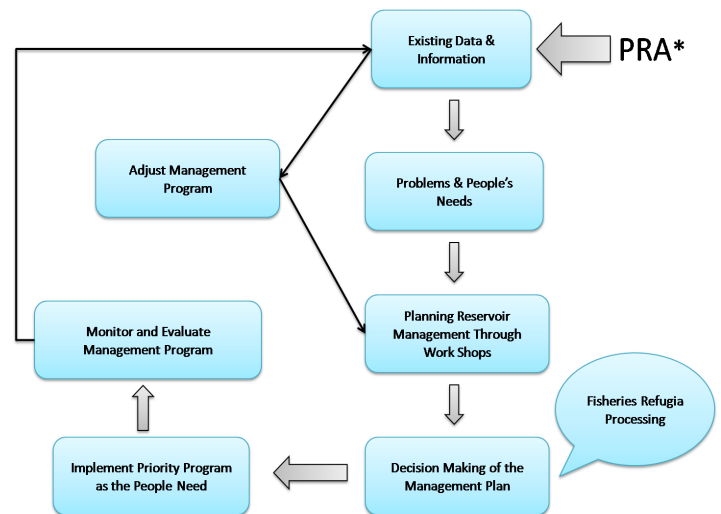


Figure 2. Fisheries Co-management Using Group User Rights (Adapted from MRC Fisheries Programme, 2005)

*PRA = Participatory Rural Appraisal

discussion. The committees select the appropriate areas for the development of the refugias, after which these are restocked with fish. A community regulation is then declared restricting the use of some fishing gears in the refugias. Members of the committees and the villagers work together in monitoring, inspecting and guarding the fisheries refugias. **Figure 2** shows the diagram of the steps in Fisheries Co-Management Using Group User Rights.

Co-management for Reservoir/Lake Fisheries: Experience of Thailand

Co-management concept has been integrated in the fisheries projects that are carried out in reservoirs and rivers in the northeastern part of Thailand. The experiences in major water bodies such as the Huay Luang Reservoir in Udon Thani Province, Nam Oun Reservoir at Sakhon Nakhon Province, the Songkhram River Basin, etc. could be used as models for co-management for reservoir/lake fisheries.

Huay Luang Reservoir

Many activities have been conducted in the Huay Luang Reservoir using the co-management process. Three activities have been implemented to address certain urgent needs of the villagers in the community when they participated in the workshop on data collection mechanism. First is the monitoring of the water quality owing to the water pollution caused by a nearby cassava factory. The villagers around the reservoir have been trained by biologists on water analysis using test kits. Results of such water monitoring activity are presented to the community meetings conducted every month.

The second activity is on nursing of fish fingerlings in cages before stocking them into the reservoir. Since fish fingerlings from hatcheries are normally quite small and

survival rate has been low, the villagers have worked together to nurse the fish fingerlings before stocking and the results have been very encouraging. The third activity involved the setting up of women's group to carry out fish processing and packaging. In order that the women could learn the methods of fish processing and packaging, fisheries extension officers took the women for a study tour to the central part of Thailand to observe the proper methods of fish processing and packaging.

Nam Oun Reservoir

The activities implemented by the stakeholders and government officers (Nam Oun Dam Inland Fishery Patrolling Center) in the Reservoir comprised the Fish Home and Training the Youths on Fish Conservation. The objectives of the Fish Home Project are to: establish a process of community participation in resources management, construct fish habitat and spawning area, and build a recreation area for the community.

The Fish Home Project, which has been conducted since June 2006, comprised as its first step the establishment of a group of committees consisting of a leader of the villagers, teacher, fisheries officer, representative from the women's group and other local organizations (about 10 persons). The next step was the conduct of a meeting to find out the suitable location for establishing the fish home and discuss about the working processes. In the identified fish home area, members of the group worked together to find some materials for developing the fish home area such as branches of trees, old tires, etc. and sank such materials into the water. The group also set the scope of the fish home area and the standard regulations including fishing restrictions.

The objective of the second project on Training the Youths about Fish Conservation is to build awareness among the students from schools around the Nam Oun Reservoir about fish conservation. Officers from the DOF introduced and trained the students about spawning seasons as well as on how to conserve fish and which fishing gears are illegal or legal, etc. At their school libraries, the students are encouraged to work together to improve their knowledge and gain information concerning fisheries, through such materials as posters, fisheries bulletins/gazettes/leaflets, models of fishing gears, etc.

Songkhram River Basin

Some research activities have been conducted in the Songkhram River Basin on how to optimize the use of a destructive fishing gear (barrage) in the river and on



Fish restocking activity at Huay Luang Reservoir involves the young and the old

the need to develop and implement conservation zones. The urgent need to address the problem on the use of barrage in the river was raised by the stakeholders during their meeting held in August 2005 at Nakhon Phnom Province. A research activity was therefore carried out using the co-management process to find out the suitable standard regulation for community utilization of the river basin resources. The research started with a discussion and planning among the researchers and villagers in the community, followed by the site selection and setting up of the committees.

The researchers and committees participated in designing the mesh size of the back net for the barrage as well as in harvesting and length-weight measurement of the fish caught. The water level of the river was recorded everyday. The research result showed that using mesh size of 2 cm, fish would be released to the river at about 16% of the weight of high economic value fishes, and when the water level is only 1 m, fish inside the barrage at 4-12% of the weight would be released back to the river. The results also showed that there were about 103 fish species caught by the barrage. The researchers then presented the results of the study through a public hearing. Upon acceptance by the community, the standard regulation was set up and is now being applied in the community.

Outcomes from the Fisheries Co-management Using Group User Rights Process

The outcomes from the Fisheries Co-management Using Group User Rights Process adopted in reservoir/lake fisheries in Thailand can be concluded briefly as follows:

- Active participation of the community and government in fisheries management
- The efficiency of illegal fishing gears which destroy fish population has been decreased
- The responsibility, authority and role of the community in fisheries management have been enhanced

What is very important is the efficiency of fisheries management have been strengthened and the awareness of the fishers and the communities on fisheries co-management have been enhanced.

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Enhancing Fisheries HRD in Asia through Educational Cooperation in Fisheries Science: A Case of the Hokkaido University, Japan

Nualanong Tongdee and Junichiro Okamoto

Hokkaido University (HU) of Japan is reaching out to many countries in the globe to promote human resource development (HRD) through its programs in education, research and social development. Established in 1876, HU has its main campuses in Sapporo and Hakodate, Hokkaido, Japan. In its effort to promote HRD through internationalization, HU is engaged in four major activities, namely: (1) exchange programs with universities worldwide; (2) campaign for the increase in the number of international students; (3) strengthening of its overseas networks; and (4) promotion of international cooperation. Thus far, HU has established partnership with more than 40 universities in 16 countries worldwide. HU also launched the “Hokkaido University Initiative for Sustainable Development (HUISD)”, laying the foundation for HU’s internationalization policy to be fulfilled in the next five years. Under this project, HU aims to: make the rest of the world aware of its internationally competitive education and research program; promote high affinity with international communities; and contribute to enhancement of international academic communities through international cooperation. HU is now intensifying efforts to expand its present partners especially with institutions and universities in the ASEAN region.

The fisheries schools of HU are located in Hakodate, Hokkaido, Japan, where efforts are being intensified to invite more foreign students to study at HU especially those coming from the ASEAN countries. As part of HU’s effort to promote international cooperation through HRD, its Faculty of Fisheries Science has conducted exchange

programs with universities in South Korea and the USA in the early 2000s. From 1985 to 2007, the Hakodate Campus has entered into exchange agreements with 16 agencies (2 in the USA; 1 each in Malaysia, Canada, Russia, Chile, Australia, Indonesia; 4 in South Korea; 3 in China); as well as with 2 institutions in Thailand: SEAFDEC and the Faculty of Fisheries of Kasetsart University (**Box 1**).

HU Fisheries HRD Program

Specifically for the promotion of fisheries HRD in the Southeast Asian region, SEAFDEC and HU’s Faculty of Fisheries Sciences (FFS) signed a Memorandum of Agreement in February 2006 to endeavor on HRD cooperation in fisheries research, training and other activities of mutual interest. The cooperation covers: joint research and education/training; visit or exchange of researchers and students for study, research, education and training in areas of common concern that are mutually agreed upon; and participation of researchers/students in conferences and meetings on matters of mutual interest.

The provisions of the Agreement’s exchange of researchers between SEAFDEC and HU was initialized in 2006 when an Intern from Hokkaido University attended the short-term training course in Fishing Technology for University Students at the SEAFDEC Training Department in Samut Prakan, Thailand. A meeting between SEAFDEC and HU convened in March 2007 in Bangkok, Thailand initiated the identification of fisheries R&D collaboration specifically focusing on HRD for the ASEAN Member Countries as well as the SEAFDEC Secretariat and Departments.

International Workshop on Educational Cooperation in Fisheries Science in Asia

It was under such arrangement that two senior staff of SEAFDEC attended the International Workshop on Educational Cooperation in Fisheries Science in Asia which was organized by the FFS of Hokkaido University at its Hakodate Campus, Hokkaido, Japan from 17 to 19 March 2008. Attended by resource persons and representatives from universities, research institutes and regional/international organizations in Asia, the Workshop



Box 1: International Exchange Programs at Hakodate Campus of Hokkaido University

Country	University	College/Department	Year
<i>Exchange between Universities</i>			
South Korea	Pukyong National University		2000
USA	University of Hawaii		2003
<i>Joint Research Memoranda based on Inter-University Agreements</i>			
USA	University of Alaska, Fairbanks	School of Fisheries and Ocean Resources	1998
USA	University of Maryland	Center of Marine Biotechnology	1989
Malaysia	University Putra (Pertanian) Malaysia	Department of Oceanography	1990
Canada	University of British Columbia	Faculty of Science	1990
Russia	Research Academy of Science-Far Eastern Branch	Institute of Marine Biology	1992
China	Dalian Fisheries University		2000
South Korea	Cheju National University	College of Ocean Science	2002
South Korea	Gyeongsang National University	College of Marine Science	2003
South Korea	Yosu National University (Chonnam National University)	College of Fisheries and Ocean Sciences	2004 (2007)
China	Shanghai Fisheries University		2005
Australia	Queensland University	Faculty of Health Sciences	2005
South Korea	Kursan National University	College of Ocean Science and Technology	2005
Indonesia	Udayara University		2005
China	Ocean University of China		2005
Thailand	Southeast Asian Fisheries Development Center		2006
Thailand	Kasetsart University	Faculty of Fisheries	2007

generally aimed to share experiences and establish network of cooperation for the improvement of fisheries science education in Asia through the Special Lectures, a Student Session and Four Plenary Sessions (**Box 2**).

Way Forward

As enhanced education and cooperation in fisheries science are necessary for conserving the aquatic environments and sustaining aquatic resources for guaranteeing a safe food supply and developing local/national economies, the Workshop was envisaged to: explore the challenges for national higher education systems in fisheries science in Asia in a global environment; update the status of higher fisheries education in the region; and discuss ways and means to improve the education system, the internationalization of education, the programs to foster young scientists as well as improve international cooperation in fishery science education. It is expected that in the near future, the network on educational exchange in the field of fisheries among the countries participating in the Workshop, would be strengthened through partnership and cooperation in fisheries education. For more information, about the programs of Hokkaido University please refer to <http://www.fish.hokudai.ac.jp/21coe/index.htm>



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Mr. Junichiro Okamoto once served as the Deputy Secretary-General of SEAFDEC based in Bangkok, Thailand from 2002-2005. After SEAFDEC, Mr. Okamoto serves as Professor of the Faculty of Fisheries Science, Hokkaido University, Hakodate, Japan.

Box 2. International Workshop on Educational Cooperation in Fisheries Science in Asia

SPECIAL LECTURE 1: Needs and Possibility of Mutual Accreditation of Academic Degree in Fisheries Sciences among Asian Countries (Prof. Hisashi Kurokura, Graduate School of Agricultural and Life Sciences, University of Tokyo, Japan)

Information on the Japan Accreditation Board for Engineering Education (JABEE) was presented, and being signatory to the Washington Accord, engineers qualified for the standards set by JABEE could practice their professions in Japan or in countries that are also signatories to the Washington Accord. The standardization and accreditation undertaken by JABEE could be used as model for the accreditation of the fisheries professions.

SPECIAL LECTURE 2: International Cooperation in University Education in Japan (Ms. Helga Tabuchi, Ministry of Education, Culture, Sports, Science and Technology, Japan)

Information on higher education in Japan including number of higher education institutions, students, and entry rate to higher education, and information on the International Cooperation of University Education in Japan were presented. Also presented was the University Reforms that includes quality assurance system and third party evaluation system as well as the Center of Excellence (COE) Programs to enhance competitiveness and cooperation with industries.

Plenary Session 1: Present Status of the Higher Education in Fisheries Sciences in Asian Universities

Recent Innovation and Reorganization of Fisheries Education at Hokkaido University (Prof. Katsutoshi Arai, Faculty of Fisheries Sciences, Hokkaido University, Japan)

Higher Education in Fisheries Science of Korea (Dr. Ju-Hee Lee, Pukyong National University, Busan, South Korea)

Present Status of Higher Education in Fisheries Science and Related Areas in Thailand (Dr. Kangwan Juntarashote, Kasetsart University, Bangkok, Thailand)

Today and Tomorrow - Education in Fisheries Science in SFU (Prof. Min Jiang, College of Life Science and Technology, Shanghai Fisheries University (SFU), China)

Plenary Session 2: Recent Progress in International Cooperation in Fishery-Science Education in Asia

International Cooperation for Fisheries Sciences Education in Thailand and Faculty of Fisheries, Kasetsart University (Dr. Suriyan Tunkijanukij, Kasetsart University, Bangkok, Thailand)

Introduction on the National University Regional Innovation (NURI) Program in Korean University (Prof. Chun-Woo Lee, Pukyong National University, Busan, South Korea)

Brain Korea 21 (BK21) and NURI Programs in College of Ocean Sciences (COS) in Cheju National University (Dr. Byung-Gul Lee, Cheju National University, Jeju, South Korea)

International Exchange Program and Cooperative Relationship in Fisheries Science Education in Ocean University of China (Dr. Xiumei Zhang, Ocean University of China, Qingdao, China)

Plenary Session 3: Obstacles in International Educational Cooperation in Fisheries Sciences in Asia

The Language of Science (Dr. John Bower, Hokkaido University, Hakodate, Japan)

Construction of New College English Teaching Mode in Strengthening Listening and Speaking Abilities Based on Multi-media (Prof. Yanling Guo, Dalian Fisheries University, Dalian, China)

Support and Statistics for Organizations of Women in Science and Technology in Korea (Dr. Deuk-Hee Jin, Kangnung National University, Kangnung, South Korea)

Fostering Program for Young Scientists and Female Scientists: Attempting Gender Equality in Science and Academia (Dr. Sanae Ariga, Graduate School of Agriculture/Life Science, Hokkaido University, Sapporo, Japan)

Plenary Session 4: International Cooperation for Fostering

Current Research Progress on Marine Bioscience at the Eco Marine Bio Research Center (EMBC) (Prof. Myung-Joo Oh, Chonnam National University, Yosu, South Korea)

The Progress of Post-Graduate Education in Chinese Academy of Fishery Sciences (Prof. Xiao-qin Zhang, Chinese Academy of Fishery Sciences, Beijing, China)

Partnership in Higher Education Innovation for Fisheries in Southeast Asia: Challenges, Directions and Opportunities (Ms. Pouchamarn Wongsanga, Southeast Asian Fisheries Development Center, Bangkok, Thailand)

Student Session

Education and Research at Universiti Kebangsaan Malaysia (Dr. Muzzneena Ahmad Mustapha and Tukimat Lihan, Hokkaido University) Information on the Universiti Kebangsaan Malaysia (UKM) including its efforts to improve its research capability in order to contribute to teaching and enhance the competitiveness of UKM in obtaining research grants from various sources, were presented.

Fisheries Education in the Faculty of Fisheries, Bangladesh Agricultural University, Bangladesh (Mr. Mohammed Matiur Rahman, Hokkaido University)

Information on the fisheries education in the Faculty of Fisheries, Bangladesh Agricultural University including its leading role in the development and management of the fisheries sector of Bangladesh was presented.

Valorization of Palm Kernel Meal via Bioconversion: Indonesia's initiative to address aquafeeds shortage

Saurin Hem, Melta Rini, Chumaidi, Maskur, Ahmad Hadadi, Supriyadi, Ediwarman, Michel Larue and Laurent Pouyaud

This article outlines the initiative of Indonesia to convert “waste to wealth” through the natural process of bioconversion to produce aquafeeds from palm kernel meal for the country's rural aquaculture. This is based on a poster paper presented by the authors during the International Conference on Oil Palm and Environment (ICOPE), 15-16 November 2007, Bali, Indonesia.

Indonesia's demand for aqua feeds, specifically the commercial fish pellets has increased due to the expansion of its rural aquaculture sub-sector. However, the price of aquafeeds or commercial pellets for aquaculture nowadays has become unaffordable to many small-scale fish farmers due to the ever increasing price of fishmeal, which the country imports from Peru, Chile, and other South American countries. The price of fishmeal also continues to soar not only because of its high demand worldwide but also because of the stagnation of fish production from the natural resource. Indonesia spends about USD 200 M per year for the imported fishmeal for its aquaculture industry. If such situation continues, the development of the country's aquaculture will be hampered. Fearing further decline of fish production from aquaculture while boosting the rural economic sector to address the country's food security concern, Indonesia has tried various alternatives to produce aquafeeds using locally available ingredients.

Many research efforts related to the production of alternatives to fish meal have already progressed in many countries not only in Asia but also in the Americas. The use of insects as source of protein in fish diets has already been successfully tried. In China for example, the nutritive value of insects as feeds for cultured fish has already been recognized where studies have demonstrated that insect-based diets are cheaper alternatives to fish meal. The most popular insect used in this particular case is the Black Soldier (BS) fly, *Hermetia illucens* (Stratiomyidae, Diptera).

BS fly is a non-pest tropical and warm-temperate insect that has been found useful for managing large concentrations of bio-solids as well as other by-products and wastes. A cosmopolitan species that is widespread in Indonesia, the larvae (maggots) of the BS fly at first sight might look like those of the blue fly or house fly. However, there is a huge difference since the latter species are true pests, while the BS fly is rather a “flower species” and not a pest at all. Its



usefulness as source of protein for fish culture has been recognized since the 1950s by many researchers from the USA. Many research studies on the larvae of *Hermetia illucens* have also been conducted in some Southeast Asian countries and expanded in Indonesia, after a huge population of the BS fly was spotted in Sukabumi and Depok Provinces of West Java.

Bioconversion of Palm Kernel Meal

Indonesia is the second world producer of palm oil after Malaysia. Aside from palm oil, the industry yields huge amounts of palm kernel meal (PKM or Bungkil). PKM is a by-product after palm oil has been extracted from the African Oil Palm (*Elaeis guineensis*), which was introduced in Sumatra in the early 1900s. It was reported that in 2006, Indonesia produced about 2 million tons of PKM of which only one-half was exported. Since so much PKM is available and sometimes considered as wastes, the country's fisheries sector is conducting a bioconversion research program which aims to address two-tailed concerns: reducing the need for imported fishmeal for its aquaculture industry; and value-adding a local resource, the locally-produced PKM. However, proteins and fats locked in the PKM can not be used directly by fishes (Hem, et. al. 2008), but since the enzyme from maggots, e.g. larvae of

H. illucens could be used as fish feeds, this leads to maggot biomass production through bioconversion.

Bioconversion is a natural process which consists of the transfer of nutrients via biodegradation using the larvae of an insect. It has been considered the cleanest, most efficient and most economical way to recycle waste products. Since bioconversion does not require electricity, chemicals not even water, it does not produce any greenhouse gases, and the process does not require any imported technology. The agent chosen for the bioconversion process of the PKM in this Indonesian initiative is the BS fly.

As previously reported, BS fly has been found effective in reducing the mass of solid wastes. Fish feeding experiments and analysis also indicated that dried BS fly prepupae grown in selected solid wastes have the nutritive value required in cultured fishes. Since BS fly is capable of converting residual protein in solid wastes and other nutrients into biomass, it could produce high quality protein feedstuff. Some studies have also proved that pollution reduction could be one of the returns for good bioconversion management.

While research studies conducted in some countries made use of fungus and insects such as silkworm, housefly, etc. for the bioconversion of PKM to produce fish feeds, a key step in the bioconversion process in Indonesia is the elucidation of the life cycle of the BS fly, *Hermetia illucens*, with particular emphasis on its reproductive biology (breeding behavior, reproductive cycles, etc.). As demonstrated in previously reported research works, the resulting biomass of larvae (42% crude protein and 30% crude fat) acts as a viable alternative source of animal protein for sustaining the development of aquaculture.

Recently developed in Indonesia, the PKM bioconversion program aims to promote an in-depth understanding of the bioconversion process and at simplifying the production process of the maggot feeds or “magfeeds” so as to promote its implementation in the rural context. The initial application in Indonesia of the bioconversion technology at a small-scale level (1 mt of magfeeds per month) has been validated in 2006-2007 at its Aquaculture Development Center (Balai Budidaya Air Tawar or BBAT) in Jambi Province.

Way Forward

The country’s pilot PKM bioconversion project planned in 2008 will aim to produce a maggot biomass of 10-15 mt/month with direct application to aquaculture. The bioconversion of PKM into “magfeeds”, a natural process dubbed “from waste to wealth”, is a promising research

topic. With the objectives of addressing local needs with local resources, it could also contribute to fishmeal replacement in a broader, worldwide context, since the bioconversion agent is locally available. Furthermore, “the capacity of a country to produce local resources that substitute imported products represents a strong criterion of sustained economic growth.”

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CALENDAR OF EVENTS

Date	Venue	Title	Organizer
2008			
1 Jul -15 Aug	Kuala Terengganu, Malaysia	Malaysian Technical Cooperation Programme (MTCP) Training Program: Fisheries Resource Management Course 2008	MFRDMD
3-5 July	Bangkok, Thailand	ASEAN-SEAFDEC Regional Technical Consultation on Human Resources Development for Poverty Alleviation	Secretariat
4-16 July	Samut Prakan, Thailand	Training Course on Coastal Fisheries Management and Extension Methodology for Thai Fishery Officers	TD
14-16 July	Kuala Terengganu, Malaysia	Malaysian National Fisheries Symposium (NaFIS 2008)	MFRDMD
15-16 July	Bangkok, Thailand	Regional Consultation Meeting on the Emerging Regional Fishery Policy Issues	Secretariat
15-19 July	Kuala Terengganu, Malaysia	Training on the Taxonomy and Biology of Sharks and Rays	MFRDMD
22-24 July	Samut Prakan, Thailand	Regional Workshop on the Implication of Indicators Using for Coastal Fisheries Management in ASEAN Region	TD
22-25 July	Nha Trang, Vietnam	Conference of the International Institute of Fisheries Economics and Trade (IIFET)	IIFET
28-31 July	Bangkok, Thailand	Regional Workshop for Streamlined Reporting of Fishery Statistics in Southeast Asia	Secretariat
29 Jul-14 Dec	Distance Learning	Distance Learning on Principles of Health Management in Aquaculture (AquaHealth Online)	AQD
5-7 August	Chiang Mai, Thailand	29 th Special Senior Officials Meeting of the Meeting of the ASEAN Ministers on Agriculture and Forestry (SOM-AMAF)	ASEAN
6-10 August	Manado, Indonesia	2 nd Regional Consultative Forum Meeting of the Asia-Pacific Fishery Commission (APFIC)	APFIC
11-13 August	Manado, Indonesia	30 th Session of the Asia-Pacific Fishery Commission (APFIC)	APFIC
18-23 August	Chiang Mai, Thailand	Regional HRD Workshop on Identification of Potentials and Problem Areas for Promotion of "FOVOP" in the ASEAN Region	Secretariat
1-15 September	Lao PDR	2 nd Joint Regional Training on Community-Based Freshwater Aquaculture for Remote Rural Areas of Southeast Asia	Secretariat
2-4 September	Manila, Philippines	End-of-Activity Workshop on Good Manufacturing Practices for Pre-Processing Establishment: QA systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries	MFRD
6-10 October	Puerto Varas, Chile	4 th Session of FAO Sub-Committee on Aquaculture	FAO
13-17 October	Bangkok, Thailand	International Conference on Securing Sustainable Small-scale Fisheries: Bring together responsible fisheries and social development	FAO
19-22 October	Qingdao, China	Coastal Zone Asia Pacific Conference (CZAP2008)	CZAP
20-24 October	Yokohama, Japan	5 th World Fisheries Congress	World Fisheries Congress
20-24 October	Hanoi, Vietnam	Senior Officials Meeting of the Meeting of the ASEAN Ministers on Agriculture and Forestry (SOM-AMAF)	ASEAN
22-24 October	Singapore	End-of-Activity Seminar for the Program on Chemical and Drug Residues in Fish and Fish Products in Southeast Asia	MFRD
30 Oct-1 Nov	Singapore	9 th Meeting of SEAFDEC Information Staff Exchange Program (ISEP)	Secretariat&MFRD
3-5 November	Singapore	31 st Meeting of SEAFDEC Program Committee	SEAFDEC
6-7 November	Singapore	11 th Meeting of Fisheries Consultative Group (FCG) for the ASEAN-SEAFDEC Strategic Partnership (ASSP) Program	SEAFDEC

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 the Philippines.