FISH for the PEOPLE

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

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Maximum utilization of fish through *responsible* post-harvest practices

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Editorial

This year is indeed very significant for SEAFDEC. Having been established in 1967, SEAFDEC will be 40 by December 2007.

For almost 40 years, SEAFDEC has consistently worked towards the development of sustainable fisheries in the Southeast Asian region. Even if along the way, SEAFDEC had to undergo changes and adjustments in its programming and activities in order to respond to the changing paradigm in the region's fisheries management and requirements. Since fisheries is an important sector for the Southeast Asian region providing food and improved livelihood as well as creating employment and increased income, SEAFDEC strengthened the cooperation of its Member Countries in order to achieve food security.

At 30, SEAFDEC embarked on new challenges to support the Member Countries in response to the new fisheries requirements at international, regional and national levels. Thus, in 1998, SEAFDEC adopted the "Strategic Plan" for the development of sustainable fisheries in the region through sound management. Its implementation was intensified when a collaborative mechanism between SEAFDEC and the Association of Southeast Asian Nations (ASEAN) was established through the ASEAN-SEAFDEC Fisheries Consultative Group (FCG) in 1999. With such collaboration, several programs in support of the development of sustainable fisheries in the ASEAN region have been carried out using SEAFDEC's technical expertise and with sustained financial support from the Government of Japan Trust Fund Program.

Before turning 35, the dynamism of SEAFDEC as a regional fisheries organization was boosted in 2001 by the increase in its Members, comprising all the ASEAN. A very significant chapter for SEAFDEC started on that same year when major initiatives took place providing directions and strategies for greater ASEAN and SEAFDEC collaboration. The conduct of the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium "Fish for the People" in 2001 paved the way for the formulation of policies and strategies in order to achieve sustainable management of fisheries in the ASEAN.

The "Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region" adopted during the Millennium Conference are important regional policy frameworks, which have been used as guidelines in promoting sustainable fisheries and in ensuring food security in the ASEAN region. The Resolution and Plan of Action, which were developed following the guiding principles and thematic issues of the global Code of Conduct for Responsible Fisheries (CCRF), also demonstrated SEAFDEC's obligation to assist the member countries in the implementation of the CCRF.

In fulfilling such commitment, SEAFDEC implemented the Regionalization of the CCRF for the four major themes, namely: responsible fishing operations, aquaculture development, fisheries post-harvest, and fisheries management that considered and clarified the region's requirements and specificities concerning the CCRF.

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CONTENTS

With its technical expertise, SEAFDEC continued to support the Member Countries in the implementation of the CCRF as well as the Resolution and Plan of Action through the "ASEAN-SEAFDEC Special Five-year Program", culminating with a commitment by the member countries to the ASEAN's vision: "***To be the leader in sustainable tropical fisheries for the people***".

Supplementing such efforts are the SEAFDEC programs on promoting effective communication system in the region through information exchange and dissemination; establishing common policy and approach on issues of international concerns; and raising the profile of SEAFDEC at various levels. The Special Publication "***Fish for the People***" therefore serves as avenue for SEAFDEC to fully publicize its initiatives and promote awareness on its activities and achievements as well as on the available wealth of expertise and technologies that SEAFDEC has amassed through its years of existence.

As SEAFDEC celebrates its 40th anniversary in December 2007, Volume V of the Special Publication "***Fish for the People***" is committed to continue to drum beat the initiatives and achievements of SEAFDEC in the promotion of sustainable fisheries in the region. "***Fish for the People***" will continue to follow the course that SEAFDEC is undertaking as it intensifies and refocuses its strengths in promoting sustainable fisheries; and in addressing the various fisheries issues and concerns to best serve the priorities and needs of all countries in the region.

"***Fish for the People***" will therefore, continue to feature the progress and changes that SEAFDEC is and will be undergoing for although "continuity must have given SEAFDEC some roots", it has changed and "produced branches allowing it to stretch, grow and reach new heights." Such changes have indeed contributed much to the fulfillment of its objectives and in steering SEAFDEC towards a solid focus in the future. The efforts of the ASEAN countries reflecting their own initiatives in fisheries management and conservation will also be promoted in the issues of the Special Publication. As promised, this year's Volume V is committed to come up with three issues that will carry the initiatives and achievements of SEAFDEC as well as those of the ASEAN countries in promoting sustainable fisheries and aquaculture in the region.

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.

SPECIAL FEATURE:

Towards Sustainable Post-harvest Technology Development in the ASEAN

Goh Kian Heng and Yeap Soon Eong

It is well recognized that in the ASEAN region, the fisheries sector contributes significantly to food security. Food security according to FAO/UNDP (**Box 1**) is attained when "people at all times have access to sufficient and safe food they need." But considering their present state, the region's marine and inland fishery resources may not be able to continue providing food sufficiency. Although aquaculture may have the potentials for increased fish production, its fast development is constrained by environmental impacts as alleged by some sectors of the society. Nevertheless, the region is making strides in the management and conservation of its marine and inland fishery resources while putting environment-friendly and sustainable aquaculture in its proper perspective, in order that these sectors will be able to provide food security through increased fish production.

Some prospects and alternatives to achieve food security are not lacking in the ASEAN region. A very important alternative but oftentimes not given much attention is the development of sustainable post-harvest technologies, which could supply the people's needs for safe and nutritious fish products. Peoples of the ASEAN region are producers and at the same time also consumers of traditional fish products.

ASEAN and SEAFDEC organized in November 2001 the "Conference on Sustainable Fisheries for Food Security in the New Millennium". As a consensus and awareness-building exercise on various fisheries issues, it was designed to help develop regional fisheries policies and plans of activities for achieving sustainable fisheries through increased supplies of fish and fishery products in the region. Specifically, the "Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region", which the Conference adopted include among others the need to "promote the maximum utilization of catch, including the reduction of discards and post-harvest losses to increase fish supply and improve economic returns" (***Resolution 11***).

The ASEAN-SEAFDEC Conference also recognized that maximum utilization of fish catch, improving fish quality, and production of culturally important fish products are among the concerns that should be addressed in order to help prevent future shortage of food supply in the region. Towards this end, the SEAFDEC Marine Fisheries Research Department (MFRD) has been tasked to promote the sustainable development of fisheries post-harvest technologies through its R&D activities, and to transfer the technologies to the fish processing industry in the ASEAN region.

Box 1: Definition of Food Security by FAO/UNDP

Food security is defined as "when all people at all times have both physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." Achieving food security requires that the aggregate availability of physical supplies of food is sufficient, that households have adequate access to those food supplies through their own production, through the market or through other sources, and that the utilization of the food supplies is appropriate to meet the specific dietary needs of individuals."

Sustainable development of fisheries post-harvest technology

The development of sustainable fisheries post-harvest technology is vital in advancing the production of fish and fishery products in the region in terms of safe and good quality standards. As a result, this would help place the ASEAN fish and fishery products in the world market, and eventually boosting the flow of foreign exchange into the region's economies. Finally, this could lead to increased availability of fish and fish products for human consumption. Sustainable development in fisheries post-harvest technology can therefore, be achieved through maximizing the utilization of fish catch; and at the same time minimizing wastage of the fishery resources by reducing post-harvest losses and ensuring safe and quality fish and fish products.

Maximum utilization of fish catch

Technological approaches on the use of the small demersal fish species (also called "trash fish") as raw materials for making frozen surimi and fish jelly products are already available for adoption in the region. For the production of frozen surimi, trash fish such as small demersal fish species like the big eye snapper (*Priacanthus* spp.), threadfin bream (*Nemipterus* spp.), lizard fish (*Saurida* spp.), etc. could be utilized. The technology of using frozen surimi to produce fish jelly products was easily picked up by the region's fish processing industries. This breakthrough has led to the dramatic growth of the surimi industry in the region (Goh and Yeap, 2005). In fact the number of surimi factories in the ASEAN region has since then increased from 32 in 2003 to 60 in 2006 (**Figure 1**).

The utilization of small pelagic fish species often regarded as low economic value due to their poor quality resulting from poor handling by fishermen and the lack of on-board and on-shore processing facilities, has also been promoted in the region. Since these small pelagic fishes are under-utilized contributing to post-harvest losses, R&D on the production of surimi from such species as the scads (*Decapterus* spp.) and mackerel (*Rastrelliger* spp.) were conducted. Through this R&D, a range of pelagic fish surimi-based products have been produced such as fish sausages, fish nuggets and fish tofu as well as minced fish products such as sweet meat and fish floss. Singapore with its booming fish processing industry is one of the biggest importers of surimi from the region (**Figure 2**).

Recently, under-utilized freshwater fish species for development into value-added products for domestic consumption as well as for the export market was also promoted. Value-added products such as fish murukku and fish satay were developed from the soldier river barb (*Cyclocheilichthys enplos*) (SEAFDEC, 2005), while fish siew mai, fish crackers, fish bak kwa (sweetmeat) and fish tofu were developed using the featherback fish (*Notopterus* spp.) and snakehead fish (*Channa* spp.).

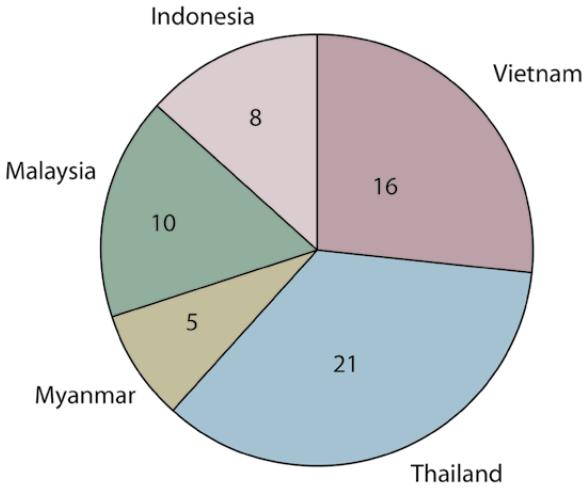


Figure. 1. Number of surimi factories in the ASEAN as of 2006

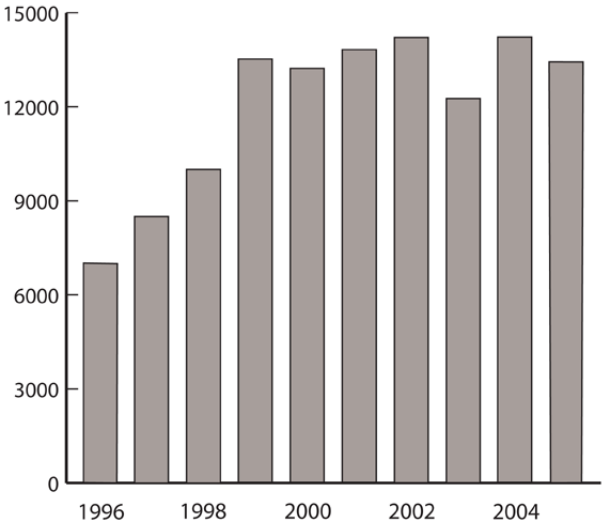


Figure. 2. Annual import of surimi into Singapore (in metric tons (mt))

Tonle Sap (Cambodia)

It has been reported that in Cambodia's Tonle Sap, there is abundance of small freshwater fishes (considered as trash fish) during the lunar cycle in December to February. Production is so much (nets could burst if not lifted every 20 minutes) that the fishes are discarded and left to rot on the lake side. Attempts were made by Cambodia to manage this small freshwater species (e.g., Trey Kangchanchras, Trey Riel, Trey Knongveng, Trey Kroh, Trey Changva, etc.), through post-harvest means but since their catch is very seasonal this was found not very sustainable. Some fishers however, transport their trash fish catch to Vietnam for processing into fish meal for livestock and aquaculture feeds as well as fertilizers.

Surimi-based products developed and promoted by MFRD in the region (left to right): fish balls/prawn balls, fish cakes, chikuwa and imitation crab sticks

It is therefore necessary that countries should identify their under-utilized fish resources as well as identify the resources that are used for non-food products, e.g. fish meal, and explore the possibility of converting these fishery resources into value-added fish products for human consumption. With technological approaches, value-added products from low value small demersal and pelagic fishes and under-utilized freshwater fishes could be developed. Maximizing the utilization of fish catch (marine and freshwater low-value fish species) could eventually address the issue on sustainable fisheries and food security.

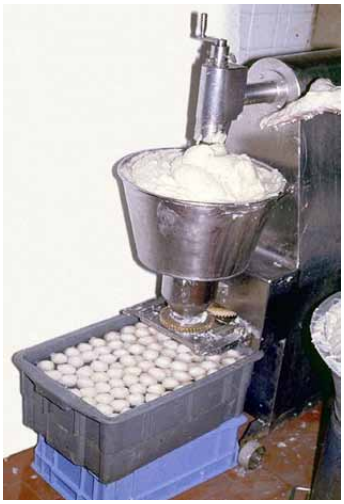
Minimizing waste of fishery resources

While efforts are made to maximize the utilization of fish catch, it is also necessary to minimize wastage of such resources. Staples and Funge-Smith (2005) noted that there is high demand and good economic gains from "low-value/ trash fish" for processing into fish meal and fish oil. The absence of chilling facilities in most small-scale fishing vessels is turning high value fish into low-value catch. The irony is while trash fish species are considered important as source of food and income for the region's poor, some high value fish are turned into low value catch (trash fish)

to supply the high demand for raw materials in the fish meal and fish oil processing industries. Thus, many fishers have lost the initiative of applying proper handling and chilling technologies on-board since their "low value fish" catch are also needed to supply the huge demand of the fish meal and fish oil products sector.

Even if some fishers want to improve the quality of their catch, many vessels are not well equipped with good chilling and storage facilities on-board while on-shore storage facilities in the landing areas are also not available.

Considering that some technological approaches have already been developed, the countries in the region should take advantage of such technologies, e.g, improved on-board fish handling technology to reduce post-harvest losses (SEAFDEC, 2007) such as the modified fish hold on a medium sized trawlers (25-50 m long) and the low cost but effective refrigeration system for small-scale fishing boats that have been verified and found very useful (SEAFDEC, 2002). These techniques have been continuously improved and published by SEAFDEC in On-Board Fish Handling and Preservation Technology (SEAFDEC 2005a).



Some examples of low-cost fish processing equipment (left to right): meat-bone separator, silent cutter, fishball forming machine

The utilization of tuna trimmings and by-products from the fish processing industry has also been promoted in the region. Since the ASEAN region is a major exporter of tuna, which are processed as fresh, frozen or chilled or canned, some amount of trimmings and other by-products could be considered discards. FAO FishStat Plus 2006 indicated that in 2004, the value of the region's export of canned tuna amounted to about USD1.0 billion, of which Thailand accounted for about 82%, Indonesia about 10%, the Philippines about 8%, while the rest was provided by Malaysia and Vietnam. In terms of fresh or chilled or frozen tuna, the ASEAN's export in 2004 amounted to about USD 170.00 million of which Indonesia accounted for 69%, Philippines about 18%, Thailand about 11%, and the remaining 2% were from Myanmar, Malaysia and Vietnam. MFRD has developed the tuna trimmings and by-products into value-added products for human consumption such as tuna chunk sausage, tuna burger, tuna loaf, tuna *piko*, barbecued tuna, etc.

Upgrading the fish processing industry

In order to upgrade the fish processing industry, efforts should be made by the countries to adopt mechanization and promote automation of the industry. Many low-cost equipment, facilities and systems could be put up locally such as the meat-bone separator, silent cutter, fish ball forming machine, fish cake forming machine, etc. The use of these machines will ensure increased productivity by the fish processing industry. In addition, there are also automated systems such as automated fish ball processing line, imitation crab stick processing line, automated battering and breading line, chikuwa processing line, etc. The adoption of these automated systems ensures not only increased productivity but also clean and safe fishery products.

Automated systems for fish processing: chikuwa processing (above), imitation crab stick processing (right top), and fish ball processing (right)

Implementing HACCP-based quality assurance programs is also an important means of upgrading the industry, as this leads to the road to ISO certification of the processing plants, a plus factor in the foreign trading arena. Since most of the fish processing plants in the region are small and medium-sized establishments and could not easily comply with the requirements of importing countries due to technical constraints, efforts are now made by SEAFDEC through the MFRD to assist the region's SMEs in meeting safety and quality assurance requirements. The ability of the SMEs to apply HACCP-based programs (i.e. good manufacturing practices or GMP and standard sanitation operating procedure of SSOP) is necessary to improve the safety and quality of the fish products from the region thus, towards food security. A related article on Assisting ASEAN SMEs Meet Quality Assurance Requirements in this Volume explains such efforts of SEAFDEC.

Future Direction

SEAFDEC through the MFRD is committed to driving ASEAN's efforts towards sustainable development in fisheries post-harvest technology. Thus, MFRD will continue to develop integrated fisheries post-harvest technologies that would address sustainable development of fisheries in the region such as optimizing limited resources, development of value-added products, and reducing post-harvest losses

and wastage. MFRD will also promote the harmonization of analytical methods and testing capabilities to evaluate the freshness and quality of fish and fish products in the region with the ultimate aim of upgrading the region's fish processing industry and meeting the requirements of importing countries on the fishery products from the region.

References

Goh K.H. and Yeap S.E. 2005. Maximizing utilization of fish catch for human consumption. Paper presented during the Regional Workshop on Low Value and "Trash Fish" in the Asia-Pacific Region, Hanoi, Vietnam, 7-9 June 2005.

SEAFDEC. 2002. Refrigeration for Local Fishing Boats. Training Department, SEAFDEC, Samut Prakan, Thailand. May 2002. 46 pp.

SEAFDEC. 2005. SEAFDEC Annual Report 2005. SEAFDEC Bangkok, Thailand. 105 pp.

SEAFDEC. 2005a. On Board Fish Handling and Preservation Technology. Training Department, SEAFDEC. Samut Prakan, Thailand. September 2005. 73 pp.

SEAFDEC 2007. Report of the Twenty-Ninth Meeting of the Program Committee of SEAFDEC, Thailand, 4-6 December 2006. SEAFDEC Secretariat, Bangkok, Thailand. February 2007. 283 pp.

Staples, D. and Funge-Smith S. 2005. Prized Commodity: Low Value/Trash Fish from Marine Fisheries in the Asia-Pacific Region. Fish for the People Vol. 3 No. 2: 2005. SEAFDEC, Bangkok, Thailand, p. 2-15.

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Conserving and Managing the Sea Cucumber Resources in Southeast Asia: SEAFDEC Initiative

Rujarek Bumrasarinpai

The present trend in the ASEAN towards overfishing of sea cucumbers in commercial species especially under the Families Holothuriidae and Stichopodidae to support international market demand, has become an urgent concern in the international community, particularly at the Convention on International Trade in Endangered Species (CITES). There have been very limited studies and collection of information on the biology and production of sea cucumbers in the ASEAN countries. Nonetheless, sea cucumbers clearly represent an economically important fisheries resource in the region but inadequate attention is given to the management of these species and its fisheries status is not very well known.

Sea cucumber: Photo provided by M.F. Nievales during the Regional Technical Consultation on Stock Enhancement of Threatened Species of International Concern, Philippines, July 2005

The ongoing global initiative to possibly include sea cucumber in commercial species in the CITES Appendices has alarmed the ASEAN countries as this would greatly affect the region's sea cucumber fisheries. In order to address such concern, ASEAN and SEAFDEC convened the Preparatory Meeting on Environmental Related Tasks in October 2005 in Bangkok, Thailand to discuss this issue. The outcome was submitted to the 8th Meeting of ASEAN- SEAFDEC Fisheries Consultative Group (FCG) and the 38th Meeting of SEAFDEC Council held in April 2006 in Brunei Darussalam, during which the following proposals were approved:

- Conduct of a regional comprehensive compilation of data and information on sea cucumbers; and
- The management of sea cucumber resources should be the purview of competent national fisheries agency

Subsequently, SEAFDEC organized the ASEAN-SEAFDEC Regional Technical Consultation on International Fisheries Related Issues in September 2006 in Phuket, Thailand where updated information on sea cucumber in commercial species proposed for listing under CITES and the relevant initiatives undertaken by FAO were provided. The Consultation reaffirmed the need to conduct a regional study on sea cucumber fisheries, utilization and trade and reiterated its recommendation that economically important sea cucumber species should not be listed under any of the CITES Appendices.

Conservation and Management Efforts

In order to support the aforementioned recommendation, SEAFDEC Secretariat launched in June 2007 a regional activity on Information Collection of Sea Cucumber Fisheries, Utilization, and Trade under the SEAFDEC Program on Environmental Related Tasks in Southeast Asia supported by the Trust Fund Program of the Government of Japan. For such regional activity, each member country nominates their respective National Focal Point who will conduct the relevant desk study and will be designated member of the 'SEAFDEC Ad-hoc Regional Working Group on Sea Cucumber Fisheries'. The Working Group will be involved mainly in the planning and coordination work on sea cucumber.

its resource utilization, management and trade. Their output will be assessed for the possibility of developing national action plans and policy recommendations on the conservation and management of sea cucumbers.

Towards the end of 2007, SEAFDEC will organize the ASEAN-SEAFDEC Expert Consultation on Sea Cucumber to discuss the outcome of the regional study on sea cucumbers and come up with policy recommendations and management strategies for the region's sea cucumbers conservation and management. In addition, findings at the FAO Workshop on Sustainable Use and Management of Sea Cucumber Fisheries scheduled in November 2007 will also be considered during the Expert Consultation. The regional synthesis and policy recommendations on sea cucumbers conservation and management in Southeast Asia resulting from the Consultation will be submitted to the SEAFDEC Council and the ASEAN Sectoral Working Group on Fisheries (ASWGFi) for consideration and support.

SEAFDEC is keeping itself abreast with the developments related to the proposal to list sea cucumbers species in the CITES Appendices. At the CITES CoP14 in June 2007, SEAFDEC participated in the sea cucumber working group to raise the common concern and safeguard the interest of the Member Countries. The adopted decisions concluded to bring such concern to the attention of FAO during its planned Workshop in November 2007. Although the proposed listing of sea cucumbers in commercial species under the CITES Appendices was not done during the CoP14, additional measures to conserve and manage the sea cucumbers might be brought up at the CoP15. In this regard, the ASEAN Member Countries is preparing sufficient facts and related scientific information that would support the concerns of this fisheries sector.

Meanwhile, SEAFDEC in collaboration with the Member Countries will continue to echo its efforts on the conservation and management of sea cucumbers in the international arena, and this article will hopefully help SEAFDEC publicize such efforts. A related article in this issue illustrates the initiative of the Philippines to conserve its sea cucumber resources in line with the efforts being demonstrated by SEAFDEC.

About The Author

Rujarek Bumrasarinpai is currently working as the Program Administration Officer of the SEAFDEC Secretariat. After obtaining M.Sc. Fisheries Science from Kasetsart University, Thailand in 2003, she started working with SEAFDEC under the Policy and Program Office of the Secretariat. She is now involved mainly in programs related to Assistance for Capacity Building in the Region particularly those that address International Trade Related Issues, and Environmental Related Tasks in Southeast Asia.

CALL FOR ARTICLES

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

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

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

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

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

Efforts to Conserve Sea Cucumber Resource

Ludivina L. Labe, Lea K.C. Acera, November A. Romena, Valeriano V. Manlulu

There are about 100 known species of sea cucumber in the Philippines, 25 of which are harvested commercially. These are found in shallow waters within the wide seagrass soft bottom beds as well as in coral reef areas. The Philippines is the 2nd largest exporter of processed sea cucumber meat known as "trepang". Sea cucumber is a marine echinoderm, named after its cucumber-like shape. In other countries, it is known as sea slug because of its sluggish locomotion. Sea cucumber is considered the Philippines' 4th priority fishery commodity. Its processed meat, which ranks 8th among the country's major fishery exports, is a multi-million US dollar industry. In 2002, the Philippine export of trepang amounted to 4.42 million USD and increased to 4.93 million USD in 2004 (FAO Fishstat Plus 2006). More than 60 coastal municipalities in 14 regions of the country depend on sea cucumber fishery for their livelihood. Trepang is almost synonymous to the Chinese cuisine, making it a major export product from Southeast Asia to China and Hongkong for many years. In 2004, the sea cucumber export from Southeast Asia was dominated by Indonesia (2648 mt valued at 5.32 million USD) surpassing that of the Philippines. Being an export-oriented commodity in the Philippines, the market of sea cucumber plays an important role in the country's resource management and conservation efforts.

More than half of the sea cucumbers traded in the Philippines belong to the genera Holothuria. The others belong to genera Actinopyga, Bohadschia, Stichopus and Thelenota. Akamine (2001, 2002) noted that Holothuria scabra and H. fuscogilva are the most popular species sold in Hongkong and Singapore while Actinopyga echinites is most popular in China and Stichopus horrens and S. hermanni are popular in Korean market. In the Philippines, there are no data on the rate of extraction of this resource. Nevertheless, the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) recognized the localized depletion of this heavily exploited resource. While confirming such observation, the fishermen are now saying that it is taking them longer time than before to accumulate a certain volume of sea cucumber required by middlemen for trans-shipment to Metro Manila for export. Some said they have to resort to collecting the low-value species in order to meet the demand even if these are traded at much lower prices.

In the Philippines, sea cucumbers are harvested and dried for direct selling to middlemen or sold fresh in nearest local markets. Some fishers collect sea cucumber as by-catch from traditional fishing activities. Some dive into deeper reefs for the high value species collected individually. There is no regulation nor monitoring of the catch, and there is also no size nor value restriction neither is there a closed season not even tax collection on landing. The fishermen are not size selective arguing that the middlemen buy whatever catch they could produce regardless of the size. As recently reported, the Philippine trepang industry produces more low value species for export than before. The Philippine wild

sea cucumber population is on the verge of collapse due to massive international trade of the processed meat. Despite increased effort, there has been a dramatic decline in traded dried and salted sea cucumber from 1407 mt in 2002 to 1079 mt in 2004 (FAO Fishstat Plus 2006).

Conservation and Management Efforts

As one of the major exporters of sea cucumber, the Philippines is also a signatory to the CITES. The "impending inclusion of Holothuriidae and Stichopodidae species in Appendix II of CITES" encouraged the Philippines to implement measures addressing the issue on the country's sea cucumber industry. The Philippines agreement to: limit or regulate the export of Appendix II species taken from the wild; impose acceptable regulatory measures; and develop the culture technology for Appendix II species, prompted the government to exert efforts to promote a conservation and management program for the country's sea cucumber resource. The responsibility of implementing such program was given to the National Fisheries Research and Development Institute (NFRDI) as the research arm of BFAR.

Many factors have constrained the country's management efforts because of many reasons that include the absence of fishery regulations and management plan on the fishery and breeding of sea cucumber; and the absence of inventory and monitoring of existing stocks in both unexplored and exploited areas. Other factors include lack of baseline survey to ascertain the extent of depletion; problems in species identification that render available fishery statistics unreliable and meaningless; and lack of understanding on the holothurian life history. These factors have hindered the sustainable development of the sea cucumber industry in the country. In order to address these concerns, the NFRDI in 2006 implemented a project on the Fishery Investigation and Molecular Applications for the Sustainable Use and Development of Commercial Aspidochirotid Holothurians (Sea Cucumber). The project comprises three major activities, namely: (1) stock assessment and fishery investigation; (2) population genetics and DNA profiling; and (3) identification of good stock of selected species for breeding and hatchery program using molecular markers.

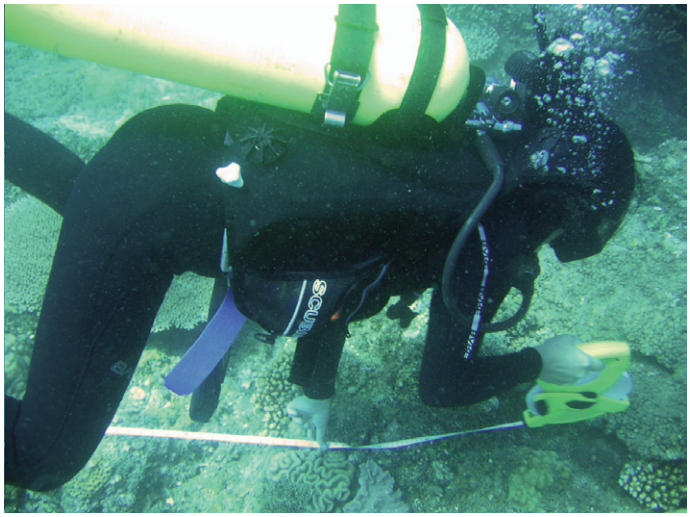
This project aims to "combine the traditional and innovative approaches in addressing the complex management and development issues on Philippine sea cucumber fisheries". Specifically, it also aims to: conduct regular monitoring of the catch and trade in all existing collection sites; and create database of genomic DNA profile of the commercial holothurians as listed in the CITES as protected species. For taxonomic purposes, the identification of stock origin and forensic investigations are also being carried out.

NFRDI Researchers conducting the land-based data collection in Bohol, central Philippines

NFRDI conducted marine and land-based surveys in 10 regions of the country, where the marine underwater surveys were done in the entire collection areas of sea cucumber. The land-based data were collected from fishermen through interviews on the quantity of their landed catch and processed meat. Other information were also gathered such as species name, length, weight, production value and trade route.

Initial Findings

Identifying through their shapes and "ossicles", 33 commercial species from the five major genera of aspidochirotids have been identified in major locations in the country. The aspidochirotids were also observed to be substrate selective. The low value species are abundant but low in densities in muddy/mangrove and sandy/seagrass areas while the high value species are found in deeper areas, coral reefs and lagoons but their densities are very low due to over-harvesting.



NFRDI Researcher conducting the marine-based sampling of sea cucumber

The spatial distribution in seven sites of the country indicated that *Actinopyga* sp. were commonly found in Cagayan Valley and La Union in northern Philippines. *Holothuria* sp. is found in La Union and Zambales (northern Philippines), Panay Island and Eastern Samar (central Philippines), Zamboanga-Sibugey and Compostela Valley (southern Philippines). *Bohadschia* sp. and *Stichopus* sp. were observed mainly in Compostela Valley.

Sea Cucumber R&D

In order to hasten resource conservation and management of sea cucumber, R&D activities have been conducted to enhance the natural stock with hatchery-bred individuals using broodstock developed through culture or collected from the wild, specifically by the Bolinao Marine Laboratory (BML) of the Marine Science Institute of the University of the Philippines. BML reported that its researchers have successfully pilot-tested the production of *H. scabra* in the hatcheries (Gamboa and Juinio-Meñez, 2003) while grow-out trials indicated that juveniles in cages had better survival rate when cultured at larger sizes while also showing positive growth in coral sand and muddy seagrass substrates.

Since the hatchery technology for *H. scabra* is ready for pilot-testing in other parts of the country, BML intends to set up hatcheries outside Luzon area, i.e., in the Visayas and Mindanao areas, to fast track the reseeding intervention that would enhance the recovery of depleted stocks. BML has also examined the potential of sea cucumber to mitigate feed wastage and initial findings showed that sea cucumbers placed at the bottom of the tank where milkfish is grown can remove feed and fish wastes like NH_4, PO_4 and NO_2 (San-Diego-McGlone *et al.,* 2003). The potentials of polyculture can therefore, be an alternative technology that is not only environment friendly, but also adding value to the investment.

The NFRDI also started conducting a study on the effect of sea cucumber as bioremediation under fish cages. The study aims to provide remedial measures in the accumulating wastes under fish culture cages and at the same time growing sea cucumber as an alternative means of livelihood. The study also intends to establish the effect of sea cucumber on the soil and water qualities in fish cage areas.

Conclusion and Recommendations

Sea cucumber and its processed meat trepang are sources of food and income for marginal fishers in the coastal areas in Southeast Asia. In a situation like the Philippines and learning from experiences with other commercially important commodities, the sea cucumber industry should be backed up by breeding and hatchery efforts to cover for the over-exploitation that oftentimes result in resource depletion.

The absence of regulations, lack of law enforcement arresting the violators and weak judicial system led to the irresponsible over-exploitation of the resources especially for commodities like the sea cucumber whose fisheries are highly dependent on the wild stock. Efforts of the Philippine Government to conserve the country's sea cucumber resource are now with the hands of the NFRDI. The initiatives of NFRDI are envisaged to serve as basis for the establishment of effective measures to ensure sustainable and continuous harvest; and development of aquaculture technique for sea cucumber. In totality, these efforts are aimed at achieving food security, job generation, and increased income for the fisherfolk.

References

Akamine, J. 2001. Holothurian exploitation in the Philippines: continuities and discontinuities. *Tropics,* 10(4):591-607.

Akamine, J. 2002. "Trepang exploitation in the Philippines: Update Information." SPC Beche-de-Mer Information 18 Bulletin # 17. October 2003.

FAO Fishstat Plus 2006. FAO, Rome, Italy. 2006

Gamboa, R. and Juinio-Meñez, M.A. 2003. Pilot-testing the laboratory production of the sea cucumber, *Holothuria scabra* (Jaeger) in the Philippines. *The Philippine Scientist,* 40:111-121.

Gamboa, R., Gomez, A.L. and Nievales, M.F. 2003. "The Status of sea cucumber fishery and mariculture in the Philippines." International Workshop on the Advances in Sea Cucumber Aquaculture and Management, China, 14-18 October 2003. FAO, Rome, Italy.

San Diego-McGlone, M.L., del Norte-Campos, A., Ganzon-Fortes, E., Biduare, J., Hernandez, E., Ranches, G. and Tad-y, M.A. 2003. "Is polyculture able to mitigate waste?" 7th National Symposium on Marine Science. List of Abstracts. Philippine Association of Marine Sciences, Inc. Cagayan de Oro City, Philippines, 22-24 October 2003.

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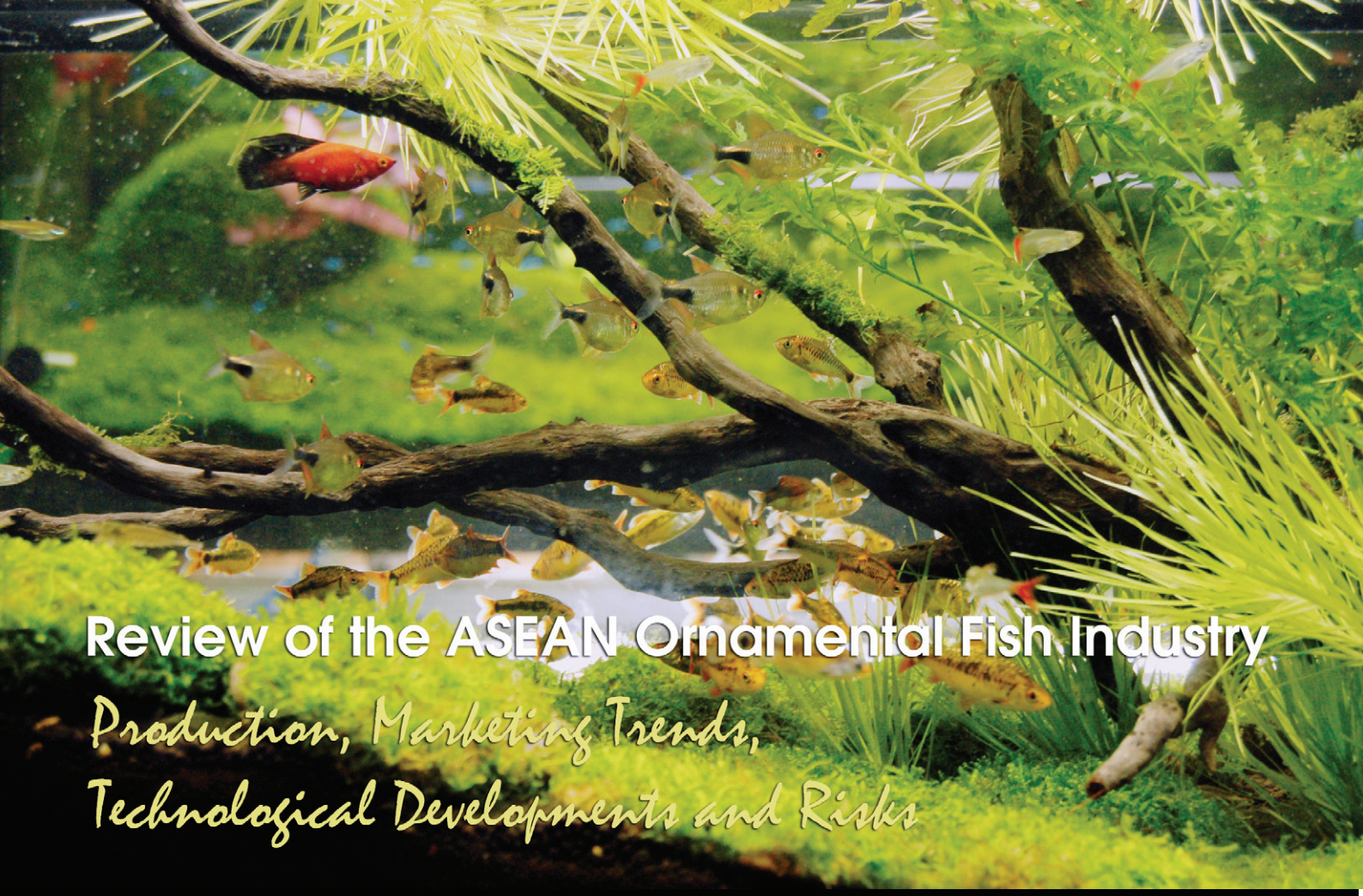

Review of the ASEAN Ornamental Fish Industry

Production, Marketing Trends, Technological Developments and Risks

Ma. Teresa M. Mutia, Anto Sunaryanto, Arthur Besther Sujang, and Virgilia T. Sulit

Ornamental fishes are now being treated as consumer-based commodities. According to the World Trade Organization, the world's ornamental fish trade is worth more than 45 billion USD with an average annual growth rate of 8%, of which the Asian countries (Singapore, Thailand, Malaysia, Indonesia, Sri Lanka, Japan, China, Philippines, etc.) accounted for more than 60%. It is therefore becoming imperative that the region's production of ornamental fishes, whether from culture or collected from the wild should be made sustainable. Except for Indonesia and the Philippines, which also export marine aquarium fishes, the other countries produce and market mostly the freshwater fishes. In the world's ornamental fish trade (its importance is best appreciated in terms of the value instead of volume since the fishes are traded by the number of pieces), freshwater ornamental fishes represent about 90% while marine aquarium fishes contribute only about 10%.

While breeding and production of freshwater ornamental fishes in captivity in the ASEAN region is already mature, most marine aquarium fishes are still collected from the wild and the industry has been blamed for the massive destruction of the region's coral reef areas, i.e., in Indonesia and the Philippines. Very few fishers are involved in breeding marine aquarium fishes, for although profitable, it requires a good amount of capital outlay and modern culture technologies. Unless technical and financial assistance are provided, only then can production of marine aquarium fishes in captivity become an alternative livelihood for the small-scale fishers (Pomeroy and Balboa, 2004).

Ornamental Fish Production

In spite of being major exporters of freshwater ornamental fishes, many countries in the ASEAN region (e.g., the Philippines) are still developing their respective ornamental fish industry. Thailand and Singapore however, have already turned the industry into a high-level dollar-earner sector at different stages of development concentrating in the freshwater sector. While Thailand is a major producer and exporter of ornamental fishes, Singapore is importing ornamental fishes from neighboring countries such as Indonesia, Thailand and Malaysia for breeding and re-export. Their high technology-based infrastructures have made Thailand and Singapore the region's leaders in the ornamental fish trade. The experiences of Thailand and Singapore serve as the other countries' examples in

developing their own ornamental fish industry as a supplemental livelihood for their respective fisherfolk.

Produced from "backyard" outdoor earthen or concrete ponds or in tanks as well as in indoor aquaria, ornamental fishes could be grouped into livebearers and egg layers. Livebearers include guppy, molly, platy, swordtail, while egg layers include barb, tetra, betta, gourami, cichlids, and are classified as either mouth brooders, bubble nest builders, substrate breeders, etc. The livebearers are usually cultured as hybrids to produce a variety of colors, unique body forms and body patterns, and when the desired colors, body forms, body patterns, e.g. with readable characters as in cichlids, finnage such as long flowing fins or lyre-tails, etc. are not attained, the fishes are discarded. Although most ornamental fishes spawn in earthen ponds, the larvae are reared in hatchery and nursery facilities for commercial production where their growth is closely monitored for the desired varieties, which could command very good prices in the trading arena. Thus, the good are reared and traded, while the bad and the ugly are discarded.

As in food fish, developed aquaculture technologies such as spawning through environmental manipulation using hormones are also adopted in the culture of ornamental fish in captivity. This allows the industry to produce fishes, which were previously available only from the wild, e.g., freshwater sharks, freshwater stingray, clownfish, etc. Feeding the larvae with live food such as rotifers, Artemia nauplii, etc. to improve survival rates during the larval stages, a technique developed for food fish aquaculture, has benefited the ornamental fish industry. High-protein feeds, e.g. larvae of insects and worms are also used for the bigger ornamental fish species.

Live feeds shop for ornamental fish

Production of ornamental fishes also requires good farming management such as the use of aeration and other techniques, e.g. water filtration, flow-through, recirculating systems, etc. to maintain good water quality. Incidence of diseases common in food fish aquaculture could cause high mortalities in ornamental fishes, thus, fish health management is also very important in the industry. The very steep competition in the international market is a major concern and the region's ornamental fish industry therefore, capitalizes on its much cheaper and sturdier fishes, trading mostly the most exquisite varieties to draw in more clients and get considerable profit as well as better return of investments.

Marketing Trends, Technological Developments, and Risks

Reports have indicated that Brunei Darussalam in 2003, exported ornamental fishes valued at 35,000 USD mostly varieties of Betta or Siamese fighting fish, but it also imported ornamental fishes valued at 218,000 USD (FAO Fishstat Plus 2006). The country has already developed the technology for breeding and seed production of the indigenous freshwater ornamental fish, *Betta macrostoma*.

The value of Cambodia's export of ornamental fishes in 2003 was 83,000 USD, while its import in 2004 was valued at 5,000 USD (FAO Fishstat Plus 2006). Some Betta varieties, e.g. *Betta splendens* are indigenous in Cambodia, where the local name of this fish is "pla kat" (meaning biting fish). "Pla kat mhor" is more famous as the fighting fish while "pla kat cheen" is the ornamental fish. Another common hybrid is "pla kat kmer" or the Cambodian strain, and the best variety of the Siamese fighting fish in the international market is reported to be the cross between "pla kat cheen" and "pla kat kmer". *Betta splendens* is indigenous to Thailand, Cambodia and Malaysia. Bettas are bubble nest builders and nest guarders.

The most important ornamental fish produced and traded in Indonesia is the dragon fish or Arowana. The Silver Arowana (*Osteoglossum bicirrhosum*) belongs to Class Actinopterygii, Family Osteoglossidae, and Genus Osteoglossum. Since the Silver Arowana is not listed in the CITES Appendix, it is used as a substitute for the more expensive red and golden Asian Arowana (*Scleropages formosus*), which is listed in CITES Appendix I. Treasured as living dragons, Arowanas are believed to bring good luck and wealth to its owners, making Arowanas the most expensive among the ornamental fishes. Indonesia produces Arowanas in farms for export and conservation purposes, and recently molecular tools are used to manipulate their colors. Ornamental Fish Specialist, the Qian Hu Corporation of Singapore is supporting a study on the reproductive

Mr. Tanapat Matchayakulawit (left) and Arowana culture farms in Indonesia (right)

genomics and DNA barcoding of the Arowanas in Indonesia. The Corporation foresees that their investment could be profitable as many buyers could not get enough dragon fish because the demand always exceeds supply.

During an interview with a Thai importer of Arowanas, Mr. Tanapat Matchayakulawit who runs an ornamental fish shop in Chatuchak, Bangkok, said that legally, it usually takes two to three weeks to import Arowanas from Indonesia. While waiting for his orders to arrive, he keeps receiving orders from other countries such as Japan and China. He added that it does not take him 24 hours to dispatch his stocks especially that he also receives orders from the local hobbyists. He also said that the most expensive fishes are the red and golden Sumatera Arowanas.

In addition to breeding Arowanas, Indonesia has also developed the breeding technology for discus, *Symphysodon discus* and botia, *Botia macracantha*. While Indonesia imports mostly the Koi fish broodstock from Japan for breeding and for local marketing, it is also a major exporter of the Napoleon fish. However, since the Napoleon fish is listed in Appendix I of CITES, Indonesia has been granted an export quota of 8,000 Napoleon fish/year and the fish size allowed for export is 1-3 kg/fish. FAO Fishstat Plus 2006 has recorded that Indonesia's export of ornamental fishes in 2003 was valued at 4,644,000 USD (freshwater) and 8,728,000 USD for marine aquarium fishes. Its import also in 2003 was valued at 400,000 USD for freshwater ornamental fishes and 64,000 USD for the marine species.

Although not much information is reported on the ornamental fish industry of Lao PDR, FAO Fishstat Plus 2006 has indicated that in 2003 the export value of the country's ornamental fishes was 2,000 USD. The main species cultured in Lao PDR are hybrids of the koi carp (*Cyprinus carpio*).

The Malaysian ornamental fish industry is fast growing, producing about 500 million pieces of ornamental fishes annually, of which 70% is exported to 30 countries worldwide. More than 250 local and exotic species are bred in the country for the domestic and export markets. Small- and medium-sized enterprises operate the country's ornamental fish industry utilizing about 456 farms located in Johore, Perak, Penang and Kedah, providing employment opportunities to more than 5,000 people. The country is very proud for being recognized as the world's leading producer of the Asian Arowana (*Scleropages formosus*) with seven CITES certified farms producing several varieties including the incomparable Malaysian Golden Arowana. Its discus variety (*Symphysodon discus*) has won Merit Certificates for Malaysia in open competitions in Germany.

Malaysia's export of ornamental fish in 2003 was valued at 14,147,000 USD and 18,361,000 USD in 2004 while import was valued at 3,971,000 USD in 2003 and 3,681,000 USD in 2004, with re-export valued at 4,754,000 USD in 2003 (FAO Fishstat Plus 2006). The ornamental fish industry of Malaysia has been recently highlighted because of the alleged dumping of undesired flowerhorn into the natural environment. Since many people believe that the flowerhorn can bring good luck, prosperity, protection and success in their businesses, a "Flowerhorn Craze" occurred in Malaysia from 2003 until 2004.

Flowerhorn, one of the most popular ornamental fishes

Produced from cross-breeding cichlid hybrids, the flowerhorn commanded very good prices in the local and export markets especially at the height of Malaysia's Flowerhorn Craze in 2003. When the craze ended in 2004, its price dropped together with the demand and many aquarium operators were left with unsold flowerhorn, most of which were either killed or thrown away or perhaps released into the wild. Once in the wild, the flowerhorn is believed to have adapted their new environment and feeding on other aquatic organisms, thus possibly wrecking havoc to the natural environment.

In Myanmar, keeping ornamental fish in homes, offices and restaurants is becoming very popular. It has been reported that there are more than five exporters of ornamental fishes in Yangon City alone, trading a variety of Arowanas or the "lucky fish" as it is called in Myanmar, gold fish, flowerhorn and other fishes of the tetra family. Reports have also indicated that the cost of ornamental fish in Myanmar could range from Kyat 50 up to Kyat 2 million, the most expensive of which is the lucky fish with price ranging from thousands of Kyat up to millions, depending on the color.

Myanmar produces silver, green, gold, blue, red Arowanas as well as various other colors attained through crossbreeding. Many Burmese also believe that the flowerhorn with distinctive Chinese characters on its body, have brought them good fortune and financial successes. There is no data on the country's export of ornamental fishes although import in 2003 was valued at 11,000 USD (FAO Fishstat Plus 2006).

The Philippines is a major supplier of marine live ornamental fishes, trading more than 340 species and supplying 70% of the world's demand. In the USA, 80% of their marine ornamental fishes come from the Philippines (Mutia, 2007). BFAR Fisheries Profile 1978-2003 has indicated that for almost three decades, marine ornamental fishes have been one of the top fishery exports of the Philippines (Fig. 1). (*Note that in the FAO Fishstat Plus 2006, the export value of ornamental fishes for the Philippines has been recorded as a whole and not broken down into freshwater or marine fishes.*)

Savaris (2007) reported that there are 4,000-7,000 marine aquarium fish collectors in the Philippines with 3,000-4,000 persons directly involved by the industry and its ancillaries. There are about 70 exporters or marine aquarium fishes, about 40 are based in Metro Manila while the rest are in Cebu (central Philippines). Despite the economic benefits derived from the industry, it is not regarded sustainable because of the perceived widespread use of destructive fishing methods, especially the use of cyanide for collecting the target aquarium fishes. Moreover, there are also other issues such as the absence of a management system for the industry which could result in over-fishing the species that are highly in demand, and social issues related to the health and safety of the collectors who use air compressors for diving without getting the proper dive safety training.

The country's marine aquarium fish industry has one of the most complicated supply chains (Savaris, 2007), involving a number of players from the collectors, middlemen, traders, exporters, airline companies, importers and the retailers before the fish gets to the end consumers, which are the marine aquarium fish hobbyists. Handling of the fish from the reef to the retailers and consumers is not very reliable resulting in rejected fishes.

In an effort to improve the processes involved in the entire supply chain, the Marine Aquarium Council (MAC) was organized by the Philippine Government in 1998 to develop and introduce practice and product standards throughout the supply chain from "reef to retail". The MAC standards comprise the criteria for best practices in all activities throughout the supply chain such as managing the collection area, collecting and holding, and handling and transport. MAC has also developed a certification system for those

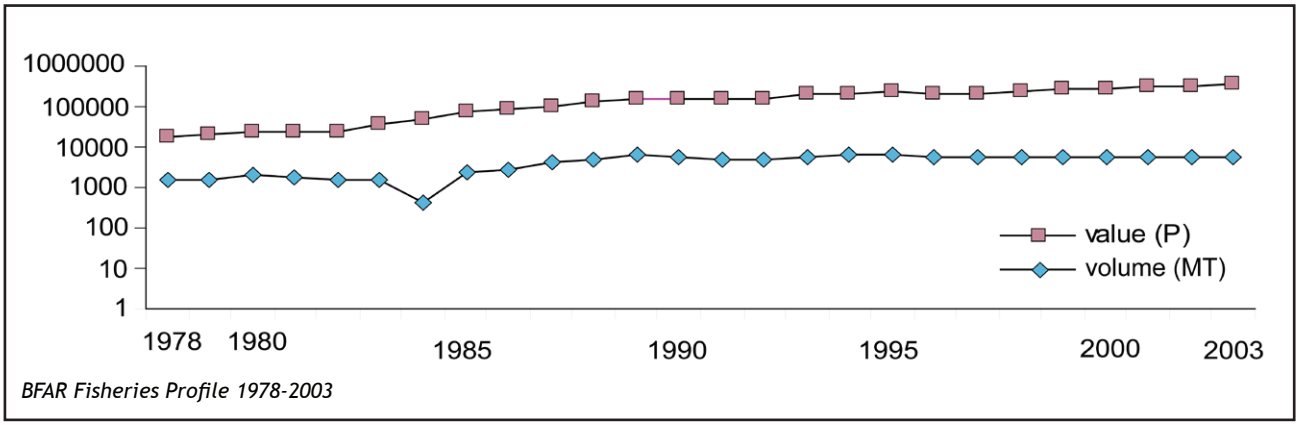

Figure 1 Ornamental Fish Export of the Philippines (1978-2003)

engaged in the collection and care of the marine aquarium fishes.

Clownfish or Anemonefish of the Family Pomacentridae and Genus Amphiprion is the most popular marine aquarium species collected or cultured and bred in the Philippines for more than 30 years, the important species are the False Percula (*Amphiprion ocellaris*), Yellowtail or African Clownfish (*A. clarkii*) and Tomato Clownfish (*A. frenatus*). The country's demand for the clownfish has significantly increased in 2003 after the movie "Finding Nemo" was shown in Philippine movie theaters.

Clownfish is collected from the coral reefs using sodium cyanide, where local fishermen squirt the cyanide solution towards the targeted fish inhabiting the top of coral heads. The target fishes, which become disoriented and semi-paralyzed, are easily gathered and kept alive in small onboard containers. Since cyanide damages the corals and other coral reef organisms causing total deterioration of the entire coral reef ecosystem, this collection method has been banned in the Philippines. Nonetheless, the small-scale fishers continue to use this illegal and destructive method because of the large demand and high prices offered by the ornamental fish industry. It has been reported that since the 60s, more than one million kilograms of cyanide has been squirted into Philippine reefs and the practice is believed to have spread in other Southeast Asian countries such as in Indonesia.

In order to address the damage inflicted on the coral reef ecosystems and fish stocks, culture in captivity of the important marine aquarium fishes, i.e. *Amphiprion* spp. is being promoted in the Philippines to reduce pressure on the coral reefs. The country's ornamental fish industry was given a special responsibility to educate the public on the effects of destructive fishing to the environment, promote the use of responsible fishing gear, i.e., fish nets instead of using cyanide, and to breed ornamental fishes in captivity.

The Philippines imports freshwater ornamental fishes from other countries such as Hong Kong, Thailand, Taiwan, Malaysia, and Japan, about 469,326 pc in 2003 (Mutia, 2006). The Philippine Government in collaboration with the private sector promoted since 2003 the breeding and production of freshwater ornamental fishes locally. With favorable weather conditions, available technology, sufficient manpower and related resources, the Philippines has the potentials to produce and supply the growing world market for freshwater ornamental fishes. Thus, in 2004 the Philippine Government through the Bureau of Fisheries and Aquatic Resources (BFAR) formulated the Roadmap for Ornamental Fish including a five-year development plan with the cooperation of the private sector. The National Fisheries Research and Development Institute (NFRDI) being the research arm of BFAR, conducts R&D on ornamental fish culture at its National Fisheries Biological Center in Butong, Taal, Batangas. The Center implements research on breeding and culture of ornamental fishes, conducts national training sessions for fisherfolk, establishes pilot projects throughout the country, and organizes ornamental fish exhibitions. The Center has also been designated to be the focal point where all parent stocks are bred and the resulting quality breeders are dispersed to the regions for mass production and distribution to the fisherfolk and other clients. During the training sessions conducted by the Center, the participants are made to understand the danger of irresponsible introduction or release of alien species to the wild and encouraged to culture only the indigenous species instead.

Lessons have been learned by the country's ornamental fish industry when the "janitor fish" (*Hypostomus plecostomus*) found its way into Laguna de Bay, the biggest lake water body in the Philippines as well as its river systems like the Marikina River near Metro Manila. An imported freshwater catfish species native to South America, the "janitor fish" was introduced in the Philippines in the 90s. Its ability to clean an aquarium by feeding on algae growing on its sides made it known as janitor fish, and it was a craze for sometime in the Philippines. The irresponsible release of the janitor fish into the natural environment has caused havoc since the fish is reported to feed on algae growing on the net cages installed in the Lake, cutting the nets and resulting in massive breakout of the cultured fish. Although not valued as a food fish, the prolific-growing "janitor fish" is now being considered as source of fishmeal and fish skin leather.

In Singapore, freshwater aquaculture is monopolized by the production of ornamental fishes, which concentrates on the production of guppy (*Poecilia reticulata*), platys (*Xiphophorus maculatus, X. variatus, X. reticulata*), mollies (*P. velifera, P. sphenops*), swordtail (*X. helleri*), angelfish (*Pterophyllum scalare*) and dragon fish (*Sclerophagus formosus*) in ponds and tanks.

There are about 100 ornamental fish farms occupying an area of about 150 ha in the Singapore's Agrotechnology Park, where the ornamental fish cultured are mainly for export. Capitalizing on the fact that most ornamental fishes breed in tropical climate, the country's very meticulous fish breeders have been producing exquisite varieties of ornamental fishes. With good handling and packing capabilities of the exporters coupled with its strategic geographical location, Singapore has become one of the major centers for exporting ornamental fishes in the ASEAN region, making the country as the ornamental fish capital of the world, with more than 24% share of the global export market. Reports have

indicated that annually, Singapore exports some 500 species and varieties of ornamental fishes to about 70 countries. The country's excellent logistics hub (e.g. access to the internet) helps connect the local traders to the international markets.

Thailand's ornamental fish industry has now developed into a significant income-generating sector in the country's economy. There are more than three hundred different ornamental fish species produced in captivity, such as sharks, barbs, Siamese fighting fish, catfish, gold fish, eel, loach, gourami, botia, oscar, discus, carps, etc. The country's biggest ornamental fish market is located in Chatuchak Weekend Market in Bangkok, where there are about 150 shops selling specialized species such as Arowanas, bettas, cichlids, goldfish, fighting fish, etc. as well as aquatic plants, feeds and aquarium accessories. Other markets are also located outside Bangkok, such as in Chiang Mai, Phuket, Nakorn Ratchasima, Khon Khaen, and Udon Thani (Saelee, 2005). Thailand's ornamental fish species for export are classified into 11 groups (Box 1).

Box 1: Classification of ornamental fish species exported by Thailand (Saelee, 2005)

1. Siamese fighting fish
2. Native Thai freshwater fishes (e.g. *Epalzeorhynchos* sp.: red fin shark, red tail shark, silver shark, etc.)
3. Vivaparous fish
   - 3.1 Guppy (*Poecilia reticulate*), given names according to body color, e.g. Neon tuxedo guppies, Golden tuxedo guppies, King Cobra guppies, etc.
   - 3.2 Mollies (*Poecilia latipinna*) including Balloon Platy (*Xiphophorus sp.)*
4. Gourami (*Colisa* sp.): Dwarf gourami, Blue dwarf gourami, Diamond gourami and etc.
5. Gold fish (*Carassius* sp.*)*: Runchoo, Hollunda, Comate and etc.
6. Discus (*Symphysodon* sp.*)* given names according to body color: Brown discus, Red turquoise, Green and blue, Snake skin, Solid pigeon blood and Spotted discus.
7. Angel fish (*Pterophyllum* sp.): Half black angel fish, Marble angel fish
8. Oscar (*Astronotus* sp.*)* given names based on color: Tiger oscar, Golden oscar, Albino red oscar, etc.
9. Barb (*Puntius* sp.*)*: Tiger bard, Red cheek barb, etc.
10. Peacock fish (*Aulonocara* sp.*)*: Sunshine peacock, Red peacock, Blue peacock, etc.
11. Other fishes: some native freshwater species that are listed under CITES such as Jullian's brook (*Probarbus jullieni*), Mekong giant catfish (*Pangasius gigas*), Asian arowana (*Scleropages formosus)* are prohibited for export. In addition three native freshwater species such as Dwarf clown loach (*Botia sithimunkii*), freshwater batfish (*Oreoglania siamensis*), and Siamese tiger perch (*Colus microlepsis*) are prohibited for export.

The internet has also facilitated easy access to Thailand's information on fish varieties, producers, traders, etc. As reported, Thailand's ornamental fish industry involves more than 1,500 fish producers employing more than 350,000 workers. Fish producers usually restrict themselves to breeding limited fish varieties and are required to obtain breeding license from the Department of Fisheries of Thailand, which then sends their biologists to check the sanitary conditions of their fish rearing facilities, and recommends quarantine of fishes as and when deemed necessary.

Vietnam's ornamental fish export has generated about 8M USD in 2005 and has forecasted that this value will increase in the coming years. In 2006, there were 106 ornamental fish breeding farms in the Ho Chi Minh City alone, producing more than 36 million fish and exporting 3.5 million pieces to Singapore, Thailand, United States, China and other countries. The country's ornamental fish export includes the flowerhorn, red discus and carps, accounting for 15% of the country's total ornamental fish export. Concerned with the negative effects of introducing alien aquatic species,

Shops in Chatuchak, largest ornamental fish market

the Vietnamese Government has banned the importation of exotic species by the industry, after learning lessons from other ASEAN countries.

Conclusion and Way Forward

Having tropical climate ideal for breeding and growing wide varieties of ornamental fishes, many countries in the ASEAN region has the potentials to increase the supply of ornamental fishes in the world market. With breeding and culture technologies already available coupled with expert technicians, breeders and growers, the ASEAN region can easily achieve the goal of making the ornamental fish trade a multi-million dollar industry (Box 2). Contributing much to the region's economy, the region's ornamental fish industry could also improve the livelihood of the small-scale fishermen.

Being tropical in nature and sturdy, many ornamental fishes can be easily bred and produced in captivity. Captive breeding of marine ornamental fishes is also a means of relieving too much pressure on the coral reefs due to the use of destructive collecting methods. However, the region's ornamental fish producers should be careful in breeding ornamental fishes and be responsible in their culture operations. The cases of the flowerhorn in Malaysia and the janitor fish in the Philippines should be considered classic examples of some alien species going wild. Another reported case of alien species in the wild is the presence of lionfishes in North and South American waters.

A member of the scorpion fish family (Scorpaenidae) and sub-family Pteroinae, the lionfish is native to the Indo-Pacific region from Australia to Malaysia, and from north to southern Japan and South Korea. It has venomenous dorsal, pelvic and anal spines, and is highly carnivorous. The recent reported sighting of the Indo-Pacific lionfishes (*Pterois volitans*) along the east coast of the USA means that populations of the lionfish must have already established in the Western Atlantic, which could have an impact on biodiversity.

References

BFAR. Philippine Fisheries Profile, 1978-2003

Mutia, M.T. M. 2006. Overview of the Aquarium Fish Industry. Lecture presented during the National Training on the Breeding and Production of Freshwater Ornamental Fish for the Fisherfolk: Luzon, Visayas and Mindanao Clusters. National Fisheries Biological Center, Butong, Taal, Batangas, Philippines, 11-14 September 2006, and 12-16 November 2006.

Mutia, M.T. M. 2007. Status of Freshwater Ornamental Fishes in the Philippines. Paper presented during the FishLink 2007, Iloilo Grand Hotel, Iloilo City, Philippines, 17-19 May 2007.

Pomeroy R.S. and Balboa C. 2004. "The Financial Feasibility of Small-Scale Marine Ornamental Aquaculture in the Philippines." Asian Fisheries Science 17 (2004): 365-376. Asian Fisheries Society, Manila, Philippines.

Saelee, W. 2005. "Production in Aquatic Peri-urban Systems in Southeast Asia: The Current State and Potential of Ornamental Fish Production in Bangkok, Thailand." PAPUSSA, ICA4-CT2002-10020, Bangkok, Thailand.

Suvaris, J.P. 2007. The Trade in Marine Ornamentals. Paper presented during the FishLink 2007, Iloilo Grand Hotel, Iloilo City, Philippines, 17-19 May 2007.

Box 2: Trading of Ornamental Fishes in the ASEAN Region

Country	2000	2001	2002	2003	2004
Brunei Darussalam					
Export Value ('000 USD)	-	19	8	35	-
Import Value ('000 USD)	129	126	133	218	145
Re-Export Value ('000 USD)	-	162	-	-	-
Cambodia					
Export Value ('000 USD)	13	33	37	83	17
Import Value ('000 USD)	-	-	-	-	5
Indonesia					
Freshwater fishes					
Export Value ('000 USD)	3,917	5,836	4,624	4,644	6,591
Import Value ('000 USD)	205	382	212	400	712
Marine fishes					
Export Value ('000 USD)	8,924	7,886	8,024	8,728	6,798
Import Value ('000 USD)	-	20	24	64	35
Lao PDR					
Export Value ('000 USD)	-	-	-	2	-
Malaysia					
Export Value ('000 USD)	8,219	10,583	17,559	14,147	18,361
Import Value ('000 USD)	4,493	3,755	4,916	3,971	3,681
Re-Export Value ('000 USD)	3,301	3,790	-	4,754	20
Myanmar					
Import Value ('000 USD)	19	49	7	11	10
Philippines					
Export Value ('000 USD)	6,737	6,497	6,439	6,729	7,346
Import Value ('000 USD)	30	4	-	83	-
Singapore					
Export Value ('000 USD)	43,502	41,581	41,460	41,427	49,528
Import Value ('000 USD)	10,107	9,927	11,274	13,334	13,955
Thailand					
Export Value ('000 USD)	2,446	3,370	5,245	7,392	9,864
Import Value ('000 USD)	185	28	40	128	647
Vietnam					
Import Value ('000 USD)	142	40	58	40	43
TOTAL					
Freshwater fishes					
Export Value ('000 USD)	64,834	57,919	75,372	74,459	91,707
Import Value ('000 USD)	15,310	14,311	16,640	18,185	19,198
Re-Export Value ('000 USD)	3,301	3,952	-	4,754	20
Marine fishes					
Export Value ('000 USD)	8,924	7,886	8,024	8,728	6,798
Import Value ('000 USD)	-	20	24	64	35

Source: *FAO Fishstat Plus 2006*

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Assisting ASEAN Fish Processing SMEs Meet Safety and Quality Assurance Requirements

Yeap Soon Eong, *Ira Hariono* and *Virgilia T. Sulit*

A major source of animal protein among the Southeast Asians, traditional fish products also represent a significant component of fish utilization in the region accounting for 30-45% of the total landed catch (Yeap and Tan, 2002). The production of these economically and culturally important products is an important means of preserving fish in the developing countries where storage facilities for fresh fish are rather scarce.

Yagi (2006) reported that in 2003, the value of internationally traded fish and fishery products amounted to more than USD 68.0 billion, of which about 48% was supplied by the developing countries. Among the major importers of fishery products from the ASEAN region are the US, EU, and Japan. In 2004, the export of fishery products from the ASEAN countries to Japan amounted to USD 2.9 billion or about 20% of the total value of fish and fishery products imported by Japan. However, the developing countries are faced with difficulty in coping with the food safety requirements imposed by the importing countries because of technical and financial constraints.

In the Southeast Asian culture, condiments and seasonings produced from fish materials are integral part of the people's meals to perk up soups or simply as dips or spicy accompaniments. The most popular condiments in the region are fish sauce and fermented fish or shrimps (known in the region's local languages as either *bagoong, sambal belacan, terasi, budu, cincaluk, patis, pha ork, nam pla, hmyin ngapi, kecap ikan, teuk trey*, etc.). The production of condiments and seasonings in the region through fish processing is an industry in itself.

For economic as well as cultural reasons and as a means of maximizing the utilization of fish catch, the production of traditional fish products, which contribute largely to providing additional protein supply for the ASEAN populace and to the region's food security, should therefore be promoted. However, there are various issues and concerns in the sustainable production of traditional fish products. One of the most important concerns is the need to provide appropriate support to the fish processing industry especially in the development and adoption of safety standards for the well-being of the consumers.

The ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium "Fish for the People" convened in Bangkok, Thailand in November 2001, recognized the need to improve the quality of the traditional fish products as these are oftentimes far from satisfactory. The consumers, increasingly becoming aware of the hygiene requirements, are demanding for better quality of the fish products that they eat. Since fish processing in the region is usually done by small-scale industries, the Conference in its adopted Resolution on Sustainable Fisheries for Food Security for the ASEAN Region, stipulated the need to "improve post-harvest technologies to ensure fish quality assurance and safety management systems, which are appropriate for small- and medium-sized enterprises in the region, taking into account the importance of traditional fish products and food security requirements" (***Resolution 14***). Guided by the Resolution, the Conference also adopted the Plan of Action which included the need to "develop and apply fish quality and safety management systems that ensure food safety and support the competitive position of ASEAN fish products on world markets through the implementation, validation and verification of Hazard Analysis and Critical Control Point (HACCP) based systems and improved laboratory practices, and adapting quality and safety management systems so that they may be applied to small and medium enterprises in the ASEAN region" (SEAFDEC, 2001).

Towards this end, the Southeast Asian Fisheries Development Center (SEAFDEC) through its Marine Fisheries Research Department (MFRD) based in Singapore, has been conducting R&D on the development of sustainable fisheries post-harvest technology. With financial support from the Trust Fund Program of the Government of Japan, MFRD's programs concentrated in the development of two major areas, namely: fish processing and packaging technology; and fish quality management. The program on fish processing and packaging technology focused on the improvement of processing and packaging of traditional fish products as well as the development of value-added products from low-value, under-utilized pelagic fishes. For fish quality management, MFRD conducts R&D on heavy metals and chemical residues (e.g., pesticides, antibiotics) in fish and fishery products, and also on hazard analysis and critical control point (HACCP) procedures for the traditional fish processing industry.

Manual labor in ASEAN fish processing

Safety and Quality of ASEAN Fishery Products: Issues and Concerns

For the ASEAN region, it has been recognized that traditional fish products are cheap sources of protein for human consumption. The region has a wide range of processed products, varying from country to country according to traditional processing practices, such as boiled, dried, salted, smoked, marinated, fermented, minced and powdered. However, most of these traditional fish products are usually of low value and supplied for domestic market, except for some specialized products such as fish sauce that are exported to the US, EU as well as to Japan. These concerns have been taken into consideration during the production of the Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Post-Harvest Practices and Trade under the SEAFDEC Project on the Regionalization of the Code of Conduct for Responsible Fisheries, which was funded by the Government of Japan Trust Fund Program.

Most of the traditional fish products in the ASEAN region are produced through backyard processing and their production has been a source of income generation and rural livelihood. However, the region's fish processing industry is faced with constraints that include seasonal availability and low quality of raw materials since the materials used are mostly the fish by-catch, leading to seasonal production and to some extent low-quality of the products. In general, processors are poorly educated, lack the know-how in preservation as well as in standardized processing techniques, and do not have access to skills development and information on food hygiene. This makes it difficult for the processing industry to comply with the safety and quality standards and requirements.

The absence of proper infrastructures and the unsanitary surroundings make some traditional processes not hygienic which lead to low quality and market value. With many processors not equipped with ample knowledge in marketing strategies, most products end up in local markets only. Nevertheless, it is important to maintain the confidence of seafood safety and quality assurance for the traditional fish processing industry. Attention should therefore, be given to the development and implementation of food safety standards for the traditional processing methods to ensure food security. Like in some progressive ASEAN countries,

Vietnam has established a competent authority through its National Fisheries Quality Assurance and Veterinary Directorate (NAFIQAVED) of the Ministry of Fisheries, which is tasked to manage and control the quality, safety and hygiene assurance conditions in its fisheries sector "from farm to table."

Moreover, many countries in the region also lack the necessary regulatory tools related to food safety and quality, especially regulations and standards on quality, safety and hygiene for fishery products that meet the requirements of the domestic as well as the foreign markets. The adoption of good manufacturing practices (GMP) and standard sanitation operating procedure (SSOP) should be enforced as there have been reported cases of adulteration in some of the region's traditional fish products and some incidence of food-borne diseases. These are the concerns being addressed in the projects and activities of SEAFDEC/MFRD, and related SEAFDEC initiatives that are in consonance to the articles in the Regional Guidelines, specifying the development of appropriate guidelines in food safety measures such as GMP; and providing appropriate technical and other assistance to the various kinds of SMEs in order to ensure the effective implementation of the applied safety measures taking into account economic, social, environmental and nutritional aspects (SEAFDEC, 2005).

Backyard fish processing common in many countries in the ASEAN region (top); and fish fermentation by direct exposing to sunlight, sometimes in exposed jars (above)

Thus, with financial assistance from the Government of Japan Trust Fund Program, MFRD implements a project mainly aimed at assisting the SMEs in the fish processing industry. The project, Quality Assurance Systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries specifically aims to develop GMP/SSOP programs for SME Fish Processing Establishments in the ASEAN; and promote the implementation of GMP/SSOP as first step towards the implementation of HACCP by the SMEs and help the SMEs in meeting the safety and quality assurance requirements for their products.

ASEAN SMEs and Fish Processing Industry

The fish processing industry in the ASEAN region is basically dominated by the small- and medium-sized enterprises (SMEs). The varying definitions of SMEs in the ASEAN countries could be based on their capital assets or in the number of employees working in the establishments. Although in some countries, traditional (Malaysia) and micro industries are also reported to be engaged in fish processing. Micro establishments are those with less than USD 32,600.00 capital assets and employing 1-9 workers (Philippines).

Generally, SMEs in the region employ household labor and most establishments are home-based utilizing backyard areas with simple facilities, usually managed by traditional processing families or communities. The ASEAN SMEs engaged in fish processing comprised mainly of two types: (1) Pre-Processing Establishments (PPE) which produce semi-processed raw materials for inputs in main processing establishments; and Traditional Products Processing Establishments (TPE) which produce products for the market. Brunei Darussalam, Lao PDR and Singapore have only TPEs and no PPEs.

Many processors do not have access to improved technology and information on food hygiene and good manufacturing practices. As a consequence, food-borne illnesses occur that affects production and stability of household earnings. Since products are processed in unhygienic conditions, this usually results in low product quality and possible contamination of the products with pathogens. The ability of SMEs to apply HACCP programs is necessary to improve product safety and quality. However, this would require technological,

Fish being prepared for fillet processing

manpower and financial resources, which many SMEs do not possess. This may also require processing to be relocated to more formal premises, which needs investment aside from possibly causing labor displacement. The region's fishery products are mostly traded in domestic markets except for some products which are exported by some ASEAN countries to the US, EU and Japan. The need to expand the export market for the fishery products should be explored for the upliftment of the region's economies.

Pre-Processing Establishments (PPEs)

PPEs are mainly involved in such activities as preparing materials for frozen shrimp, crab meat picking, squid cleaning, fish filleting or loining, mollusk or bivalve shucking, preparing fish for otoshimi and surimi, etc. In preparing for frozen shrimp, the process includes washing, skinning, peeling and deheading. For the preparation of otoshimi and surimi, the process involves de-gutting, de-heading, and de-skinning. PPEs are usually located near fish landing areas or near shrimp farms or scattered in coastal areas close to the source of raw materials. In some cases, PPEs are operated by owners of processing plants. PPEs do not uausally have proper and formal working areas where processing is done in open space or in fish landing jetties exposing the raw materials and products to flies and other disease-carrying insects. There is also the problem of unavailability of ice and potable/clean water, and with harsh

Box 1: Major Fishery Products/Activities of PPEs and TPEs in the ASEAN Region

ASEAN Countries	Fishery Products/Activities	
	PPE	TPE
Brunei Darussalam	NA	Fermented (*belacan*/shrimp paste), Fish/shrimp crackers Comminuted/value-added products, Smoked fish, Dried salted fish, Marinated fish, Barbecued fish
Cambodia	Crab peeling, Shrimp peeling	Fish sauce, Shrimp paste, Fermented fish (*prahok*) Slated dried fish (snakehead)
Indonesia	Fish filleting, loining, Crab meat picking Squid skinning and cleaning, Shrimp peeling	Dired salted fish, Salted boiled fish (*pindang*) Fermented: fish paste, *peda, wadi, rusip, bakasang*, Smoked fish, Fish cracker, Fish floss, Minced fish product: fish ball
Lao PDR	NA	Fermented fish: *padek, pasome, pachao,* Fish sauce, Dried fish, Smoked fish
Malaysia	Raw materials for frozen shrimpMaterials for canning fish and shellfish Otoshimi and surimi materials	Otoshimi and surimi-based products: fish ball/cake Fermented products, Salted-dried products, Boiled and smoked fish, Fish cracker (*keropok lekor*)
Myanmar		Fermented products, Dried products, Smoked products, Salted products, Fish paste, Fish sauce
Philippines	Salted shrimp for shrimp paste, Crab meat picking	Fish sauce, Fish paste (boneless), Smoked fish, Dried fish, Bangus fillet, deboned, choice cut (belly)
Singapore	NA	Fish ball, Fish cake, Fish *otah*
Thailand	Fish fillet, Tuna loinSquid, Shrimp	Dried shrimp, Dried fish, Fish sauce, Fish cracker
Vietnam	Peeling, de-heading, degutting, de-skinning, filleting (depending on raw materials involved)	Dried: shrimp, fish squid, Fish sauce, Fermented: tiny shrimp paste, fish paste


drying of fish crackers on cement ground

tropical temperature changes the quality of the products deteriorates fast. The major activities and products of the PPEs in the ASEAN region are shown in **Box 1**.

In some countries, HACCP-based programs are in place especially for export-oriented (commercial scale) processing establishments, but many PPEs that supply the materials to the commercial processors do not adopt the HACCP-based programs, so the risks is eventually channeled to the final processed products.

Traditional Products Processing Establishments (TPEs)
TPEs produce the finished fishery products ready for the market, such as dried or salted shrimp, squid or fish, fermented shrimp or fish, fish sauce, snacks such as fish or shrimp cracker, surimi-based products, etc. Most TPEs are not mechanized and are operating manually in backyards. Possible contamination of the products by disease-causing elements could take place from handling, preparation and processing due to the unsanitary surroundings thereby producing poor quality products. Most workers are family members or from extended families, and often lack awareness on food hygiene requirements and oftentimes they do not see the need of implementing HACCP since they have been operating for many years without their products causing adverse effects on the consumers. This is coupled with the fact that in some countries there are no skilled food inspectors and many establishments have limited food analysis capacities. The major activities and products of the TPEs in the ASEAN region are shown in Box 1.


Dried fish ready for the market

Action Plan

In an effort to assist the ASEAN fish processing SMEs meet safety and quality assurance requirements and as part of the implementation of the Project on Quality Assurance Systems for Small and Medium-Sized Fish Processing Establishments in ASEAN Member Countries, SEAFDEC/MFRD convened the Regional Planning Meeting in Singapore from 20 to 21 June 2007. Participated in by representatives from the ASEAN member countries and Japan, the Meeting finalized the national pilot projects for the development of GMP/SSOP programs for PPEs and TPEs. The pilot project activities in the countries will be implemented on cost-sharing basis with considerable operating funds to be provided by the Trust Fund Program of the Government of Japan while the capital outlay, other related expenditures and personnel requirements will be provided by the participating countries.

The Project, which will run from June 2007 until December 2011 with MFRD as the Lead SEAFDEC Department in-charge of managing, coordinating and monitoring all activities, is expected come out with three major outputs, namely, GMP/SSOP programs for SMEs (PPEs and TPEs); Manuals on GMP/SSOP to promote their implementation by the SMEs; and pilot projects on GMP/SSOP implemented in cooperation with the SMEs. In order to achieve the expected outputs, the Meeting considered the list of products for development of GMP and SSOP for PPEs and TPEs through the pilot projects in respective countries (**Box 2**).

Box 2: Approved Products for Development of GMP for PPE and TPE through the National Pilot Projects

ASEAN Countries	Products	
	PPE	TPE
Brunei Darussalam	NA	Fermented fish paste(*belacan*)
Cambodia	Crab meat (picking)	Fermented fish paste (*prahok*), Salted dried fish (snakehead)
Indonesia	Fish fillet (for surimi)	Salted boiled fish (*pindang*)Salted dried fish
Lao PDR	NA	Fermented fish; Dried fish
Malaysia	Shrimp peelingFish dehead/ degut (for surimi/otoshimi)	Fermented fish (*keropok lekor*)Dried fish
Myanmar	Shrimp peeling/ deheading/ sizing	Fermented fish (pickled fish), Fish cracker
Philippines	Shrimp salting (for shrimp paste) Crab meat (picking)	Smoked fish Milkfish filleting (for choice-cut belly)
Singapore	NA	Fish balls/ fish cakesFish *otah*
Thailand	Shrimp peeling	Fish sauce; Dried shrimp
Vietnam	Shrimp deheading Cuttlefish/ squid preparation (degutting, deskinning, semi dried)	Fish sauceFermented tiny shrimp paste

References

SEAFDEC. 2001. Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region. Adopted during the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium "Fish for the People", 19-24 November 2001, Bangkok, Thailand.

SEAFDEC. 2005. Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Post-Harvest Practices and Trade. SEAFDEC Marine Fisheries Research Department, Singapore. April 2005, 58 pp.

Yagi, N. 2006. Seafood Safety: An Attempt to Coordinate Between Exporting and Importing Countries. Paper presented during the Workshop on Policy Coherence for Development in Fisheries, 24-25 April 2006, Paris, France.

Yeap, S.E. and Tan, S.M. 2002. Issues facing the traditional fish products industry in Southeast Asia. 9th JIRCAS International Symposium 2002: "Value Addition to Agricultural Products". p. 115-121.

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Seafood Quality Assurance Program for Small-Medium Enterprises in Japan

Masaki Kaneniwa and *Masataka Satomi*

This article is based on two papers presented by the authors during the Regional Planning Meeting on Quality Assurance Systems for Small and Medium Sized Fish Processing Establishments in ASEAN Member Countries convened by SEAFDEC Marine Fisheries Research Department in Singapore, 20-21 June 2007 under the Japanese Trust Fund II Project.

The Fishery Products Industry of Japan

In Japan, fishery products are very important because they account for 20% of the protein supply (40% of the animal protein) of its people taken from foods, and their nutritious benefits have been more recognized in recent years. The significance of fishery products in the Japanese diet is greater than those in the diets of peoples from other countries. Therefore, the safety and reliability of fishery products are of utmost importance for the wellbeing of its people and assuring them of safe fishery products that they eat.

As of 2003, reports have indicated a variety of fishery products in Japan with more than 11,000 food processors providing such products in the market (Table 1).

The fishery products in Japan are classified into: surimi (fish paste) based products (Kamaboko), frozen food, and other fishery products, e.g., dried salted fish (Hiraki-boshi), cured fish (Katsuobushi), etc. (Fig. 1). Japan's total production of fishery products in 2004 was 2.6 million mt. Although fishery products processors vary in size from large to small in terms of production scale, more than 99% of seafood processors in Japan are categorized as small-medium sized (under 300 employees) as shown in Table 2.

Table 1. Fishery products processing plants in Japan (as of 1 November of each year)

Year	Total	Canned & Bottled	Paste	Frozen Food	Salted & Dried	Feed & Fertilizer
1988	13,674	135	2,422	560	5,404	236
1993	12,575	107	2,163	527	4,866	199
1998	11,272	80	1,929	430	4,212	159
2003	11,465	84	1,929	509	3,732	129

Source: *Results of Census of Fisheries from 8th to 11th, Statistics Department, Ministry of Agriculture, Forestry and Fisheries (http://www.maff.go.jp/toukei/abstract/1_9/43c.htm)*

Quality Assurance Program for Seafood in Japan

Japan has adopted a Quality Assurance Program for Seafood Products, which include: (1) Policies for Application of HACCP System; (2) Certification for Export of Seafood; and (3) Improvement and Enhancement of Labeling.

Policies for Application of HACCP System

In Japan, two major policies for the application of HACCP system have been put in place. These are: (1) Approval system for comprehensive sanitary controlled manufacturing process; and (2) Temporary law on the advancement of management of production process of foods.

As a food safety control system, the hazard analysis and critical control point (HACCP) system had been introduced in Japan through the Ministry of Health, Labour and Welfare (MHLW). Using the HACCP system, MHLW aims to advance sanitary management at respective stages in the production and processing of foods. In 1995, the MHLW revised Japan's Food Sanitation Law with the establishment of the Approval System for Comprehensive Sanitary Controlled Manufacturing Process based on HACCP. The food products covered in this approval system are: milk, dairy products, meat products, foods packed in containers or packaged and pasteurized under pressure, fish paste products, non-alcoholic beverages, etc. By the end of May 2007, the MHLW approved 36 cases of fish paste products under this system (MHLW, *http://www.mhlw.go.jp/topics/bukyoku/iyaku/syoku-anzen/jigyousya/sougoueisei/index.html*).

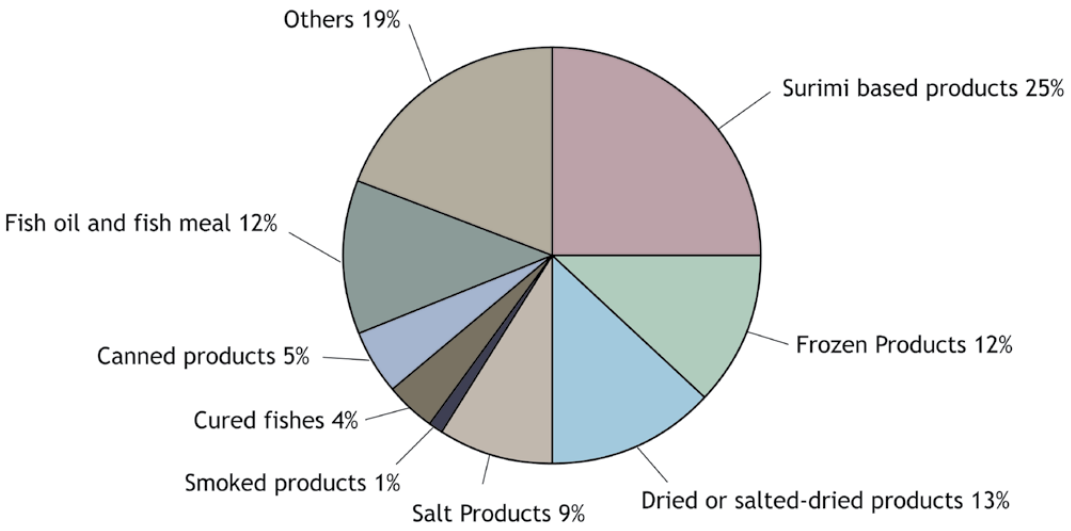

Figure. 1. Japan's production of fish-based products in 2004 (http://www.maff.go.jp/toukei/abstract/1_9/46.htm)

Table 2. Small and medium-sized processing plants (under 300 employees) and big-sized plants processing fishery products in Japan

Size (no. of employees)	Canned Seafood & Seaweeds		Seaweed products except canned		Fish paste products		Salted-dried and salted products		Frozen seafood (unprocessed and packaged)		Frozen seafood (processed and packaged)		Miscellaneous seafood products	
	no	%	no	%	no	%	no	%	no	%	no	%	no	%
4-299	132	(99.2)	901	(99.9)	1080	(99.2)	809	(100.0)	445	(100.0)	1062	(99.9)	3283	(99.8)
> 300	1	(0.8)	1	(0.1)	9	(0.8)	0	0.0	0	0.0	1	(0.1)	6	(0.2)

***Source**: http://www.meti.go.jp/statistics/kougyou/2004/k3/h16-k3-data-j.xls*

As concerns have increased about the quality and safety of fishery products for food, the producers were called upon to exert efforts in hygiene management including the application of the HACCP system. However, many producers found it difficult to apply the HACCP system since it requires equipment investments and most of them are small-sized enterprises. Thus, the Temporary Law on the Advancement of Management of Production Process of Foods was enforced in July 1998 in order to support the upgrading of the facilities of food producers and processors, and encouraging them to adopt more sophisticated management schemes in the production processes based on the HACCP system.

In order to facilitate implementation of the Temporary Law, loans were provided by the Agriculture, Forestry and Fisheries Finance Corporation for the development of facilities that are required for the upgrading of control and manufacturing processes by food enterprises in order to promote the adoption of HACCP methods. Moreover, measures were undertaken by Japan for the modernization of its small-medium enterprises (SMEs) in the fishery products industry. Information related to such measures (Box) was extracted from the White Paper on SMEs in Japan (2001-2006) of the Small and Medium Enterprises Agency (*http://www.chusho.meti.go.jp/sme_english/whitepaper/whitepaper.html*).

1) Surimi (fish paste) based products (Kamaboko); 2) Dried-Salted fish (Hiraki-boshi); 3) Frozen food; and 4) Cured fish (Katsuobushi)

Measures for modernization of SMEs in the fisheries industries of Japan
(extracted from White Paper on SMEs in Japan, 2001-2006; Small and Medium Enterprises Agency, http://www.chusho.meti.go.jp/sme_english/whitepaper/whitepaper.html)

Fiscal Year	SME Policies	Budget (million ¥)
2001	Subsidies are provided for activities to upgrade quality and hygiene control through comprehensive adoption of HACCP at all stages, from production to consumption of marine food products as well as new aquaculture techniques.	134.00
2002	Subsidies are provided for activities to upgrade quality and hygiene (adoption of HACCP) of marine products.	110.00
2003	Steps should be taken to promote the introduction of HACCP procedures at marine product processing plants to provide consumers with safe and reliable marine products. Comprehensive measures should also be taken to establish concrete standards to raise hygiene control at markets in areas of production, provide support to ensure their adoption, and draw up new manuals for the production of low salt, high water content marine products.	153.00
2004	Steps should be taken to promote the introduction of HACCP procedures at marine product processing plants to provide consumers with safe and reliable marine products. Comprehensive measures should also be taken to establish concrete standards to raise hygiene control at markets in areas of production, provide support to ensure their adoption, and draw up new manuals for the production of low salt, high water content marine products. In addition, in order to develop the conditions suitable for the introduction of HACCP, "HACCP Sanitation Level Standards" will be developed to provide benchmark by which to assess the hygiene level of individual businesses, and assessments in accordance with the said standards will be promoted.	167.00
2005	Steps should be taken to promote the introduction of HACCP procedures at marine product processing plants to provide consumers with safe and reliable marine products. Comprehensive measures should also be taken to establish concrete standards to raise hygiene control at markets in areas of production, provide support to ensure their adoption, and draw up new manuals for the production of low salt, high water content marine products. In addition, in order to develop the conditions suitable for the introduction of HACCP, "HACCP Sanitation Level Standards" will be developed to provide benchmark by which to assess the hygiene level of individual businesses, and assessments in accordance with the said standards will be promoted.	150.00
2006	In order to reinforce a marine-product supply system so that it may be trusted by consumers, steps should be taken, including introduction of HACCP procedures at marine product processing plants, issuance of guidelines on implementation of hazard analysis and sanitation control for each item to support small marine processors in adopting HACCP systems, and evaluation of sanitation performance at marine product processing plants using the "HACCP Sanitation Performance Standards" and also giving advice based on such evaluations. In addition, markets with controlled sanitation performance will be popularized through issuance of guidelines on quality control according to the characteristics of each market in producing centers, and by approving and having public entities with good sanitation management announces in markets in the producing centers.	122.00

Certification for Export of Seafood

The Certification for Japan's Seafood Export to the United States was established by the MHLW and the Ministry of Agriculture, Forestry and Fisheries (MAFF). The Director of Inspection and Safety Division of the Department of Food Safety, MHLW issues the "Directive for US Export Seafood Processors" to the local governments at the Prefecture level. The directive stipulates that when a processor wishes to obtain certification from MHLW to be able to export seafood to the United States (US), the processor must comply with the FDA Seafood HACCP Regulation and Good Manufacturing Practice Regulation (21 CFR part 110 and 123).

The directive also requires designated food sanitation inspectors in the prefecture governments to inspect the processing facilities based on the aforementioned regulations, in addition to the usual inspection conducted in accordance with the Food Sanitation Law of Japan. The designated food sanitation inspectors are trained and are equipped with knowledge relevant to 21 CFR 110 and 123.

For seafood export to the European Union (EU), the MHLW elaborated on the rules and regulations so that each exporting processing plant is required to process the seafood under its own-control system based on HACCP and to comply with all the pertinent requirements by the EU. The list of certified seafood processors allowed to export seafood to the US and EU are announced officially on the website of MHLW and MAFF. As of the end of May 2007, about 90 processing plants were certified to export seafood to the US while 20 processing plants were certified to export seafood to the EU.

Improvement and Enhancement of Labeling

Since occurrences of fraudulent food labeling were observed in Japan since July 2000, various measures were developed and adopted to improve the labeling of the country's fishery products. Thus, it has been required that the label of each fresh fishery product must show the name and place of origin of the product under the Japan Agriculture Standards Law, and also to indicate in the label whether the product is "defrosted" or "cultured" as the case may be. Moreover, starting in April 2001, it has been required that the label of each processed food must indicate the "ingredients" and "use-by date". Since February 2002, the label of each designated processed item such as salted mackerel, etc. should show the "place of origin of its raw material". Currently, there are six (6) designated processed items that are required to show this label.

In order to make the labels easily understood, two sets of guidelines were established and adopted: (1) Guidelines for the Names of Fish and Shellfish, which were implemented since April 2003; and (2) Guidelines for Indication of Place of Origin (the Producing Water Area) of Fresh Seafood implemented since July 2003.

In September 2004, the "labeling standards for processed foods" were revised requiring to also include in the label the place of origin of main ingredients of all processed foods close to fresh foods such as dried young sardines (shirasu boshi) and lightly-roasted sliced bonito (katsuo no tataki). These two are in addition to the six processed products (e.g., salted mackerel) to which such requirements have already been applied. The revised labeling for these groups became obligatory starting in October 2006.

dried young sardine (shirasu boshi); and lightly-roasted sliced bonito (katsuo no tataki)

In Japan, the national and prefectural governments have implemented surveillance and guideline regarding compliance of food label regulations by conducting on-site inspections and regular monitoring surveys at food stores. A nationwide telephone number has been established for food label inquiries and to collect information on food labeling from a wide range of people. In July 2005, the MAFF formulated guidelines for the labeling of place of origin of ingredients used in the food service industry.

Related Topics on Food Safety and Reliability of Seafood in Japan

Traceability of Seafood

The establishment of a traceability system of seafood is important for the safety and reliability of the seafood products. In Japan, the Japan Fisheries Association and the Fishing Boat and System Engineering Association initiated a traceability system of seafood based on the EU TraceFish system with subsidy from the MAFF. Known as the J-FISH system, this traceability system facilitates verification by consumers on such data in the labels as "place of capture of fish", "time of capture of fish", "changes in temperature during transport", etc. and in case of inquiries and complaints, to input the "traceability number" of the products in the website http://www.j-fish.net/.

ISO 22000

In September 2005, the International Organization for Standardization (ISO) published a new food safety management system based on the HACCP, which is officially called ISO 22000 for Food Safety Management Systems-Requirements for any organization in the food chain. This system, which is being applied in Japan, can be applied to all players in food production ranging from the feed producers, primary producers through food manufacturers, transport and

storage operators and sub-contractors to retail and food service outlets – together with interrelated ancillaries such as producers of equipment, packaging materials, cleaning agents, additives and ingredients. ISO 22000 is the food safety system from "farm to table."

Histamine Accumulation in Fish Sauce Fermentation in Japan

A research was conducted at the National Research Institute of Fisheries Science of the Fisheries Research Agency of Japan on controlling histamine accumulation during fish sauce fermentation in Japan, considering that fish sauce is a common and traditional condiment not only in Southeast Asian countries but also in Japan. In the production of fish sauces, small fishes are used and the long-term fermentation process takes about one year or more. In Japan, many kinds of fish are used in the production of fish sauce such as sardines, squid, sailfin sandfish, etc. Recently, fish sauce production in Japan has increased as the fishing industry tries to reduce waste by making full use of the fish materials.

As reported, large amount of Histamine (Hm) can cause hypertension, headache, urticaria, nausea and vomiting, and that Hm accumulations have been observed to occasionally occur in fish sauces and are typically the result of decarboxylation of L-histidine (His) by certain Gram-positive bacteria. In the case of the fish sauces in Japan, *Tetragenococcus* spp. was isolated as the primary Hm producer. In order to develop a method for controlling Hm accumulation, which is the main objective of the research, it was necessary to conduct a polyphasic study on the Hm producing bacteria.

The genus *Tetragenococcus* is a member of lactic acid bacteria with its main habitat the salted environments such as soy sauce mash and salted fish products, and are known as the predominant bacteria in salted fermented foods. The role of these bacteria in salted fermented food is lactic acid production and decreasing the pH, which are useful to inhibit growth of spoilage bacteria and for addition of taste and flavor to the fish sauce. Therefore, the Hm producing bacteria will produce Hm by consuming the His present in their surroundings until pH is optimized.

The results of this research study are still being scientifically analyzed. Meanwhile, observations showed that it is difficult to control contamination of Hm producing strains because *Tetragenococcus* spp., which is dominant in salted fish product fermentation, includes the Hm producing strains. Nevertheless, many middle-small food manufacturers in Japan just pass off Hm accumulation in fish sauces because there are no regulations on Hm contents in fish sauces in Japan. However, some companies reported that keeping the fermentation tanks below 25°C or above 50°C was effective to inhibit Hm accumulation.

Since controlling the temperature below 25°C or above 50°C during fermentation needs specialized equipment and occasionally results in undesirable taste, it was suggested that fermentation starter of lactic acid bacteria be used instead. This latter method could be economical and provide stable fermentation. While there is still no specific starter culture for salted fish fermentation products in Japan, some fish sauce producers use soy sauce starter as a substitute.

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Rice-Prawn Culture: experience of Myanmar

Khin Ko Lay and Thin Thin Oo

Myanmar has a total land area of 676,577 km^2 and its population is about 54 million in 2006. As common with many of its ASEAN neighbors, rice and fish are the key staples in Myanmar. Its socio-economy is dependent on the agricultural and fishery sectors. Fresh fish, mostly from freshwater environment, constitutes a big bulk of the country's fish supply. Out the total fish production of 400,360 mt from aquaculture in 2004, production from freshwater aquaculture for the same year was 370,360 mt (93%). Of this total, giant freshwater prawn accounted for only less than 0.01% (FAO FishStat Plus 2006).

The Department of Fisheries of Myanmar is intensifying its efforts to attain increased fish production in various ways and means. Among the activities the country has recently promoted is the production of fish fingerlings for fish ponds and for replenishing depleted stocks in natural water bodies such as dams, rivers, reservoirs and rice fields during the rainy season. Another strategy being promoted is rice-cum-prawn culture, and a pilot project was conducted at Lay Daunk Kan Fishery Station of the Department of Fisheries in 2006 with the collaboration of Japan International Cooperation Agency (JICA) under the country's project on "Small-Scale Aquaculture Project for Promotion of Rural Livelihood".

Myanmar has extensive rice field resources with a network of water and shallow flooded paddy areas that could also be used as rich source for fish production. The Government of Myanmar focuses its food production in rice as well as fish, as the county's major staple food. Production of freshwater prawns in rice lands is an alternative source of income for the rice farmers. With the adoption of sustainable rice-prawn culture, the country's rice lands can also be used to produce prawns without converting these into ponds as rice and prawn can co-exist within the same rice land areas.

Rice and fish culture

Contributing largely to the country's economy, freshwater aquaculture in Myanmar has been significantly developed since the promulgation of a law relating to aquaculture in 1989. Its development is however, constrained by many factors that include inadequate supply of quality seeds and feeds, low technology, insufficient capital, etc. The Department of Fisheries of Myanmar is addressing these constraints in order to attain sustainable aquaculture development in the country. There are more than 15 freshwater commodities being cultured in Myanmar, but the

dominant species is rohu (*Labeo rohita*) followed by catla (*Catla catla*) and mrigal carp (*Cirrhina mrigala*).

The Department of Fisheries is now promoting rice-fish farming as an alternative livelihood to improve the income from rice farming, i.e. producing fish with rice in the same land area. Rice-fish culture has a very long history in many Southeast Asian countries and the technology is already available for adoption elsewhere.

In a country such as Myanmar, where vast tracts of rice lands are available, there is no problem about verifying such rice-fish culture technology and the impacts could be evaluated in the process. Rice-fish culture is therefore envisioned to benefit more families in terms of providing sufficient supply of protein and additional income for the rural communities. The country's rice-fish culture program was initiated by the Department of Fisheries in 2003 and after realizing the benefits from this program, the country proposed to give it a high priority for rural community development.

Myanmar shares the experiences and technology with the other ASEAN countries through program cooperation with the SEAFDEC Secretariat and SEAFDEC Departments, by specifically participating actively in the ASEAN-SEAFDEC Special Five-Year Program for Sustainable Fisheries Development in the ASEAN Region. In keeping up with development of the various sectors in fisheries in the region, Myanmar acquires technologies and experiences from its fellow ASEAN members. The experiences gained are utilized to achieve further development in the country's fishery activities. Specifically, the experience from other countries in the region on rice-prawn culture promoted through the Aquaculture Component of the Special Five-Year Program encouraged the country to promote the technology for food security in its rural communities. The implementation of the country's rice-prawn culture pilot project was boosted with the technical assistance from JICA.

The giant freshwater prawn

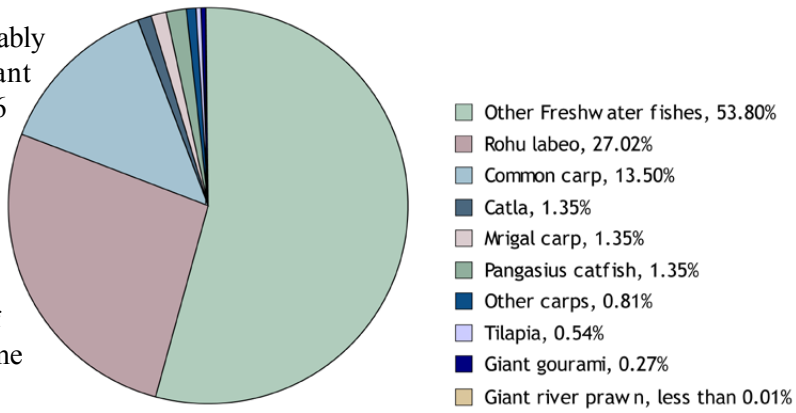
Although Myanmar's freshwater fish resource is considerably wide, very little report has been made on the giant freshwater prawn resource. The FAO Fishstat Plus 2006 indicated a very negligible data on this resource, which was below 0.01% of the country's total freshwater production from aquaculture (Figure). The Department of Fisheries of Myanmar reported three common species of the giant freshwater prawn in the country, these are: the very popular *Macrobrachium rosenbergii* (locally called "yea cho pazon htoke kyee"); and to some extent, *M. villosimanus* (locally called "yea cho pazon sark htoke") and *M. malcolmsonii (*locally called "yea cho pazon let ma kar").

As is the trend in other countries in the region, Myanmar also considers *M. rosenbergii* as an attractive alternative to the penaeid shrimps (e.g, *P. vannamei*) as the export price of the penaeid shrimp has plummeted to a record low because of over supply. Although exporters may be making good margins in the foreign trade, the penaeid shrimp farmers from Southeast Asia are not getting much profit for their produce; so many countries are now considering the giant freshwater prawn culture as an option.

Giant freshwater prawn is found throughout the warm waters of the Indo-Pacific region from India to the Philippines. However, the culture of this prawn is constrained by the non-availability of high-quality broodstock. At present, farmers still rely on the wild gravid females for the larvae. There have been many pilot projects implemented in the Southeast Asian region for the sustainable culture of the freshwater prawn.

One such project is the collaborative effort between Cantho University of Vietnam and Japan International Center for Agricultural Sciences (JIRCAS) for the seed production and culture of *M. rosenbergii* in the Mekong Delta Region of Vietnam, which resulted in the development of technology for determining the maturity of prawn spawners (Wilder and Ogata, 2004). Since prawn hatcheries largely depend on broodstock from the wild that leads to over exploitation of the natural stocks, the findings of Cantho University-JIRCAS Team give hope for the development of captive freshwater prawn spawners that can lessen the industry's dependence on wild spawners.

There are many reports indicating problems in the large-scale production of the freshwater prawns. These include stocking density as the prawns can not be cultured intensively and longer culture period. While 2-3 crops per year could be



Freshwater fish production in 2004, Myanmar (in mt, expressed in %)

attained in penaeid shrimp culture, it can take from six to ten months to grow the freshwater prawn to commercial size (1-2 crops per year). Another concern is the varying sizes of the prawns at harvest within the same culture period. Usually the prawns do not grow at the same rate and not in the desired uniform size and in most cases, there are many small sizes, priced much lower than the larger ones.

The giant freshwater prawn can command good prices in the market, and its culture technology is ready for adoption. In Thailand, some large shrimp-farming companies have invested much in freshwater prawn farming and applying good farming practices, making the quality of their prawns generally very consistent. Thailand has gone quite far in developing the aquaculture of freshwater prawns with production steadily increasing at 10,000 mt/year (Uraiwan and Sodsuk, 2004). Through the Department of Fisheries of Thailand, breeding techniques have been developed producing good quality seeds for distribution to farmers, resulting in high survival rates and impressive growth rates. Thailand has also established good production procedures for freshwater prawn aquaculture through a code of conduct similar to that established for marine shrimps. It has also embarked on a number of R&D activities aimed at improving the quality of the prawn such as its selective breeding program and the application of biotechnological approaches to genetic improvement. Myanmar is hoping that in the near future it will also be able to reach its goal of producing the giant freshwater prawns in commercial quantities.

Rice-prawn culture pilot demonstration project

In the country's initial effort to produce prawn side-by-side with rice, a one-acre rice field was used for the pilot demonstration project on growing rice with prawns. This was conducted in 2006 at the Lay Daunk Kan Fishery Station of the Department of Fisheries of Myanmar, where rice was produced for 101 days in August-November 2006 and the prawn was cultured for 88 days during the same period.

Digging of canal along the ricefield bund for prawn culture (above) and the prawn culture area (right)

Pond preparation

The preparation was done in two phases, rice field preparation and prawn stocking. In the rice field (400 ft x 100 ft) used for this project, a 2.5 ft x 2.0 ft ditch was made along the bund. The field was properly surrounded by nylon net to prevent predators from entering the field and to prevent the prawn from escaping out of the experimental field.

Harvesting

Rice and prawns were harvested on 15 November 2006 and 22 November 2006, respectively. A total of 735 of prawns were harvested with an average weight of 9.6 g and 8.7 cm and survival rate of 73.5%. The smallest prawn weighed 4 g while the biggest weighed 48 g.

Before harvesting, transverse bunds were made inside the canal and the water was drained out by hand. Then the prawns were harvested by netting and picked manually. The yield obtained from one acre of rice field was 7.56 kg of prawns while rice production was 32 baskets (one basket = 45 lbs).

Conclusion

The pilot project on rice-cum-prawn culture resulted in increased production even if 6.25% of the rice growing area was set aside in order to dig a canal for the prawn culture. In this project, it was found that the unconsumed food in the paddy field also served as fertilizer for the rice. As for prawn production, the yield was considerable during the 88-day culture period with survival rate of 73.5%. The prawns have also been observed to have used the paddy plants as shelter during molting. One of the factors that may have led to better production of rice and prawns was the abundance of water flowing through the rice field all the time during the experiment.

The prawn harvest: unequal sizes (above) and one kg harvest (right)

The farmers in that village where the pilot demonstration was conducted have become interested in stocking fish and prawn seeds in their rice fields too, and intend to conduct rice-cum-prawn culture in their next paddy growing season. Through this practice, farmers can harvest rice and prawns obtaining better production from the same area. In other words, "Two Crops in One Harvest from the Same Field at the Same Time" is a means of promoting food security in rural communities, contributing to enhance the socio-economic status of the country.

Integrated agri-aqua activities are now gaining importance in many Asian countries. As better demonstrated in China, multiple water uses vis-á-vis the integrated agri-aqua system have contributed to increasing the income in rural communities. Myanmar's initiative in carrying out this rural livelihood strategy will contribute significantly to the country's' food security. Rice-prawn culture indeed could form a vital part of the household's livelihood especially for the rural communities. The Department of Fisheries of Myanmar under the Ministry of Livestock and Fisheries, in playing its role in managing the country's fisheries and aquaculture activities, can now intensify its efforts to attain food sufficiency through increased fish production by maximizing the multiple uses of its water resource. With agri-aqua technologies already developed in other ASEAN countries as well as in neighboring Asian countries, Myanmar is already paving the way to increase food production not only for local consumption but also for sharing the surplus with its neighboring countries.

Harvesting of the prawns (top) and cleaning the produce (above)

References

FAO. 2006. Fishstat Plus 2006. FAO, Rome, Italy.

Uraiwan, S. and Sodsuk P. 2004. "The Macrobrachium Culture Industry in Thailand." In: Report of the Round Table Discussion of Genetically Improved Strain of Macrobrachium, SEAFDEC Aquaculture Department, Philippines, March 2004: 28-41.

Wilder, M.N. and Ogata, H.Y. 2004. "Development of freshwater prawn (*Macrobrachium rosenbergii*) seed production and culture technology in the Mekong Delta Region of Vietnam". In: Promotion of Mangrove-Friendly Shrimp Aquaculture in Southeast Asia. SEAFDEC Aquaculture Department, Philippines, February 2004: pp 111-118.

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Attempts to manage *Ludong Fisheries* in the Philippines

Edna V. Agasen, Elmer B. Alba, Ronnie O. Romero

Cestraeus spp., locally known as "ludong" is a rare and indigenous migratory fish species caught in northern Philippines that commands very high price. It has been recently reported that the price of ludong in Cagayan Province (northernmost province of the Philippines) ranged from ₱2,000.00 to ₱3,000.00/kg (₱50.00 = US$1.00). Its exorbitant price makes the fish affordable only to the very rich Filipinos or to foreigners and politicians (it seems that politicians resorted to buying the fish as peace offering to government officials). This situation has led to the irresponsible exploitation of the fishery resource. With increasing threat of overexploitation and environmental degradation, the Philippine Government deemed it necessary to conduct a biological study and an assessment of the fisheries of this indigenous species for management and conservation purposes.

Biology of Ludong

Ludong (*Cestraeus* spp.) is also known as lobed river mullet belonging to Family Mugilidae and recorded to be found in Asia especially in the Celebes Sea areas and New Caledonia. It migrates from freshwater to marine waters to spawn. Information on its fisheries and biology is very limited while research on its habitat and spawning is constrained by its low survival in captivity. The National Fisheries Research and Development Institute (NFRDI) as the research arm of the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) therefore initiated the country's Ludong Fisheries Development Program for the conservation of this endangered fish species. Starting in 2006, NFRDI conducted a study to gather baseline information on *C. plicatilis* to serve as basis for the formulation of management measures to attain sustainability and develop fisheries to increase production.

Literatures have cited three species of ludong in the Philippines, namely, *Cestraeus oxyrhynchus, C. goldei*, and *C. plicatilis*. Preliminary results of NFRDI's study in Cagayan River, confirmed the difficulty in identifying ludong based on morphological characteristics because *Cestraeus* spp. show almost similar characteristics, but confirmed that the species found in Cagayan River is *C. plicatilis*, supporting the findings of J.M. Thompson (1982). NFRDI is also conducting a DNA profiling of the ludong samples collected from Cagayan River.

1.3 kg gravid ludong caught by gill net in Cagayan River, northern Philippines (top); and actual gill net fishing operation in Cagayan River for catching ludong (above)

Modification of Traditional Fish Pot for Catching Ludong in Cagayan River

A related NFRDI study on the gears for freshwater fisheries resources in Cagayan River specifically in the Isabela Province and Cagayan Province areas, indicated that in Cagayan Province, gill nets were used for catching ludong, tilapia and carp; and traps (filter net, shrimp pots, traditional

fish pots) for catching shrimps, ludong, eel fry and tilapia. In Isabela Province, hook-and-line is used to catch ludong. The existing gears used for catching "ludong" in Cagayan River are not sustainable considering that the fish are already dead by the time these are taken from the net by hand, making the fish no longer useful for any biology and breeding studies. Another survey was conducted on the appropriate site for the installation of the fish pots in Cagayan River since it has been noted that the water depth of Cagayan River could be very high during floods and the amount of debris could also be large during flooding. The results indicated that it would be appropriate for the fishing gear to be set closer to the shore.

Traditional bamboo fish pot

is pointed to lessen the entrance of floating debris and also for attaching the anchor and retrieving rope. A steel anchor approximately 15 kg is used in operating the gear, which is hauled and retrieved using retrieving ropes, 10 m long and 12 mm ø or depending on the water depth. Flag markers determine the locations of the pot. Hauling is usually done after sunrise and before sunset by simply pulling off the retrieving ropes attached in between the

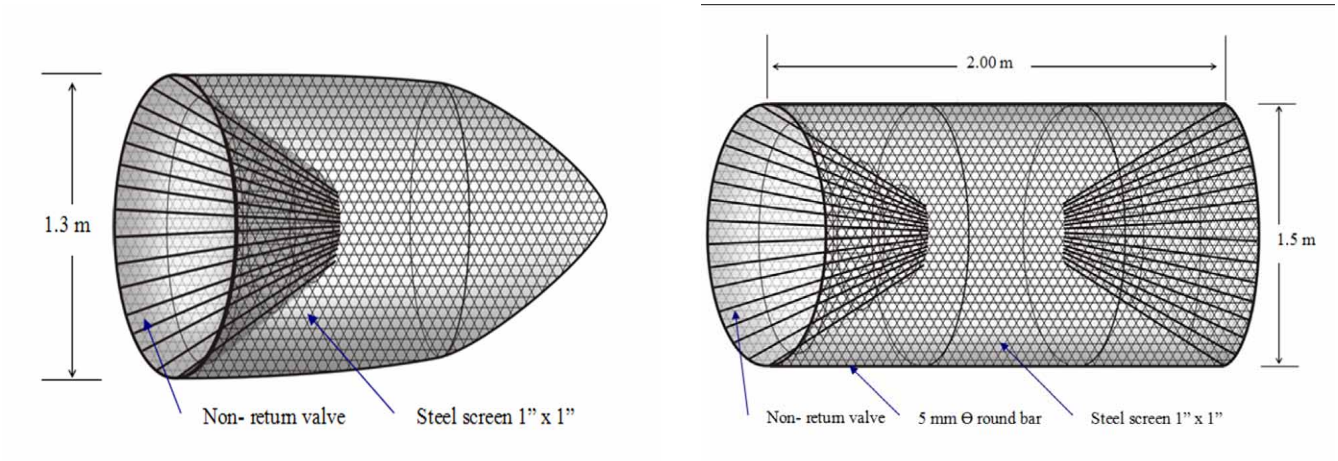
The traditional bamboo fish pot has been used by fishermen in Cagayan Province for decades to catch "ludong", carps and other freshwater species from Cagayan River. Also known as three-dimensional enticing device, this is constructed using bamboo splits and rattan woven into wickerwork like that of baskets. It is equipped with a non-return valve that allows trouble-free entrance but difficult to exit. The gear measures 1.2 m in ø and 1.5 m long. The end part is pointed to minimize the entrance of floating debris serving also as attachment area for the anchor and retrieving ropes. This gear is good only in shallow waters approximately 2-4 fathoms depth with water current of 2-3 knots.

An exit door for taking out the catch is installed at the mid center of the non-return valve and the catch is directly collected using bare hands. Due to its weak construction, the gear is not very resistant to the river's strong water currents and the pressure of the heavy debris occurring in the river especially during flooding.

Steel single entrance fish pot

As a modification of the traditional bamboo fish pot, the steel single entrance fish pot was tried in Cagayan River to catch live ludong. This gear has the same design and pattern as the traditional bamboo fish pot except that steel is used instead of bamboo and rattan.

This modified gear is supposed to resist strong water current and heavy debris and could be set in deeper waters that are approximately 5-8 fathoms deep. Its frame and braces are made of round steel bar 5 mm ø and covered with steel screen, 0.5 mm ø with mesh size of 1"x1". The frames of the non-return valve or entrance are made of the same materials supported with bamboo splits. The exit or door for taking out the catch is located at the middle part and the rear part



Modified single entrance steel fish pot (left) and double entrance steel fish pot (right)

Gilled "ludong" is removed from the net using bare hands

anchor and pots. This gear was found effective only when the "ludong" swims against the water current or after spawning in the sea.

Steel double entrance fish pot

Another modification was also tried, the double entrance steel fish pot. The gear has a total length of 2.00 m with a diameter of 1.50 m. The frames and braces are made of round steel bar 5.0 mm ø and covered with steel screen, 0.6 mm ø with mesh size of 1"x1". Entrance or non-return valves are installed at both ends with the same measurement as in the single type non-return valve. It is tubular in shape wherein the anchor is attached either in front or at the rear part of the pot. The exit or door opening for taking off the catch is located at the mid-center in between the ends of the two non-return valves. The operation of the gear is the same as that of the single entrance design and the gear has been found effective even when the target catch swims upstream or downstream.

Conclusion

The two studies conducted by NFRDI in 2006 are still ongoing and are enhanced in 2007-2008. It is the desire of the Philippine Government to intensify these two activities in order to conserve the ludong fishery resource of the country. As part of the Ludong Fisheries Development Program, the NFRDI has lined up studies to be undertaken in the next five years. These include population genetics, broodstock development and breeding trials including development of hatchery and nursery techniques, and modification of traditional fishing methods in order to develop environment-friendly and selective fishing gear for catching ludong in Cagayan River for breeding and culture purposes. Results of the studies will serve as basis in the formulation of management and conservation measures to attain sustainability and to develop the culture and breeding of this high valued species to increase production.

Related Readings

Conlu, P.V. 1986. Fishes. Guide to Philippine Flora and Fauna. Natural Resources Management Center, Ministry of Natural Resources and University of the Phil. Vol. lX. Quezon Ave., Quezon City. 495 pp.

Harrison, I.J. and H. Senou, 1997. Order Mugiliformes. Mugilidae. Mullets. p. 2069-2108. In K.E. Carpenter and V.H. Niem (eds.) FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Volume 4. Bony fishes part 2 (Mugilidae to Carangidae). FAO, Rome.

Ong, P.S., L.E. Afuang and R.G. Rosell-Ambal (eds.), 2002. Philippine biodiversity conservation priorities: a second iteration of the national biodiversity strategy and action plan..Dep't of Environment and Natural Resources-Protected Areas and Wildlife Bureau, Conservation Int Phi, Biodiversity Conservation Prog-University of the Philippines Cen. for Integrative and Dev't Studies, and Foundation for Phil Env't, Quezon City, Phil. 113 pp.

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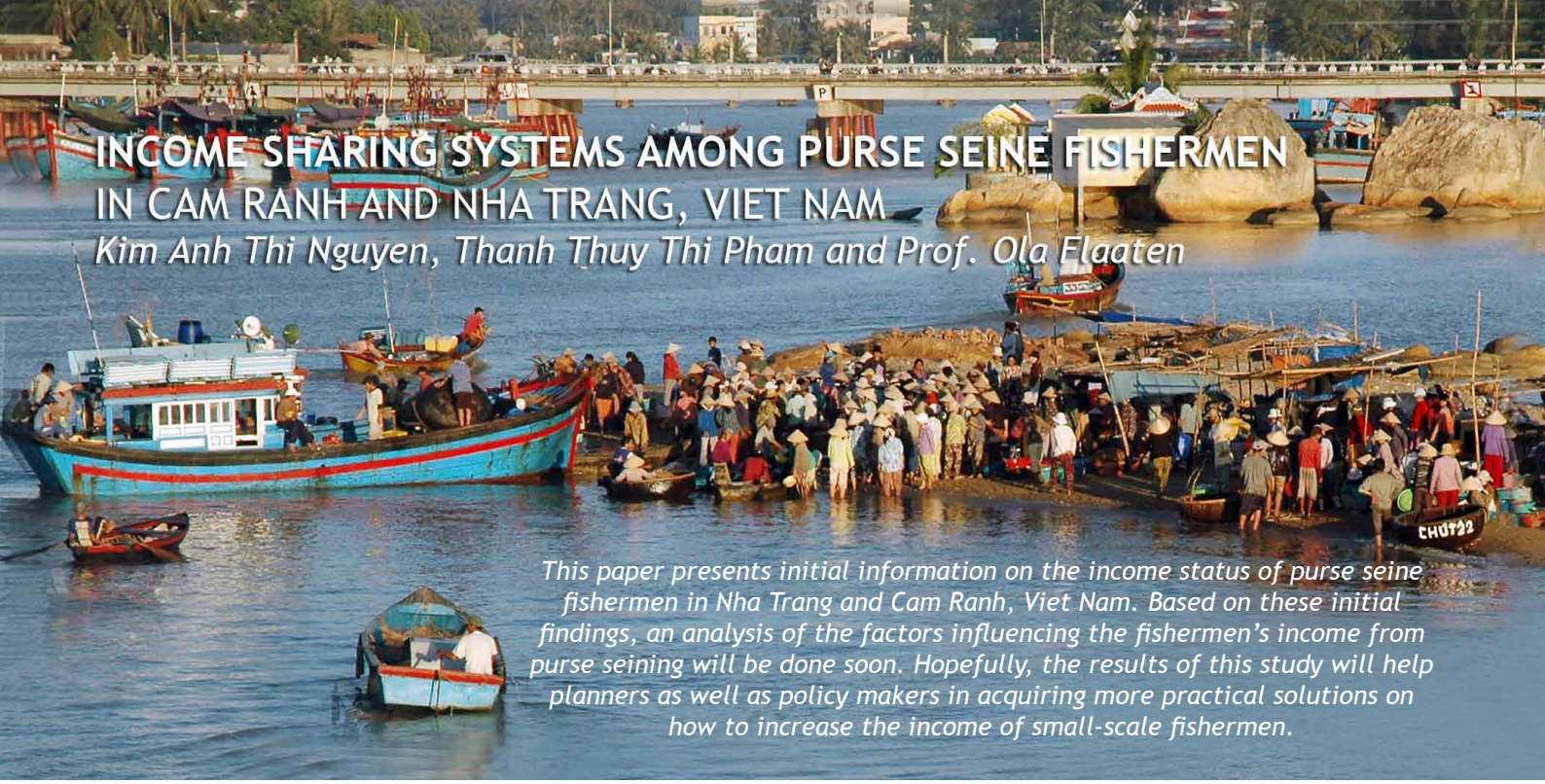

INCOME SHARING SYSTEMS AMONG PURSE SEINE FISHERMEN IN CAM RANH AND NHA TRANG, VIET NAM

Kim Anh Thi Nguyen, Thanh Thuy Thi Pham and Prof. Ola Flaaten

This paper presents initial information on the income status of purse seine fishermen in Nha Trang and Cam Ranh, Viet Nam. Based on these initial findings, an analysis of the factors influencing the fishermen's income from purse seining will be done soon. Hopefully, the results of this study will help planners as well as policy makers in acquiring more practical solutions on how to increase the income of small-scale fishermen.

It can be said that, the coastal zone has provided the fishing grounds and income sources for generations of poor fishermen who live along the coasts and earn their livelihood through traditional fishing practices, namely: trawling, purse seining, lift netting and others. In Vietnam, small-scale fishing operations contribute 86% of the total production generated by the nation's marine fisheries (Nam, 2005). Fish represents a source of local nutrition as well as the main, if not the sole, income generator in fishing communities.

Khanh Hoa is a coastal province in south central Vietnam bordered by Phu Yen Province on the north, Dak Lak and Lam Dong Provinces on the west and Ninh Thuan Province on the south. Khanh Hoa also includes well known bays such as Cam Ranh, Van Phong and Nha Trang. It is among the provinces in south central Vietnam that utilizes and develops various fishing methodologies, e.g. long lining, gill netting, purse seining, trawling, however, small-scale fishing is still prevalent. With an aim of assessing the living conditions of the province's fishing communities, this study hopes to provide valuable information on the income status of fishermen using purse seining techniques along the coast of Cam Ranh and Nha Trang.

Introduction

Purse seining was first introduced in northern Vietnam in 1959 and later in the south. Its development however, started only in 1975. Purse seining comprises two widely used fishing methods, namely: luring light and searching methods**.** The luring light method is very popular throughout the whole country. The purse seine in this method is usually about 250-500 m in length and about 45-70 m in depth (Long *et al,* 2002). Since the fish schools often concentrate around fish shelters and under light sources, large size nets are not necessary, but the nets should be big enough to surround the schools of fish.

On the other hand, since pelagic fishes move at high speed, purse seiners using the searching method must also move fast especially in setting the nets. Thus, the purse seine must be both long and deep, usually 500-1200 m long and 70-120 m deep (Long *et al,* 2002).

In Khanh Hoa Province, purse seining operations cover the Cam Ranh district and in some wards of Nha Trang. Majority of the fishing boats using the luring light method are small and operate in the coastal areas 10-15 miles from the shore. Its geographical features however, make the Khanh Hoa waters not very attractive to the purse seiners using the luring light method like in other provinces**.** In Cam Ranh, purse seining is classified into pelagic purse seining and anchovy purse seining. The average capacity of the purse seiners is 44 HP with an average length of 14.03 m, and chiefly operating the luring light method**.** Whereas in Nha Trang, anchovy purse seining is widely used with the purse seiners having an average capacity and length of 66 HP and 13.79 m, respectively, and conventionally using the searching method.

With regards to anchovy purse seining, the target species are the seasonally migrating fishes in schools, namely: anchovy, mackerel, skipjack tuna, scad, etc. Among these, anchovy makes up a large proportion in the total catch**.** The average duration of their operations is 8.15 months/year with high season from January until August or September with the remaining months regarded as low season. The average mesh size of the anchovy purse seine is relatively small (approx. 0.2 cm), making it incapable to operate in waters

Anchovy purse seiner in Nha Trang

with strong pressure such as in offshore fishing grounds. For this reason, the popular fishing ground for Nha Trang purse seiners is around Nha Trang Bay, and similarly in Cam Ranh, in the vicinity of Cam Ranh Bay. Since schools of fish are sometimes unpredictable in Cam Ranh Bay, some anchovy purse seiners often sail towards the waters of nearby Ninh Thuan Province for their fishing operations.

For pelagic purse seining, the target species are the schools of pelagic fishes migrating seasonally, such as scads, mackerel, skipjack tuna, etc. The average duration of their operations is 6.83 months/year from January until June or July. In February or March, pelagic purse seiners move to the waters of Ninh Thuan Province to catch mackerel. While before fishing vessels often leave ports at 4 or 5 PM and return early the next morning, today, with the expansion of the fishing grounds from Khanh Hoa to Ninh Thuan, some fishermen prolong their typical trips to 3-5 days, increasing the days-at-sea by 1 to 3 days. The average mesh size of the pelagic purse seines varies between 0.8 and 1.2 cm, relatively larger than that of anchovy purse seines. Subsequently, if well equipped, some fishing vessels move to fish in the offshore waters.

In general, there are minor variations in terms of hull lengths and engine capacities in Cam Ranh, where its pelagic purse seiners have average length and capacity higher than that of the anchovy purse seiners (**Table 1**). In contrast, the engine capacity varies significantly in Nha Trang, where its purse seiners have generally higher power than those in Cam Ranh, but the mean length is not much greater. The incompatibility between engine capacity and vessel length, caused by installing high capacity engine in small vessels, could cause imminent danger to the fishers' safety**.**

In terms of capital investment, small-scale fishing operations receive little or no support from the government unlike in offshore fisheries which have been encouraged for further development. Small-scale fishermen from in Cam Ranh and Nha Trang mostly self-finance the procurement of their vessels**.** In contrast to large scale fisheries, there is no partnership between small-scale fishermen and financers to raise the investment capital for acquiring fishing vessels. A

Table 1. Some technical characteristics of the purse seiners in Cam Ranh and Nha Trang

Items	Cam Ranh								Nha Trang			
	Pelagic purse seiners				Anchovy purse seiners				Anchovy purse seiners			
	Max	Mean	Min	SD	Max	Mean	Min	SD	Max	Mean	Min	SD
Hull length (m)	16.00	14.28	9.10	1.62	15.00	13.81	12.00	0.83	15.00	13.76	10.60	1.24
Engine power (HP)	80	47	20	19	80	42	20	14	240	66	22	51
Crew size (person)	14	11	5	2	15	12	10	2	15	13	8	2

Table 2. Typical investment structure per purse seiner in Cam Ranh and Nha Trang (Unit: VND 1,000; USD 1.00 = VND 15,900)

Items	Cam Ranh				Nha Trang	
	Pelagic purse seiners		Anchovy purse seiners		Anchovy purse seiners	
	Mean	%	Mean	%	Mean	%
Hull	149,692.89	39.55	127,937.17	45.98	164,013.62	45.00
Engine	65,441.75	17.29	33,804.64	12.15	64,599.55	17.73
Mechanical equipment	18,877.78	4.99	18,678.95	6.71	10,280.92	2.82
Electronic equipment	14,427.78	3.81	13,100.00	4.71	4,702.89	1.29
Fishing gear	124,595.60	32.92	79,485.24	28.57	115,870.13	31.79
Light system	5,435.56	1.44	5,254.00	1.89	4,974.21	1.36
Total	**378,471.36**	**100.00**	**278,260.00**	**100.00**	**364,441.32**	**100.00**

small number of fishing households avail of loans from the private sector as they are not eligible for loans from banks since investment in small-scale fisheries is considered a high risk venture requiring also large collaterals other than their own fishing vessels.

The purse seiners generally have large engine capacities and large nets in order that schools of fish could be encircled successfully. The number of fishers on board is around 8 to 15 providing enough manpower for each haul. Members of the crew are usually relatives of the vessel owner while only a small number may be hired. Hired labor may be thought of as working only for the money, but this misconception is not true in the fishermen's communities. Vessel owners and the crew consider themselves as partners bearing the difficulties and sharing the benefits together. Thus, the income sharing pattern between the vessel owners and the crew is more or less determined by this mindset.

Research method

The data were collected in 2005 from purse seine fishermen in Cam Ranh and Nha Trang. Direct interviews with the skippers, fishermen and vessel owners were conducted to gather information on the fishing grounds, fishing time, production, vessel characteristics, fishing gears, income, expenses and the income sharing pattern used. Information on taxes and registration fees were collected from the local authorities. In addition, visit to gear and equipment retailers were also conducted to confirm the accuracy of information provided by the fishermen.

Stratified sampling was employed to select the target respondents, and face-to-face interviews were conducted based on standardized questionnaires. In Cam Ranh, thirty eight samples for pelagic purse seining and 20 for anchovy purse seining, representing 30.4% of the vessel population, were chosen. In Nha Trang, 19 samples equivalent to 24.17% of the total vessel population, were taken from Vinh Nguyen and Vinh Truong wards and Vung Ngan island where anchovy purse seining is developing at a fast pace.

Table 3. Number of purse seiner samples in Cam Ranh and Nha Trang

Localities	Number of vessels	Number of samples	%
1. Cam Ranh	125	38	30.4
- Binh Ba -Binh Hung island	47	12	25.5
- Mainland Cam Ranh	78	26	33.3
2. Nha Trang	79	19	24.1
- Vinh Truong and Vinh Nguyen	43	11	25.6
- Vung Ngan island	36	8	22.2

Since pelagic purse seining is not progressing well in Nha Trang, this was not investigated during the course of this study and thus, is not included in this paper. Moreover, existing regulations exempt vessels under 20 HP from registering at the Fisheries Resource Protection Department, therefore, it is not possible to obtain exact information on addresses of the vessel owners. As a result, this report focuses only on the vessels with 20 HP capacities and above.

Results and discussion

Income sharing system of the purse seine fishery in Cam Ranh

For the purse seine fishery in Cam Ranh, at the end of the month and after the operating costs are deducted from the revenue, the remaining income is shared between crew and the vessel owner. Income sharing, which is subject to mutual agreement, can follow the 5:5 or 6:4 ratio for owner and crew, respectively. If the sharing system follows the 5:5 sharing ratio, the operating costs that include variable costs, maintenance costs, taxes, fees, and insurances, are deducted from the gross income before the sharing takes place. Maintenance costs cover expenses for hull, engine, and fishing gear.

If the sharing system follows the 6:4 sharing ratio, the operating costs that include variable costs, maintenance costs, taxes, fees, and insurances are deducted but in this case the maintenance cost is applied only for the fishing gear. Then the vessel owners calculate the individual shares based on a preset point system in accordance with an individual's job duties and responsibilities, i.e, the skipper gets 1.5 points, chief mechanic 1.1 points and fishers get 1.0 point each.

However, there may be instances when vessel owners assign a higher point to the chief mechanic, while some skippers, who are also the vessel owners would receive 1.0 point instead of 1.5 as is the common practice. The vessel owners use this scheme as incentives for the crew. Thus, by increasing their earnings and improving their conditions, the boat owners hope to gain the crew's support and loyalty. The general income sharing pattern on a monthly basis, adopted for purse seine fishermen in Cam Ranh is shown in **Figure 1**.

Generally, the income of fishermen consists of the monthly output-dependent income as well as income derive from a number of other related activities, such as amount for daily

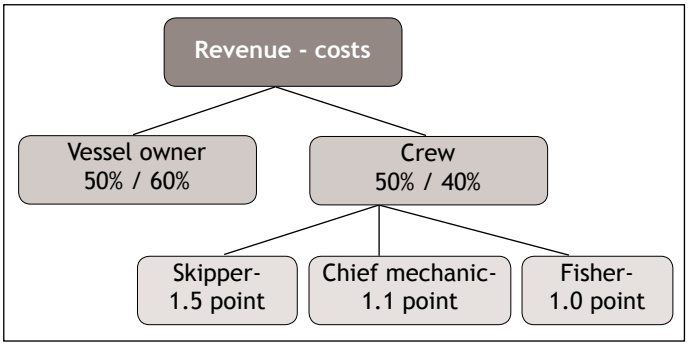

Figure 1. Income sharing pattern for purse seine fishermen in Cam Ranh

living expense support and on-board meal support. The composition of the total income of the purse seine fishermen in Cam Ranh is shown in **Figure 2**.

However, the above method of operational organization and income sharing in the fishing communities of mainland Cam Ranh have somewhat changed, except at the Binh Ba - Binh Hung island, where the sharing pattern has not changed for years, particularly the practice of "contributing individual food for collective meals". In these island communities, every afternoon, the fishermen gather before boarding the boats heading towards the sea. Every fisherman bring his own supply and prepared food, since the vessel owners provide only the essential cooking materials and equipments such as gas, cooking oil, fish sauces, etc.

There are no onboard meal benefits given by the vessel owners. Instead, the members receive their share from the daily income of selling their produce and the amount of fresh fish they receive as supplement for their family's meals. The vessel owners do not normally set a fixed quantity of fish to be taken by the fishers because they are very sensible enough to take only a reasonable amount. As a result, the income sharing practiced in Binh Ba island is different from that in the mainland Cam Ranh (**Figure 3**).

Income sharing system of the purse seine fishery in Nha Trang

In anchovy purse seining, income sharing practices among vessel owners and crew in Nha Trang are to some degree different from those in Cam Ranh. In Vinh Truong and some fishing communities in the mainland of Vinh Nguyen, boat owners often rent daily laborers at VND 30,000 to 40,000/ day/person. After each fishing trip, each member equally gets 10% of the total sales. When asked why the conventional sharing practice like those in Cam Ranh was discontinued, many fishers considered as among the reasons the increasing difficulty in the fishing operation therefore, secure daily earnings can help their family's monthly expenses. Some crew members also doubt some boat owners' honesty in regard to sales reporting and recording. The composition of the monthly income of purse seine fishermen in Vinh Truong and Vinh Nguyen is shown in **Figure 4**.

In Vung Ngan island of Vinh Nguyen ward, the income sharing pattern among fishermen is similar to that of Cam Ranh. Since the crew members come from other provinces, they live with the vessel owners' families. At the end of the month and on holidays, they are allowed to visit their families and the sharing of income is usually done at this time. After deducting all the expenses (variable expenses, taxes, insurances, gear repairing costs), the owner and the crew get 6 and 4 parts, respectively. In addition, after each trip, each fisher is eligible for daily living expense support based on the net hauling time, which is usually VND 10,000 for one net hauling time (**Figure 5**).

Differences in the income sharing patterns by purse seine fishermen in Cam Ranh and Nha Trang

It should be noted that the average incomes in this research comprise those that are statistically identifiable and collectible. In practice, especially the pelagic purse seining,

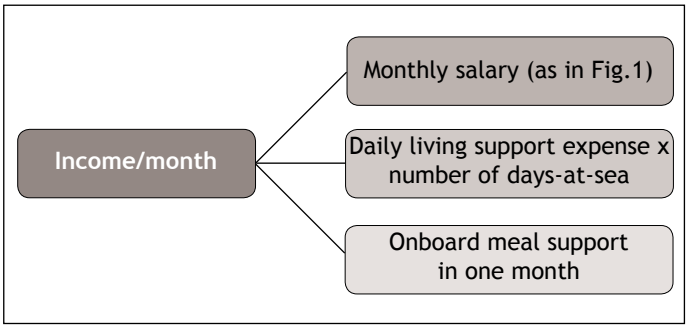

Figure 2. Composition of the total income of purse seine fishermen in Cam Ranh

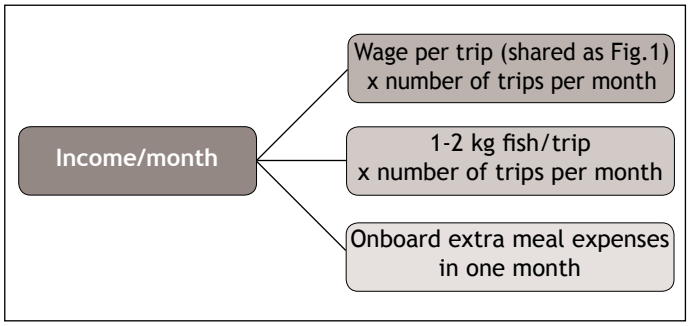

Figure 3. Income sharing for purse seine fishermen in Binh Ba island (Cam Ranh)

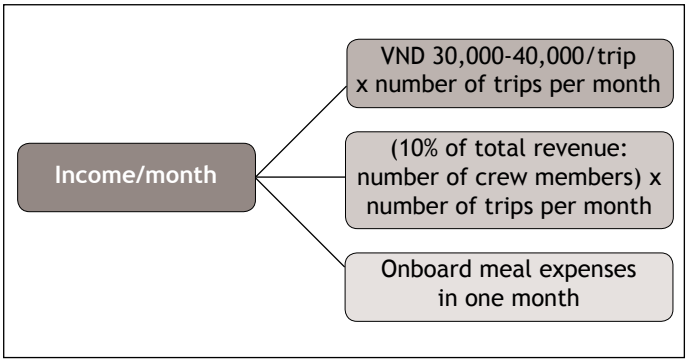

Figure 4. Composition of the income of purse seine fishermen in Vinh Truong and Vinh Nguyen (Nha Trang)

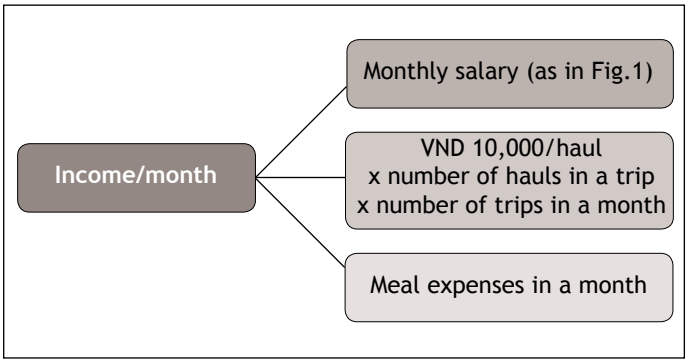

Figure 5. Composition of the income of purse seine fishermen in Vung Ngan island (Vinh Nguyen, Nha Trang)

fishers have other prominent income sources coming from individual fishing during the waiting time between two consecutive hauls. A productive fisherman can earn more from VND 70,000 to 100,000 a day. However, since this additional earning is not stable and depends on the individual's effort, it is not included as a source of income in the report (**Table 4**) because this is largely on case-to-case basis.

The income data revealed that under the four income sharing patterns, the fishermen's individual earnings are higher than the average per capita in Khanh Hoa (in 2005 it was USD 730/year, equivalent to VND 967,250/month (Report, 2005)). With such attractive earnings, a question on why coastal fishermen continue to live in such poor conditions remains unexplained. There could be several reasons for this. Firstly, fishing is almost the sole livelihood providing income to the majority of people living along the coast. Although some households have been successful in seeking alternative livelihood to secure their income, such as from aquaculture (lobster culture), handicraft making and others, the number of such households is relatively small.

Secondly, the birth rate in fishing villages still remains high with each family having four (4) children on the average. In a family with maximum of six (6) members, the average income per person ranges from VND 250,000 to 300,000/month. For Vietnam the poverty limit is on an income of VND 200,000/person/month in rural areas and VND 260,000/person/month in urban zones (Decision, 2005). Based on such poverty limit, the fishermen in Cam Ranh enjoy a small margin above the poverty standard while in Nha Trang the fishers' incomes fall below the poverty line.

Looking at the social perspective, the high birth rate stems from the preference for boys in the fishing villages. The local people believe that only men are capable of doing fishing activities and that families having more male children will surely attain a secure financial status. Thus, for families that earn their living through fishing, having no male children as the main labor provider of the family, is an ultimate disaster. For the local people, women can only do house work, bringing up children and selling fish after the vessels return from the sea.

It is such village perception that places many households in unfortunate situations where one person works to care for many dependents. Men try their utmost effort to support the whole family. A high birth rate consequently becomes one of the main factors that lead to the rampant overexploitation, presenting inherent obstacles in improving the living conditions of the fishermen.

On the other hand, if the sharing method used in Cam Ranh is applied to calculate the average monthly revenue of purse

Table 4. Average monthly income of purse seine fishermen in Cam Ranh and Nha Trang (Unit: VND 1,000; USD 1.00 = VND 15,900)

Items	Sharing pattern on ratio basis			Sharing pattern on daily fixed basis
	Binh Ba island - Cam Ranh	Mainland - Cam Ranh	Vung Ngan island - Nha Trang	Mainland - Nha Trang
1. Salary	1,627.27	1,248.08	1,131.25	940.00
2. Living expense support, earnings converted from quantity of fish	200.00	300.77	485.00	361.82
3. Meal expense support	109.57	254.72	295.55	224.48
Total income ((1)+(2)+(3))	**1,936.84**	**1,803.57**	**1,911.80**	**1,526.30**

Fishermen carry their catch in trays from fishing boat to the fish landing port

seine fishermen in Nha Trang, the results obtained could be different as shown in **Table 5**.

With fixed daily wages, the fishermen earn the highest average income/month (**Table 5**). Thus, the fixed daily wage offers the greatest benefit to the crew members of the purse seiners in Nha Trang. This proves that in the sharing pattern, the vessel owners do not set the rules against the will of their crew. From direct conversations with vessel owners, it was revealed that they have been waiving their rights for the wages of the fishers as was always done in the past, for the main reason that low wages can be a problem in looking and hiring enough laborers for a fishing trip.

Factors that influence the income levels of purse seine fishermen in Cam Ranh and Nha Trang

Results from the interviews with purse seine fishermen in Cam Ranh and Nha Trang revealed many factors that could have influence on their incomes, the most dominant include:

Table 5. Average monthly income of purse seine fishermen in Nha Trang using the sharing pattern practiced in Cam Ranh (Unit: VND 1,000; USD 1.00 = VND 15,900)

Items	The sharing pattern used		
	6/4	5/5	Fixed salary
Average income/month	692.71	865.99	940.00
Living expenses support	356.29	356.29	361.82
Meal expense support	224.48	224.48	224.48
Total income	**1,273.48**	**1,446.76**	**1,526.30**

Knowledge and experiences of the skippers to locate abundant fishing grounds

For a successful and productive haul, the skippers need to assess the wind and water directions as well as the strong, weak and still times of the water current to determine the exact net-setting time. The skippers must have good knowledge of fishing seasons, migrating and schooling habits of different fish species, etc. They should also understand the basic characteristics of fishes. For example, when fish is confronted with obstacles they tend to make a U-turn or swim to the bottom, and knowledge on such behavior determines the productivity of the fishing trip. A thorough understanding of the fishing grounds is also among the important factors determining the success of the hauls. In practice, the skippers' predictions are often supplemented with data recording on geographical coordinates, date, time and weather conditions of their previous successful hauls. In addition, they also get information from other fishing vessels to predict and search for the precise abundant fishing grounds.

The survey also demonstrated that majority of the fishermen's families have long fishing traditions that have been passed on for many generations. The households having long history of fishing accounted for 90% of the total samples. Although most young fishermen do not attend academic marine training courses, they have mastered the trade by working with the senior fishermen. Through practice they acquire fishing skills as well as technical, mechanical, and navigation skills on the job. This explains the fact that even if many fishermen have not attended schools formally, they are very accomplished and are experts in fishing as well as marine navigational skills. They can also do some technical demanding jobs like construction and repair of fishing vessels.

Technical properties of fishing gears

The nets should also meet the standards, such as appropriate height, sinking speed (lead fishing weights), and the direction for reversed capacity in order to produce high yield.

Distance of the fishing grounds

The data in Table 4 (page 44) illustrate that the average income of fishermen on the islands are higher than those from the mainland mainly due to lower fuel costs for traveling from the islands to the fishing grounds. Lower fuel costs naturally lead to higher income for the fishermen on the islands.

Figure 6 shows that the fuel expense for traveling from Binh Ba island to the fishing grounds is the lowest because of the proximity of the island to the fishing ground. Moreover, the fishermen do not use ice to preserve the fish as their catch is sold on-the-spot to boats coming to the island to immediately purchase their produce or shipped to the mainland for sale within the same day.

According to fishermen in Cam Ranh and Nha Trang, their expenses per trip in 2005 increased significantly as compared to those in the past several years. One of reasons is the fuel hike, which occurred three (3) times in late 2005 from VND 4,500 to 7,560/liter an increase of about 67% compared to the fuel price in early 2005 (Report, 2006). With increased costs of labor, fishing gears, provisions and other necessary supplies for a fishing trip, and increased in fuel price, it is surprising to note that fish prices have either not increased or increased only at a very small margin.

Conclusions

The fishermen's income mentioned in this study is the main and almost the sole income source from purse seine fishing in Cam Ranh and Nha Trang. In fact, the number of households with secondary jobs other than fishing is quite small. According to the research findings, in Cam Ranh, there are only 6 out of 38 households having alternative livelihood such as the culture of lobsters or catching shrimps using luring light. In Nha Trang the percent of households without alternative livelihood is close to 100%. This explains why even if the income of the fishermen is relatively higher than the average income per capita in Khanh Hoa Province, their living conditions are still below the poverty standard.

An analysis of the factors influencing the fishermen's income from purse seining will be done in another study. Meanwhile, it is hoped that the results of this study will provide information that could help the country's planners as well as policy makers in providing practical solutions on how to improve the living conditions of the purse seine fishermen.

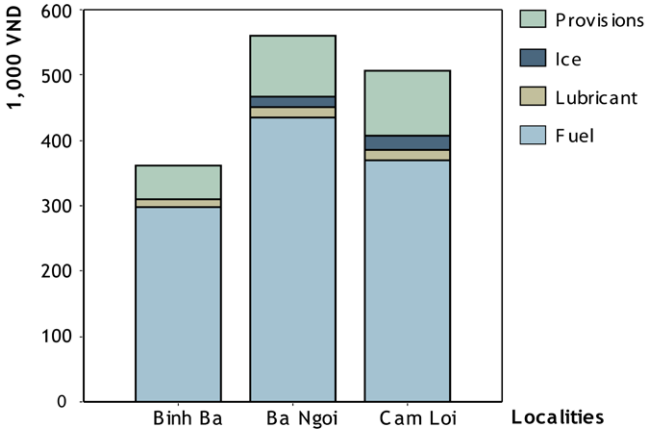

Figure 6. Average variable costs per day of anchovy purse seining at some wards in Cam Ranh (Capacity group under 45 HP)

References

Decision. 2005. Decision No 170/2005/Q□-TTg of July 8th, 2005 Promulgate *Poverty Standard applied for the period 2006-2010* of The Prime Minister. Hanoi, Vietnam. Available from: http://vbqppl.moj.gov.vn/law/vi/2001_to_2010/2005/200507/200507080002

GSO. 2005. *Khanh Hoa's Statistic Yearbook*. Khanh Hoa, Viet Nam: General Statistics Office.

Long, N., N. V. Khang, V. D. Hai and B. Chokesanguan. *Fishing Gear and Methods in Southeast Asia*: IV. Vietnam. Printed by Cooperation between SEAFDEC and RIMEF.

Nam, V. N. 2005. *Fisheries Import & Export Market*. Statistic Publishing House.

Report. 2005. *The Year-End Summation about Economics and Society Situation*. At the meeting from 24-26/12/2005: Khanh Hoa Party Steering Committee.

Report. 2006. *The Summary Report in Situation of Effectuate the Plan in 2005 and Direction to Develop Economic-Society in 2006 of Fisheries Industry:* Fisheries Ministry.

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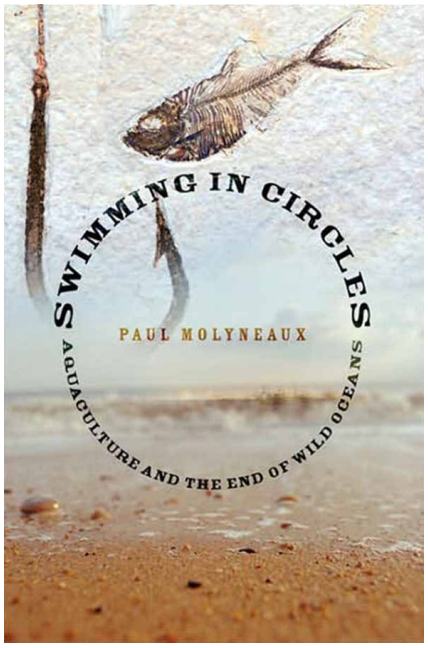
Whither Aquaculture ?

Disturbing views on a promising sector



"Swimming in Circles" - Aquaculture and the End of Wild Oceans"
Author: Paul Molyneaux
Paperback: 304 pages
Publisher: Thunder's Mouth Press (December 19, 2006)
Language: English
ISBN-10: 1560257563
ISBN-13: 978-1560257561

As worries about the status of the world's fish resources are mounting and marine capture fisheries arguably having reached its limits, aquaculture is widely seen as a promising way to ensure the future supply of seafood to mankind.

To many, aquaculture makes good environmental sense as it may give people more control of the environmental conditions under which seafood is grown and may replace wild catches to meet the growing demand for seafood.

Proponents of aquaculture look at its potential to generate employment and revenues for coastal communities and to offer new and additional livelihood opportunities. With aquaculture, uncertainties of capture fisheries can be overcome and the markets be supplied with a steady flow of fresh and reliable seafood products.

In his book, "Swimming in Circles, Aquaculture and the End of Wild Oceans," Paul Molyneaux however, takes a disturbingly different look at the sector, and questions the much praised benefits of raising fish and shrimp in captivity. He based his criticism of the industry on extensive travels and visits to major global aquaculture hot spots, on interviews and discussions with industry representatives, fish farmers and fishers, scientists and his own experiences in the fishery sector.

Molyneaux, an ex-fisherman who holds degrees in marine biology as well as in writing and literature, warns of pollution, genetic impacts on wild fish populations and biodiversity, negative social impacts and local impoverishment as likely consequences of unrestrained expansion of fish farming activities.

In his book, Molyneaux vigorously attacks the industry and seeks to counter any claim of aquaculture benefits, be they economic, social or ecological. The evidence he has collected during his tireless research endeavors in Mexico, the US and the UK is impressive. Displacement of small fishers and coastal communities by aquaculture and shrimp farming businesses are quoted as evidences for the negative social and economic impacts of the sector. Numerous incidents of pollution from fish feeds, high level of PCBs in farmed fish, escapes and interbreeding of farmed fish with wild populations and epidemics of fish diseases underline the potential negative environmental impacts of the booming industry.

Molyneaux does not reject all forms of aquaculture – small-scale, extensive fish farming efforts that benefit local communities and economies, as these are seen as good and sustainable ways to increase fish production. But the author's account of his personal encounters and experiences with the sector shows, that such "good management practices" are not really characteristic of the industry and are often overlooked, as attention is drawn to the "black sheep" in the industry, that do not show any environmental or social concerns.

Its total lack of objectivity makes "Swimming in Circles" an easy target for counter claims from an industry that, admittedly, is undergoing tremendous changes and experiencing a growing awareness of the problems highlighted by Molyneaux. It is a compelling attempt of a minority voice amid the dominating pro-industry voices, which are lobbying for expanding aquaculture despite the many unsolved problems that the book draws attention to.

Events Calendar

Date	Venue	Events	Organizer
		2007	
3-15 June	Hague, Netherlands	14th Meeting of the Conference of Parties of CITES	CITES
5-7 June	Kuala Lumpur, Malaysia	2nd Regional Technical Consultation on Research for Stock Enhancement of Sea Turtles	MFRDMD
10-24 June	Thailand	International Training Course on Coastal Fisheries Management for Fishery Managers	TD
13-15 June	Phuket, Thailand	Regional Workshop on Managing Fishing Capacity and IUU Fishing in Asia	APFIC/FAO
19-22 June	Singapore	Regional Training Course on Drug Residues	MFRD
20-21 June	Singapore	Regional Planning Meeting of the Project on "Quality Assurance Systems for Small and Medium-sized Fish Processing Establishments in ASEAN Member Countries"	MFRD
24-28 June	Malaysia	Training on Hatchery Management of Sea Turtles	MFRDMD
26-28 June	Bangkok, Thailand	ASEAN-SEAFDEC Regional Expert Consultation on Future Roles of SEAFDEC in Fisheries Management in Southeast Asia	Secretariat
28-29 June	Bangkok, Thailand	SEAFDEC Program Planning Meeting for Japanese Trust Fund for 2008 and Onwards	Secretariat
2-15 July	Lao PDR	Joint Regional Training on Community-based Aquaculture for Remote Rural Areas in Southeast Asia	Secretariat
2 July-15 August	Malaysia	Technical Cooperation Programme on Fishery Resources Management	MFRDMD
9 July	Malaysia	Training on Hydroacoustics	MFRDMD
23 July	Bangkok, Thailand	International Conference on Willingness to Pay for Marine Turtle Conservation: A Cross-country Comparison in Asia	Thailand, EEPSEA
20 August-20 September	Thailand	International Training Course on Coastal Fisheries Management and Extension Methodologies	TD
3-4 September	Penang, Malaysia	Regional Workshop on Fish Trade and Development	FAO/INFOFISH/ DOF Malaysia
6-26 September	Iloilo, Philippines	International Training Course on Abalone Hatchery and Grow-out	AQD
11-14 September	Bangkok, Thailand	Expert Consultation on International Guidelines for the Management of Deep-sea Fisheries in the High Seas	FAO
18-20 September	Ho Chi Minh City, Vietnam	Regional Workshop on Certification Schemes for Capture Fisheries and Aquaculture	APFIC
8-9 October	Bangkok, Thailand	ASEAN-SEAFDEC Workshop on Implementation of ASEAN Roadmap for Integration of the Fisheries Sector	Secretariat
16-18 October	Bangkok, Thailand	Regional Technical Consultation on Fishery Statisitcs and Information in Southeast Asia	Secretariat
22 October	Bangkok, Thailand	SEAFDEC Seminar on Implementation of CCRF in Southeast Asia	Secretariat
23-24 October	Bangkok, Thailand	2nd ASEAN-SEAFDEC Regional Expert Consultation on Future Roles of SEAFDEC in Fisheries Management in Southeast Asia	Secretariat
5-7 November	-	FAO Workshop on Knowledge and Data on Deep Sea Fisheries in High Sea	FAO
5-6 December	Bangkok, Thailand	International Workshop on Emerging Fish Diseases in Asia	AQD

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 Vietnam.