

# SEAFDEC Annual Report 2015



Southeast Asian Fisheries Development Center



# SEAFDEC Annual Report **2015**



Southeast Asian Fisheries Development Center

## Preparation and Distribution of this Document

This SEAFDEC Annual Report 2015 was prepared by the Secretariat of the Southeast Asian Fisheries Development Center (SEAFDEC) in collaboration with the SEAFDEC Departments, namely: Training Department (TD), Marine Fisheries Research Department (MFRD), Aquaculture Department (AQD), Marine Fishery Resources Development and Management Department (MFRDMD), and Inland Fishery Resources Development and Management Department (IFRDMD). The Annual Report is distributed to the SEAFDEC Member Countries and Departments, partner agencies and other fisheries-related organizations, and to the public to make them aware of the activities and achievements of SEAFDEC and promote the visibility of the Center.

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## EXECUTIVE SUMMARY

SEAFDEC Annual Report 2015 summarizes the programs of activities undertaken by SEAFDEC throughout the year 2015, in-line with the priority needs and policy directives of the Member Countries conveyed through the SEAFDEC Council and SEAFDEC Program Committee. The programs in 2015 had been categorized into: 1) Programs under the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) (20 projects); Departmental Programs (8 programs); and Other Programs (3 projects).

In addition to the development and promotion of technologies to support sustainable development of fisheries, in 2015 SEAFDEC also made significant progress in the formulation and implementation of several regional fisheries policy frameworks in support of the ASEAN Economic Community Building. In particular, several initiatives had been undertaken by SEAFDEC towards combating Illegal, Unreported and Unregulated (IUU) fishing, and conservation and management of shared/migratory stocks. Efforts were also pursued by SEAFDEC to enhance cooperation among countries at the regional, sub-regional and bilateral levels. Furthermore, with the recent establishment of SEAFDEC Inland Fishery Resources Development and Management Department (IFRDMD) in 2014, much progress had been made by SEAFDEC on inland fishery development and management, fulfilling its mandate of covering all fisheries disciplines, i.e. capture (marine and inland), aquaculture, post-harvest practices and trade, and fishery resources management.

During the year, SEAFDEC also continued to strengthen cooperation and partnership with other international/regional organizations and non-member governments sharing common interest on the sustainable utilization of fishery resources. Specifically, SEAFDEC took part in various fora organized by collaborating partners to ensure that the specificities of fisheries in Southeast Asia are appropriately addressed in such fora, and that the regional policy frameworks of SEAFDEC are harmonized with corresponding international initiatives.

It is envisioned that this Annual Report could provide a better picture on the role and activities of SEAFDEC in supporting the Member Countries in their efforts towards achieving sustainable development of fisheries in the Southeast Asian region. It is also expected that the information in this Annual Report could help support a strong ASEAN Economic Community which targets fisheries as a priority sector for integration.



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## LIST OF ACRONYMS

|             |   |
|-------------|---|
| ACIAR       | Australian Centre for International Agricultural Research                         |
| AFCF        | ASEAN Fisheries Consultative Forum  |
| AIFS        | ASEAN Integrated Food Security  |
| AMSS        | ASEAN Member States   |
| AQD         | SEAFDEC Aquaculture Department  |
| APFIC       | Asia-Pacific Fisheries Commission   |
| ASEAN       | Association of Southeast Asian Nations  |
| ASSP        | ASEAN-SEAFDEC Strategic Partnership   |
| ASWGF       | ASEAN Sectoral Working Group on Fisheries   |
| AVA/PHTC    | Post-harvest Technology Centre of the Agri-Food & Veterinary Authority, Singapore |
| BOBLME      | Bay of Bengal Large Marine Ecosystem  |
| CITES       | Convention on International Trade in Endangered Species of Wild Fauna and Flora   |
| CTI-CFF     | Coral Triangle Initiative – Coral Reefs, Fisheries and Food Security              |
| EAFM        | Ecosystem Approach to Fisheries Management  |
| FAO         | Food and Agriculture Organization of the United Nations                           |
| FCG         | ASEAN-SEAFDEC Fisheries Consultative Group  |
| GEF         | Global Environmental Facility   |
| IFRDMD      | SEAFDEC Inland Fishery Resources Development and Management Department            |
| IOTC        | Indian Ocean Tuna Commission  |
| IUU Fishing | Illegal, Unreported and Unregulated Fishing                                       |
| JTF         | Japanese Trust Fund to SEAFDEC  |
| MCS         | Monitoring, Control and Surveillance  |
| MFRD        | SEAFDEC Marine Fisheries Research Department                                      |
| MFRDMD      | SEAFDEC Marine Fishery Resources Development and Management Department            |
| NATC        | National Agricultural Training Council Malaysia                                   |
| PSM         | Port State Measures   |
| RFMOs       | Regional Fisheries Management Organizations                                       |
| RFVR        | Regional Fishing Vessels Record for Vessels 24 m in Length and Over               |
| RIHN        | Research Institute for Humanity and Nature, Japan                                 |
| SEAFDEC     | Southeast Asian Fisheries Development Center                                      |
| TD          | SEAFDEC Training Department   |
| USAID       | United States Agency for International Development                                |
| WCPFC       | Western and Central Pacific Fisheries Commission                                  |



## ABOUT SEAFDEC

The Southeast Asian Fisheries Development Center (SEAFDEC) is an autonomous inter-governmental body established in 1967. SEAFDEC comprises 11 Member Countries: Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam. The Center operates through the Secretariat located in Thailand and has five Technical Departments, namely: the Training Department; Marine Fisheries Research Department; Aquaculture Department; Marine Fishery Resources Development and Management Department; and the newly established Inland Fishery Resources Development and Management Department. The mandate of SEAFDEC as endorsed by the 41<sup>st</sup> Meeting of the SEAFDEC Council is *“to develop and manage the fisheries potential of the region by rational utilization of the resources for providing food security and safety to the people and alleviating poverty through transfer of new technologies, research and information dissemination activities”*.

### The Secretariat

The SEAFDEC Secretariat is mandated to coordinate and oversee the general policy and planning of the Center, and acts as focal point for channeling and implementing the decisions and resolutions of the SEAFDEC Council of Directors. In addition, the Secretariat organizes the regular SEAFDEC meetings to obtain directives and guidance from the Member Countries on the operations of the Center, as well as regional technical consultations and meetings to address emerging issues as recommended by the Member Countries.



SEAFDEC Secretariat

### The Training Department (TD)

Established in Thailand in 1968, TD has been focusing its efforts on the development of modern fishery techniques to aid regional fisheries in a more sustainable approach through the promotion of responsible fishing technologies and practices, exploration of resources, and advancing the coastal fisheries management approach. Under the new Strategic Plan which was endorsed by the SEAFDEC Council in 2006, the structure and activities of TD have been adjusted to emphasize on the promotion of coastal fisheries management to ensure responsible



SEAFDEC/TD

resource utilization and sustainable livelihoods in coastal communities, and off-shore fisheries through the development of best fishing practices and energy optimization technology to ensure stable supply of food fish and reduce fishing pressure in coastal areas.

### The Marine Fisheries Research Department (MFRD)

MFRD was established in Singapore in 1969 and is responsible for promoting, undertaking, and coordinating research in fisheries post-harvest technology and furthering the development of the fish processing industry in the Southeast Asian region. Its tasks include research and development on fisheries post-harvest technology and practices, such as fish processing technology to optimize the utilization of harvested fish and enhance the quality and safety of fish and fishery products. MFRD also develops technology-based analytical methods to assess

seafood safety and quality, and publishes several manuals as reference materials for the Member Countries.

As of 2007, the Post-Harvest Technology Centre of the Agri-Food and Veterinary Authority (AVA), Singapore (PHTC/AVA) has been approved as the Collaborating Centre of SEAFDEC to undertake the activities of MFRD under the SEAFDEC Regional Programmes including those supported by the Japanese Trust Fund.



SEAFDEC/MFRD

### **The Aquaculture Department (AQD)**

Established in the Philippines in 1973, AQD has been carrying out activities in aquaculture research, technology verification, training and information dissemination on a wide range of aquaculture disciplines, including broodstock management and seed quality improvement, promotion of responsible and environment-friendly aquaculture, diagnosis and control of aquatic diseases, aquaculture for stock enhancement, and culture of aquatic species under international concern. The aquaculture commodities covered by AQD include fishes, shrimps, mud crab, mollusks, and seaweeds. In addition, AQD also promotes good aquaculture practices and effective management of aquatic resources to support rural development and alleviate poverty.



SEAFDEC/AQD

### **The Marine Fishery Resources Development and Management Department (MFRDMD)**

MFRDMD was established in Malaysia in 1992 to conduct activities on marine fishery resources focusing on biological studies of commercially important fish species, resource assessment and management, and conservation and management of aquatic species under international concern, *e.g.* sharks and marine turtles. MFRDMD also implements activities that support the Member Countries, especially in the compilation of information on small pelagic species, and establishment of indicators that could be used for the sustainable development and management of fisheries.



SEAFDEC/MFRDMD

### **The Inland Fishery Resources Development and Management Department (IFRDMD)**

Recently established in 2014 in Indonesia, IFRDMD is tasked to carry out activities that support the sustainable development and management of inland capture fisheries. Activities of IFRDMD also cover development of methodologies for data collection, as well as monitoring and assessment of inland fishery resources to provide scientific basis for sustainable development and management of inland fisheries in the Southeast Asian region.



SEAFDEC/IFRDMD

## SEAFDEC COUNCIL IN 2015

### Chairpersons of the SEAFDEC Council

*Dr. Tan Lee Kim (until April 2015)*

*Dr. Joompol Sanguansin (April-November 2015)*

*Dr. Wimol Jantrarotai (Since November 2015)*

### SEAFDEC Council and Alternate Council Directors:

#### Brunei Darussalam

Council Director: **Mr. Abdul Halidi Mohd. Salleh**  
Acting Director, Department of Fisheries

Alternate Council Director: **Ms. Ranimah Haji A. Wahab**  
Acting Deputy Director, Department of Fisheries

#### Cambodia

Council Director: **H.E. Prof. Dr. Nao Thuok** (*until March 2015*)  
Director-General, Fisheries Administration  
**H.E. Eng Cheasan** (*since March 2015*)  
Delegate of the Royal Government of Cambodia, and  
Director-General, Fisheries Administration

Alternate Council Director: **Mr. Ing Try** (*until March 2015*)  
Deputy Director-General, Fisheries Administration  
**Dr. Kao Sochivi** (*since March 2015*)  
Deputy Director-General, Fisheries Administration

#### Indonesia

Council Director: **Dr. Sjarief Widjaja**  
Secretary-General of Ministry of Marine Affairs and  
Fisheries

Alternate Council Director: **Dr. Achmad Poernomo**  
Advisor to Minister for Public Policy, Ministry of Marine  
Affairs and Fisheries

#### Japan

Council Director: **Mr. Kenji Kagawa**  
Deputy Director-General of Fisheries Agency, Ministry of  
Agriculture, Forestry and Fisheries

Alternate Council Director: **Mr. Tadayuki Miyashita** (*until July 2015*)  
Director, First Country Assistance Planning Division,  
International Cooperation Bureau, Ministry of Foreign  
Affairs  
**Mr. Keiichi Hara** (*since July 2015*)  
Director, First Country Assistance Planning Division,  
International Cooperation Bureau, Ministry of Foreign  
Affairs



## Lao PDR

- Council Director: **Dr. Bounkhouang Khambounheuang** (*until December 2015*)  
Director-General, Department of Livestock and Fisheries  
**Dr. Somphanh Chanphengxay** (*since December 2015*)  
Director-General, Department of Livestock and Fisheries
- Alternate Council Director: **Mr. Bounthong Saphakdy**  
Deputy Director-General, Department of Livestock and Fisheries

## Malaysia

- Council Director: **Y. Bhg. Datuk Hj. Ismail bin Abu Hassan**  
Acting Director-General, Department of Fisheries
- Alternate Council Director: **Mr. Haji Johari bin Ramli**  
Deputy Director-General of Fisheries (Management),  
Department of Fisheries

## Myanmar

- Council Director: **Mr. Khin Maung Maw**  
Director-General, Department of Fisheries
- Alternate Council Director: **Mr. Htun Win**  
Deputy Director-General, Department of Fisheries

## Philippines

- Council Director: **Atty. Asis G. Perez**  
Undersecretary for Fisheries, Department of Agriculture  
and National Director, Bureau of Fisheries and Aquatic  
Resources
- Alternate Council Director: **Mrs. Drusila Esther E. Bayate**  
Assistant Director for Technical Services, Bureau of  
Fisheries and Aquatic Resources

## Singapore

- Council Director: **Dr. Tan Lee Kim**  
Deputy CEO (Corporate & Technology), Agri-Food  
& Veterinary Authority of Singapore
- Alternate Council Director: **Mrs. Tan-Low Lai Kim**  
Group Director, Food Supply Resilience Group, Agri-Food  
& Veterinary Authority of Singapore

## Thailand

- Council Director: **Dr. Joampol Sanguansin** (*until November 2015*)  
Director-General, Department of Fisheries  
**Dr. Wimol Jantrarotai** (*since November 2015*)  
Director-General, Department of Fisheries
- Alternate Council Director: **Mr. Chirdsak Vongkamolchoon** (*until February 2015*)  
Deputy Director-General, Department of Fisheries  
**Dr. Waraporn Prompoj** (*since February 2015*)  
Deputy Director-General, Department of Fisheries

## **Viet Nam**

Council Director:

**Mr. Pham Anh Tuan** (*until July 2015*)

Deputy Director-General, Fisheries Administration,  
Ministry of Agriculture and Rural Development

**Mr. Nguyen Viet Manh** (*since July 2015*)

Director of Science, Technology and International  
Cooperation Department, Fisheries Administration,  
Ministry of Agriculture and Rural Development

Alternate Council Director:

**Mr. Nguyen Viet Manh** (*until July 2015*)

Director of Science, Technology and International  
Cooperation Department, Fisheries Administration,  
Ministry of Agriculture and Rural Development



## SEAFDEC SENIOR OFFICIALS IN 2015

### Secretary-General

Dr. Chumnarn Pongsri (*until September 2015*)

Mr. Hajime Kawamura (*Acting, October-December 2015*)

### Deputy Secretary-General

Mr. Hajime Kawamura

### Training Department (TD)

#### Chief

Dr. Chumnarn Pongsri (*until September 2015*)

Mr. Hajime Kawamura (*Acting, October-December 2015*)

#### Deputy Chief

Mr. Hajime Kawamura

### Marine Fisheries Research Department (MFRD)

#### Chief, MFRD Programmes

Mr. Yeap Soon Eong

### Aquaculture Department (AQD)

#### Chief

Dr. Felix G. Ayson

#### Deputy Chief

Dr. Takuro Shibuno

### Marine Fishery Resources Development and Management Department (MFRDMD)

#### Chief

Ms. Mahyam Mohd Isa (*until June 2015*)

Mr. Ahmad Adnan bin Nuruddin (*since July 2015*)

#### Deputy Chief

Dr. Masaya Katoh (*until March 2015*)

Dr. Osamu Abe (*since April 2015*)

### Inland Fishery Resources Development and Management Department (IFRDMD)

#### Chief

Mr. Budi Iskandar Prisantoso

#### Deputy Chief

Dr. Satoshi Honda (*since January 2015*)

## MESSAGE FROM THE CHAIRPERSON OF SEAFDEC COUNCIL FOR THE YEAR 2015



The year 2015 has been very significant for the Southeast Asian region, especially in terms of promoting sustainable fisheries development in the light of the ASEAN Community Building. The works and achievements of SEAFDEC this year had also been very prominent, especially its several programs of activities that address the fisheries priorities of our region. Specifically, we could note the number of regional policy recommendations and guidelines developed by the Members Countries with support from SEAFDEC during the recent years. On behalf therefore of the SEAFDEC Council, I wish to extend our utmost appreciation to SEAFDEC for its works that have not only strengthened the capacity and helped in creating unity among countries, but also raised the profile of the fisheries sector particularly its contribution to food security, livelihood and improved national economies of the respective countries.

Allow me also to take this opportunity to emphasize once again important matters related to the emerging concerns and more stringent requirements for countries in the region to comply with, such as issues on combating IUU fishing. We are all aware that IUU fishing is a complicated matter, taking into consideration the transboundary nature of our fishery resources, as well as the very nature of our region's fishing activities that are undertaken across borders of neighboring countries. Addressing problems on IUU fishing therefore requires collective efforts and close cooperation among concerned countries, and SEAFDEC could therefore play a very significant role in supporting regional cooperation towards this matter in the future.

While the efforts and good works of SEAFDEC throughout the year 2015 have been very well recognized by countries and relevant organizations, I would like to urge SEAFDEC to continue such momentum in providing technical support to all Member Countries. I would also wish to express my heartfelt appreciation to my colleagues in the SEAFDEC Council of Directors for extending their utmost support during my term as Chairperson of the SEAFDEC Council. My appreciation is also extended to the collaborating partners of SEAFDEC for their generous support and cooperation throughout the year. Moving towards achieving sustainable fisheries is a long process that requires lots of efforts by the Member Countries, but with strong collaboration and with the support of SEAFDEC, I truly believe that such goal would not be too far to achieve in the near future.

A handwritten signature in black ink, which appears to read 'Wimol Jantrarotai'. The signature is fluid and cursive, with a long horizontal stroke at the end.

Wimol Jantrarotai, Ph.D.  
Director-General  
Department of Fisheries, Thailand

## MESSAGE FROM THE SEAFDEC SECRETARY-GENERAL

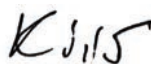


The year 2015 has been another challenging period for SEAFDEC, especially considering the several emerging issues and requirements at the global and regional levels towards sustainable development of fisheries. While SEAFDEC continued to provide technical support for enhancing the capacity of the Southeast Asian countries in advancing its fisheries development, SEAFDEC also proceeded with undertaking initiatives that require regional cooperation among the countries, particularly in the light of the ASEAN Community Building.

One of the challenges faced by several countries, especially the major producers of fish and fishery products for international markets is the need to comply with the requirements for combating IUU fishing. Throughout the past years, several initiatives had been undertaken by the Southeast Asian countries with support from SEAFDEC, the results of which started to be more tangible within the year. The “ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain” for example, which provides an overall regional framework for combating IUU fishing was endorsed by the ASEAN through its SOM-37th AMAF in 2015, while supportive tools such as the database on Regional Fishing Vessels Record (RFVR) was put in place with data inputs from relevant countries. Development of the ASEAN Catch Documentation Scheme (ACDS) and the NPOA for Managing Fishing Capacity had also made very good progress.

In addition to addressing the issues on IUU fishing, several policy frameworks were also developed by SEAFDEC under the ASEAN-SEAFDEC Strategic Partnership mechanism, such as those that aim to address the traceability of aquaculture products, explore alternative feed ingredients to replace the use of fish-based materials, as well as to establish the way forward for addressing issues on transboundary aquatic animal diseases and labors/workers in fisheries. On conservation and management of the fishery resources, several species were focused in 2015, e.g. neritic tunas, pelagic fishery resources, sharks and rays, and catadromous eels, among others. SEAFDEC also continued to promote fisheries management approaches that are practical for the region, particularly community-based fisheries management and the ecosystem approach to fisheries management.

Accomplishing the activities of SEAFDEC could not have been possible without the support and cooperation of all Member Countries and partner organizations. On behalf of SEAFDEC, I would like to express my gratitude to all those who have been involved in SEAFDEC activities throughout 2015. In particular, I would also like to extend my appreciation the Government of Japan and the Government of Sweden for extending continued support to SEAFDEC throughout the past years that enabled SEAFDEC to carry out wide range of activities toward our common goals of enhancing the contribution of fishery resources to food security of people, not only in the Southeast Asian region but all over the world.



Kom Silapajarn, Ph.D.  
Secretary-General



## OVERVIEW OF SEAFDEC PROGRAMS IN 2015

The activities of SEAFDEC in 2015 were formulated and implemented in line with the policy directives given by the SEAFDEC Member Countries during SEAFDEC annual meetings, *i.e.* the 37<sup>th</sup> Meeting of the SEAFDEC Program Committee (1-3 December 2014, Ubon Ratchathani, Thailand), 17<sup>th</sup> Meeting of the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) (4-5 December 2014, Ubon Ratchathani, Thailand), and the 47<sup>th</sup> Meeting of SEAFDEC Council (31 March - 3 April 2015, Chiang Rai, Thailand).



*SEAFDEC Council Directors attending the 47<sup>th</sup> Meeting of the SEAFDEC Council hosted by the Government of Thailand*

Formulation and development of the SEAFDEC programs and activities for 2015 had been guided by regional and international fisheries policy frameworks, particularly the Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020, adopted by the ASEAN-SEAFDEC Ministers during the ASEAN-SEAFDEC Millennium Conference in 2011. Moreover, under the ASEAN-SEAFDEC Strategic Partnership (ASSP) established since 2007, SEAFDEC has been implementing activities to support the ASEAN in its efforts towards the realization of the ASEAN Economic Community, particularly the ASEAN Roadmap for Integration of the Fisheries Sector, the ASEAN Integrated Food Security (AIFS) Framework, and the ASEAN Fisheries Consultative Forum (AFCF).

Progress of the programs and activities implemented by SEAFDEC in 2015 had been considered and endorsed by the 38<sup>th</sup> SEAFDEC Program Committee Meeting on 23-25 November 2015 in Manila, Philippines, and the 18<sup>th</sup> Meeting of the FCG/ASSP on 26-27 November 2015 also in Manila, Philippines, for subsequent submission to the SEAFDEC Council at its 48<sup>th</sup> Meeting in 2016.



*Participants of the 38<sup>th</sup> SEAFDEC Program Committee Meeting (left), and the 18<sup>th</sup> Meeting of the FCG/ASSP co-chaired by the delegate from Myanmar representing the Chairperson of the ASWGF and SEAFDEC Acting Secretary-General (right)*



Programs and activities implemented by SEAFDEC in 2015:

| Program Category/Project Title   | Responsible Department | Funding Source |
|--|------------------------|----------------|
| <b>ASEAN-SEAFDEC FCG/ASSP Programs</b>   |                        |                |
| <b>Thrust I: Developing and Promoting Responsible Fisheries for Poverty Alleviation and Food Security</b>  |                        |                |
| 1. Human Resource Development for Sustainable Fisheries  | TD                     | JTF            |
| 2. Optimizing Energy Use/Improving Safety Onboard in Fishing Activities  | TD                     | JTF            |
| 3. Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia                                  | TD                     | JTF            |
| 4. Environment-friendly, Sustainable Utilization and Management of Fisheries and Aquaculture Resources   | AQD                    | JTF            |
| 5. Enhancement of Sustainability of Catadromous Eel Resources in Southeast Asia  | IFRDMD                 | JTF            |
| 6. Promotion of Responsible Utilization of Inland Fisheries in Southeast Asia  | IFRDMD                 | JTF            |
| <b>Thrust II: Enhancing Capacity and Competitiveness to Facilitate International and Intra-regional Trade</b>  |                        |                |
| 7. Chemical and Drug Residues in Fish and Fish Products in Southeast Asia - Biotxin (ASP, AZA and BTX) and Harmful Algal Blooms (HABs) in the ASEAN region   | MFRD                   | JTF            |
| 8. Cold Chain Management for Seafood   | MFRD                   | Singapore      |
| 9. Reinforcement and Optimization of Fish Health Management and the Effective Dissemination in the Southeast Asian Region                                    | AQD                    | JTF            |
| <b>Thrust III: Improving Management Concepts and Approaches for Sustainable Fisheries</b>  |                        |                |
| 10. Strategies for Trawl Fisheries By-catch Management   | TD                     | FAO/GEF        |
| 11. Promotion of Countermeasures to Reduce IUU Fishing Activities  | TD                     | JTF            |
| 12. Combating IUU Fishing in the Southeast Asian Region through Application of EU Catch Certification for International Trading in Fish and Fishery Products | MFRDMD                 | JTF            |
| <b>Thrust IV: Providing Policy and Advisory Services for Planning and Executing Management of Fisheries</b>  |                        |                |
| 13. Fisheries Resource Survey and Operational Plan for M.V. SEAFDEC 2  | TD                     | JTF            |
| 14. Offshore Fisheries Resources Exploration in Southeast Asia   | TD                     | JTF            |

| <b>Program Category/Project Title</b>   | <b>Responsible Department</b> | <b>Funding Source</b> |
|---|-------------------------------|-----------------------|
| 15. Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region | TD/SEC                        | JTF                   |
| 16. Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region   | MFRDMD                        | JTF                   |
| 17. Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region   | MFRDMD                        | JTF                   |
| <b>Thrust V: Addressing International Fisheries-related Issues from a Regional Perspective</b>  |                               |                       |
| 18. Assistance of Capacity Building in the Region to Address International Trade-related Issues   | SEC                           | JTF                   |
| 19. Strengthening SEAFDEC Network for Sustainable Fisheries   | SEC                           | JTF                   |
| <b>Special Project</b>  |                               |                       |
| 20. Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia  | Secretariat                   | Sweden                |
| <b>Departmental Programs*</b>   |                               |                       |
| 1. Tailor-made Training Programs  | TD                            | TD                    |
| 2. Promotion and Enhancement Fisheries Information  | TD                            | TD                    |
| 3. Improvement of Fisheries Technology and Reduction of the Impact from Fishing   | TD                            | TD                    |
| 4. Adapting to Climate Change Impacts   | AQD                           | AQD                   |
| 5. Healthy and Wholesome Aquaculture  | AQD                           | AQD                   |
| 6. Maintaining Environmental Integrity through Responsible Aquaculture  | AQD                           | AQD                   |
| 7. Meeting Socio-economic Challenges in Aquaculture   | AQD                           | AQD                   |
| 8. Quality Seed for Sustainable Aquaculture   | AQD                           | AQD                   |
| <b>Other Programs</b>   |                               |                       |
| 1. Coastal Area Capability Enhancements in Southeast Asia   | TD                            | RIHN                  |
| 2. Application of Fish Passage Design Principles to Enhance Sustainability of Inland Fishery Resources in the Southeast Asian Region                                  | SEC/TD                        | ACIAR                 |
| 3. Technical Exchange between Thailand and Myanmar Fisheries Scientists on Hilsa  | SEC                           | FAO/BOBLME            |

\* Funding sources for Departmental Programs are mainly the regular contribution from the respective Host Governments.

## SEAFDEC PROGRAMS OF ACTIVITIES IN 2015

The programs and activities of SEAFDEC in 2015 have been formulated and undertaken in response to the requirements of the Member Countries, taking into consideration the priority issues stipulated in the “Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020” adopted in 2011. The results and progress of the implementation of programs and activities carried out in 2015 are summarized in this Annual Report.

### THRUST 1. DEVELOPING AND PROMOTING RESPONSIBLE FISHERIES FOR POVERTY ALLEVIATION AND FOOD SECURITY

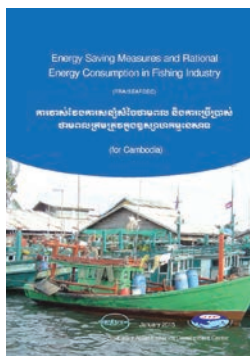
#### 1.1 Responsible Fishing Technologies and Practices

For almost five decades, TD has been undertaking several programs aimed at promoting responsible fishing technologies and practices, including those that are aimed at reducing the various impacts of fishing activities through improvements in onboard fishing practices; development of deck machineries; and conduct of practical research on fishing technology and marine engineering. Recently, activities on responsible fishing technologies and practices focus on energy optimization in fishing operations with particular emphasis on trawl net design and standard energy audit for shrimp trawlers in the Gulf of Thailand.

TD implemented the project on “**Optimizing Energy Use/Improving Safety Onboard in Fishing Activities**” since 2013 with the objectives of developing appropriate technologies, transferring knowledge, enhancing awareness on optimizing energy use in fishing activities, and promoting safety at sea for small fishing vessels of the Southeast Asian countries. In order to maximize the impacts of this project, TD organized an “On-site Training on Optimizing Energy and Safety at Sea for Small Fishing Vessels” in Cambodia as pilot site, on 29 September-1 October 2015 in Preah Sihanouk. For better understanding of the procedures by the trainees, the FAO-published “Guidelines on Energy Saving Measures and Energy Consumption in Fishing Industry” and “Safety Recommendations for Decked Fishing Vessels of Less Than 12 Meters in Length and Undecked Fishing Vessels” translated earlier into the Khmer language, were used as references during the on-site training.



*On-site Training on Optimizing Energy and Safety at Sea for Small Fishing Vessels in Cambodia*



*Publications used during the “On-site Training on Optimizing Energy and Safety at Sea for Small Fishing Vessels” organized in Cambodia*

With the collaboration of FAO, TD implemented the project on **“Energy Audit for Trawlers in the Gulf of Thailand.”** As a follow-up to the experiment on energy audit of trawl design conducted in 2014 using the M.V. Plalung, an activity focusing on energy audit for commercial trawlers was carried out by TD in 2015. Six trawlers, two each representing the different categories of trawl vessels, namely: vessels less than 14 meters in length in Chonburi Province (small-size trawlers); vessels 14-18 meters in length in Satun Province (medium-size trawlers); and vessels more than 18 meter in length in Songkhla Province (large-size trawlers), were used during the 6-month trial conducted 5 days per month, during the new and quarter phases of the moon. Data collected include fuel consumption, gas emission, as well as costs and earnings from the different categories of trawlers. From the results of the study, recommended techniques for fuel optimization were established, *e.g.* periodical check and maintenance of engines; clearing ship hulls of barnacles to reduce friction; improvement of fishing gears, methods and materials to reduce drag force/friction; and optimum speed in fishing operations taking into consideration cost-revenues to maximize the benefits from fishing activities. The final report of the study would be published in 2016, after which fuel optimization techniques would be subsequently promoted to fishers in the Southeast Asian region.

## 1.2 Improving Fish Handling On-board Fishing Vessels

In order that utilization of catch from fishing operations would be improved, TD promoted the principles of fish handling technology at sea onboard fishing vessels through the Regional Training Course on Fish Handling Techniques Applicable to Various Fishing Operations in Southeast Asia on 9-13 March 2015 in Samut Prakan, Thailand. The training course aimed to promote food safety and minimize post-harvest losses during catching, storing and transporting of fish utilizing fish handling tools and simple techniques to maintain the quality of catch, and facilitate sharing and exchange of views and ideas among the Southeast Asian countries on the practical techniques and concepts related to reduction of fisheries post-harvest losses.

Moreover, TD in collaboration with the Department of Fisheries (DOF) of Thailand also designed a “sorting table” to improve fish unloading and hygienic practices at fishing ports. This design was tried and compared with the ordinary method of sorting fish on the floor. Results of the trial suggested that using the “sorting table” was advantageous, especially



*Energy audit of commercial trawler in Satun Province, Thailand*



*Participants in the Regional Training Course on Fish Handling Techniques Applicable to Various Fishing Operations in Southeast Asia*

in terms of the hygienic aspects, time required for sorting and separation of species, and so on.

### 1.3 Habitat Conservation and Resources Enhancement

TD continued its momentum in the implementation of habitat conservation and resource enhancement measures through its project on **“Rehabilitation of Fisheries Resources and Habitat/Fishing Grounds Through Resources Enhancement.”** Implemented during 2010-2014, the project activities were carried out in three project sites, namely: sea grass bed areas in Sriboya Island, Krabi Province, Thailand; artificial reef areas in Rayong Province, Thailand; and in inland manmade Nam Houm Reservoir in Lao PDR.

For the conservation and enhancement activities in sea grass beds of Sriboya Island, Workshops on Andaman Province Dog Conch Shell Resource Management Measures were organized in Krabi Province, Thailand in 2013 and 2014. Results of the Workshops had created ripple effects in promoting several management schemes for the economically-important sea snail, the dog conch (*Strombus canarium*). Having been enlightened on the relevant issues discussed during the Workshops, the participants comprising representatives coming from nearby local communities and government fisheries offices enhanced their awareness of the need to conserve and sustainably utilize the dog conch. As a result, the Andaman Province group subsequently allocated funds to enhance the dog conch resource in the Island by supporting the release of one million dog conch seeds during 2015-2016. A permanent conservation area, where harvest of dog conch is prohibited, had also been established. The lessons learnt from the project’s case study on dog conch shell resource enhancement through community-based management could be shared with other countries of Southeast Asia for possible adoption where appropriate.



*Banner on the conservation of dog conch put up in strategic areas in Krabi Province, Thailand*



*Dog conch (*Strombus canarium*)*

In order to share the results of this project to the Member Countries, and for such results to serve as inputs in the implementation of future resources enhancement activities in Southeast Asia, TD in collaboration with AQD organized the “Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region” on 27-30 July 2015 in Pattaya, Thailand. Through the Symposium, experiences and lessons learnt from resources enhancement initiatives undertaken by SEAFDEC and the Member Countries were

exchanged, while knowledge on the subject of renowned experts was imparted serving as basis for the development of resources enhancement activities by the Southeast Asian countries. The Strategic Plan for Fishery Resources Enhancement based on two approaches, namely: Habitat Improvement and Management, and Artificial Propagation and Stock Release, which was established during the Symposium, would serve as effective ways and means of protecting and restoring the aquatic resource habitats and target fishery stocks in the region. The aforesaid Strategic Plan for Fishery Resources Enhancement was submitted and subsequently supported by the SEAFDEC Program Committee at its 38<sup>th</sup> Meeting in November 2015 for endorsement during the forthcoming SEAFDEC Council Meeting in April 2016.

Using as reference the Strategic Plan for Fishery Resources Enhancement adopted during the aforementioned Symposium, TD commenced a new project in 2015 on the **“Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia.”** To enable the project to take off in 2015, the “Regional Inception Workshop on the Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia” was organized on 31 July 2015 in Pattaya, Thailand. The Workshop aimed to identify the appropriate resource enhancement tools for developing fishery resources enhancement and habitat conservation measures, analyze and diagnose the effectiveness of the measures, and formulate strategies and guidelines for the implementation of such resources enhancement measures. As a result, a broad direction for the new resources enhancement project was established, *i.e.* selection of appropriate project sites, identification of the most effective resources enhancement tools/measures, and development of rehabilitation plans for various critical habitats/fishing grounds.



*Discussion on the development of rehabilitation plans for various critical habitats/fishing grounds*



*Discussion on the way forward for the implementation of management measures for dog conch in Krabi Province, Thailand*

#### 1.4 Coastal Area Capability Enhancement

With the collaboration of the Research Institute for Humanity and Nature (RIHN) of Japan and other partners, TD has been implementing a research project on **“Coastal Area Capability Enhancement in Southeast Asia”** starting in 2012. Adopting a *“holistic approach”* to come up with full understanding of how people utilize the coastal resources, the project also supports the establishment of rational and practical measures for attaining social and ecological sustainability.



*Interviewing a fisher about his livelihood and social activities*



*Collecting samples of the fishery resource in a coastal area*



*Analyzing samples of fish from coastal areas*

The project activities from 2012 to 2015, emphasized on undertaking preliminary surveys to examine the present status of the resources, biology, livelihoods, social activities, and environment, the results of which were used to evaluate the area capability of coastal areas with set-net fishing operation as a core of the project activity. In 2015, activities on standardization of methods for data collection, monthly field surveys and tests, equipment and system development, and environmental data collection were continued. Specifically, data collection was pursued under six components, namely: fishing gear, biology, environment, social aspects, acoustic, and set-net fishing operation. Specifically, on 23-30 January, samples were taken for organic matters, phytoplankton/zooplankton, and biological analysis. Collection of biological and marine environment data was subsequently carried out on 16-19 February to obtain information on existing fishery resources and the environment around the set-net area. Samples of fish tissues were collected and preserved for DNA analysis.

On 9-11 July 2015, a field survey was conducted to obtain information on fishing operation and fish catch from small-scale gill-nets, traps and hand-lines along Mae Ram Phung Beach in Rayong Province, Thailand, using fishing logbooks accompanied with GPS data. Interviews of fishers on their daily and seasonal fishing activities were also conducted. Such information would serve as inputs for the production of a publication on “fishing gears and operations inventory.” Furthermore, data on physical conditions such as wind, water current and oceanographic parameters were also compiled considering that these are key factors to evaluate the catchability and performance of set-net and other fishing activities. Wind logger systems were introduced for monitoring of wind direction and speed at two sites, one near the landing site of set-net (west side), and another at the top of EMDEC Aquarium (east side). The project also carried out a socio-economic study of the fishers’ livelihoods along the coastline of Mae Ram Phung Beach and adjacent areas on 27-28 August 2015. Papers from the study would be subsequently published to provide information on the actual situation of the livelihoods of small-scale fishing households in Thailand including fisheries management, based on the case study in the eastern and central parts of Thailand.

Furthermore, as the permit to install the Japanese-type set-net in Rayong Province which was supported by SEAFDEC since 2003, has already been terminated in 2014 ceasing all set-net operations since then, the project staff took the opportunity to visit and interview the set-net fishers’ groups on their willingness to continue set-net operations in the area.



Meanwhile, all data collected and accumulated through the set-net operations from 2003 to 2013 were analyzed. Results of the analysis of such data could provide better understanding of the effects of water current on the set-net's chamber-net geometry and catch trend as well as on the mean trophic level of major catch species from set-net fisheries.

## 1.5 Management for Sustainability of Inland Capture Fisheries

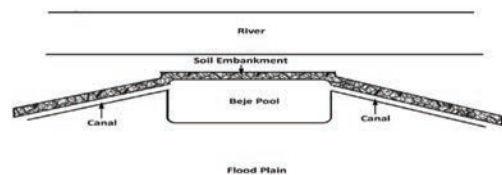
One of the most important socio-economic activities of many Southeast Asian countries is inland capture fisheries, contributing to poverty alleviation, food security and the nutritional well-being of peoples in rural communities. Since the sustainability of inland capture fisheries depends on the quality of the aquatic habitats and ecosystems, this should be enhanced and fully recognized for its role in socio-economic development of the countries. However, it is well known that besides fisheries, other sectors are also making use of the inland water ecosystems to the extent that in most cases, inland fisheries have been overlooked by planners and policy makers. It has therefore become necessary to give importance to this sector in terms of development in order that its contribution to the national economies is maximized.

As it has been recognized that improved management of inland fisheries in the region is of utmost importance, the newly-established IFRDMD has been tasked to carry out activities on the improvement of data collection, as well as enhancement of governance through the application of ecosystem approach to fisheries and co-management. The five-year project on **"Promotion of Responsible Utilization of Inland Fisheries in Southeast Asia"** was therefore initiated by IFRDMD in 2015 to establish and strengthen regional networking for the improvement of fisheries management and conservation of fisheries resources and environment in inland waters of the Southeast Asian region.

As part of the project, a research on fishing gears and methods around Rungan River in Central Kalimantan, Indonesia was carried out by IFRDMD from 27 April to 1 May 2015, the result of which showed that fishing activities in Kahayan River Basin including the Rungan River are generally carried out by people living along the river. Fishing activities are dominated by capture fisheries with fishing rights given to specific local fishers as a matter of heredity. Various kinds of fishing gear are used in the area, such as pot traps (*kabam*), long line (*rawai*), stake line (*banjur*), gill net (*rengge*), stage trap (*lukah*), seine



*Discussion between IFRDMD staff and local government fisheries officers in Central Kalimantan on the IFRDMD project activities*



*Design of "beje" used in Central Kalimantan, Indonesia*

net (*selambau*), cast net (*lunta*), portable lift net (*hancau*), portable trap with gate (*jabak*), portable trap (*kalang*), and pond trap (*beje*). Developed based on local wisdom, *beje* has been operated by the Dayak tribe for generations by heredity.

Moreover, since harvest of fish from *beje* is limited during the dry season, *beje* fishing could serve as protection for the parental stocks of fishery resources. Results of the research also suggested that traditional fishing methods based on local wisdom contribute to resources conservation with low level of fishing efforts, and therefore, should be promoted. Furthermore, other measures were also found to enhance the sustainable use of the fishery resources such as conservation, restocking, and others. In order that the sustainable use of resources is assured, important issues on preservation of the habitats and biodiversity taking people's welfare as priority would be advocated.

IFRDMD also provided a forum for sharing of views, knowledge and experiences relevant to the roles and functions of inland fisheries on 9-11 November 2015. With *Dr. Masahito Hirota* from the National Research Institute of Fisheries Science, Research Center for Fisheries Economics and Business Administration, Fisheries Management Group of the Fisheries Research Agency of Japan, as the Resource Person, the forum was meant to address some important issues pertaining to social sciences and fisheries economics for small fishing communities. During the discussion, the ways and means of strengthening the roles of inland fisheries for better resources management in the future were established. As an offshoot, a field study was undertaken to interview persons familiar with fishery products, processing factories and facilities as well as fishers using different types of gears in downstream Musi River. Visit to a landing place in Palembang was conducted to obtain information on fisheries activities, total catch per day, and gears used among others.



*a. Rungan River, b. Lake Rawe, c. riparian vegetation of Rungan River, d. swamp forest next to Lake Rawe.*

A project on “**Technical Exchange between Thailand and Myanmar Fisheries Scientists on Hilsa**” was also initiated in 2015. Hilsa (*Tenealusa ilisha*) is one of the flagship species distributed across the Andaman Sea area that include the waters of Myanmar and Thailand. While hilsa is mostly depleted in the waters of Thailand, the species is still abundant in Myanmar, making it necessary to manage the resource sustainably by enhancing stakeholders’ knowledge of the biology of the species, *e.g.* life history parameters, stock structure, genetics, morphometric aspects, interaction of different fisheries sub-sectors, critical habitats for the species’ life-history stages. This project therefore served as means for sharing knowledge to enhance better understanding of the species, and supporting conservation and management efforts for sustainable utilization of the species.



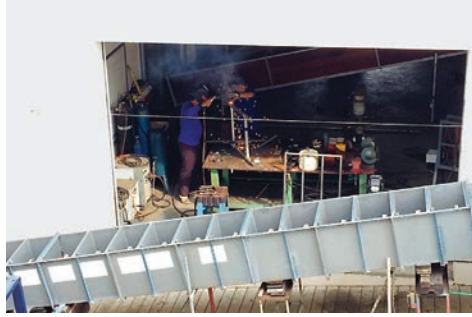
*Collection of hilsa juveniles in the waters of Myanmar*

At the outset, three experts from the Department of Fisheries (DOF) Thailand conducted a pre-survey of hilsa in protected areas of Yangon River in Myanmar on 1-6 March 2015, by observing catch landings and interviewing middlemen at two landing sites. This was followed by visit of scientists from Myanmar to Thailand on 11-15 May 2015 to observe relevant activities, including collection of live pelagic fishes, live feeds, and marine and inland aquaculture production facilities and techniques. Subsequently, on 5-10 June 2015, a field activity was undertaken by scientists from Thailand and Myanmar to collect hilsa juveniles in Myanmar waters and transporting the juveniles to Thailand for rearing. From such activities, knowledge and experience of scientists from Myanmar and Thailand had been shared. Thus, Myanmar scientists had enhanced their knowledge on the biology of hilsa and improved their skills on the collection and transportation techniques of live fish especially pelagic species. Myanmar scientists have also enhanced their awareness of the importance of their role in the conservation of fishery resources and with their technical knowledge on aquaculture, are now capable of developing plans for modified techniques to suit their available resources and facilities, as well as initiating activities on the development of a whole system of hilsa production and conservation.

SEAFDEC also initiated the project on “**Application of Fish Passage Design Principles to Enhance Sustainability of Inland Fishery Resources in the Southeast Asian Region,**” to come up with a fishway model design that focuses on such critical parameters as slope, water flow/velocity, and pass dimension among others, and developing the most appropriate design for various conditions. Under this project, experiments would be conducted on-station using selected indigenous fish species, the results of which are expected to provide basic information on the considerations for designing fish passes for different localities



*Group discussion to prepare for the launching of the Fishway Project*



*A sample fishway model designed and developed by TD*

of the Southeast Asian region. During the early stage of the project, an “Informal Group Discussion for Preparation of the Project” was convened on 8-10 May 2015 in Nakhon Nayok, Thailand to identify the key factors that would be considered in designing a fishway model. Participated by researchers from SEAFDEC and DOF Thailand, the Group Discussion came up with an initial model design and the research plan for the project. Based on results of the discussion, an initial model of small-size fishway was constructed at TD with initial trials on hydrological aspects and the applicability of the model during the migration of some fish species. The design would be used as basis for discussion during the Experts Workshop in early 2016.

## **1.6 Promotion of Sustainable Aquaculture Development**

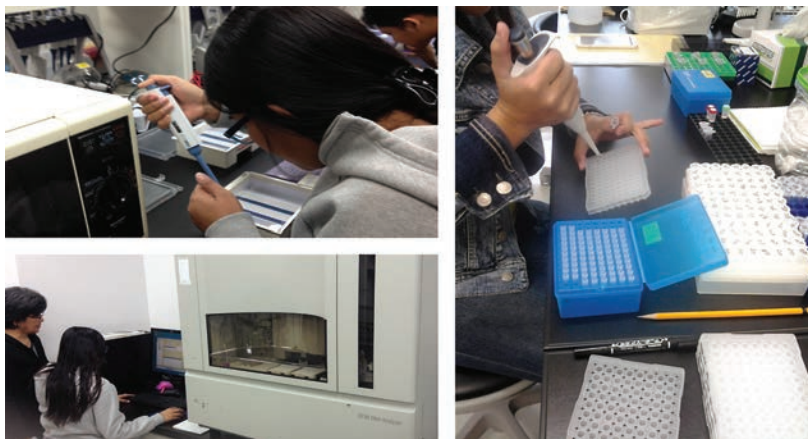
### **1.6.1 Quality Seeds for Sustainable Aquaculture**

One of the main constraints in enhancing aquaculture production in Southeast Asia is the inadequacy of supply of good quality seed stocks and required domesticated broodstocks. With the intensification of aquaculture systems and environmental challenges, genetic quality and culture management are equally important in ensuring a steady yield of good quality seeds and subsequently, marketable products from aquaculture. Recognizing these concerns, AQD implemented a Program that aims to generate, verify and promote technologies that would ensure the sustainable production of quality seed stocks for aquaculture as well as for stock enhancement.

Focus of the Program in 2015 was placed on determining the optimal conditions and methods for the production of quality seed stocks in sufficient quantities. These include the use of methods for stock improvement such as domestication, broodstock management, strain evaluation, and selective breeding or genetic improvement of traditional and emerging freshwater and marine species.

***Developing good quality broodstock and implementation of proper stock management protocols:*** To ensure the production of healthy larvae or stocks that survive and grow well when farmed or released in specific environments, the activities put emphasis on: monitoring the genetic structure of base populations, establishing husbandry techniques, culture of live food, and developing suitable formulated diets necessary for good

reproductive performance of various commodities. Molecular markers to identify stocks and consequently aid in determining genetic quality were used in several commercial species. Collaborative studies were continued with the University of the Philippines and Tohoku University in Japan for the development of quality milkfish, abalone, oyster and mud crab broodstock through molecular marker-aided stock monitoring and management.



AQD researchers performing DNA analysis of abalone and crab samples at the laboratory of Tohoku University, Japan

For milkfish *Chanos chanos* stocks, nine microsatellite marker loci identified as utilizable were applied in delineating stocks and were used in assessing milkfish samples from three wild populations, eleven local hatchery stocks, and a hatchery stock from West Java, Indonesia. Results showed significant but low genetic differentiation among the milkfish populations and much of the variation is attributed to intrapopulation differences. The Indonesian stock had genetic variability levels comparable with those of local Philippine stocks. As for the abalone, wild stocks were collected and families per stock were continuously being produced for genetic assessment. To improve the abalone veliger survival rate, techniques in harvesting and incubation were refined, where trochophore larvae incubated at 26°C for 24 hours using a flow-through system, attained higher survival rates. With regard to oyster *Crassostrea irredalei*, molecular characterization of broodstock from wild sources is currently being done by the University of the Philippines in the Visayas as part of the National Oyster R&D Program led by SEAFDEC/AQD. In the newly approved study on selective breeding of mud crab, tissue samples from broodstock sourced from Camarines Sur, Northern Samar and Surigao in Philippines that were sent for primer screening and development in Japan, led to the identification of three new potential msDNA markers.

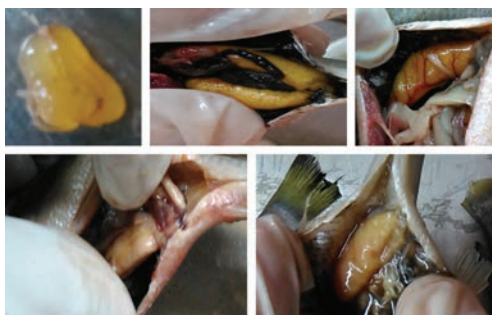
To improve the reproductive performance in farmed aquatic commodities, sustainable production of marine annelids (*Marphysa mossambica*) as potential feed for mud crab *Scylla serrata* broodstock, was pursued. Results showed that increasing the level of *Marphysa* meal in formulated diet in combination with natural feed without live polychaetes correspondingly increased the mud crab zoeal production.

With regard to tiger shrimp *Penaeus monodon*, broodstock diets have been tested with the aim of improving the broodstock reproductive efficiency. Results supported earlier observations that mortalities during domestication are significantly reduced when vitamin C is incorporated in the diet. Some of the postlarvae produced were stocked in tanks for determining the level of inositol in the diet that improves survival during the grow-out stage. In another study, monitoring the maturation of *P. monodon* sub-adult females stocked in pens and tanks, and given various experimental diets (formulated feed with either 125 ppm Vitamin C, 250 ppm Vitamin C or without Vitamin C-control) has been started.

For indigenous species such as the silver therapon, a new study was initiated to compare the growth and reproductive performance as well as the nutritional composition of wild and hatchery-reared stocks.



Land-based tank set-up to compare the growth and reproductive development of wild-sourced and hatchery-bred silver therapon, *Leiopotherapon plumbeus juveniles*



Representative colors of gonadal tissue of wild female silver therapon *L. plumbeus*

For oyster *C. irredalei*, protocols for broodstock management and conditioning for maximized production suggested faster gonadal development in oysters stocked and reared to maturity in estuaries and in semi-intensively managed ponds than in tanks. Trials were also conducted to determine the effects of salinity on the oysters' gonadal maturation.

On species for stock enhancement, genetic characterization of seahorses *Hippocampus barbouri* and *H. comes* collected from various sites (Molocaboc Is., Sagay City; and AQD's seahorse hatchery in the Philippines and a seahorse hatchery in Japan) through microsatellite marker analysis showed a very low degree of differentiation among populations of wild and hatchery-produced seahorses. Cross-amplification of primers of *H. comes* microsatellite loci in other species of seahorses and a pipefish was successful. With regard to sandfish *Holothuria scambra*, application of nutritional approaches improved the reproductive performance of broodstock. Survival of broodstock fed with shrimp feed and *Sargassum* powder was 100% when reared for the entire 8-week experimental run. When warm shock vs. cold shock was used in artificial spawning, the percentage of broodstock that spawned was 7% for those exposed to warm shock whereas it was 2% for those under the cold shock treatment. On blue swimming crab, production is still totally reliant on wild broodstocks making it necessary to consider as a priority the effective transport of potential spawners from the wild to aqua farms. A study which tried to develop a suitable

protocol for the transport of blue swimming crab broodstock resulted in the possibility of transporting crabs at high loading density (10 pieces) for 6-hour transport period.

**Refining hatchery and nursery management methods:** In the abalone, hatchery production was improved with the administration of microparticulate diets as alternative feed. When fed a combination of natural food and microparticulate diet for 90 days, mean survival rate was highest for the hatchery and wild stocks (38.6% to 43.3%) regardless of feeding duration. In an effort to increase abalone juvenile production through the improvement of hatchery culture techniques, evaluating the efficiency of using chemical cues (positive ions, algal extracts) to improve settlement rate resulted to higher settlement rate (32.6-37.3%) when dopamine hydrochloride was used at  $10^{-6}$  M than the control (22.3%). For algal extract, the alga *Nitzschia* sp. was noted to consistently induce high abalone settlement (4.0-4.7%) and survival rates (50.9-52.9%). Finally, in the development of an efficient sorting and harvesting protocol, the use of anaesthetic agents as muscle relaxant for abalone juveniles was effective. In the oyster, when combined spawning methods of desiccation with flow-through UV-irradiated water were used in the production of quality seedstock, hatching rate was higher (39-48.5%) when sperm solution was mixed with 0.75 million-2.00 million eggs, and the most suitable substrate for settlement were empty oyster shells. To improve spat production, treatment of epinephrine bitartrate resulted in 100% settlement rate and survival rate of 64.7%. Tests on the methods of remote settling (where larvae or pediveligers that are competent to settle are transported to nursery sites where they can settle) of oysters showed that survival of pediveligers transported with water was higher than those transported without water.

On mud crab *Scylla serrata*, improvement of the hatchery schemes was carried out by testing different types of AQD formulated diets. *S. serrata* larvae fed diets containing polychaete meal, squid meal or their combination had similar survival and population development index. In an intervention to help increase hatchery and nursery production of mud crabs, such as use of shelters, the ideal number of shelters (4, 8, 12 units, covering 1, 2 and 3 m<sup>2</sup> of the base of cage) and stocking density (30, 50 and 100 individuals/m<sup>2</sup>) could improve crablet yield, although the percentage of medium-sized crablets significantly decreased as the stocking density increased regardless of the number of shelters used. For the blue swimming crab (BSC) *Portunus portunus*, larvae were fed natural food and commercially available shrimp formulated diets (*lansy*, *japonicus* and *monodon*) to reduce the use of natural food that requires more labor and facilities. In determining larval quality, stress test using formalin at varying concentrations and exposure duration suggested that as the formalin concentration increased cumulative larval mortality also increased, implying that the formalin stress test could be used to determine the quality of newly hatched BSC zoeae for seed production. On the use of antibiotics during larval rearing, BSC megalopae can be produced without antibiotics if larval quality is good. For nursery rearing of the BSC, shelter requirement and stocking of crab instar stages indicated that at 600 individuals/m<sup>2</sup>, BSC exhibited significantly higher survival with net curtains and framed nets. For *Kappaphycus*, tissue cultured cultivars were produced in the laboratory and reared in land-based nursery tanks and sea cages. The protocol in land and sea-based nurseries is continuously being optimized to shorten the culture period while tissue culture explants were successfully outplanted in Bohol, Zamboanga, and Guimaras.



*Seaweed farming is a family activity in Cabalaganan, Guimaras where family members together harvest and clean *Kappaphycus alvarezii**



*Checking *Kappaphycus alvarezii* propagules outplanted using micropropagation*

On silver therapon *Leiopotherapon plumbeus*, a promising species for commercial inland aquaculture, feeding protocol for larvae has been developed, where the rotifer *Brachionus rotundiformis* was found to be a suitable starter food for the first feeding silver therapon larvae. Meanwhile, the larvae attained best growth and highest survival at 5 L<sup>-1</sup> after 35 days of rearing. In sandfish *Holothuria scabra*, refinements in the hatchery protocol using appropriate food and stocking densities showed that *Chaetoceros*-fed larvae had better survival, faster development and lesser deformities. Furthermore, seahorses *Hippocampus barbouri* and *H. comes* are continuously being propagated at AQD hatcheries for possible stock release.

***Developing schemes for production, management, maintenance and dissemination of genetically selected and improved stocks:*** A new project on the selective breeding of mud crab aims to develop a disease resistant stock and fast growing strain. This would involve mass selection scheme for both traits, and collection of additional breeders to build the base population for selective breeding has started. For milkfish, growth in stocks known to have potentially high genetic variability and/or fitness would be compared and reared through field trials in ponds based on the outcome of the molecular marker studies. For the abalone, hybridization using the local commercial abalone species (*Haliotis asinina*) crossed with other Philippine abalone species *H. planata* and *H. glabra*, to produce stocks/species with improved traits. Some samples of the abalone hybrid stocks were sent to Hokkaido University in Japan for genetic characterization.

On seaweeds, methods to develop strains of *Kappaphycus* that are resistant to diseases and epiphytes indicated that diploid *Kappaphycus* have higher specific growth rate than haploids, while the carrageenan quality from both diploids and haploids were not different. Nevertheless, the carrageenan viscosity of the diploid was significantly higher than that of the haploid.

In summary, when aquatic resources from the wild have become limiting, the need to properly utilize and manage stocks both for conservation and sustainable aquaculture is of utmost importance. Resource management can be achieved through techniques that allow a balance between exploitation and production. Advances in aquatic animal breeding and seed production, such as the genetic and nutritional techniques described in





Monitoring settlement rate, growth and survival of hybrid abalone larvae: (counter clockwise from left) brushing of plates to monitor larval settlement; settled larvae; C-90-day old juvenile; sampling of stocks to monitor shell length and body weight

Sampling of abalone to determine growth rates (left) and foot muscle excision for DNA analysis (center and right)

the aforementioned contribute to this target. Scientific interventions that ensure quality seed production undoubtedly benefit the growth of the aquaculture industry in Southeast Asia. Once technologies such as those currently being refined and verified by AQD are successfully adopted on-farm, these could be directly translated into increased yield.

### 1.6.2 Healthy and Wholesome Aquaculture

Practices that threaten food safety and concerns relating to the impact of aquaculture on the ecosystem still persist, and in order to assist the Member Countries in addressing this problem, SEAFDEC has been promoting the concept of 'healthy and wholesome aquaculture'. A holistic approach to fish disease management for food safety and security, this concept promotes the use of efficient feeds (cost effective and low polluting) to optimize production of robust and healthy farmed aquatic animals with the least negative impact on the environment. This is therefore aimed at improving aquaculture production through innovations in nutrition and feeding as well as fish health management, and preserving the environmental integrity of aquaculture areas.

**Investigating the efficacy of indigenous probiotics:** An indigenous poly- $\beta$ -hydroxybutyrate (PHB)-accumulating mixed bacterial culture and two PHB-accumulating *Bacillus* spp. when isolated from a Philippine shrimp culture pond and investigated for their capacity to improve growth, survival and robustness of *Penaeus monodon* postlarvae, demonstrated that the indigenous bacilli is capable of accumulating PHB and provide beneficial effects

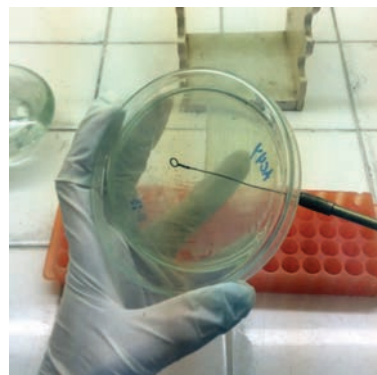
such as improved growth performance, survival and resistance against pathogenic infection and ammonia stress test to *P. monodon* post-larvae during culture. Another indigenous probiont (*Bacillus subtilis*) possessing antimicrobial activity against *V. harveyi*, a known pathogen in mud crab hatcheries, isolated from the rearing environment, body surface, and gastro-intestinal tract of mud crab showed that oral administration of *B. subtilis* could confer protection in mud crab as evidenced by the successful production of crab instar.

**Applying diagnostics that will ensure biosecurity within culture systems:** Site selection and effective zoning hold the keys to sustainable production of high quality aquaculture products. After investigating two major oyster-producing areas located in Cabugao Bay and Agojo River (Capiz, Western Visayas, Philippines) for their sanitary quality, the microbial quality of major oyster culture areas in Visayas (Roxas Province) was established. The composition of bacterial microbiota in the culture environment and also the threshold level to bacterial load in water, sediment, gills and intestines of healthy tilapia, *Oreochromis niloticus* reared in earthen ponds that was established could provide baseline information for the establishment of Tilapia GAqP (good aquaculture practices for tilapia).

**Promoting wider use of conventional diagnostic as well as new methods for newly reported, emerging diseases:** Through studies on diseases affecting farmed and wild mud crab including predisposing, risk and protective factors, and possible prevention and control measures, the risk factors for WSSV were identified in terms of low temperature and presence of WSSV positive shrimp. Pathogenicity tests suggested that opportunistic bacteria could only induce mortality when mud crabs are stressed, especially when newly molted. Refinements have been made to improve the detection limit of a lateral-flow strip biosensor (LFSB) kit, *i.e.* to be at par with the nested-step of the optimized WSSV PCR method. The lack of comprehensive online information resource on shrimp pathogens with a centralized facility to store and archive isolates collected from outbreaks all over the Philippines necessitated the establishment of a database of aquatic pathogens occurring in the country with a total of 1321 bacterial isolates collected and bio-banked. To obtain meaningful information from the data generated, database software intended for web-based accessibility by users was developed, and a Biobank Room dedicated for storing and archiving isolates compliant to at least level 2 biosafety and biosecurity standards has been established at AQD.



Collecting shrimp samples using cast net for bacterial isolation



Isolation of bacteria collected from shrimp hepatopancreas



A barcoding scheme that directs information to Online Philippine Shrimp Pathogen Information Resource

**Finding effective alternative safe drugs/chemicals to manage aquaculture diseases in lieu of harmful chemicals and drugs:** Infectious diseases of bacterial etiology are some of the constraints limiting mud crab hatchery production, while lack of alternatives to antibiotics (whose use has been banned or discouraged due to food safety concerns) has hampered the production of adequate seeds to spur production in grow-out facilities. Two plant extracts (*Terminalia catappa* local name: *talisay* and *Nephelium lappaceum* local name: *rambutan*) were tested for antimicrobial activity *in vitro* (agar disc diffusion method) and *in vivo* (oral administration followed by bacterial challenge). Hatchery runs showed that dried crude extract from *talisay* (*T. catappa*) leaves when added to the rearing water (125 ppm) successfully produced crab instar with survival rates of 1.2% and 1.8% in trials which are comparable to the control with antibiotic treatment.

**Finding alternatives to fish meal and fish oil as feed ingredients in aquaculture feed formulations and developing effective feeding strategies that may incorporate sound environmental management:** The aquaculture feed industry has a pressing need for suitable fish meal and fish oil substitutes since it cannot continue its dependence on fish meal and fish oil which are finite resources and may cause the demand for these ingredients to exceed the global fish meal and fish oil supply. Considering that the situation could become worse when the price of aquaculture products either decrease or stagnate, it has become imperative to test several alternative feed ingredients as substitutes to fish meal and fish oil in various fish species. After the experiments, results revealed that fermented cowpea could replace 40% of fishmeal in milkfish feed. In another study on milkfish, feeds where 50% of the fish meal was replaced with defatted soybean meal or 40% of fish meal replaced with soy protein concentrate were tried both in marine cages in Igang, Guimaras Province and brackishwater pond in Dumangas, Iloilo.

Results showed that the use of this SEAFDEC-USB diet gave lower FCRs (in cages - 1.6; in ponds - 1.8) compared with the commercial milkfish feed (in cages - 2.3; in ponds - 2.6). The SEAFDEC-USB-fed stocks also attained a marketable size of >400 average body weight in less culture time. As distillers dried grain solubles (DDGS) could also replace 45% of soybean meal in milkfish diet, verification of the use of DDGS has been carried out in milkfish culture in marine cages in Igang. Moreover, inclusion of 10-15% milkfish hydrolysate in grouper feed has



Fertilized *Ulva pertusa* could be a potential alternative protein source for abalone feed formulation

been tested in a small-scale experiment. In abalone, studies have shown that fertilized microscopic green seaweed *Ulva pertusa* could serve as fish meal substitutes for juvenile feed but not *Sargassum* sp. The use of these locally available alternative protein sources in the diet of various fish species could offer opportunities to reduce feed cost and decrease environmental degradation.

Effective feed management strategies have also been developed through the use of low feeding rates and skip feeding for freshwater prawn; inclusion of marine based and purified attractants, namely: *Acetes*, squid meal, shrimp paste, putrescine, cadaverine to improve feeds for grow-out culture of mud crab; and the application of different feed shapes such as spherical, cube, and tubular also for the mud crab diet that allow the crabs to grasp the feed and eventually result in higher feed consumption.

***Developing suitable feed formulations for a wide range of aquaculture species at various growth stages for which no artificial feed has been formulated:*** Very limited numbers of commercial feeds have been currently developed for some species at specific growth stages, which significantly affect feed efficacy when used with other species or growth stages. Several studies have therefore been carried out by AQD to come up with specific formulations for each species at different stages. In pompano, a study initially found out that taurine requirement for juveniles was around 1.5% at 46% protein. A cost-effective feed will be made available to fish farmers as soon as this finding is confirmed. In another study, the refinement of abalone diet formulation for the grow-out culture resulted in a water stable and highly digestible feed that significantly improved growth rate and shortened the culture period. The meat quality of the abalone fed the refined formulated feed, as determined through Hedonic scale taste testing, was comparable in terms of color, odor, taste, texture and general acceptability with those abalones fed seaweeds.

In mud crab, the protocols for the production of hatchery-reared stocks for soft-shell mud crab farming have been classified. Strategies for the reduction of cannibalism in mud crab nursery have also been identified. More recently, for the Asian sea bass, the quantitative amino acid requirements (leucine, isoleucine, and histidine) for juveniles have been continued and will be used as the ultimate guide in the diet formulation for a cost-effective feed for this fish species.

***Addressing the issue on lack of awareness among small-scale fish farmers on efficient and healthy feeding practice:*** Various demonstration studies were conducted in 2015 to address this issue, and some of the important findings include the following: (i) grow-out culture of *P. indicus* was more economical in a 60-day culture period, (ii) groupers (*Epinephelus coioides* and *E. fuscoguttatus*) and rabbitfish (*Siganus guttatus*) reared in brackishwater ponds under separate semi-intensive culture showed that those fed AQD formulated diets had lower FCR values than those fed the commercial feed; (iii) strategy developed for cannibalism reduction in mud crab nursery through the use of frame ribbon nets as shelters was found most suitable for nursery rearing with 60-70% survival at density of 50 individual/m<sup>2</sup>; and (iv) mud crab hatchery technology was successfully demonstrated in Guindulman, Bohol, Philippines. Apart from demonstration studies, technology packages developed by AQD on aquafeeding and nutrition were transferred through e-learning (*i.e.* 2015 AquaNutrition On-Line) financially supported by the Government of Japan Trust Fund and participated in by 17 international and local trainees.

The program achievements and important findings in 2015 will contribute to the development of best management strategies and good aquaculture practices, particularly in the areas of feeding and aquatic health management. In the long term, these could lead to optimization of production yield with the least impact on the environment.

### **1.6.3 Maintaining Environmental Integrity Through Responsible Aquaculture**

Considering that the aquatic environment offers enormously rich resources, SEAFDEC recognized that it is crucial for its activities to be directed towards achieving a balance between aquaculture development and protection of the environment and aquatic biodiversity. However, despite the significant progress made by SEAFDEC and ASEAN Member States in promoting the Code of Conduct for Responsible Fisheries, the aquaculture sector in the region is still confronted with issues related to environmental protection and wise use of resources. This Program is therefore implemented by AQD with the objective of developing environment friendly-based aquaculture technologies by integrating environmental factors in AQD's research activities and promoting responsible aquaculture. For 2015, studies were continued on assessing the impacts of aquaculture on biodiversity, and water and sediment qualities in the culture areas and adjacent ecosystems both in marine and freshwater systems; developing and promoting efficient and suitable environment-friendly culture systems; and conducting biological and ecological studies on species with potentials for resource enhancement.

***Assessing the impacts of aquaculture on biodiversity, water and sediment qualities in culture areas and adjacent ecosystems:*** The impact of the aquaculture activities carried out in various AQD stations (*i.e.* Igang Marine Station-IMS, Tigbauan Main Station-TMS, and Binangonan Freshwater Station-BFS) was assessed for their consequences in terms of water and sediment quality as well as on the diversity of aquatic organisms of nearby and adjacent ecosystems. Varying results were attained, with IMS showing some benefits of the aquaculture structures attracting organisms (mainly found attached to nets and other relevant installations). At BFS on the other hand, significantly lower fish diversity was observed in the aquaculture site, compared to an adjacent non-aquaculture site.

***Identifying the appropriate extractive species for Integrated Multi-Trophic Aquaculture:*** AQD is conducting an integrated multitrophic aquaculture (IMTA) using a combination of milkfish, sandfish and seaweeds with funding support from the Government of Japan through the Japan International Research Center for Agricultural Sciences (JIRCAS). This is mainly aimed at quantifying the extent of eutrophication caused by aquaculture. Milkfish, sandfish and seaweeds were stocked in pens and monitored for environmental and production parameters. The compiled data would be used to estimate the nutrient flow within an IMTA system. In a separate milkfish mariculture site, monitoring of the temperature, tidal current, in situ chlorophyll fluorescence, dissolved oxygen, and other parameters is also being carried out. Data from these studies would serve as inputs in the development of a numerical model of nutrient flow within a milkfish mariculture system. With the quantitative elucidation of the extent of eutrophication from aquaculture, appropriate management conditions for IMTA operation could be promoted.

**Developing and promoting efficient and suitable environment-friendly culture systems:**

A number of studies are being carried out on sandfish *Holothuria scabra*, abalone *Haliotis asinina*, slipper oyster *Crassostrea iredalei*, giant freshwater prawn *Macrobrachium rosenbergii*, and seaweed *Caulerpa lentillifera*. For sandfish, two experimental nursery sites were established in Guimaras Province and in an open bay in Concepcion, Iloilo. After extensive site evaluation, the best sea ranch sites for rearing were also selected. Formal agreements with local government units and concerned communities' People's Organizations have been finalized, while social resource mapping was conducted as part of the process to engage the active participation of local communities in the project. Nursery of sandfish was also set-up at a local college's facilities for the production of juveniles.

In another study on abalone, results of culture trials showed that mean shell length and body weight of juveniles reared in reef flats and in nursery tanks were inversely proportional to stocking density with optimum stocking density at 400 individuals/m<sup>2</sup> in both rearing environments. Grow-out trials in a reef flat gave the highest growth rate (shell length) and best survival at stocking density of 50 individuals/m<sup>2</sup>. Meanwhile, improvement of grow-out rearing techniques of slipper oysters was continued in two sites: Batan Bay in New Washington, Aklan and in Dumangas, Iloilo, with the pouch method giving the best result. In another site in Ajuy, Iloilo, grow-out rearing techniques would be carried out as part of the IMTA project.



Oyster spats reared in pouches (left), harvesting oyster pouches after six months of culture (center), oysters harvested from pouches (right)

Optimization of the culture of seaweed *Caulerpa lentillifera* in tanks and ponds is being carried out using different levels of nitrogen, irradiance, and salinity. Results from the nitrogen trials the highest gross photosynthesis (GP) was obtained in treatments without fertilization. GP (110  $\mu\text{mol photons m}^{-1} \text{sec}^{-1}$ ) was also highest at 25 and 30 ppt salinities.

With regard to giant freshwater prawn, a biofloc system is currently being tested for its culture in indoor polyethylene tanks using different sources of carbon (molasses, table sugar and potato starch). Based on the 3-month results, ammonia in the different treatments was not significantly different even in the biofloc treatments indicating that the biofloc was able to process ammonia from the system despite no water replacement. Meanwhile, a study on the culture of shrimp in an aquasilviculture system in Leganes, Iloilo is expected to define the factors affecting mangrove efficiency to remove nutrients (*i.e.* surface area mangrove species, bark, leaf litter, etc.), and promote aquasilviculture of shrimp as an ecosystem based management strategy for increased shrimp production in the ASEAN Member States.

**Conducting biological and ecological studies on species with potentials for resource enhancement:** Promotion of resource enhancement of seahorse was initiated with activities geared towards the development of appropriate transport and acclimation strategies of seahorses from hatcheries to release sites. The study also aims to determine the appropriate size of seahorses for release and the appropriate monitoring strategies of released stocks would be developed and promoted.



*Pond with dense growth of mangrove trees: AQD's study looks into the microbial property of mangrove for improved water quality of shrimp farms*

#### 1.6.4 Adapting to Climate Change Impacts on Aquaculture

Changes in the climate are projected to impact broadly across ecosystems increasing pressures on all livelihoods and food supply chains, including the fisheries and aquaculture sectors. The future food supply situation would be a central issue as food resources come under greater pressure. Under such a scenario, the sustainability of aquaculture would be challenged further considering that the effect of climatic change on the aquaculture organisms in general is largely unknown, and in the different aquaculture systems and structures, in the various support systems to aquaculture operations, and to the fish farmers as well. The small-scale fish farmers in the region that produce the great bulk of the aquaculture production are largely vulnerable being dependent on aquaculture operations for food and income. Some urgent adaptation measures are therefore required in response to the threats to food and livelihood availability that could arise due to the changing climatic conditions observed around the globe. The long-term objective of the program is to ensure that aquaculture production of important aquaculture commodities is sustained even under conditions of higher temperature and more acidic waters, the continuous supply of food fish is secured and income generation of people is assured.

**Generating scientific information on the effects of high water temperature on the reproductive performance of economically important marine aquaculture fishes:** One of the physiological processes highly affected by water temperature is reproduction. Among tropical marine fishes, very little is known about the effect of high temperature and acidic seawater on gonadal maturation and spawning. Thus, the effect of elevated temperature on gonadal maturation and spawning in tropical marine aquaculture fishes was investigated in rabbitfish *Siganus guttatus*. Results showed that at 33°C water, gonadal development and spawning performance were disrupted in the group maintained (with 31°C considered normal) and the effect became severe with prolonged exposure to elevated temperatures.

In the group maintained at 33°C, most females had oocytes that were atretic. During 7 months of exposure to 33°C, spawning was observed only on two occasions and in both times, the eggs did not hatch.

Considering that water temperature in the natural environment follows a diurnal fluctuation with slightly lower temperature observed during nighttime compared to daytime, and to mimic the natural temperature fluctuation, an experiment was conducted following the diurnal fluctuation in the water temperature with slightly higher temperature during daytime compared to nighttime, *i.e.* a difference of 2°C. The results indicated a significant improvement in the gonadal development and spawning success of the breeders subjected to 33-31°C temperature cycle, which were high and comparable to the control and the 31-29°C temperature cycle group. These results indicated that rabbitfish can still spawn at 33°C as long as its daily exposure is not constant.

***Generating scientific information on the effects of high water temperature on embryonic and early larval development of economically important marine aquaculture commodities:***

Ensuring that embryonic development and early larval survival will proceed is important since the succeeding culture operations in nursery and grow-out systems depend on the success in seed production for the supply of fry.

For marine fishes, *i.e.* milkfish, Asian sea bass, rabbitfish: The effect of high water temperature on embryonic development was investigated in economically important marine fishes like milkfish, Asian sea bass and rabbitfish. Embryonic development proceeded normally in all 3 species when fertilized eggs were incubated at ambient temperature of 28-29°C (control). In all 3 species, embryonic development was aborted when fertilized eggs were incubated at 33°C. Although embryonic development proceeded normally in embryos incubated in 31°C, hatching rate was lower compared with those incubated in ambient temperature. Hatching rates were always high (>80%) in the control group (ambient temperature). In another experiment, the effect of high water temperature on larval survival after 10 days of rearing of the said 3 species was also investigated. While survival of milkfish at ambient water temperature (28-29°C) ranged from 8 to 24%, the survival (ranging from 0.1 to 3.2%) was similar at 31°C and 33°C. Rabbitfish larvae, being the most difficult to rear in the hatchery, did not survive at 33°C, and barely survived at 31°C (mean of 0.7%). Among the 3 species, Asian sea bass larvae survived the best at higher temperatures of 31°C and 33°C. Survival of Asian sea bass at ambient temperature was very high.

For mollusks, *i.e.* abalone (*Haliotis asinina*): The reproductive performance of abalone when exposed to elevated water temperatures was also investigated. Abalone breeders were exposed for 3 months to temperatures ranging from 27-28°C (ambient) to 33°C. Mature females did not survive the continuous high water temperature of 33°C as all died after 45 days of exposure, whereas a few males (10%) survived until day 60. Only 50% of the breeders survived for 3 months when exposed to 31°C whereas 80% survived in the ambient temperature. A significant reduction in feeding rates and consequently growth were observed in those exposed at higher temperatures. The study needs to be repeated under conditions where the daily diurnal fluctuation in the water temperature is followed.



Crustaceans - Mud crab (*Scylla serrata*): The technologies for breeding and seed production of mud crab in captivity have been developed and recently were further improved by AQD. There are now mud crab hatcheries in the country and in the region. Some mud crab hatchery operators reported of non-spawning of mud crabs when the water temperature is high. This will be investigated starting 2016.

**Promote public awareness on the possible effects of climate change to aquaculture activities.** Increasing the awareness of the fish farmers and the general public on the possible effects of climate change to aquaculture operations is a continuing activity of the Program. The AQD library is continuously sending updates and new information about the effects of climate change to aquaculture to all the staff. In addition, the training courses offered by AQD also include a lecture on climate change and its impact on aquaculture since 2013.

### 1.6.5 Meeting Social and Economic Challenges in Aquaculture

Despite the technological improvements and overall economic performance of the aquaculture sector, it has been facing a number of challenges, which need to be addressed to attain sustainable development. Aquaculture is still confronted with issues on equity in terms of opportunities and the distribution of benefits that fall short in addressing food security and livelihood of small-scale sector stakeholders. Therefore, the social and economic challenges in the promotion of rural or smallholder aquaculture in the ASEAN region should be addressed and the steps that need to be taken to address them should be shaped. The issues that need urgent attention include among others, capacity building, access to capital as well as markets, policies and governance, and seeking avenues for aquaculture as an option for improving resilience of fish farmers and fishers to the impacts of climate change. This Program is aimed at developing and implementing social and economic strategies in aquaculture and resource enhancement to secure food and income through stakeholder collaboration.

In 2015, the Program engaged in research studies that promote the dissemination and adoption of sustainable aquaculture technologies for fisherfolks. Ten fisherfolks in Barangay Pipindan in Laguna Lake, Philippines were trained on hatchery and nursery rearing of giant freshwater prawn, *Macrobrachium rosenbergii*. Prawn post-larvae harvests of these fisherfolks were either sold to other fish farmers or reared with tilapia in cages to improve income from monoculture operations. In coastal areas, the concept of IMTA



*Seminar on family-based IMTA of milkfish, sandfish and seaweeds in Guimaras Province, Philippines (left); monthly sampling of IMTA set-up conducted with fisherfolk cooperators (center); and sorting of milkfish harvest by AQD researchers and fisherfolks while a fish trader buys fish for retail sale in local market (right).*

through the combined pen culture of milkfish, *Chanos chanos*, with sandfish, *Holothuria scabra*, and seaweeds, *Kappaphycus* sp., was successfully introduced to fishing families in Nueva Valencia, Guimaras. The aim of this project is to demonstrate the potential of IMTA in mitigating the impacts of excess nutrients from uneaten milkfish feeds and feces while obtaining additional income from other non-fed species.

In another project, the emerging role of aquaculture in providing seeds for resource enhancement was also demonstrated. Seed production is necessary to sustain the benefits from stocking of threatened species such as abalone, *Haliotis asinina* in Barangay Molocaboc in Sagay Marine Reserve. Hence, the Sagay City local government has committed to build a solar-powered hatchery after witnessing the successful enhancement of >2.5cm abalone seeds, now being harvested at 145g each on average, in the abalone demonstration site in Molocaboc. In another study on sandfish in Barangay Molocaboc in Sagay Marine Reserve, fisherfolks have also participated in the nursery cage rearing of sandfish early juveniles. A total of 3,200 juveniles (>2g weight) have already been released in pens and subsequently in sea ranch site. Monitoring was conducted with fisherfolks and local students who glean sandfish for cash income.

Through a community-based stock enhancement project in New Washington tributaries in Aklan province, the Program has promoted the technology on the intermediate culture of tiger shrimp, *Penaeus monodon*, for release. Local fisherfolks participated in the intermediate culture of post larvae sourced from private hatcheries near the release site. While some fishers now catch mature shrimps, there are economic losses as under-sized pieces are caught by illegal fine meshed net gears.



(left): tagged mature size *P. monodon* (100 g) caught by fisherman four months after release; (inset): tagged shrimps (1 g) for release; (center): sample species caught by active fine-meshed net gears; (right): college students from Aklan State University participating in monthly monitoring of fish catch and water quality in the New Washington Tributaries while AQD and RIHN researchers look on

Market and consumption studies were also conducted to evaluate investment opportunities in the culture of rare high-value indigenous fish species such as silver therapon or 'ayungin', *Leiopotherapon plumbeus*, in Laguna Lake; giant trevally or 'maliputo', *Caranx ignobilis*, in Taal Lake; lobed river mullet or 'ludong', *Cestraeus* sp., in Cagayan River; and tapiroid grunter or 'bulidao', *Mesopristes* sp., in Abra River. Results indicate that the private sector may invest in the grow-out and breeding of giant trevally and silver therapon as high market demand and prices for these species can overcome cost of culture. Meanwhile,



*Giant trevally (C. ignobilis) fingerlings being sold in Lemery, Batangas for stocking in cages in Taal Lake (upper left); C. ignobilis cage culture in Taal Lake (right); under-size silver therapon commonly caught and sold in markets around Laguna Lake (lower left)*

public investments on the biology of rare lobed river mullet and tapiroid grunter are recommended.

Results of the various studies conducted in 2015 under this Program have provided local fisherfolks with on-farm aquaculture experience as well as skills that would help them diversify their livelihood and engage in various segments of the aquaculture industry (*i.e.* either to produce food fish and income, produce seeds for stock enhancement, and invest in the culture of new species). The successful outcomes, limitations and recommendations from the above-mentioned studies could provide examples for researchers and local government collaborators on improved options for fisheries and aquaculture development in the Philippines and similar environments in SEAFDEC Member Countries. Fish reared through aquaculture will continue to supply food fish demand in most countries. Thus, in the case of the Philippines, promoting IMTA to small-holder milkfish mariculture operators aside from large operators would mitigate the unintended impacts of excess nutrients to the environment while food supply and incomes are enhanced by non-fed IMTA species. Fisheries management regulations, policies and governance need improvement to overcome economic losses in mismanaged fisheries, aquaculture and stock enhancement initiatives.

#### **1.6.6 Environment-friendly, sustainable utilization and management of fisheries and aquaculture resources**

Development of active approaches for the establishment of environment-friendly culture technologies, promotion of community-based management of aquatic resources and replenishment of endangered species are some of the important measures that will help address the environmental and social issues arising from fisheries and aquaculture practices. SEAFDEC/AQD has generated science-based information and has developed skills especially in the fields of feed development, aquasilviculture, and community-based management for aquatic species production under the regional program “**Promotion of sustainable aquaculture and resource enhancement in Southeast Asia**” funded by the Government of Japan-Trust Fund (GOJ-TF5). However, the said activities need to be followed-up to ensure development and transfer of technologies for effective utilization and management of aquatic resources in Southeast Asia. Hence, this Project aims to: 1) establish responsible aquaculture technologies guaranteeing environment-friendliness, 2) promote community-based production and resource enhancement of high-value aquatic resources, and 3) disseminate and demonstrate resource enhancement practices.

In 2015, biologically, environmentally and socio-economically acceptable and region-oriented approaches have been promoted through initiation of various studies and capacity building activities. One of these studies involved the use of plant-based protein sources in tilapia feeds for improved production traits. Evaluation on the nutritional value of selected non-conventional plant-based feed ingredients (*e.g.*, sugarcane bagasse and molasses) was made prior to the refinement of existing diet formulations for cultured freshwater fish species. Preliminary experiments showed that these ingredients have potential either as protein or energy sources in fish diets. However, most have high crude fiber which would limit their utilization in fish diets; hence, the need for appropriate treatments to increase their nutritional value and enhance their suitability as feed ingredients. Trials were also conducted to assess the effects of refined formulated diets on the growth and reproductive performance, nutrient excretion and health condition of cultured species.



*Agricultural wastes and by-products currently being converted into valuable protein sources in tilapia diets (counterclockwise from left): pineapple peels, sugarcane 'bagasse,' citrus pulp and seeds, 'okara' meal or soy pulp*

In another study, the community-based integrated production of abalone, *H. asinina* and sea cucumber *Holothuria scabra* through culture, sea ranching and stock enhancement was initiated. With the objective of developing strategies towards improving governance of coastal resources in the Philippines and similar areas in Member Countries, the establishment of a solar-powered abalone hatchery, pens for sandfish broodstock and nurseries for hatchery-bred seeds, were promoted. Activities related to monitoring of the abalone and sandfish stock enhancement demonstration site and improvement of awareness and governance of released stocks were continued. There was delay in some of the activities involving the local government units, indicating the importance of proactive local government in stock enhancement. As part of the effort to promote resource enhancement of seahorses, the stocks in Molocaboc Island, Sagay City were monitored monthly through the participatory involvement of the community in management of the natural resources which was facilitated through the hands-on training during monitoring and acclimation of seahorses.

Apart from research, activities in 2015 also included implementation of capacity building programs. The International Training Course on Marine Fish Hatchery was conducted at AQD's Tigbauan Main Station from 17 June to 24 July 2015 with 12 participants from Viet Nam, Malaysia, Indonesia, India, and Philippines. Four participants, one each from Viet Nam, Malaysia, Indonesia, and Philippines, were awarded with GOJ-TF Training Fellowship Grant.



*Participants of the International Training Course on Marine Fish Hatchery*

### 1.6.7 Other R&D Activities

***AQD's ABOT (Agree-Build-Operate-Transfer) AquaNegosyo (aquaculture business):*** AQD continued promoting the technology packages it has developed for local and international business investors. This is being done through technical assistance in every phase of on-farm operation. For 2015, the Program received 49 inquiries, most of which came from residents of the Philippines, 3 from other Southeast Asian countries, and 7 from other countries (Maldives, Sri Lanka, Iran, and Nigeria). A few (17%) were general inquiries, usually on how to start an aquaculture business and details of ABOT. Among those that made inquiries, 9 became ABOT clients and all were local residents.

***Institutional Capacity Development on Sustainable Aquaculture (ICDSA):*** Another important initiative of AQD which provides an effective mechanism to disseminate the technologies and science-based approaches it has developed, ICDSA had rendered technical assistance in the construction of multi-species marine fish hatcheries in different parts of the country in collaboration with Philippine Bureau of Fisheries and Aquatic Resources (BFAR). The multi-species marine fish hatcheries in Baler, Aurora; Sta. Lucia, Palawan; Bongabong, Oriental Mindoro; and Sta. Cruz, Davao del Sur are already operational, while construction of the hatchery facilities in Lao-ang, Samar and Sagnay, Camarines Sur is ongoing. AQD through ICDSA would continue to provide technical assistance in the operation of these facilities.

Significant efforts have also been made in building the capacity of fishfarmers and other industry stakeholders on appropriate breeding and larval rearing technologies. As part of the Philippine Department of Science and Technology (DOST)-supported mud crab hatchery refinement study, seven private sector collaborators completed their training at AQD and were provided assistance in their hatchery operations. Two other related DOST-supported

projects, namely: a) Promotion of mud crab hatchery and nursery technologies and, b) Pilot demonstration for a commercial scale model mud crab hatchery, have been initiated, in partnership with several academic institutions in Luzon, Visayas and Mindanao, in the Philippines. These academic institutions shall benefit from the collaboration in the form of capacity building on mud crab hatchery and nursery technologies and on-site technical assistance. Apart from assistance in terms of capacity building for hatchery operations, AQD also started to transfer the nursery technology it had developed to the private sector and other stakeholders.

AQD also continued working with Winrock International (an NGO) in implementing a development project for improved aquaculture production efficiency in CARAGA Region, Philippines. An onsite technology forum and aquaculture clinic, attended by 220 participants, was conducted in Butuan City, southern Philippines. This was followed by an onsite training course on feed and fish health management, nursery and grow-out culture of mud crab, disease recognition as well as collection and processing of samples for diagnosis, with more than 30 participants in each course. The main role of AQD was on capacity building in aquaculture through introduction of technologies that enhance production of economically-important aquaculture species in the region.



*One of mud crab hatcheries owned by private sector being assisted by AQD under DOST-funded project*

**Training and Information:** A total of 256 trainees (foreign and local) participated in the training courses conducted by AQD in 2015 on various aspects of aquaculture. A distance learning course on principles of health management in aquaculture (Aquahealth online) was also conducted. AQD also conducted internship program that had been availed of by 24 individuals assigned in different AQD facilities and student on-the-job training program participated in by 207 students from 26 schools/universities. Overall, AQD's



*Participants of the training on ASEAN Shrimp Good Aquaculture Practices for BIMP-EAGA*

capacity building programs have helped built the critical mass of experts in the region on aquaculture technologies.

With regard to information dissemination, apart from scientific publications in international peer-reviewed journals, AQD published and disseminated three new manuals, namely: Culture of Rotifer *Brachionus rotundiformis* and Brackishwater Cladoceran *Diaphanosoma celebensis* for Aquaculture Seed Production; Soft-shell Crab Production using Hatchery-reared Mud Crab; and Development and Management of Milkfish *Chanos chanos* Forsskal Broodstock. Also, in collaboration with various partner institutions, the monographs “Health Management of Milkfish *Chanos chanos*” and “Important Findings and Recommendations on Chemical Use in Aquaculture in Southeast Asia”, the “Book of Abstracts of the 1<sup>st</sup> National Mud Crab Congress”, and Proceedings of the International Workshop on Resource Enhancement and Sustainable Aquaculture Practices in Southeast Asia, were published. Flyers about SEAFDEC/AQD, its stations, programs, commodities, information such as the monograph “2014 SEAFDEC/AQD Highlights” and monthly issues of AQD Matters were also produced. AQD’s Institutional Repository which was established as the official digital repository of scholarly and research information, continued to contribute to enhancement of accessibility of AQD publications and visibility of AQD and SEAFDEC. To further enhance AQD’s visibility to various stakeholders, AQD carries out frequent updating of its website resulting in a significant increase in the number of monthly unique visitors, posts stories about events at SEAFDEC/AQD in Facebook and Twitter, does press releases, and participates in fairs and exhibits. For 2015, AQD participated in seven major aquaculture exhibits, including an exhibit for APEC 2015 delegates at its Tigbauan Main Station in Iloilo. Overall, these activities help address AQD’s mandate of timely dissemination of information and at the same time help enhance SEAFDEC visibility to various stakeholders.

## **THRUST 2. ENHANCING CAPACITY AND COMPETITIVENESS TO FACILITATE INTERNATIONAL AND INTRA-REGIONAL TRADE**

### **2.1 Biotoxins Monitoring in the ASEAN Region**

Marine biotoxins represent significant and expanding threat to human health in many parts of the world. Their impacts could be visible in terms of human poisoning or even death following the consumption of contaminated shellfish or fish, as well as mass killings of fish and shellfish, and death of marine animals and birds. Thus, monitoring seafood for toxicity is essential to manage the risks. However, there are several limitations in monitoring for toxicity such as variations in toxin contents between individual shellfish, different detection and even extraction methods for various toxins that require a decision on which toxins should be tested for, and the frequency of sampling to ensure that toxicity does not rise to dangerous levels in temporal or spatial gap between sampling times or locations. Furthermore, the growing harvest of non-traditional shellfish (such as moon snails, whelks, barnacles, and so on) could also increase human health problems and management responsibilities.

The MFRD Programmes through the Post-Harvest Technology Centre of the Agri-Food and Veterinary Authority of Singapore (PHTC/AVA), implemented a project on “**Chemical**

**and Drug Residues in Fish and Fish Products in Southeast Asia - Biotoxins Monitoring in the ASEAN Region”** from 2009 to 2012 to increase attention in expanding and improving initiatives to monitor, detect and share information on marine biotoxins in order to reduce public health risks associated with consumption of contaminated shellfish and fish. The project covered training in analytical methods for Diarrhoetic Shellfish Poisoning (DSP) toxins, lipophilic toxins, Paralytic Shellfish Poisoning (PSP) toxins and Tetrodotoxin (TTX), and a monitoring survey on PSP toxin in ASEAN Member States. After the completion of the project’s first phase, this was extended to address the needs of Member Countries on capability building in biotoxins analyses and monitoring, with proposed focus on other biotoxins like Amnesic Shellfish Poisoning (ASP) toxin (Domoic Acid) and Azaspiracids (AZA). Brevetoxins (BTX) which causes Neurotoxic Shellfish Poisoning (NSP) was also recommended to be included in the new project as ASP, AZA and BTX along with DSP and PSP, should be regulated according to the CODEX for shellfish.

During the End-of-Project Seminar for the Biotoxins Monitoring Project in 2012, the Member Countries also pointed out the importance of identifying the species of biotoxin-producing harmful algal bloom (HAB) to complement the existing biotoxins monitoring programs and ensure that fish and shellfish are not contaminated with toxic algae or their toxins. The Member Countries therefore suggested that the MFRD Programmes could consider conducting a project on toxic HABs to enhance regional capabilities for the identification of biotoxin-producing HAB Species. Thus, the MFRD Programmes has taken up this suggestion by including a separate component on biotoxin-producing HAB species identification within this project.

The key stakeholders/beneficiaries of this project are the relevant agencies in fisheries departments of the ASEAN Member States (AMSs) responsible for ensuring the safety of fish and shellfish for human consumption, and monitoring and testing of fish and shellfish for biotoxins; the aquaculture farmers and harvesters of fish and shellfish; as well as the international and domestic consumers/buyers. By the end of the project, the AMSs would have achieved the project’s objectives of upgrading their laboratory capabilities and credibility testing for ASP, AZA and BTX biotoxins, establishing biotoxins monitoring programs for routine surveillance testing of fish and fisheries products, improving their knowledge and understanding on the levels of biotoxins occurrences and incidences in fish and fishery products as well as of toxic HAB occurrences and incidences in the ASEAN region, and enhancing their capabilities for identification of biotoxin-producing HAB species to ensure that fisheries products are safe for human consumption. Activities under this project include: a regional training course in AZA, ASP and BTX biotoxins analyses, regional training course in identification of biotoxin-producing HAB species, biotoxins monitoring surveys in the AMSs, and a technical compilation for publication.

In 2015, the AMSs (except Cambodia) carried out their respective Biotoxins Monitoring Surveys covering one and a half years from 2015 to mid-2016. Quarterly progress reports of their surveys are to be submitted to MFRD for compilation.

The MFRD Programmes also convened the Regional Technical Consultation (RTC) on Harmful Algal Bloom (HAB) species in the ASEAN Region on 5-6 August 2015 in Singapore. Attended by two representatives from each Member Countries who presented country reports on





*Participants (left) and presentation (right) during the RTC on Harmful Algal Blooms in the ASEAN Region*

toxic HAB occurrences and incidences, as well as the management of toxic HABs in their respective waters, the RTC was so-designed to also serve as inputs for the preparation for the Regional Training Course to be conducted in Singapore in 2016. The RTC also agreed that Japanese Expert, *Dr. Yasuwo Fukuyo* would serve as the principal trainer and that the individual training needs of the AMSs should be taken into consideration in the planning of the Regional Training Course. The RTC also identified the Key Project Leaders for each country and initiated the process of establishing a network or directory of responsible national authorities and HAB experts in the Southeast Asian region.

## 2.2 Cold Chain Management for Seafood

Seafood is an important commodity in many AMSs and serves as an important source of foreign exchange and food supply for these countries. There is an increasing demand for seafood as consumers around the world recognize their nutritional value. However, seafood is very perishable and several chemical and biological changes occur immediately after capture and/or harvest. The deterioration process of seafood quality by microbiological metabolism, oxidative reaction and enzymatic activity is accelerated by poor temperature control along the supply chain. Thus, good cold chain management is one of the most critical requirements to keep the seafood products fresh and safe, extend their shelf life and maintain their quality and economic value from catch to consumer.

Throughout the seafood supply chain, the seafood industry relies on proper cold chain to ensure the commercial viability of seafood products. Modern technologies for seafood production at aquaculture farms, seafood catch on fishing vessels, pre-harvest considerations, post-harvest handling techniques, processing, packaging, storage, distribution and transportation modes, wholesale and retail, constitute integral parts of the seafood cold chain management process. Only proper management at every stage of this cold chain would enable the supply of fresh, quality, wholesome, and safe seafood to consumers. Cold chain could take various forms including ice, refrigerated seawater, refrigerated compartments and cold stores. Low temperature conditions have to be supported by careful, hygienic handling practices during the processing, storage and transportation to effectively reduce the spoilage of fish.

Implementation of cold chain for seafood in the ASEAN region involves a number of challenges. One of the major challenges is lack of or limited integrated supply chains from farm to fork where each industry player regards itself as a separate entity and does

not impose cold chain requirements on the next stage in the supply chain. However, any breakage in the cold chain would have cumulative effects on the final quality of the seafood. The great diversity of species combined with multiple international origins and production methods (fishing or farming) further complicate the cold chain requirements. Secondly, seafood and many other traditional fish products in the ASEAN region are largely handled by small and medium-sized establishments with inadequate appropriate facilities, technologies and knowledge in adopting cold chain practices. While cold chain management is still considered non-mandatory in many countries, some cold chain guidelines have already been established but could not be enforced as regulation, especially in the Southeast Asian region.

Notwithstanding these challenges, the project on “**Cold Chain Management for Seafood**” was initiated by MFRD Programmes for implementation from 2015 until 2017 to provide a platform for the ASEAN region to share knowledge, experiences and cost-effective technologies on cold chain management for seafood. Specifically, the project is aimed at upgrading the regional seafood industry in cold chain management and technologies, as well as developing generic guidelines on cold chain management for the ASEAN regional seafood industry. Activities under this project include: a Regional Training Workshop on Cold Chain Management for Seafood, cold chain pilot trials in Member Countries, and a general guidelines that could serve as benchmark for the AMSs in developing their respective national guidelines to promote the application of cold chain management to safeguard consumers’ health and food security, and ensure the sustainability of the seafood industry. The key stakeholders/beneficiaries of this project are the relevant agencies in the fisheries departments of the AMSs responsible for ensuring product quality and safety throughout the seafood supply chain; the seafood producers, suppliers, distributors and other stakeholders in the seafood supply chain; as well as the international and domestic consumers/buyers.

To start off the project activities, the MFRD Programmes through the PHTC/AVA convened the “Project Inception and Planning Meeting on 19-20 May 2015 in Singapore, which was attended by representatives from the ten AMSs who reported on the status and current cold chain management practices for seafood in their respective countries. Two resource speakers from the local Singapore seafood industry shared their experiences, insights and the challenges faced in implementing cold chain management in their companies. The Meeting then deliberated and agreed on the details and schedules for the project activities.



*Participants (left) and discussion (right) during the Project Inception and Planning Meeting on Cold Chain Management for Seafood*

Subsequent to the Project Inception Meeting, MFRD also convened the Regional Workshop on Cold Chain Management for Seafood on 17-19 November 2015 at AVA/PHTC in Singapore. The Workshop was attended by 17 participants from government and private sectors of nine AMSs (except Brunei Darussalam) as well as three local participants from Singapore seafood industry. Two Australian experts were engaged as resource trainers for the Workshop, which comprised both lecture and hands-on practical sessions to provide training on basic knowledge and skills needed for implementing and monitoring the supply cold chain for seafood including methodologies and techniques to measure and monitor appropriate quality parameters. Moreover, the Workshop also developed the quality indices for various types of seafood such as fish, shrimp, crab and squid. A field trip to observe a local cold chain facility in Singapore and best practices was also arranged as part of the Workshop.



*Participants (left) and actual monitoring of quality parameters(right) during the Regional Workshop on Cold Chain Management for Seafood*

### **2.3 Accelerating Awareness on Fish Health Management in Southeast Asia: Reinforcement and optimization of fish health management and effective dissemination in the region**

There is an increasing need for information dissemination and technology transfer in the AMSs, especially in lesser developing countries in terms of fish health management. The present and emerging aquatic animal diseases have seriously affected several aquafarmers, hindering the sustainable development of aquaculture in the region. Realizing that the global market has become more stringent for exporting countries like the Southeast Asian countries, it is highly recommended that useful information such as precautions of potential diseases outbreak and recommendations on appropriate fish health management be disseminated promptly and appropriately to local government unit officers, aquafarmers, traders, and other stakeholders. Building the capacity of the AMSs with emphasis in resource-deprived countries and innovative research to guarantee food safety and sustainable production are therefore crucial. In response to this need, a new project was initiated in 2015, which is aimed at: 1) developing and accelerating the dissemination of effective fish and shrimp health management strategies, 2) enhancing the efficacy of vaccine treatment in tropical cultured species, 3) establishing protective measures against persistent and emerging parasitic diseases of tropical fish, 4) identifying the risk factors and developing protective measures against Early Mortality Syndrome (EMS), and 5) extending and demonstrating relevant technologies to practitioners and aquatic animal health officers from the AMSs.

The immunogenicity of the vaccine previously established in pompano reared in floating net cages in open sea (at AQD's Igang Marine Station) was investigated. The immunogenicity of the vaccine was determined through intraperitoneal injection of fish and periodic monitoring of the nervous necrosis virus (NNV)-neutralizing antibodies in the sera of the fish after vaccination. In another study, efforts were continued to enhance the antiviral immune response of shrimp to the white spot syndrome virus (WSSV) through the application of adjuvants, carriers and RNAi technology. Preliminary experiments would be carried out to optimize the conditions for the production of dsRNA and efficacy trials. These include LD<sub>50</sub> test, production of dsRNA from bacteria, and isolation of primary cells from shrimp lymphoid organs. The antiviral efficacy of the treatments was decided by *in-vivo* challenge.

In response to the pressing concern of the AMSs on the outbreaks of transboundary diseases on shrimps, AQD initiated a study that aims to determine the epidemiology of the early mortality syndrome (EMS). Preliminary results showed that 10<sup>7</sup> cfu/ml *Vibrio parahaemolyticus* in the rearing water can cause acute hepatopancreatic necrosis disease (AHPND) and significant mortality in *P. monodon* post larvae. The threshold level of AHPND bacteria in the environment in the absence of stressor, which shrimp can eliminate from its body is 10<sup>5</sup> cfu/ml suggesting that pathogenic AHPND bacteria may lose its virulence/toxic genes, although this needs further investigation.



*Shrimp (P. monodon) infected with WSSV*

In another study on tropical finfish, efforts were made to establish the protective measures against persistent and emerging parasitic diseases. Quantification of the parasite (*Pseudorhabdosynochus lantauensis*) load in grouper *Epinephelus coioides*, in relation to water quality parameters was carried out. The dynamics of transmission of *P. lantauensis* under laboratory conditions and the pathological effects on naturally and experimentally infected grouper were elucidated.

**Technology extension and demonstration:** Activities that examine the status and needs of the primary aquatic animal health care in small-scale aquaculture in Myanmar, Cambodia, Lao PDR, and the Philippines were carried out in 2015. Although substantial improvements have been noted in the capacity of aquatic animal health workers to implement basic fish health (level 1) activities, further upgrading of the capacity of aquatic animal health workers to conduct level 2 and 3 laboratory diagnostics needs immediate attention to enable these countries (especially Myanmar, Cambodia and Lao PDR) to be compliant with the ASEAN Standards. To achieve this goal, follow up on-site training courses and guided research studies designed for fish health personnel to keep abreast with diseases, especially those notifiable to the World Organisation for Animal Health (OIE) would be conducted in 2016.

### THRUST 3. IMPROVING MANAGEMENT CONCEPTS AND APPROACHES FOR SUSTAINABLE FISHERIES

#### 3.1 Promotion of Fisheries Management and Combating IUU Fishing

MFRDMD has implemented since 2013 project on “**Combating IUU Fishing in the Southeast Asian Region through Application of Catch Certification for International Trade in Fish and Fishery Products**” to address concerns on IUU fishing. Under this project, problems encountered by the ASEAN Member States (AMSs) in complying with the requirements of EC Regulation 1005/2008 were reviewed and based on the information compiled, a series of meetings were conducted by MFRDMD in cooperation with the SEAFDEC Secretariat to develop the “Regional Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain” and the “ASEAN Catch Documentation Scheme”.

Developed during the Regional Technical Consultation organized in 2014, the Draft “Guidelines for Preventing the Entry of Fish and Fishery Product from IUU Fishing Activities into the Supply Chain” was submitted to the SEAFDEC Council at its 47<sup>th</sup> Meeting in 2015 for consideration, and after accommodating comments from the SEAFDEC Council, this was submitted and subsequently endorsed by the 23<sup>rd</sup> Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGF) and the SOM-37<sup>th</sup> AMAF also in 2015. The endorsed Guidelines would serve as basis for the AMSs in formulating relevant policies and provide an enabling environment for a clear direction and understanding of the need to prevent the entry of IUU fish and fishery products into the supply chain. The AMSs were also encouraged to develop and/or strengthen their respective strategies and measures for immediate implementation of the Guidelines. For its part, MFRDMD would continue to support the AMSs during the promotion of the Guidelines at the national level.

For the development of the “ASEAN Catch Documentation Scheme (ACDS)”, the draft generated through the Regional Technical Consultation in December 2014 together with comments from the SEAFDEC Member Countries was submitted to the SEAFDEC Council at its 47<sup>th</sup> Meeting in April 2015. While supporting the ACDS, the SEAFDEC Council was of the view that before the ACDS could be adopted, SEAFDEC should convene a stakeholders’ consultation to ensure the applicability of the ACDS in the region, and examine whether the ACDS could be acceptable for importing markets. Thus, MFRDMD and the SEAFDEC Secretariat convened an Experts Group Meeting on ASEAN Catch Documentation Scheme on 25-27 May 2015 in Langkawi, Malaysia which came up with the revised draft ACDS as well as the info-graphic on the usage of ACDS in various scenarios of catch flows of fish and fishery products into the region. The Meeting suggested that SEAFDEC should consider conducting a stakeholders’ consultation to test the system in collaboration with AMSs and other partners in the future.

Along the process of developing the ACDS, SEAFDEC sustained its partnership with the U.S. Agency for International Development (USAID) in accordance with the MOU signed by the USAID/Regional Development Mission for Asia (RDMA) and SEAFDEC in 2014, and under the project on “Oceans and Fisheries Partnership” which commenced in 2015. This

project aims to combat IUU fishing and seafood fraud through the development of a catch documentation and traceability system for marine fisheries products.

TD also continued to implement the project on “**Promotion of Countermeasure to Reduce IUU Fishing**” as part of SEAFDEC initiatives in combating IUU fishing in the Southeast Asian region. Specifically, the Regional Fishing Vessels Record (RFVR) was developed through collaborative initiative of AMSs to share information among countries on vessels engaged in “international fishing operations” (or fishing operations in foreign country’s EEZ or in the high seas) in order that related authorities of AMSs could check and take corrective actions against inappropriate behavior of its fishing vessels, thereby supporting the elimination of IUU fishing in the region. In 2013, development of the RFVR for fishing vessels 24 meters in length and over was endorsed by the SEAFDEC Council and the Special SOM-34<sup>th</sup> AMAF, and subsequently the AMSs agreed in 2014 to provide information required for the RFVR, e.g. fishing vessels identification and other relevant data/information.



*Participants during the Regional Technical Consultation on Regional Fishing Vessels Record (RFVR): Use and Way Forward of RFVR Database as Management Tool to Reduce IUU Fishing in the Southeast Asian Region*



*RFVR Database on webpage as tool to combat IUU fishing in the Southeast Asian region*

As a follow-up activity, TD in 2015 continued to work with AMSs for compiling the data for the RFVR Database. TD also convened the “Regional Technical Consultation on the Regional Fishing Vessels Record (RFVR): Use and Way Forward of RFVR Database as Management Tool to Reduce IUU Fishing in the Southeast Asian Region” on 2-4 June 2015 in Pattaya, Thailand. The RTC came up with strategies and ways forward for the AMSs and SEAFDEC to prevent, deter and eliminate IUU fishing by utilizing the RFVR. More particularly, some basic requirements for the RFVR Database had been added, i.e. from 24 to 26 items, improvement of the initial data set was ensured, and usage of the RFVR Database promoted. An agreement had also been reached among AMSs on the management and updating of data in the RFVR Database, especially the timeline for annual updating/renewing of data and the responsibility of National Focal Points for maintenance of the Database.

### **3.2 Management of Fishing Capacity**

Activities toward management of fishing capacity in the Southeast Asian region were undertaken by SEAFDEC in response to the request of the ASEAN Member States (AMSs) during the 22<sup>nd</sup> ASEAN Sectoral Working Group on Fisheries in 2014. Management of fishing capacity, focuses not only on the management of “fish” but also in regulating fishing

efforts by providing schemes that give direction on where and how to fish, total number of vessels allowed to fish, and types of gear that could be used in fishing to balance with the available fishery resources.

To start off, SEAFDEC in collaboration with the Department of Fisheries Malaysia organized the First Regional Technical Consultation on Development of Regional Plan of Action for Management of Fishing Capacity in Southeast Asia on 24-26 February 2015 in Kuala Lumpur, Malaysia. The Consultation provided the platform for identifying the issues and challenges in managing fishing capacity in the Southeast Asian countries, and brainstorming on the contents and feasible measures that could serve as useful inputs to the draft RPOA or Guidelines to ensure that these meet the requirements and specific situation with regards to fisheries and fishing capacity in the region.



*First RTC on Development of Regional Plan of Action for Management of Fishing Capacity in Southeast Asia (24-26 February 2015, Kuala Lumpur, Malaysia)*

The Experts Group Meeting on the Regional Plan of Action for Managing Fishing Capacity (RPOA-Capacity)” was subsequently organized by SEAFDEC in Songkhla Province, Thailand on 19-21 August 2015 with the objective of sharing experiences and lessons learned with respect to the measures adopted by respective countries for management of fishing capacity that could serve as basis for preparing a zero draft of the RPOA-Capacity.

To conclude the preparatory works for the RPOA-Capacity, SEAFDEC convened the Regional Technical Consultation on Development of the Regional Plan of Action for Managing Fishing Capacity on 15-17 December 2015 in Phuket, Thailand. The Consultation reviewed and discussed the zero draft developed during the Experts Group Meeting in August 2015 generating the final draft of RPOA-Capacity. After the adoption of the final draft, the Consultation agreed that the final Draft RPOA-Capacity and the template for development of NPOA-Capacity would be submitted for endorsement during the 48<sup>th</sup> Meeting of the



*RTC on Development of the Regional Plan of Action for Managing Fishing Capacity (15-17 December 2015, Phuket, Thailand)*

SEAFDEC Council in April 2016 in Viet Nam as well as the 24<sup>th</sup> ASEAN Sectoral Working Group on Fisheries (ASWGF) scheduled in June 2016. The RPOA-Capacity would be used as guide for the management of fishing capacity in the region, and as reference for the development of respective countries' National Plan of Action for Management of Fishing Capacity (NPOA-Capacity) in the future.

### 3.3 Management of By-catch from Fisheries

Trawl fisheries, one of the most common fishing operations of the Southeast Asian region, targets multi-species resulting in concerns on by-catch, discards and sustainability of the fishery resources. The project on **“Strategies for Trawl Fisheries By-catch Management”** (REBYC-II CTI Project) was therefore initiated in 2012 with TD as the Regional Facilitation Unit (RFU) to work closely with the FAO Project Regional Coordinator in the implementation of the project. Participating countries for this project are those bordering the Coral Triangle area, namely: Indonesia, Papua New Guinea, Philippines, Thailand, and Viet Nam. This project aims to come up with more sustainable use of the fishery resources and healthier marine ecosystems in the Coral Triangle and Southeast Asian waters by reducing by-catch, discards and fishing impact from trawl fisheries as well as enhance the participation and partnership of public and private sector in improving trawl and by-catch management.

The activities in 2015 emphasized on the development of better approaches for management of by-catch taking into consideration the ecological, human, and institutional and legal components. During the REBYC-II CTI Project Planning Meeting organized on 15-16 May 2015 in Calbayog, Samar, Philippines, as well as the subsequent 3<sup>rd</sup> Project Steering Committee Meeting on 18-19 May 2015, the progress achieved based on the workplan and budget plan for 2014-2015, was reviewed and assessed by the project participating countries and RFU. Moreover, the official protocol for developing a Letter of Agreement (LOA) and Terms of Agreement (TOA) between Philippines and Indonesia was approved by FAO, while the process of developing LOA and TOA for Papua New Guinea, Thailand and Viet Nam is still ongoing. Collaboration on monitoring the project activities in participating countries and RFU of REBYC-II CTI in 2015 was established.

The project partners had developed the activities based on the concept of trawl fishery policy and management reforms elaborated in the “International Guidelines on By-catch Management and Reduction of Discards” and APFIC “Trawl Fisheries Guidelines” and “Ecosystem Approach to Fisheries Management (EAFM),” taking into consideration in particular human resource capacity building on socio-economic and gender mainstreaming in trawl fisheries. The Regional Workshop on Trawl Fisheries Socio-economics was organized on 26-29 October 2015 in Danang City, Viet Nam to review the socio-economic aspects of trawl fisheries and the progress of activities undertaken by the respective participating countries.

The project was also involved in the promotion of Ecosystem Approach for Fisheries Management (EAFM). The Essential EAFM (E-EAFM) Training Course was convened for Papua New Guinea on 6-10 July 2015 and Thailand on 3-8 August 2015. Furthermore, under the cooperation between the project and relevant project partners, *i.e.* FAO/APFIC, FAO-BOBLME, NOAA, SEAFDEC-Sweden Project Japanese Trust Fund of SEAFDEC and IMA-





*LEAD Working Group discussing the development of EAFM LEAD materials (above-left); and EAFM training course for Thailand (above-right) and for Papua New Guinea (left)*

UK, a Meeting was convened on 6-8 April 2015 in Phuket, Thailand to Discuss the Further Development of Essential-EAFM Lead Sessions and Courses. Subsequently, the EAFM LEAD Material Writeshop was convened on 13-17 July 2015 in Bangkok, Thailand to develop the tools and materials that could be used to promote the concept of EAFM to decision makers and policy makers.

### **3.4 Promotion of Ecosystem Approach for Fisheries Management (EAFM)**

Under the “**Human Resource Development for Sustainable Fisheries**” of TD, promotion of the application of Ecosystem Approach for Fisheries Management (EAFM) concept by countries in the Southeast Asian region was continued. In 2015, TD organized two regional training courses on EAFM, the first of which was the Regional Training Course on Essential Ecosystem Approach to Fisheries Management (Essential EAFM) on 2-8 March 2015 in Rayong Province, Thailand, in conjunction with the Essential EAFM Training of Trainers on 10-12 March 2015. The course was aimed at providing basic knowledge on EAFM process and application of EAFM in decision-making for responsible and sustainable capture fisheries. Moreover, understanding the principles of co-management and fostering cross-sector coordination was also imparted to the trainees through the practical sessions which aimed to develop their skills in effective communication, facilitation and conflict management. The second course was the Regional Training Course on Essential EAFM and Extension Methodology on 6-16 October 2015 also in Rayong Province, Thailand. This course was aimed at developing capacity on the application of EAFM concept by extension officers and staff who are responsible for management of fisheries and marine environment at the national/local levels of respective countries. Extension concepts, tools, facilitation and communication skills required for extension officers were also introduced during the training.



*E-EAFM training course for representatives from AMSs on 2-12 March 2015*



*E-EAFM training course on 6-16 October 2015 attended by representatives from AMSs*



*Training Course on E-EAFM in Lao PDR (left) and Myanmar (right)*

TD also organized On-site Training Course on Ecosystem Approach to Fisheries Management for Fisheries Officers of the AMSs. The first was organized in Thailand (22-27 June and 6-11 July 2015), then in Lao PDR (2-7 November 2015) and Myanmar (14-18 December 2015).

## **THRUST 4. PROVIDING POLICY AND ADVISORY SERVICES FOR PLANNING AND EXECUTING MANAGEMENT OF FISHERIES**

### **4.1 Improving Understanding on the Status of Fishery Resources in Southeast Asia**

Since 2004, TD has been utilizing the M.V. SEAFDEC 2 to support the Southeast Asian countries in conducting fishery resource surveys for better understanding of the marine fishery resources in their respective waters. TD has carried this out through its projects on **“Fisheries Resource Survey and Operational Plan for M.V. SEAFDEC 2”** and **“Offshore Fisheries Resources Exploration in Southeast Asia.”**

Since 2014, TD has been providing technical support for the implementation of a collaborative research project on ***Tuna Stock Assessment in Sulu and Sulawesi Seas (SSSs)*** in collaboration with Indonesia, Malaysia and the Philippines. Surveys were conducted based on the plan agreed at the 2014 “Sub-Regional Technical Meeting” that include: 1) research on tuna early life history using fish larvae sampling net and bongo net in the near shore and

offshore areas of the SSSs to determine the relative abundance and species composition of the fish larvae; 2) oceanographic survey using the conductivity-temperature and depth (CTD) attached with other sensors, namely: pH, DO, Fluorescence, among others; 3) use of scientific hydro-acoustic during the track survey and hydro-acoustic survey by scanning sonar on FADs, and 4) fish sampling by “short” pelagic longline, hand line and trolling line. After completing the first survey (Cruise No.47-3/2014) from 17 October until 8 December 2014 (pre northeast monsoon period), TD then proceeded with the second cruise (Cruise No.48-1/2015) from 20 March to 2 May 2015 (post northeast monsoon period). The surveys under both cruises were separated into 3 trips based on the survey areas. The first trip was in Sulu Sea in the EEZ of the Philippines involving a total of 25 survey stations; the second trip was in the Moro Gulf from the north to central Sulawesi Seas in Philippine and Malaysian waters with a total of 21 survey stations; and the third trip was around the northern part of Sulawesi Sea within the EEZ of Indonesia with a total of 17 survey stations. Activities undertaken during the second survey cruise were similar to those of first cruise in 2014, *i.e.* 1) oceanographic survey using ICTD, bongo net, Neuston net, and current indicator for 63 stations; 2) hydro-acoustic survey by scientific echo-sounder (operated according to track of sailing); and 3) fishing trials by trolling, handline and “short” longline at survey stations or any appropriate position.



*Activities during the collaborative research on tuna stock assessment in Sulu and Sulawesi Seas*

Besides the cruise survey, the project also supported human resource development on tuna stock assessment in Sulu and Sulawesi Seas by analyzing the historical data and data on fish landing. Stock assessment models acceptable by Regional Fisheries Management Organizations (RFMOs), *e.g.* Western and Central Pacific Fisheries Commission (WCPFC) and Indian Ocean Tuna Commission (IOTC) were introduced by the invited resource person from Japan, *Dr. Tsutomu Nishida* who is also the Chair of IOTC Scientific Committee 2012-2015. The project also provided the platform and maintained mechanism for sharing of data and information from research surveys in offshore areas of the SSS countries. Furthermore, the participating countries were encouraged to provide historical data such as catch and CPUE that are available in order that stock assessments of yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*) and skipjack tuna (*Katsuwonus pelamis*) in Sulu and Sulawesi Seas could be carried out, nevertheless, caveat on the stock structure issue was noted.

Reports on the aforementioned tuna stock assessment study are being verified by the concerned SSS countries. However, initial results from the analysis of *Dr. Nishida* using ASPIC Production Model revealed that the stock status of yellowfin tunas may further reduce in

terms of population. Thus, yellowfin tuna stock could be classified with an “overfished” status in the near future. As for bigeye tuna, the current stock is clearly in “overfished” status, however there are signs of stock recovery in the future. For skipjack tunas, the stock is placed as “underexploited” status, but the trend shows that skipjack tuna stock may move to “risk” status in the near future. Trends of the stock status of yellowfin and bigeye tunas based on the initial results of this study are resemblance to those of WCPFC.

In 2015, TD also collaborated with the Government of Malaysia in undertaking the **National Research Survey on Demersal Resources in the Waters of Malaysia**. Specifically, the cruise survey was undertaken in Kota Kinabalu, Labuan, Miri, Bintulu and Kuching using the M.V. SEAFDEC 2. Sampling of demersal species was undertaken using bottom otter board trawl at 196 stations, while oceanographic survey on plankton abundance, petroleum hydrocarbons and heavy metals in sediments, and benthic macro-invertebrate community was also conducted at 81 stations.



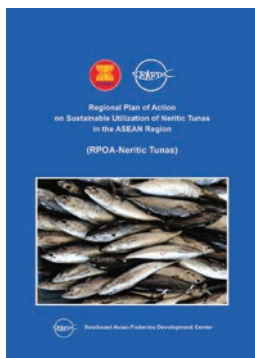
*Fish sampling using bottom trawl during the cruise survey in Malaysia*

## 4.2 Regional Cooperation for Tunas Fisheries Management

Recognizing that the management of oceanic tunas has already been covered by relevant RFMOs, the regional cooperation for management of tunas in the region focused on neritic tunas, which are abundant in Southeast Asian waters. The **Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region (RPOA-Neritic Tunas)** developed by SEAFDEC in collaboration with the Member Countries was submitted and endorsed by the 47<sup>th</sup> Meeting of the SEAFDEC Council and the 23<sup>rd</sup> Meeting of the ASWGFi in 2015. The RPOA-Neritic Tunas is expected to provide the regional framework and platform for cooperation among countries in the region in coming up with better data and information on status of neritic tuna resources that could be used as basis for sustainable utilization of the resources in the future.

In 2015, SEAFDEC Secretariat and MFRDMD convened the “Second Meeting of the Scientific Working Group (SWG) on Neritic Tuna Stock Assessment in Southeast Asian Waters” on 15-17 June 2015 in Viet Nam with the overall objective of enhancing regional cooperation in managing neritic tuna resources within the AMSs. The Meeting reviewed the workplan for data collection on catch and effort as well as the necessary indicators/parameters, finalized the budgetary requirements for genetic study and stock assessment,

and identified the capacity building priorities to support AMSs in implementing the RPOA-Neritic Tunas. The Meeting also agreed to carry out two main activities, namely: 1) Genetic Study for Neritic Tunas in the South China Sea, Gulf of Thailand and Andaman Sea; and 2) Stock Assessment for Long Tail Tuna and Eastern Little Tuna (kawakaw) using a Production Model. The final Standard Operating Procedures (SOPs) for Genetic Study and Data Collection of Neritic Tunas was also discussed and agreed upon.



*RPOA-Neritic Tunas*



*Participants in the 2<sup>nd</sup> Meeting of the SWG-Neritic Tunas*

### 4.3 Small Pelagic Fisheries Management

MFRDMD has continued the implementation of the project on “**Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region**” since 2013 to compile and compare data on Catch Per Unit Effort (CPUE) available in the Southeast Asian region during the past three decades to examine the trends and status of stocks for purse seine fisheries. Under this project, MFRDMD also reviewed the purse seine fishery management systems including Total Allowable Catch (TAC) and Total Allowable Effort (TAE) to examine the applicability of such systems for management of small pelagic fisheries in the region.

Based on the 30-year historical CPUE data compiled by MFRDMD from information provided by the countries during the “Core Experts Meeting for Comparative Study on Purse Seine Fishery in the Southeast Asian Region” in 2014, analysis was made to examine the trend of stock status for purse seine fisheries. Based on results of the analysis, the “Current Status of Purse Seine Fisheries in Southeast Asian Region” was published to provide information on catch, effort and type of fishing gear used for catching pelagic fishes in the Southeast Asian region with special focus on commercial fleets, *e.g.* purse seine fisheries, and to assess the possible application of Total Allowable Catch (TAC) system. The report also includes result of the analysis of CPUE data during the past three decades, genetic study of commercially important pelagic species, and development of management strategies for sustainable purse seine fisheries in the region.

Based on the recommendation during the 37<sup>th</sup> Meeting of the SEAFDEC Program Committee in 2014 that MFRDMD should consider applying the “Total Allowance Effort” or TAE developed by Japan as this could be more suitable for the region, MFRDMD convened

an informal forum in 2015 to discuss this issue. A Japanese Expert was invited to the forum to discuss and share information on the latest movement on sustainable fisheries management in Japan and the possibility of applying the TAE system in the Southeast Asian region.

For the genetic study of *Amblygaster sirm* as small pelagic fish targeted by purse seine, the Member Countries were asked to collect and submit to MFRDMD tissue samples of the species for analysis. Results of the analysis, which could be used to support the development of appropriate management of purse seine fisheries, would be presented at the Regional Consultation to be organized in 2016.

#### 4.4 Research and Management of Sharks and Rays

During the past decades, several species of marine animals had been considered under international concern for conservation, which include sharks and rays, leading to the development of the International Plan of Action for the Conservation and Management of Sharks by FAO in 1998, and subsequently the proposals for listing of several shark and ray species under the CITES Appendices. It has therefore become necessary for the Southeast Asian region to come up with justifications to avert the proposals to list shark and ray species in the CITES Appendices. In this connection, MFRDMD implemented the project on “Research and Management of Sharks and Rays in the Southeast Asian Waters” in 2013-2014 with the objective of promoting data collection of shark and ray species in the region as well as enhancing the capacity of the countries in data collection and identification of shark and ray species. This project was followed-up by a subsequent project on “**Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region**” which MFRDMD implements during 2015-2019.

The follow-up project started off with the conduct of the Core Experts Meeting on Sharks and Rays on 3-4 March 2015 in Kuala Lumpur, Malaysia to compile up-to-date data on landing and trade of sharks and rays from the Member Countries as well as review relevant regional initiatives on conservation and management of sharks and rays. The Meeting in particular discussed and agreed on the sampling sites for data collection in seven countries, namely Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam, in order to cover the Andaman Sea, Indian Ocean, Gulf of Thailand, South China Sea, and Sulu Sea. Subsequently, the Regional Technical Meeting (RTM) on Sharks and Rays Data



*Participants in the Core Experts Meeting on Sharks and Rays*



*Regional Technical Meeting on Sharks and Rays Data Collection*

Collection was organized on 26-28 May 2015 in Bangkok, Thailand, to assist the project participating countries in planning for their respective data collection in 2015-2016, and identify the problems associated with sharks and rays data collection. The RTM came up with an agreement on the project management and work plan for 2015-2016 based on the Standard Operational Procedures of sharks and rays data collection. Information on Non-detrimental Findings (NDF) for sharks and rays were also shared based on experiences of the countries.

In addition to the aforementioned project, TD and MFRDMD also implemented the project on **“Data Collection on Catch Landing of Sharks in Southeast Asian Countries: Sharks and Manta Rays Landing Stock Data Collection towards Sharks NDF”**, which aims to collect sharks landing data from all ASEAN Member States and come up with regional picture that could serve as basis for issuance of NDF documents by the respective governments thus, facilitate international trade of sharks and rays in the future.

Under this project, activities were undertaken to follow-up on the work plan adopted during the aforementioned RTM. Specifically, SEAFDEC convened a series of National Workshops on Sharks and Rays Data Collection, *i.e.* on 19-20 July 2015 in Yangon Myanmar; 22-23 July 2015 in Ranong Province, Thailand; 4-5 August 2015 in Sandakan, Malaysia; 17-18 August 2015 in Cilacap, Indonesia; 21-22 August 2015 in Puerto Princesa, Philippines; 6-8 September 2015 in Preah Sihanouk Province, Cambodia; and 9-11 September 2015 in Vung Tau, Viet Nam. These workshops were participated by the National Technical Coordinators (NTCs) of the respective participating countries, local enumerators, and observers. The SOP for sharks data collection, steps for data key-in, and photograph-taking techniques for scientific data collection were introduced and practiced. In addition, the national sharks group (NSG) was also established in each participating country and encouraged to use the mobile handset application to facilitate data collection and verification. After the workshops, the activities would continue with compilation of data collected at selected landing sites of the respective countries.



*National Workshops on Sharks and Rays Data Collection in Philippines (above) and Cambodia (right)*

In addition to the collection of catch landing data, MFRDMD took the opportunity during the aforementioned National Workshops to compile information on the utilization of by-catch sharks and rays from the respective Southeast Asian countries. Such information would enhance the understanding on importance of sharks and rays and the need for development of management measures for sharks and rays. MFRDMD also continued to collect genetic samples of sharks and rays from 8 landing sites in Malaysia, namely: Kuantan, Lumut, Dungun, Kuala Terengganu, Mukah, Beluran, Sandakan, and Kota Kinabalu, for DNA bar-coding research. A total of 80 samples of sharks and 70 samples of rays had been analyzed.

#### 4.5 Conservation and Management of Eel Resources

Catadromous eels (*Anguilla* spp: Anguillidae) are popular and important commercial food due to their nutritional value with high protein and fat contents. The species are also well known for their unique catadromous life history. As the population of temperate eels has dramatically decreased due to habitat destruction, illegal fishing and climatic changes, tropical eels become more important in the market during the recent years, resulting in drastic increase in capture of glass eels (juvenile stage of eels) in tropical areas. While several eel species, e.g. *A. anguilla*, *A. japonica*, had already been listed in the CITES



Glass eels in fiberglass tank

Appendices with the view of assuring that the species would not be deteriorated through international trade, a concern was expressed on the possibility of also listing *A. bicolor* which is commonly found in the Southeast Asian region, in the CITES Appendices in the future. In order to avoid the over-exploitation of glass eel resources, the Indonesian government issued a regulation to prohibit the export of eel seeds less than 150 g from Indonesia's territory. Similar policies to prohibit export of eel seeds were also enforced in some other Southeast Asian countries.

IFRDMD has started the project on “**Enhancement of Sustainability of Catadromous Eel Resources in Southeast Asia**” since 2015 with the objective of enhancing the sustainability of catadromous eel resources in Southeast Asia. Considering that lack of data and statistics on tropical eel species could bring negative impact to the fisheries sectors, the project therefore is specifically aimed at compiling information on tropical eels from various sources, i.e. fishing activities (catch statistics), biological surveys, and other stakeholders (traders, consumers and so on). Meanwhile, conservation and management policy issues on tropical eel resources for their sustainability become more important not only in Indonesia but also in the Southeast Asian region. Therefore, the region needs a policy to balance the utilization and sustainability of tropical eel resources.

In 2015, several survey trips were conducted in Indonesia and Philippines to obtain information on the present status and recent trends of eel fisheries, resource status and distribution of eels from commercial fishing activities, eel aquaculture, and eel markets in the AMSs. The surveys in Indonesia were undertaken on 14-15 January and 15-17





*Fisherman capturing glass eels in the river mouth of Cimandiri, PalabuhanRatu, Indonesia*



*Fishermen capturing glass eels in the river mouth of Manna, Bengkulu, Indonesia*



*Visit of IFRDMD researchers to an eel farm company in Indonesia and interview of farm owner*



November 2015 in Palabuhan Ratu; 16-18 January in Poso; 15-19 March in Bengkulu; 15-17 June in Bogor; and 27-28 June in Solo. The Philippine survey was undertaken on 13-18 February 2015 in Cagayan Province in northern Philippines.

In addition to the survey trip for data collection, IFRDMD is also establishing a method for species identification for *Anguilla* spp. based on molecular phylogenetics. DNA templates have been prepared from the samples collected in Bengkulu (Indonesia) and Cagayan (Philippines), to be analyzed for DNA sequencing in the future.

#### **4.6 Improving Information and Statistics Collection for Management of Fisheries**

The project on “**Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region**” has been carried out by TD in collaboration with MFRDMD and SEAFDEC Secretariat since 2013 to compile quality fisheries data and information in support of policy planning and management of fisheries. This project comprises three sub-projects, namely: 1) facilitating fisheries activity information gathering through the introduction of community-based management; 2) improvement of data collection of commercially exploited aquatic and threatened species; and 3) harmonization of fishery statistics in the Southeast Asian region. While the first sub-project focuses on the collection of information

on small-scale inland and coastal fisheries through community-based management, the second specifically intends to improve data collection of commercially exploited aquatic and threatened species, and the third emphasizes on coordination and support for statistics reporting systems of Member Countries to be able to generate timely regional fishery statistics.

In **“facilitating fisheries activity information gathering through the introduction of community-based management,”** the problems and constraints faced by countries in collecting fisheries data from coastal small-scale and inland fisheries at the national level had been reviewed. In addition, training to facilitate fisheries information gathering through introduction of community-based resources management/co-management was conducted. In 2015, TD convened the Training of Trainers (ToT) on Facilitating Fisheries Information Gathering through Introduction of Co-management and Community-Based Fisheries Management in Lao PDR (27-30 April 2015, Khammouane Province, Lao PDR), and Viet Nam (12-14 May 2015, Nha Trang, Viet Nam). Series of Mobile On-site Training (MOT) were also conducted in Thailand (22-26 February, and 3-7 August 2015) and Cambodia (6-8 May 2015). The fisheries officers who attended the ToT and had gained knowledge on the concepts and methodologies on CBRM/co-management could train community fishers of their respective countries and are able to design coastal and inland fishery management plans using participatory approach that suit their local conditions.

For pilot application of CBRM and co-management, activities were undertaken in project sites in Thailand and Cambodia. In Thailand, TD conducted an activity to address the challenges in implementing/promoting CBRM/Co-management at Nam Oon Dam in Sakon Nakhon Province on 22-26 February and 3-7 August 2015. For Cambodia, baseline survey and consultation meeting was conducted on 6-8 May 2015 at Chong Kheas fishing



*ToT on fisheries management conducted in Lao PDR (above) and Viet Nam (left)*

community in Siem Reap to compile information on the possible ways of implementing fisheries management measures by the communities.

On the **“improvement of data collection of the commercially exploited aquatic and threatened species,”** activities were implemented by TD in collaboration with MFRDMD focusing on “sharks.” During the RTM on Sharks and Rays Data Collection on 26-28 May 2015 in Bangkok, Thailand, the seven participating countries agreed on the format and template for sharks and rays data collection work plans for 2015-2016, while the Standard Operational Procedures (SOPs) of sharks and rays data collection was also prepared. The abovementioned RTM was followed by a series of National Workshops on Sharks and Rays Data Collection in each participating country. Subsequent to the workshops, activities to pursue the compilation of data collected at selected landing sites of the respective countries have also been carried out (see also 4.4 on Research and Management of Sharks and Rays).



While supporting the Member Countries in improving their respective fisheries data collection systems, SEAFDEC pursued its on-going mandate of compiling regional fishery statistics. In 2015, SEAFDEC published the *“Fishery Statistics Bulletin of Southeast Asia 2013”* using the statistics and data submitted by the AMSs. Furthermore, the project also provided platform for improving the utilization of fishery statistics, integrating these with other forms of data and information to generate better understanding of the region’s fishery resources. In this regard, the Secretariat developed the outline for the *“Southeast Asian State of Fisheries and Aquaculture”* to include information on status and trends of fisheries, important fisheries-related issues, among others.

Developed through consultative meetings among SEAFDEC Secretariat and Departments, the outline was subsequently endorsed by the SEAFDEC Program Committee at its 38<sup>th</sup> Meeting (23-25 November 2015, Philippines). To be published in 2017, the publication would provide basis for the sustainable management of fisheries in the Southeast Asian region.

## **THRUST 5. ADDRESSING INTERNATIONAL FISHERIES-RELATED ISSUES FROM A REGIONAL PERSPECTIVE**

### **5.1 Addressing International Fisheries-related Issues**

Issues related to trade of fish and fishery products have been importantly discussed at international/regional levels over the past decades, with a number of international instruments including market-driven measures agreed upon and applied by relevant organizations/countries, *e.g.* measures issued by CITES related to commercially exploited aquatic species; the EC Regulation 1005/2008 establishing a community system to prevent, deter and eliminate IUU fishing; the need for ensuring sustainable utilization of aquatic species under international concern; impacts of the development of the fisheries sector particularly for developing countries where fisheries production is derived from small-scale fisheries sub-sector. While countries in the region comply with the emerging requirements

and measures in order that their fish and fishery products could be traded internationally, it has also become necessary that the countries' understanding and capacity in addressing such requirements are enhanced. Furthermore, the participation of countries in relevant international fora related to development of fisheries-related instruments need to be improved in order that the regional specificity of fisheries would be appropriately considered in the development of such instruments and related measures in the future.

Supported by the Departments, the SEAFDEC Secretariat, under the project on **“Assistance for Capacity Building in the Region to Address International Fish Trade-related Issues,”** facilitated the development of several guidelines and policy recommendations for the region. The most significant outputs included: 1) 3<sup>rd</sup> draft ASEAN Catch Documentation Scheme (ACDS) and the Info-graphic on Usages of ACDS in Various Scenarios of Trading of Fish and Fishery Products in ASEAN Region (in collaboration with MFRDMD); 2) Concept Note of the Regional Cooperation for Promotion of Port State Measures Implementation in the ASEAN Region (in collaboration with TD); 3) draft Regional Plan of Action for Managing Fishing Capacity (RPOA-Capacity); 4) reviews on Commercially-exploited Aquatic Species listed in the CITES Appendices including the species under: (a) Class Actinopterygii (Fishes) and (b) Class Elasmobranchii (Sharks); 5) final version of the ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain (in collaboration with MFRDMD); and 6) Regional Fishing Vessels Record Database as tool to eliminate and combat IUU fishing in the ASEAN region (in collaboration with TD).

SEAFDEC also developed the Executive Report on International Fisheries-related Issues, which was submitted to the 23<sup>rd</sup> Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGF<sub>i</sub>) on 10-12 June 2015 in Myanmar. Specifically, the ASWGF<sub>i</sub> endorsed the ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain for SOM-AMAF consideration; and the Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region for notification by SOM-AMAF. The ASWGF<sub>i</sub> also took note of the Regional Policy Recommendations on Conservation and Management of Catadromous Eel Resources and Promotion of Sustainable Aquaculture, and the Regional Policy Recommendations for Development and Use of Alternative Dietary Ingredients in Aquaculture Feed Formulations.

SEAFDEC also participated in discussions related to fisheries policy framework and guidelines to ensure that the regional specificities could be appropriately addressed, and to harmonize regional policy frameworks developed by SEAFDEC with those of the global initiatives. Important events attended by representatives from SEAFDEC in 2015 include:

- Global Conference on Inland Fisheries (organized by FAO on 26-28 January 2015 in Rome, Italy)
- 4<sup>th</sup> *Ad-hoc* Steering Committee on Climate Change and Food Security (organized by ASEAN Secretariat on 23-24 March 2015 in Bogor, Indonesia)
- 11<sup>th</sup> Meeting of ASEAN Expert Group on CITES (organized by ASEAN Secretariat on 7-8 May 2015 in Brunei Darussalam)
- Expert Consultation on “Establishing Guidelines for Catch Documentation Schemes to Improve the Traceability of Fisheries Products” (organized by FAO on 21-24 July 2015 in Rome, Italy)

- Southeast Asia Regional Consultation Workshop on the Implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (organized by Indonesia on 24-27 August 2015 in Bali, Indonesia)
- 2<sup>nd</sup> Task Force Meeting & 6<sup>th</sup> ASEAN Tuna Working Group Meeting (organized by Malaysia on 5-7 October 2015 in Kuala Lumpur, Malaysia)



*The FAO Global Conference on  
Inland Fisheries*



*11<sup>th</sup> Meeting of the ASEAN Experts Group  
on CITES*

## SPECIAL PROJECT

### 6.1 Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia

“**Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia**” is a five-year (January 2013-December 2017) SEAFDEC-Sweden collaborative project with funding support from the Government of Sweden. In 2015, the SEAFDEC-Sweden Project continues its efforts in strengthening the regional cooperation among ASEAN Member States (AMSs) by giving focus on improving the management of fishery resources and fishing capacity, combating illegal and destructive fishing, maintaining and conserving critical habitats, building up the well-being of coastal and rural people, and building the capacity of fisher-folk to mitigate the effects of climate variability in the ASEAN region. With the objective of promoting sustainable use of aquatic resources and reducing the vulnerability of coastal/rural (fishing) communities in the ASEAN region, the project implements activities that could build-up the capacity of the AMSs in the areas of: (1) integrating habitat and fisheries management and adapting to climate change; (2) improving and strengthening systems for the management of fishing capacity (monitoring, record and control); and (3) drafting and implementing regional and sub-regional agreements and improvement of policy development processes. The project also aims to enhance the social well-being of fisher-folk, improve working conditions and promote alternative livelihoods by seeking the commitment of the AMSs in following-up on the development and implementation of sub-regional and regional arrangements with special focus on four sub-regions, namely: the Gulf of Thailand, Andaman Sea, Sulu-Sulawesi Seas, and the Mekong River Basin.

In 2015, the project implemented activities that accommodate the steps to reach the targets of the three defined output objectives mentioned above.

On the ***Promotion of Sub-regional Cooperation in Southeast Asia and Strengthening Regional and Sub-regional Programs and Organizations***, series of meetings and workshops were conducted for each sub-region to strengthen the cooperation between neighboring countries, and as practical in coordination with partners, improve the management of fisheries in order to sustain the use fishery resources through more efficient fisheries and habitat management in the sub-regions.

***Gulf of Thailand Sub-region:*** After the bilateral dialogue was arranged between Cambodia and Thailand in January 2015, the project team conducted a study on existing mechanisms/bilateral arrangements between Koh Kong Province (Cambodia) and Trat Province (Thailand). This was aimed at tracking the existing arrangements that have been previously established, including the functions and reporting mechanisms with recommendations to build upon the suitable existing mechanisms for strengthening cross-boundary cooperation on fisheries and habitat management.

Based on the joint actions identified during the bilateral workshops, the following activities were implemented in 2015:

- Series of workshops for development of standard operating procedures (SOPs) for data collection of transboundary species and training of enumerators from Cambodia, Thailand and Viet Nam
- Training for Trainers on Hatchery of Blue Swimming Crabs (for Cambodian officers)
- Review of laws and regulations (Cambodia and Viet Nam)
- Study on Strengthening the Malaysia and Thai Partnerships in Support of Joint Fisheries Planning and Management in the Western Gulf of Thailand



*Interview of Koh Kong fishers as relevant stakeholders, part of the study on existing mechanism/bilateral arrangements between Koh Kong (Cambodia) and Trat (Thailand)*



*Participants of the workshop for developing SOPs for data collection of transboundary species and training of enumerators from Cambodia, Thailand and Viet Nam*

In addition, the 5<sup>th</sup> Meeting of the Gulf of Thailand Sub-region was convened on 28-29 September 2015 in Nonthaburi Province, Thailand to discuss the updates of the activities implemented through the bilateral dialogue and develop the draft work-plan for 2016. After providing information and sharing updates on the current status of fishery resources and management efforts, the countries agreed on a set of priority trans-boundary species (*i.e.* anchovy, Indo-Pacific mackerel and blue swimming crab) that would be focused for

improved fishery resources management in the Gulf of Thailand Sub-region, as well as provided information on the results of the review of laws and regulations among countries in the sub-region. The Meeting formulated the joint work plans for addressing problems on IUU fishing and encroachment of foreign fishing vessels together with the steps to improve records of catches/landings at ports, and facilitated discussion on the management of fishing capacity (monitoring, record and control). The outcomes of this sub-regional arrangement would include increased understanding of the fisheries issues in transboundary areas of the Gulf of Thailand Sub-region and the ways and means of addressing such issues through joint approaches.



*Participants in the  
5<sup>th</sup> Meeting of the Gulf of  
Thailand Sub-region*

**Andaman Sea Sub-region:** Training on Essential Ecosystem Approach to Fisheries Management (E-EAFM) was organized in Yangon, Myanmar on 14-19 December 2015. Considering that 2015 is also the final year for the operations of the BOBLME Project, a main project partner in the Andaman Sea Sub-region, coordination has been maintained with the BOBLME Project. Through the final Steering Committee Meeting (November 2015), update on the progress of the two projects' collaboration had been provided. Follow-up on the progress of actions being implemented by BOBLME, SEAFDEC and other relevant partners with regards to mackerels, neritic tunas and monitoring of important habitats has been ongoing and would serve as basis for continued activity-planning in 2016.

**Mekong River Basin Sub-region:** Comparative studies on laws and regulations were conducted in 2015 to review the legal frameworks of two countries, particularly for specific areas such as Stung Treng/Preah Vihear (Cambodia) and Champasak Province (Lao PDR). This was aimed at sharing information and raising awareness among concerned officers on the relevant laws and regulations. In collaboration with SEAFDEC/TD, the project conducted the Training on Essential Ecosystem Approach to Fisheries Management (E-EAFM) on 2-7 November 2015 in Champasak Province, Lao PDR. The training course provided the skills that help trainees to develop a management plan for better management of fisheries. The project has also been in regular contact with the Mekong River Commission (MRC) Fisheries Program to seek updates on the development of the Mekong Basin Wide Fisheries Strategy. Information on the termination of the MRC Fisheries Program has been used as basis for the SEAFDEC-Sweden Project to take priority steps in 2016 including the organization of an *Ad-hoc* Technical Advisory Body (TAB) Meeting.

For the ***Promotion of Regional Cooperation on Fisheries-related Issues among ASEAN Member Countries***, the Project facilitated and supported the AMSs in developing regional cooperation on several important fisheries-related matters, including sustainable utilization of neritic tunas, management of fishing capacity, and issues related to labor and working conditions of fishworkers, based on region-wide concerns. A summary of each major area of concern supported by the Project follows:

- Strengthening Cooperation on Sustainable Utilization of Neritic Tunas in the ASEAN Region

The Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region (RPOA-Neritic Tunas) was endorsed by the 47<sup>th</sup> Meeting of the SEAFDEC Council (47 CM) and the 23<sup>rd</sup> Meeting of ASWGFi in 2015, respectively with further notification in support of the RPOA-Neritic Tunas by the SOM-AMAF in 2015. In addition, the Project made good progress in 2015 on the implementation of activities related to the RPOA-Neritic Tunas including the establishment of Scientific Working Group (SWG) and its Terms of Reference (TOR) that were endorsed at the 47 CM. The Annual Meetings of the Scientific Working Group organized in Malaysia (2014) and in Viet Nam (2015) reviewed the available status of neritic tunas, drafted the Standard of Operations (SOPs) for data collection and genetic study, and developed the work-plan for the stock assessment of long-tail tuna and eastern little tuna to be undertaken in 2016 and onwards.

- Promoting Regional Cooperation on Management of Fishing Capacity

Under the ASEAN Fisheries Consultative Forum (AFCF) with Malaysia as lead country for the cluster on “Promoting Sustainable Fisheries Practices: Fishing Capacity and Responsible Fisheries Practices,” the steps for SEAFDEC to work with the Department of Fisheries (DOF) Malaysia on the approach to support regional cooperation on the management of fishing capacity for the ASEAN region had been initiated. In line with this initiative, the 1<sup>st</sup> Regional Technical Consultation (RTC) on the Development of RPOA-Capacity was co-organized by SEAFDEC and DOF Malaysia with funding support from the Japanese Trust Fund (JTF) and the SEAFDEC-Sweden Project in Malaysia in February 2015. The RTC reviewed the practices of AMSs with regards to the management of fishing capacity, and identified the issues/problems, opportunities and key information items to be included in the draft RPOA-Capacity. Subsequently, the Experts Group Meeting on the RPOA-Capacity was organized by SEAFDEC on 19-21 August 2015 in Songkhla Province, Thailand with co-financial support from the JTF and the SEAFDEC-Sweden Project. Based on the experiences and lessons drawn from the management of fishing capacity of each country, the Experts Group developed the first draft RPOA-Capacity to serve as guide for the management of fishing capacity in the region. After discussion on the 1<sup>st</sup> draft during the 2<sup>nd</sup> RTC on 15-17 December 2015 in Phuket, Thailand, the final draft RPOA-Capacity was produced. The final draft will be submitted to the 48<sup>th</sup> Meeting of SEAFDEC Council in April 2016 for consideration and approval before submission to the next AFCF and the ASWGFi in June 2016 for their respective endorsements.



- Addressing Labor Issues and Working Conditions related to Fisheries and the Fishing Industry

In the course of implementing their respective efforts to combat Illegal, Unreported and Unregulated (IUU) fishing, the AMSs have recognized a growing understanding of the need to seriously address labor related issues, especially with regards to migratory workers, and to improve working conditions throughout the fisheries sector while at the same time strengthen institutional cooperation among institutions and countries in the region. The importance of soliciting broad institutional responses and getting international recognition of efforts being made is underlined with regards to needed improvements in this region.

On 28-29 April 2015, the project supported the participation of fisheries officers of the AMSs to take part in the 2<sup>nd</sup> Regional Meeting on the Protection of Migrant Fishers: ASEAN Review of 'Guideline on Flag State Inspection of Working and Living Condition on Board Fishing Vessels', organized by the Ministry of Manpower and Transmigration of the Republic of Indonesia and the ILO-ASEAN Triangle Project in Jakarta, Indonesia. Focusing on the protection of migrant fishers, the Regional Meeting aimed to discuss a more detailed cooperation; review the international standards and instruments on work in fishing; share national policies, legislative developments, and procedures related to flag State and port State controls; and provide inputs for the development of the draft Guidelines on Flag State Inspection of Working and Living Conditions onboard Fishing Vessels and Implementation of ILO Convention 188.



*SEAFDEC staff at the 2<sup>nd</sup> Regional Meeting on the Protection of Migrant Fishers: ASEAN Review of 'Guideline on Flag State Inspection of Working and Living Condition on Board Fishing Vessels'*

On **Cooperation with regional and international organizations**, the Project continued to give strong emphasis on the importance of cooperation with other international/regional organizations on issues of common interest. The links and cooperation with ASEAN is of special importance through the ASEAN-SEAFDEC Strategic Partnership (ASSP). The Project provided information on results and recommendations generated by the Project through the ASEAN Fisheries Consultative Forum (AFCF) and ASWGF. The Project also maintained dialogues with FAO/APFIC, BOBLME, ILO, IUCN/MFF, RPOA-IUU, MRC, Swedish Agency for Marine and Water Management (SwAM), USAID/the Ocean and Fisheries Partnership, Oxfam as well as local/national organizations.

Furthermore, the Project also supported the participation of TD staff in the Training Workshop on Vessel Inspection and Enforcement Measures against IUU organized on 5-9 January 2015 in Singapore. The training enabled the concerned TD staff to gain knowledge and understanding on Port State Measures (PSM) as introduced by three trainers from

the Australian Fisheries Management Authority. The Project also co-sponsored the USAID/Oceans and Fisheries Partnership Inception Workshop on 15-16 September 2015 in Bangkok as part of the Project's effort to build upon the coordinated work with other organizations to ensure sustainable fisheries and sustainability of the oceans for food security.

- Supporting through local partners, the build-up of local institutional and community capacity including diversified livelihood in a gender balanced perspective

At field level, the Project also provided local capacity building facilitated through local organizations with the aim of improving livelihood opportunities, securing poverty alleviation, and restoring important fishery resources and habitats. The SEAFDEC-Sweden Project continued to provide support to the Learning Institute of Cambodia on "Strengthening Community Fisheries Management and Livelihoods Diversification in Cambodia," and CORIN-Asia Cambodia for undertaking activities at local level in coastal provinces of Cambodia. This was aimed at: 1) strengthening relevant local institutions' capacity to enable them to address natural resource degradation and climate change vulnerability of target coastal communities; 2) improving local people's capacity to effectively cope with the challenges of climate change and other changes brought about by development through enhanced family livelihoods, sustainable use of natural resources and understanding of risks; and 3) strengthening the existing approaches at the local level developed through the Wetland Alliance Program (WAP) for sustainable resource management of target coastal communities.

Similarly, CORIN-Asia Myanmar implemented activities with the overall objective of building the capacity of local level government agencies and local authorities towards sustainable management of fisheries resources and important coastal habitat to protect coastal resources. The establishment of such linkages with local organizations and on-going projects would be an important factor to ensure adequate support and sustainability of the project outcomes. As common to all locally supported initiatives, support of a gender-balanced approach to the sustainability of local community development is promoted.

For ***Strengthening Networking through the Regional Fisheries Policy Network (RFPN) Program***, the Project 2015, supported the nominations of representatives from Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam (of which 7 members were women) to serve as the RFPN members and work at the SEAFDEC Secretariat in Bangkok, Thailand. The RFPN Members have been playing active role in enhancing coordination and communication between SEAFDEC and their respective countries while also being given the opportunity to attend and provide technical contributions in various events organized by SEAFDEC. The RFPN Members also support the efforts of SEAFDEC in developing strategies to promote fisheries policy dialogues, promoting regional and sub-regional cooperation among the Member Countries, and following-up the commitment for the implementation of policies under the ASEAN framework. Among themselves, they have learned to work together as a team with regional perspective and built up friendship and strengthened cooperation among the AMSS.

## SEAFDEC PROGRAMS FOR 2016

As scrutinized and endorsed during the 38<sup>th</sup> Meeting of the SEAFDEC Program Committee in 2015, the **on-going programs/projects** implemented in 2015 and would be continued in 2016 are shown below:

| Program Category/Project Title   | Responsible Department | Funding Source |
|--|------------------------|----------------|
| <b>ASEAN-SEAFDEC FCG/ASSP Programs</b>   |                        |                |
| <b>Thrust I: Developing and Promoting Responsible Fisheries for Poverty Alleviation and Food Security</b>  |                        |                |
| 1. Human Resource Development for Sustainable Fisheries  | TD                     | JTF            |
| 2. Optimizing Energy Use/Improving Safety Onboard in Fishing Activities  | TD                     | JTF            |
| 3. Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia                                  | TD                     | JTF            |
| 4. Environment-friendly, Sustainable Utilization and Management of Fisheries and Aquaculture Resources   | AQD                    | JTF            |
| 5. Enhancement of Sustainability of Catadromous Eel Resources in Southeast Asia  | IFRDMD                 | JTF            |
| 6. Promotion of Responsible Utilization of Inland Fisheries in Southeast Asia  | IFRDMD                 | JTF            |
| <b>Thrust II: Enhancing Capacity and Competitiveness to Facilitate International and Intra-regional Trade</b>  |                        |                |
| 7. Chemical and Drug Residues in Fish and Fish Products in Southeast Asia - Biotxin (ASP, AZA and BTX) and Harmful Algal Blooms (HABs) in the ASEAN region   | MFRD                   | JTF            |
| 8. Cold Chain Management for Seafood   | MFRD                   | Singapore      |
| 9. Reinforcement and Optimization of Fish Health Management and the Effective Dissemination in the Southeast Asian Region                                    | AQD                    | JTF            |
| <b>Thrust III: Improving Management Concepts and Approaches for Sustainable Fisheries</b>  |                        |                |
| 10. Promotion of Countermeasures to Reduce IUU Fishing Activities  | TD                     | JTF            |
| 11. Combating IUU Fishing in the Southeast Asian Region through Application of EU Catch Certification for International Trading in Fish and Fishery Products | MFRDMD                 | JTF            |
| <b>Thrust IV: Providing Policy and Advisory Services for Planning and Executing Management of Fisheries</b>  |                        |                |
| 12. Fisheries Resource Survey and Operational Plan for M.V. SEAFDEC 2  | TD                     | JTF            |

| Program Category/Project Title  | Responsible Department | Funding Source |
|---|------------------------|----------------|
| 13. Offshore Fisheries Resources Exploration in Southeast Asia  | TD                     | JTF            |
| 14. Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region | TD/SEC                 | JTF            |
| 15. Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region   | MFRDMD                 | JTF            |
| 16. Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region   | MFRDMD                 | JTF            |
| <b>Thrust V: Addressing International Fisheries-related Issues from a Regional Perspective</b>  |                        |                |
| 17. Assistance of Capacity Building in the Region to Address International Trade-related Issues   | SEC                    | JTF            |
| 18. Strengthening SEAFDEC Network for Sustainable Fisheries   | SEC                    | JTF            |
| <b>Special Projects</b>   |                        |                |
| 19. Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia  | SEC                    | Sweden         |
| <b>Departmental Programs*</b>   |                        |                |
| 1. Promotion on Strengthening of SEAFDEC Visibility and Image   | TD                     | TD             |
| 2. Tailor-made Training Programs  | TD                     | TD             |
| 3. Improvement of Fisheries Technology and Reduction of the Impact from Fishing   | TD                     | TD             |
| 4. Quality seed for sustainable aquaculture   | AQD                    | AQD            |
| 5. Healthy and wholesome aquaculture  | AQD                    | AQD            |
| 6. Maintaining environmental integrity through responsible aquaculture  | AQD                    | AQD            |
| 7. Adapting to climate change impacts   | AQD                    | AQD            |
| 8. Meeting social and economic challenges in aquaculture  | AQD                    | AQD            |
| <b>Other Programs</b>   |                        |                |
| 1. Coastal Area Capability Enhancements in Southeast Asia   | SEC/TD                 | RIHN           |
| 2. Application of Fish Passage Design Principles to Enhance Sustainability of Inland Fishery Resources in the Southeast Asian Region                                  | SEC/TD                 | ACIAR          |

\* Funding sources for Departmental Programs are mainly the regular contribution from Host Government of the respective Departments.

Two **new projects** were also proposed for implementation, starting from 2016:

| Program Category/Project Title  | Responsible Department | Funding Source |
|---|------------------------|----------------|
| <b>ASEAN-SEAFDEC FCG/ASSP Programs</b>  |                        |                |
| 1. Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management | MFRDMD                 | IDB            |
| 2. USAID-SEAFDEC "Oceans and Fisheries Partnership"   | TD                     | USAID          |

There were also one **pipeline project** of which the proposals are prepared in consultation with respective donor agencies and the Member Countries:

| Program Category/Project Title  | Responsible Department | Funding Source |
|---|------------------------|----------------|
| <b>ASEAN-SEAFDEC FCG/ASSP Programs</b>  |                        |                |
| 1. Establishment and Operation of a Regional System of Fisheries <i>Refugia</i> in the South China Sea and Gulf of Thailand * | TD                     | UNEP/GEF       |

\* The 38<sup>th</sup> Meeting of SEAFDEC Program Committee agreed that once this project is endorsed by UNEP/GEF, the project status would be changed from "Pipeline Project" to "On-going Project"

## COOPERATION WITH DONORS AND PARTNER ORGANIZATIONS IN 2015

- **Agency for Marine and Fisheries Research and Development (AMAFRAD), Indonesia**

SEAFDEC established a Collaborative Arrangement with the Agency for Marine and Fisheries Research and Development (AMAFRAD) under the Ministry of Marine Affairs and Fisheries, Indonesia for the conduct of joint research activities in inland fisheries in the Member Countries of SEAFDEC. Signed on 14 September 2015, the Collaborative Arrangement would be valid until 31 December 2017. The concrete objectives and scopes of activities, and other detailed research activities are made part of the signed Collaborative Arrangement including the Plans on: 1) Research activities on Catadromous Eel Resources in Southeast Asia; and 2) Cooperative Research Activities on Fisheries and Aquaculture of Tropical Eel in Java Island, Indonesia. Through this Arrangement, AMAFRAD will provide necessary support for the implementation of the planned activities, especially those by scientists, experts and/or researchers from SEAFDEC to conduct their research activities in Indonesia during the tenure of the Arrangement.

- **Asian Fisheries Acoustic Society (AFAS)**

SEAFDEC collaborated with the Asian Fisheries Acoustic Society (AFAS) and Kasetsart University of Thailand in organizing the “Ninth Annual Meeting of the Asian Fisheries Acoustics Society (AFAS2015): The International Conference on Underwater Acoustic for Sustainable Fisheries in Asia” on 16-17 November 2015 in Bangkok, Thailand. AFAS aims to promote the progress of science and technologies on fisheries acoustics in Asia. Through such cooperation with AFAS in organizing the 9<sup>th</sup> Annual Meeting of AFAS and the International Conference, SEAFDEC expects to enhance the knowledge and awareness of its staff on available acoustic technologies that could be utilized to support the relevant activities of SEAFDEC in the future.

- **Association of Southeast Asian Nations (ASEAN)**

Cooperation between SEAFDEC and the Association of Southeast Asian Nations (ASEAN) has been sustained since 1998 with the establishment of the Fisheries Consultative Group (FCG) Mechanism. The cooperation was formalized in 2007 with the signing of the Letter of Understanding on the ASEAN-SEAFDEC Strategic Partnership (ASSP), where SEAFDEC serves as technical arm to implement fisheries programs/projects for the benefit of the ASEAN Member States. In 2015, twenty (20) projects were implemented by SEAFDEC under the FCG/ASSP Mechanism. SEAFDEC also continued to support the ASEAN Member States (AMSs) in the implementation of activities in line with the “Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020” adopted in 2011.

Through the projects implemented by SEAFDEC, several regional policy frameworks, guidelines and policy recommendations had been endorsed by the highest authorities of SEAFDEC and the ASEAN while some more are still under development, all of which aim to support the promotion of a harmonized approach and enhance collaboration with the

AMs. These include: (i) the Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region and the TORs of the Scientific Working Group on Neritic Tuna Stock Assessment (endorsed by the SEAFDEC Council and the ASWGFi in 2015); (ii) Regional Policy Recommendations on Conservation and Management of Eel Resources and Promotion of Sustainable Eel Aquaculture (endorsed by the SEAFDEC Council in 2015); (iii) ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain (endorsed by the SEAFDEC Council by *ad referendum* and ASWGFi Meeting in 2015); (iv) Regional Guidelines on Traceability System for Aquaculture Products in the ASEAN Region (approved by the FCG/ASSP Meeting in 2015 for submission to the SEAFDEC Council in 2016); (v) Database for Regional Fishing Vessels Record for Vessels 24 m in Length and Over (on-going development); (vi) ASEAN Catch Documentation Scheme (on-going development); and (vii) the Regional Plan of Action for Management of Fishing Capacity (RPOA-Capacity), still on an on-going development.

In 2015, SEAFDEC also participated in the events organized under the ASEAN framework, namely: the 4<sup>th</sup> *Ad-hoc* Steering Committee on Climate Change and Food Security (23-24 March 2015, Bogor, Indonesia); 4<sup>th</sup> Meeting of the ASEAN Public-Private Taskforce for Sustainable Fisheries and Aquaculture (25-26 March 2015, Jakarta, Indonesia); 11<sup>th</sup> Meeting of ASEAN Expert Group on CITES (7-8 May 2015, Brunei Darussalam); Roundtable Discussions at the ASEAN Aquaculture Industry Summit (3 June 2015, Singapore); 7<sup>th</sup> Meeting of ASEAN Fisheries Consultative Forum (AFCF) (8-9 June 2015, Myanmar); and the 23<sup>rd</sup> Meeting of ASEAN Sectoral Working Group on Fisheries (ASWGFi) (10-12 June 2015, Myanmar).

- **Australian Center for International Agricultural Research (ACIAR)**

SEAFDEC signed a Letter of Agreement with the Australian Center for International Agricultural Research (ACIAR) on 14 May 2015, for SEAFDEC to carry out an activity on the “Application of fish passage design principles to enhance sustainability of inland fishery resources in the Southeast Asian region”. Through such Arrangement, SEAFDEC received a grant for a 16-month R&D activity starting from May 2015 until September 2016. This activity aims to: (i) develop a regional collaborative approach on fish passage through the conduct of an expert workshop; (ii) design and construct experimental fishway facilities in Thailand; and (iii) provide a pathway for further research to improve knowledge on appropriate designs that could facilitate upstream migration of indigenous fishes. Under this project, a fishway model would be designed to take into consideration the critical parameters, *e.g.* slope, water flow/velocity, pass dimension, which could be adjusted in order to determine the most appropriate design for various conditions. Experiments would be conducted on-station using selected indigenous fish species. The research results would provide the basic information on the considerations for designing fish passes that could be applied for different localities of the Southeast Asian region.

- **Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF)**

SEAFDEC signed a five-year Memorandum of Understanding (MOU) for cooperation with the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) on 3 April 2015. The MOU covers: (i) human resources development; (ii) research and development;

(iii) consultancy; and (iv) information management and networking. Such MOU would serve as platform for sharing of knowledge and experiences gained from the past works of both CTI-CFF and SEAFDEC for the benefit of the Member Countries of the two organizations. For particular collaborative activities to be undertaken under this MOU, SEAFDEC and CTI-CFF would initiate proposals for specific activities to be carried out through Letters of Agreement which shall become integral part of the MOU.

Following to the signing of the MOU, discussions had been pursued on the proposed collaborative activities between SEAFDEC and CTI-CFF (3 August 2015, Jakarta, Indonesia). The meeting discussed and agreed on the areas for future collaborative activities under the RPOA of CTI-CFF, particularly on: Ecosystem Approach to Fisheries Management (EAFM); Combating IUU Fishing for Transboundary & Port State Measures (PSM); Tuna Governance; and Coral Fish in the Live Reef Food Fish Transport (LRFFT). SEAFDEC has also attended some relevant events organized by CTI-CFF in 2015, such as: the 5<sup>th</sup> Meeting of the CTI-CFF EAFM Technical Working Group (1 June 2015, Manado, Indonesia); CTI Sulu Celebes Sea EAFM Implementation Planning Meeting (2-5 June 2015, Manado, Indonesia); and the Workshop on Combating IUU Fishing; and 11<sup>th</sup> Senior Officials Meeting of the CTI-CFF (1-3 December 2015, Manado, Indonesia).

- **Fisheries Research Agency (FRA), Japan**

The Memorandum of Understanding (MOU) for Scientific & Technical Cooperation between SEAFDEC and Fisheries Research Agency (FRA) which was renewed in 2014 and will be valid for the period of five years, has provided the framework for cooperation between SEAFDEC and FRA on: the development of scientific and technical cooperation in various fields of mutual interest; exchange of information and expertise; and conduct of detailed discussions between SEAFDEC and FRA on matters practical to both organizations.

In 2015, FRA dispatched experts to SEAFDEC, namely: *Dr. Takuro Shibuno* (as Deputy Chief of AQD from 1 April 2014 to 31 March 2016); *Dr. Masaya Katoh* (Deputy Chief of MFRDMD from 1 April 2010 to 31 March 2015); *Dr. Osamu Abe* (Deputy Chief of MFRDMD from 1 April 2015 to 31 March 2017); and *Dr. Satoshi Honda* (Deputy Chief of IFRDMD from 20 January 2015 to 19 January 2017). Furthermore, FRA also dispatched an expert on resource management, in the person of *Dr. Masahiro Hirota* from the National Research Institute of Fisheries Science to serve as visiting scientist for TD from 1 June to 30 November 2015.

- **Food and Agriculture Organization of the United Nations (FAO)**

In 2015, SEAFDEC continued its cooperation with the Food and Agriculture Organization of the United Nations (FAO) on various priority issues, *e.g.* by-catch management; energy efficiency in fisheries; human capacity development for the implementation of Ecosystem Approach to Fisheries Management (EAFM); measures to combat Illegal, Unreported and Unregulated (IUU) fishing including the application of port State measures; and the development of Regional Fishing Vessels Record (RFVR) for vessels 24 meters in length and over.

TD continued to serve as Regional Facilitation Unit (RFU) of FAO in the implementation of the project on “Strategies for Trawl Fisheries By-catch Management (REBYC-II CTI)” with



funding support from the Global Environment Facility (GEF). The four-year project which started in 2011 is aimed at addressing issues in bottom trawling which target multi-species of catch by promoting sustainable fishing practices and improving trawl management. Besides the REBYC-II CTI Project, TD also collaborated with FAO in the implementation of a pilot project on “Fishing Vessel Energy Audit” which aimed to determine fuel saving potentials of different energy efficiency practices for trawlers in the Gulf of Thailand.

SEAFDEC also signed a Letter of Agreement (LOA) with FAO in January 2015 for the “Technical Exchange in Fisheries between Myanmar and Thailand”, which was amended in March 2015. Supported by the Bay of Bengal Large Marine Ecosystem (BOBLME) Project of FAO, the LOA facilitated technical exchange of fisheries scientists from SEAFDEC and the Department of Fisheries of Thailand to work with counterparts from Myanmar in investigating the biology and life cycle of hilsa (*Tenualosa ilisha*). In return, Myanmar scientists visited some research facilities in Thailand to obtain experience on this aspect while continuing their work on hilsa. Collection of hilsa juveniles from Myanmar waters was undertaken and the juveniles were subsequently shipped to Thailand for further study.

SEAFDEC/AQD also entered into a formal agreement with FAO to carry out a Trust Fund Project of the Aquatic Science and Fisheries Abstract (ASFA) on the “Digitization, Open Access Deposition and the Provision of URL’s to Existing ASFA Records of AQD Publications” which was agreed at the 2014 ASFA Advisory Board Meeting. The output of this project would include preservation of AQD documents (publications, bibliographic records and links to full text documents) in digital format, for storage in an open access repository and inclusion in ASFA, making the information widely available to the scientific community.

In 2015, SEAFDEC also provided technical inputs to regional and international events organized by FAO, namely: the Global Conference on Inland Fisheries (26-28 January 2015, FAO HQ, Italy); Tenure & Fishing Rights 2015 (UserRights 2015) – A Global Forum on Rights-based Approaches for Fisheries (23-27 March 2015, Siem Reap, Cambodia); FAO/APFIC Regional Consultation on Improving the Contribution of Culture-based Fisheries & Related Fishery Enhancements in Inland Waters to Blue Growth (25-27 May 2015, Sri Lanka); FAO-NACA Regional Workshop on Documentation and Dissemination of Successful Practices of Sustainable Intensification of Aquaculture in Asia-Pacific (16-18 June 2015, Bangkok, Thailand); Expert Consultation on “Establishing Guidelines for Catch Documentation Schemes to improve the Traceability of Fisheries Products” (21-24 July 2015, Rome, Italy); and the BOBLME Project Steering Committee Meeting (17-18 November 2015, Phuket, Thailand).

- **Government of Sweden**

The Government of Sweden continued its cooperation with SEAFDEC by providing funding support for the 5-year project on “Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia” starting in 2013, with geographical scope focusing on four sub-regions of Southeast Asia, namely: the Gulf of Thailand, Andaman Sea, Sulu-Sulawesi Seas, and the Lower Mekong River Basin. During the implementation of this project, SEAFDEC cooperates with key partners in the region and sub-regions, NGOs as well as agencies at national levels, in sharing good practices and resources for the implementation of the planned activities.

- **Islamic Development Bank (IDB)**

SEAFDEC developed a project proposal on “Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management” for funding support from the Islamic Development Bank (IDB). Target beneficiaries of this project focus on the Muslim communities in the region’s coastal areas of three countries, namely: Brunei Darussalam, Malaysia, and Indonesia. The proposal was submitted to ASEAN Secretariat for consideration and support by ASEAN dialogue partners and IDB since January 2009. Following long communication processes, IDB informed the ASEAN Secretariat in 2015 that IDB has approved signing the Technical Assistance (TA) Agreement between IDB and SEAFDEC. On 11 August 2015, *Mr. Mohd Takyuddin bin Yahya* from IDB Regional Office in Kuala Lumpur made a Courtesy Visit to SEAFDEC Secretariat to follow-up on this matter. The Technical Assistant Grant Agreement between IDB was subsequently signed by SEAFDEC on 31 August 2015. Currently, the Agreement is still awaiting the final signature of IDB, before the project could officially commence.

- **Japan International Cooperation Agency (JICA)**

The Government of Japan provided to SEAFDEC/TD since 2004, the M.V. SEAFDEC 2 through the Japan’s Grant Aid Scheme for Eligible Countries. During the past decade, the vessel has been utilized to support the mission of TD in promoting responsible and sustainable tropical marine capture fisheries in the Southeast Asian region, through the conduct of marine fishery resources and environmental surveys in close collaboration with the Member Countries. After such long service, some equipment in the vessel were found to be no longer efficient and not in proper working condition. Discussion was therefore initiated between SEAFDEC and JICA in 2015 on the possibility of restoring the functions of the M.V. SEAFDEC 2. The draft “Minutes of Discussions on Follow-up Cooperation Study on the Project for Construction of a Fisheries Research and Training Vessel” was developed to provide framework on the roles of each Party in restoring the vessel, which was approved by the SEAFDEC Council by *ad referendum* on 16 November 2015. The Minutes of the Discussion on follow-up activities on this matter would be subsequently signed in early 2016.

- **Japan International Research Center for Agricultural Sciences (JIRCAS)**

Contract Research Agreements were signed between SEAFDEC/AQD and Japan International Research Center for Agricultural Sciences (JIRCAS) for AQD to implement two contracted research activities from April 2015 until 29 February 2016. The first Contract Agreement on “Verifying a Combination of IMTA Species in Marine Pen Culture Systems” aims to verify a combination of different aquaculture species for integrated multi-trophic aquaculture (IMTA) in a marine pen system. The capacity of oysters in filtering suspended matters, *imbao* (a species of mangrove clam) in assimilating sulfide, and seaweeds as biofilters in an IMTA system in pens would be verified by comparing the DO, sulfide and nutrient levels in different treatments using different species combinations, and by comparing the growth and survival of all species reared in different treatments.

The second Contract Agreement on “On-farm Strategies for Promoting IMTA through Sustainable Livelihood Approach (SLA) in Guimaras, Philippines” has the specific objectives of identifying the socio-economic opportunities and problems experienced during the on-farm demonstration of IMTA in milkfish mariculture for livelihood improvement in the Philippines; conducting a cost-benefit analysis of IMTA in milkfish mariculture; and recommending management practices, strategies and policies for promoting IMTA in milkfish mariculture in the Philippines.

SEAFDEC researchers attended the “Workshop on Development of Aquaculture Technologies for Sustainable and Equitable Production of Aquatic Products in Tropical Coastal Areas” organized by JIRCAS in Bangkok, Thailand on 2-3 December 2015, where they presented their research papers on: 1) Sustainable livelihoods approach for promoting IMTA in milkfish mariculture in the Philippines; and 2) Integrating oyster culture in an IMTA system.

- **Kasetsart University, Thailand**

TD continued to organize series of activities for students from Kasetsart University of Thailand to obtain knowledge and hands-on experiences on fisheries related subjects. On 10-11 October 2015, a study tour was arranged for 29 students taking the course on fisheries economics at the Faculty of Economics, Kasetsart University. On another occasion, 120 students from the Faculty of Fisheries, Kasetsart University also visited TD on 21 November 2015 to observe its facilities, particularly the model of commercial fishing gears, modern fishing gear technologies, fishery resource conservation tools, and the facilities on-board the M.V. SEAFDEC. Furthermore, TD also invited students from Kasetsart University to attend and make presentation during the SEAFDEC Technical Seminar 2015 organized on 24 December 2015, with the aim of enhancing the capacity of young TD staff and students in writing technical papers and making presentations to convey the results of their respective works to the public.

- **Marino Forum 21, Japan**

In 2015, the Marino Forum 21 continued to cooperate with SEAFDEC with the view of enhancing assistance to SEAFDEC through various supporters in Japan; strengthening cooperation and mutual understanding between SEAFDEC and its supporters in Japan; and enhancing the capacity of SEAFDEC staff in their respective fields of job assignment. On 28 June 2015, Marino Forum 21 convened the “2015 Meeting of the Technical Support Committee (TSC)” to discuss the cooperation between SEAFDEC and fisheries-related agencies, universities and institutions in Japan during 2015 and plans for 2016.

In September 2015, Marino Forum 21 facilitated the study visit programs for five (5) SEAFDEC staff to Japan as part of the initiatives to enhance the capacity of SEAFDEC staff. These include the programs on: 1) Modeling and Forecasting Annual Fisheries Production (for SEAFDEC Secretariat); 2) Port State Control and Other Measures to Prevent IUU Activities in Japan (TD); 3) High Density Culture of Marine Phytoplankton Using Photobioreactors (AQD); 4) Collection and Utilization of Oceanographic Information Affecting to Fishing Grounds Distribution of Pelagic Species (MFRDMD); and 5) Inland Fisheries Resource Management and Conservation (IFRDMD).

- **Mekong River Commission (MRC)**

The cooperation between SEAFDEC and the Mekong River Commission (MRC) was strengthened in 2014 with the implementation of SEAFDEC programs related to inland fisheries development, *e.g.* activities supported by SEAFDEC-Sweden project focusing on the Lower Mekong Basin sub-region, and those that relate to the R&D of the newly established SEAFDEC Inland Fishery Resources Development and Management Department (IFRDMD).

- **National Fisheries University (NFU), Japan**

The National Fisheries University (NFU) had been collaborating with SEAFDEC, and in 2014 the said collaboration was extended with the Fisheries Administration of Cambodia for a joint research and training cruise using the NFU training vessel the “*Koyo Maru*.” As a follow-up on the first survey conducted in 2014, NFU carried out another joint research and training cruise in Cambodian waters on 10-21 November 2015, with the objective of providing hands-on training for Cambodian researchers on the use of modern fisheries survey equipment, and conducting oceanographic and fisheries resources survey of Cambodian waters in the eastern Gulf of Thailand under the jurisdiction of Cambodia. The activities being carried out during the 2015 cruise included: 1) Oceanographic survey using CTD, seabird 911plus equipped with water sampler and Secchi-disk; 2) Biological sampling by O-ring net, Norpac Net, Phytoplankton net, Smith McIntyre grab, and mid-water trawl; and 3) Estimation of small pelagic fisheries resources by quantitative echo sounder. It is expected that through this activity, Cambodian researchers/scientists would be familiarized through hands on experience with the modern fisheries survey equipment, especially those installed onboard the *Koyo Maru*.

- **Network of Aquaculture Centres in Asia-Pacific (NACA)**

Cooperation of SEAFDEC and the Network of Aquaculture Centres in Asia-Pacific (NACA) had long been established with the SEAFDEC/Aquaculture Department (AQD) serving as one of the NACA’s regional lead centers. The collaborative activities between NACA and AQD focused on development of aquaculture technologies and sharing knowledge and experiences through various regional and international events. During the 47<sup>th</sup> Meeting of the SEAFDEC Council in 2015, NACA informed the SEAFDEC Council on the intention of NACA to revitalize the Memorandum of Understanding for AQD to serve as NACA Collaborating Centre and following on this proposal, the Memorandum of Understanding between NACA and AQD was developed. The formalization of this collaboration would facilitate exchange of information and conduct of collaborative activities between AQD, NACA and other NACA lead centres. In addition, AQD could also be requested to provide technical advice and conduct technical training for NACA member governments and participating network centres, provided that all costs are shouldered by requesting parties. This collaboration would also allow AQD to obtain information on relevant activities undertaken by other organizations that could be mobilized for the Southeast Asian region, while the services of experts and utilization of facilities at AQD could also be optimized in the future.

- **Post-Harvest Technology Centre, Singapore**

The Post-harvest Technology Center (PHTC) of the Agri-Food & Veterinary Authority (AVA), Singapore serves as Collaborating Centre of SEAFDEC to undertake the activities of MFRD under the SEAFDEC Regional Programmes, as approved by the SEAFDEC Council during its 39<sup>th</sup> Meeting in 2007. In 2014, the PHTC supported MFRD in enhancing the development of fisheries post-harvest technology in the Southeast Asian region through two regional projects, namely: (i) Chemical and Drug Residues in Fish and Fish Products in Southeast Asia - Biotoxin (ASP, AZA and BTX) and Harmful Algal Blooms (HABs) in the ASEAN Region; and (ii) Cold Chain Management for Seafood. Specifically, the project on Cold Chain Management of Seafood is supported by the Government of Singapore.

- **Research Institute for Humanity and Nature (RIHN), Japan**

TD continued to collaborate with the Research Institute for Humanity and Nature (RIHN) of Japan under the MOU which was signed in 2013 for the implementation of activities under the project on “Coastal Area Capability Enhancement in Southeast Asia” from 1 April 2012 to 31 March 2017. This project aims to create new development concept on “Area Capability” that can demonstrate how the ecosystem health could be harmonized with people’s welfare. The project has been implemented in three main sites, namely Panay Island (Philippines), Rayong and Prachuap Khiri Khan Provinces (Thailand), and Ishigagi Island (Japan); and three sub-sites, namely Guimaras Island (Philippines), Trang and Surat Thani Provinces (Thailand); and Mikawa Bay (Japan).

- **Tokyo University of Marine Science and Technology (TUMSAT), Japan**

SEAFDEC signed on 6 July 2015 an extension of the five-year Arrangement for Academic and Educational Cooperation with the Tokyo University of Marine Science and Technology (TUMSAT) for the promotion of programs that are of interest between the two organizations. The original Arrangement between SEAFDEC and TUMSAT was first established on 30 June 2004, and was extended on 1 April 2010. The Arrangement aims to promote academic and educational cooperation in the area of mutual interest. While the cooperation and exchange programs set forth in the original Agreement remains into force, extension of the Arrangement was made retroactive from 1 April 2015.

- **United Nations Environmental Program (UNEP)**

SEAFDEC has developed the project proposal on “Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand” for funding support from the Global Environmental Facilities (GEF) through the United Nations Environmental Program (UNEP). The Project focuses on establishing a regional system of fisheries *refugia* by expanding the network of fisheries *refugia* in the South China Sea and Gulf of Thailand for improved management of fisheries and critical marine habitats, with Cambodia, Indonesia, Malaysia, Philippines, Thailand and Viet Nam as participating countries. Before the end of 2015, SEAFDEC reviewed and agreed in principle the contents of the Project Cooperation Agreement (PCA) to be signed between UNEP and SEAFDEC. Once the project would be endorsed by the GEF/CEO in January 2016, the final PCA would be signed between UNEP and SEAFDEC shortly afterwards.

- **United States Agency for International Development (USAID)**

On 16 June 2014, a Memorandum of Understanding was signed between SEAFDEC and the United States Agency for International Development (USAID) to collaborate in the design and implement activities for enhancing food security and biodiversity conservation in Asia and the Pacific. Under the said MOU, USAID and SEAFDEC would engage other U.S. Government agencies, including the National Oceanic and Atmospheric Administration and the Department of Interior, to identify and provide technical experts to assist in the implementation of the planned activities.

On 24 June 2015, SEAFDEC/TD received the US Ambassador to ASEAN, *H.E. Nina Hachigian* who visited its premises in Samut Prakan, where she reiterated the willingness of the U.S. to support the sustainable utilization of fishery resources, particularly through the initiatives on combating IUU fishing, and enhancing the application of traceability system for fish and fishery products from the region. Subsequently, a new five-year project on “Oceans and Fisheries Partnership” was developed with the main objectives of combating IUU fishing and seafood fraud, and promoting sustainable fisheries management, food security, and biodiversity conservation in Southeast Asia. The project aims to come up with catch documentation and traceability (CDT) system for living marine resources, with particular focus on the Sulu-Celebes Seas as the demonstration site. Furthermore, the “Oceans and Fisheries Partnership” project also aims to strengthen partnerships with relevant private sector for long-term sustainable fisheries management. The project commenced in 2015 with TetraTech as the implementation agency. An “Inception Workshop for The Ocean and Fisheries Partnership Project” was organized on 15-16 September 2015 in Bangkok, Thailand to discuss with the ASEAN-SEAFDEC Member Countries the concept and scope of activities under this project. Subsequent to the Inception Workshop, a series of visits were arranged by TetraTech team to visit the countries targeted as implementation sites of the project.

- **Universiti Malaysia Sabah**

On 17 March 2015, a Memorandum of Understanding (MOU) between Universiti Malaysia Sabah and SEAFDEC/AQD to encourage and promote collaboration among faculty and staff members for: (i) research, symposia, and other academic pursuits as feasible and mutually agreed; (ii) exchange visits by students as mutually agreed and jointly arranged; (iii) joint research activities when mutually agreed and feasible; and (iv) exchanges of informational materials on education, training, and research matters. The MOU will remain in effect for a period of five years.

- **University of Santo Tomas, Philippines**

SEAFDEC/AQD has entered into a Memorandum of Agreement with University of Santo Tomas, a private institution of higher learning in the Philippines, for a collaborative research project on “Mass production of dsRNA to mitigate WSSV infection in *Penaeus monodon*.” Under such project, AQD is expected to implement the following research project components: (i) Accountability of resistance against WSSV infection among *P. monodon* individuals and (ii) Efficacy of feeds with dsRNA on WSSV-infected *P. monodon* individuals.

In addition to collecting data, AQD will collect *P. monodon* specimens from these studies based on an experimental plan agreed upon by SEAFDEC and UST, and would house and maintain the heritability experiments of the project.

- **University of Tokyo, Japan**

On 9 December 2015, SEAFDEC signed the extension of the Memorandum of Understanding (MOU) with the Graduate School of Agricultural and Life Sciences, University of Tokyo (GSALS-UT) for the conduct of programs that are of interest to both organizations. Signed on 5 November 2004, the original five-year MOU between SEAFDEC and GSALS-UT was first extended on 15 July 2010. Specifically, the MOU aims to encourage direct communication between researchers of the two organizations, and promote academic exchange in information, training and research as well as share knowledge and initiate discussions on matters of mutual interest. While the cooperation and exchange programs set forth in the original MOU remain in force, the extension of the five-year MOU was made retroactive from 15 July 2015. For collaborative activities in 2015, the University of Tokyo supported the services of Dr. Yasuwo Fukuyo as resource person during the Regional Technical Consultation on Harmful Algal Blooms in the ASEAN Region organized by MFRD on 5-6 August 2015 in Singapore.

## ENHANCING SEAFDEC VISIBILITY

Since its establishment, SEAFDEC has been implementing fisheries-related programs/projects that cover wide aspects of research, training and information. Starting in 2007, the SEAFDEC Secretariat and Departments made full use of the Information Strategies as guiding principles in formulating and implementing information-related activities that aim to enhance the Center's image and visibility. The Information Strategies have been developed to enhance the effectiveness of the implementation, monitoring, and reporting of the progress of SEAFDEC information-related activities.

In 2015, the progress and achievements made by SEAFDEC in the implementation of information activities were monitored and discussed during the 16<sup>th</sup> Meeting of the Information Staff Program (ISP) on 26 to 28 October 2015 in Kuala Lumpur, Malaysia, corresponding to the five Information Strategies, as follows:

### **Strategy 1: Production of relevant, timely, and useful information materials to meet the requirements of the target audience**

- Production and dissemination of technical/scientific materials (28 title/issues: 8,373 copies produced, 3,596 copies distributed)
- Production and dissemination of technical/scientific articles (82 titles: 52 titles published in SEAFDEC publications and 30 titles published in non-SEAFDEC publications)
- Recording of inquiries for information through the SEAFDEC libraries (1,858 queries recorded, 300 materials sold)

### **Strategy 2: Raising SEAFDEC image at national, regional and international levels**

- Production and dissemination of promotional materials (33 titles/issues: 30,882 copies produced, 28,931 copies distributed)
- Establishment and administration SEAFDEC websites and web blocks (SEAFDEC Departmental websites received a total of 87,433 unique visitors, made 5,101 links from other websites, and recorded 109,889 annual downloads)
- Taking part in exhibitions and related events (joined nine (9) exhibitions with 106,764 visitors recorded at SEAFDEC exhibition booths and displays)
- Official release of press statements (one (1) press statement released, and recorded 56 appearances of SEAFDEC in public media and websites)

### **Strategy 3: Enhancing communication and information sharing both within SEAFDEC and with Member and non-Member Countries, other international/regional organizations, and public**

- Management of libraries of the SEAFDEC Secretariat and Departments (SEAFDEC Secretariat and Departments libraries continued to provide library services)
- SEAFDEC libraries acquisitions (acquired a total of 1,036 issues of newsletters/serial publications, 399 titles of technical publications and 9 items of audio-visual materials)
- Cooperation and exchange of materials (sustained cooperation with 544 network libraries within and outside the region)



- Dissemination of technical and promotional materials (76 titles (with 5,200 copies) of technical materials, and 29 titles (with 24,945 copies) of promotional materials disseminated to target groups)
- Accessibility of information materials (made accessible 1,932 downloadable materials and 13 databases in SEAFDEC websites)
- Usage of e-mail systems (including e-groups) to facilitate communications both among SEAFDEC staffs and with other concerned personalities had been enhanced
- Recording of direct visitors to SEAFDEC Secretariat and Departments (recorded a total number of 22,316 visitors)
- Dispatch of SEAFDEC officials to events organized by other organizations (288 SEAFDEC officials participated in 165 events: 110 officials in events at regional/international levels, and 178 at national local levels)
- Organization of SEAFDEC events:
  - o International/regional meetings, seminars, workshops (32 meetings with a total of 1,081 participants)
  - o National/local meeting, seminars, workshops, consultations (22 meetings with a total of 849 participants)
  - o International/regional training courses (28 courses with a total of 294 trainees)
  - o National, on-site training courses (23 courses with a total of 703 trainees)
  - o Study tours (4 programs with a total of 217 trainees)
  - o Internships (6 groups with 97 persons)
  - o On-the-job training (1 colleges with a total of 217 students)
  - o Internal meetings (18 meetings with a total of 1,414 participants);
- Facilitating the participation of officials from Member Countries in events organized by SEAFDEC, *i.e.*:
  - o International/regional meetings, seminars, workshops (574 participants)
  - o National/local meetings, seminars, workshops, consultations (777 participants)
  - o International/regional training courses (262 trainees)
  - o National on-site training courses (586 trainees)
  - o Study tours (207 trainees)
  - o Internships (96 persons)
  - o On-the-Job training (217 students);
- Establishment of network and cooperation mechanisms (now with 80 fisheries-related organizations) for the implementation of collaborative activities at national, regional and international levels
- Soliciting the support from other organizations and donor agencies for relevant activities (total support received in 2015: US\$ 4,415,922 representing non-regular sources of funds for the activities of SEAFDEC)

#### **Strategy 4: Strengthening SEAFDEC capability in information-related activities**

- Enhancement of the capabilities of SEAFDEC staff in information-related offices (through HRD taking into account the scope and requirements of concerned staff, and during annual ISP Meetings)
- Boosting the financial sustainability of SEAFDEC institutional publications and information activities (through intensified sale of technical publications and souvenir items on cost-recovery basis)

### Strategy 5: Regular monitoring and evaluation of information activities

- Obtaining feedback on materials produced by SEAFDEC (developed for the training, research, and transfer through communication channels, *e.g.* dedicated e-mail, etc.)
- Organization of the Sixteenth Meeting of the SEAFDEC Information Staff Program (ISP) to monitor the implementation of information-related activities, in accordance with the Information Strategies for Enhance SEAFDEC Visibility and Communication (convened on 26-28 in Kuala Lumpur, Malaysia)

**Table 1.** Participation of Member Countries in SEAFDEC Events in 2015

| Category  | Participants from Member Countries (persons) |            |           |           |           |            |           |              |           |            |            |
|---|--|------------|-----------|-----------|-----------|------------|-----------|--------------|-----------|------------|------------|
|   | Br   | Cm         | Id        | Jp        | La        | My         | Mm        | Ph           | Sg        | Th         | Vn         |
| SEAFDEC regional/international meetings, seminars, workshops        | 18   | 78         | 54        | 20        | 27        | 54         | 30        | 80           | 31        | 117        | 65         |
| SEAFDEC national/local meetings, seminars, workshops, consultations | 0  | 33         | 9         | 0         | 0         | 24         | 8         | 428          | 0         | 247        | 29         |
| International/regional training courses                             | 4  | 6          | 14        | 2         | 4         | 13         | 10        | 186          | 0         | 16         | 7          |
| National, on-site training courses (course/trainees)                | 0  | 43         | 0         | 0         | 60        | 58         | 27        | 83           | 0         | 263        | 52         |
| Study tours (no. of program/trainees)                               | 0  | 0          | 0         | 6         | 0         | 15         | 4         | 182          | 0         | 0          | 0          |
| Internships (group/persons)   | 0  | 0          | 0         | 0         | 0         | 0          | 0         | 84           | 0         | 12         | 0          |
| On-the-job training (college/students)                              | 0  | 0          | 0         | 0         | 0         | 0          | 0         | 217          | 0         | 0          | 0          |
| SEAFDEC internal events   | 2  | 2          | 4         | 5         | 2         | 2          | 1         | 2            | 3         | 43         | 1          |
| <b>TOTAL</b>  | <b>24</b>                                    | <b>162</b> | <b>81</b> | <b>33</b> | <b>93</b> | <b>166</b> | <b>69</b> | <b>1,262</b> | <b>34</b> | <b>698</b> | <b>154</b> |

## SEAFDEC REVENUES AND EXPENDITURES IN 2015

### Un-audited Abridged Consolidated Financial Statements (In US\$)

|   | 2015 (Un-audited)        | 2014 (Audited)                        |
|---|--------------------------|---------------------------------------|
| <b>REVENUES</b>                                 |                          |                                       |
| Contributions from :-                           |                          |                                       |
| Member governments                              | 9,687,480                | 8,103,850                             |
| Other sources                                   | 2,367,862                | 3,699,866                             |
| <b>Total Revenues</b>                           | <u>12,055,342</u>        | <u>11,803,716</u>                     |
| <b>EXPENDITURES</b>                             |                          |                                       |
| Operating and Capital Expenditures              |                          |                                       |
| Research  | 3,407,640                | 4,360,504                             |
| Training  | 748,832                  | 1,027,545                             |
| Information                                     | 431,613                  | 661,367                               |
| Collaborative                                   | 195,221                  | 188,710                               |
| Others  | 378,874                  | 976,394                               |
| Administrative                                  | 6,402,576                | 4,068,066                             |
| <b>Total Expenditures</b>                       | <u>11,564,756</u>        | <u>11,282,586</u>                     |
| <b>SURPLUS (DEFICIT), For the year</b>          | 490,586                  | 521,130                               |
| <b>FUND BALANCE, Beginning of year</b>          | 7,313,251                | <sup>1/</sup> 7,375,019               |
| <b>FUND ADJUSTMENT</b>                          | <u>-28,488</u>           | <u>27,203</u>                         |
| <b>FUND BALANCE, End of year</b>                | <u><u>7,775,349</u></u>  | <u><u>7,923,352</u></u> <sup>1/</sup> |
| <b>REPRESENTED BY:</b>                          |                          |                                       |
| Cash and cash equivalents                       | 8,340,729                | 9,324,514                             |
| Other receivables and Advances                  | 832,202                  | 830,687                               |
| Supplies Inventory                              | 47,261                   | 54,474                                |
| Fuel for vessels                                | 98,155                   | 94,326                                |
| Prepayments                                     | 19,377                   | 18,697                                |
| <b>Total current assets</b>                     | <u>9,337,724</u>         | <u>10,322,698</u>                     |
| Reserved budget for vessel periodic maintenance | 75,154                   | 747                                   |
| Termination indemnity fund                      | 1,921,757                | 2,100,028                             |
| Other assets-Net                                | 306,768                  | 401,349                               |
| <b>Total Assets</b>                             | <u><u>11,641,403</u></u> | <u><u>12,824,822</u></u>              |
| Less : Liabilities                              |                          |                                       |
| Accrued payable                                 | 871,757                  | 1,071,500                             |
| Contribution received in advance                | 814,321                  | 1,336,718                             |
| Funds held in trust                             | 258,219                  | 393,428                               |
| Provision for termination indemnity             | 1,921,757                | 2,099,824                             |
| <b>Total Liabilities</b>                        | <u>3,866,054</u>         | <u>4,901,470</u>                      |
| <b>NET ASSETS</b>                               | <u><u>7,775,349</u></u>  | <u><u>7,923,352</u></u>               |

**Remark:** <sup>1/</sup> Difference of US\$ 610,101 is a result of varying exchange rates in US\$ transactions.

## Un-audited Contribution Received by SEAFDEC from Member Countries and Other Sources of Funds for the Year 2015 (In US\$)

| Sources                     | Secretariat    | TD               | MFRD     | AQD              | MFRDMD         | IFRDMD           | Total             |              |
|-----------------------------|----------------|------------------|----------|------------------|----------------|------------------|-------------------|--------------|
|                             |                |                  |          |                  |                |                  | In US\$           | %            |
| Brunei Darussalam           | 7,000          |                  |          |                  |                |                  | 7,000             | 0.06         |
| Cambodia                    | 11,000         |                  |          |                  |                |                  | 11,000            | 0.09         |
| Indonesia                   | 26,000         |                  |          |                  |                | 1,901,308        | 1,927,308         | 15.99        |
| Japan                       | 280,000        |                  |          |                  |                |                  | 280,000           | 2.32         |
| Lao PDR                     | 5,000          |                  |          |                  |                |                  | 5,000             | 0.04         |
| Malaysia                    | 21,000         |                  |          |                  | 921,398        |                  | 942,398           | 7.82         |
| Myanmar                     | 21,000         |                  |          |                  |                |                  | 21,000            | 0.17         |
| Philippines                 | 25,000         |                  |          | 3,612,410        |                |                  | 3,637,410         | 30.17        |
| Singapore                   | 13,000         |                  |          |                  |                |                  | 13,000            | 0.11         |
| Thailand                    | 33,000         | 2,784,364        |          |                  |                |                  | 2,817,364         | 23.37        |
| Viet Nam                    | 26,000         |                  |          |                  |                |                  | 26,000            | 0.22         |
| <b>Sub-total</b>            | <b>468,000</b> | <b>2,784,364</b> | <b>0</b> | <b>3,612,410</b> | <b>921,398</b> | <b>1,901,308</b> | <b>9,687,480</b>  | <b>80.36</b> |
| Other Sources <sup>2/</sup> | 19,173         | 788,681          |          | 1,560,008        |                |                  | 2,367,862         | 19.64        |
| <b>Total</b>                | <b>487,173</b> | <b>3,573,045</b> | <b>0</b> | <b>5,172,418</b> | <b>921,398</b> | <b>1,901,308</b> | <b>12,055,342</b> | <b>100</b>   |

**Remark:**

<sup>2/</sup> Other sources of contributions include bank interests, gain/loss from varying exchange rates, contributions from donors directly given to Departments and Miscellaneous Receipts.

## Other Contributions Received by SEAFDEC in 2015 (In US\$)

| Sources  | Amount in US\$ <sup>3/</sup> |
|--|------------------------------|
| Fisheries Agency-Japan (TF-V)                                    | 0                            |
| Fisheries Agency-Japan (TF-VI) (excluded: Japan-MRC=US\$280,000) | 1,514,597                    |
| Sweden   | 0                            |
| <b>Total</b>   | <b>1,514,597</b>             |

**Remark:**

<sup>3/</sup> Other sources of contributions not reported in the SEAFDEC Financial Statements





**Southeast Asian Fisheries Development Center (SEAFDEC)**  
P.O. Box 1046, Kasetsart Post Office, Chatuchak, Bangkok 10903, Thailand  
Phone: +66 2940 6326; Fax: +66 2940 6336  
E-mail: [secretariat@seafdec.org](mailto:secretariat@seafdec.org)  
[www.seafdec.org](http://www.seafdec.org)